From:
To: Minister, Env; Environment Assessment Web Account
Cc:
Subject: Replacement Effluent Treatment Facility - Focus Report - letter to Minister Wilson
Date: October 10, 2019 6:32:00 AM
Attachments: 2019 10 10 - Letter to Minister Gordon Wilson - Focus report review timeline.pdf

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Please find attached a letter to Minister Wilson, dated October 10, 2019, sent on behalf of our clients, the Friends of the Northumberland Strait.

Kindly acknowledge receipt at your earliest convenience.

Sincerely,

Barrister & Solicitor | Ecojustice
520-1801 Hollis Street, Halifax, NS B3J 3N4
T: 902-417-1700 | 1-800-926-7744
F: 902-417-1701
@ecojustice.ca

Ecojustice is Canada's largest environmental law charity. Help us build the case for a better earth.

VANCOUVER CALGARY TORONTO OTTAWA HALIFAX

ecojustice

@ecojustice.ca

@ecojustice.ca
520-1801 Hollis St
Halifax, NS B3J 3N4
902-417-1700,
File No: 1003

October 10, 2019

The Honourable Minister Gordon Wilson
Department of Environment
Barrington Tower
1894 Barrington Street, Suite 1800
P.O. Box 442
Halifax, NS B3J 2P8
Minister.Environment@novascotia.ca

Environmental Assessment Branch
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8
EA@novascotia.ca

Sent via Electronic Mail

Dear Minister Wilson:

Re: Replacement Effluent Treatment Facility Project – Northern Pulp Nova Scotia Environmental Assessment – Focus Report

We write as counsel for Friends of the Northumberland Strait to request that you grant additional time within the above-captioned environmental assessment process currently underway. Specifically, we request that you:

1. Grant additional time for the submission of public comments, with a new deadline of Monday December 9, 2019; and
2. Add 30 more days to the 25-day period within which the Administrator must submit all comments and a recommendation to you, following close of the public comment period.

As Minister, you may increase the time allotted for public comments, pursuant to section 16(2) of the *Environmental Assessment Regulations*, if the default 30 day period for review is insufficient in a particular case. Likewise, Section 17(2) of the *Regulations* empowers you to allow more time for the Administrator's review of focus reports, when the default regulatory timeframe is insufficient.

In the present case, due to the volume, complexity and highly technical nature of the Focus Report materials submitted by Northern Pulp, more time is clearly required to permit a sufficient and reasonable opportunity for the public to review and comment on the submission, and for those comments to be given serious and fair consideration by the Administrator, and ultimately by yourself.

The Focus Report and supporting materials submitted on behalf of Northern Pulp Nova Scotia amount to well over two and a half thousand pages. The materials involve many scientific disciplines and are not readily accessible or easily understandable by laypeople. Further, the Focus Report, and some of the supporting materials refer the reader back to the original materials filed within Northern Pulp's Environmental Assessment Registration Document (EARD) package submitted in February 2019. As you will be aware, that submission was also very large and consisted of many other scientific reports and technical materials. It is unfair and counterproductive to require the general public to address all of this material within the short time currently allowed.

The Focus Report was made available to the public on the Nova Scotia Environment website on October 3, 2019 at 2:32 pm. The announcement indicates that comments are due on November 8, 2019. It will be essentially impossible for people to fit a comprehensive review of all this material into their daily lives, without more time. As well, while paper copies of the Focus Report package were made available at the New Glasgow and Pictou Libraries, these are available for review only by a few people at a time, and only when the library is open.

Northern Pulp Nova Scotia has had several years to prepare these materials, and was given a second chance in April 2019, via this Focus Report, to attempt to fix all the omissions in its original submission. It is noted that most, if not all, of these materials were prepared with taxpayer monies, yet the average taxpaying resident of Pictou and area will be given almost no time to review them.

As per NSE's "Citizen's Guide to Environmental Assessment," "[p]ublic participation is vital to the success of environmental assessment."[1] In respect of Northern Pulp's original EARD, then Minister Miller acknowledged that it was very difficult for the public to address a submission of this nature, within a short timeframe. She said "I don't know that the public is really going to be able to fully digest everything that's been submitted."[2]

It is clear that this project is highly controversial and has generated a very high level of public interest and concern, within the Pictou area and across Nova Scotia. Serious concerns have also been raised by residents and officials in Prince Edward Island. Appropriately, the Terms of Reference for the Focus Report recommended that Northern Pulp Nova Scotia engage with relevant stakeholders and the Mi'kmaq including Pictou Landing First Nation, and to share relevant studies and reports, in the process of preparing its focus report. However, Northern Pulp has shared nothing with our clients or many other affected groups who have taken a consistent and active involvement in this project and the Environmental Assessment process. Instead, its materials were submitted *en masse* all at once, creating barriers for our clients and for the general public which prevent a thorough and thoughtful review. This approach has also made it very difficult for our clients to receive timely and comprehensive advice from experts in the many fields covered by this submission.

[1] Nova Scotia Environment, *A Citizen's Guide to Environmental Assessment* (Halifax, NS: Nova Scotia Environment, 2017) at p 4. Link to: https://novascotia.ca/nse/ea/docs/EA.Guide-Citizens.pdf

[2] Jean Laroche, "Northern Pulp's plans for pipeline, effluent treatment plant now public," CBC, February 7, 2019.

The additional time requested herein is also appropriate as there are materials promised, but not included in the Focus Report package. For example, it appears that the following materials are to be considered by NSE and Minister but are not included in the package:

1. Appendix 7.2 – states it includes as Appendix A an "Underwater Benthic Habitat Survey Video". However, no such video or link to any such video is included in the package.
2. Appendices 10.1 and 10.2 both refer to reports which are not provided.
3. Appendix 11.1 refers to a Mi'kmaq Ecological Knowledge Study but no such study is included in the package.

We hereby request that all these documents be posted on the NSE website forthwith, and that our clients, and all other affected groups, are given a sufficient opportunity to comment on them, and the public comment period be lengthened as requested.

As well it is unclear as to whether reports are intended to be included, or submitted late, under Appendices 3.3, 3.5, 5.2, 6.1 and 7.5 of the Focus Report. If any such report will be submitted for your consideration, it must also be made available for public comment prior to any decisions being made by you as Minister.

We make these submissions in the alternative to, and without prejudice to, our submissions dated February 12, 2019 and March 8, 2019, and our client's submission of September 27, 2018, in respect of our position that you, as Minister of Environment within the government of Nova Scotia and as a member of cabinet, have shown that a reasonable apprehension of bias exists in relation to this project and that you must recuse yourself from any further decision-making in relation to this environmental assessment process.

On behalf of the Friends of the Northumberland Strait, we therefore ask that you:

1. Provide additional time for the public comment period under section 16 of the *Regulations* such that comments may be submitted no later than Monday, December 9, 2019; and
2. Likewise, under s 17 of the *Regulations*, give the Administrator an additional 30 days, beyond the 25 day period default set out therein, to summarize all comments submitted and provide recommendations to you as Minister of Environment;

Thank you for considering these submissions and we look forward to hearing from you. As time is of the essence in this matter, we ask for a response no later than Tuesday October 15, 2019.

Sincerely,

Barrister & Solicitor

Barrister & Solicitor

c. Friends of the Northumberland Strait, by electronic mail

From:	
To:	Minister, Env; Environment Assessment Web Account
Cc:	Northumberland Fishermen"s Association;
Subject:	request for additional time, re Northern Pulp EA process
Date:	October 10, 2019 10:08:52 AM
Attachments:	letter to Minister Wilson, comment period request, Oct 10 2019.pdf

Dear Minister Wilson,

Please see the attached correspondence from the Gulf Nova Scotia Fleet Planning Board, the PEI Fishermen's Association and the Maritime Fishermen's Union regarding a request for additional time in the Northern Pulp environmental assessment process.

Best regards,

Counsel to the above-named organizations

--

Barrister and Solicitor, Juniper Law
ph: 902 817 1737, www.juniperlaw.ca

Barrister & Solicitor
3441 Purcells Cove Rd
Fergusons Cove, NS B3V 1G3
902 817 1737 /   @juniperlaw.ca

The Honourable Minister Gordon Wilson
Nova Scotia Environment
Barrington Tower
1894 Barrington St., Suite 1800
P.O. Box 442
Halifax, NS B3J 2P8

October 10, 2019

VIA Email: Minister.Environment@novascotia.ca; EA@novascotia.ca

Dear Minister Wilson:

I am counsel for three fishers' organizations representing the fishing industry in the Northumberland Strait: Gulf Nova Scotia Fleet Planning Board, PEI Fishermen's Association, and Maritime Fishermen's Union. These organizations represent some 3,000 fishers working in this region, and have been active in the environmental assessment process for Northern Pulp Nova Scotia's proposed effluent treatment system.

These organizations respectfully request that you increase the public comment period with respect to Northern Pulp's focus report. The current public comment period ends November 8th 2019; we ask that you extend this period by one month, to December 9th 2019.

Furthermore, we ask that you provide additional time to the 25-day period by which your Department must provide you with comments and a recommendation, following close of the public comment period.

As you know, sections 16(2) and 17(2) of the *Environmental Assessment Regulations* empower you to extend both the public comment period and the time allotted for your Department to review the Focus Report. Given the volume, complexity and magnitude of impact of this environmental assessment, a 30-day public comment period is unrealistic and unreasonable. Furthermore, it is difficult to accept that your Department will be able to give this assessment the thorough review required in a mere 25 days.

We note, further, that despite your Department recommending Northern Pulp to share studies and reports with stakeholders as these reports were available during the lead-up to their submission, and despite our request to Northern Pulp to share such information, Northern Pulp did not share any information with the fishers' organizations.

We look forward to your response to these requests. Given the short time-frame associated with this process, we respectfully request a response by October 15th 2019.

Sincerely,

Barrister & Solicitor

Cc:
Gulf Nova Scotia Fleet Planning Board,
PEI Fishermen's Association,
Maritime Fishermen's Union

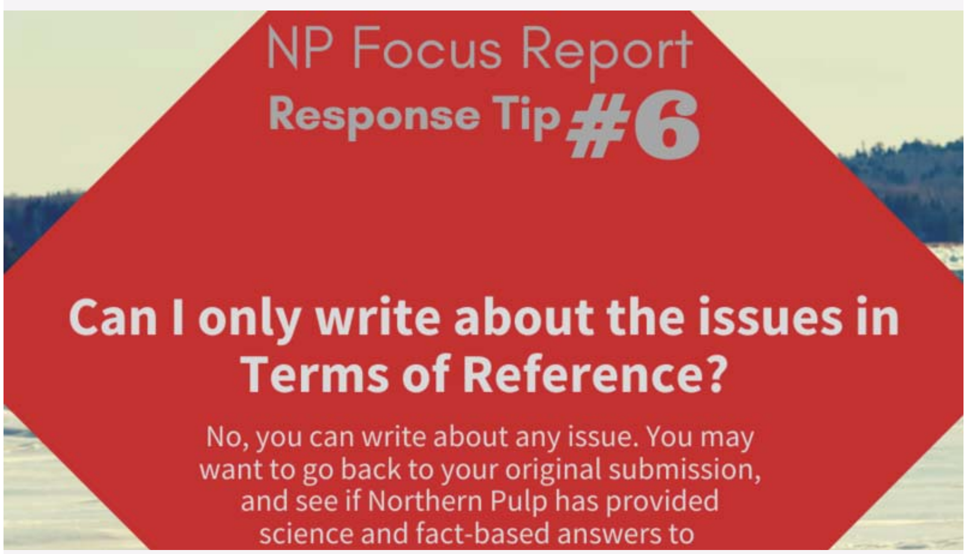
From: @gmail.com>
Sent: October 22, 2019 8:47 PM
To: Environment Assessment Web Account; info@friendsofthenorthumberlandstrait.ca
Subject: Fwd: REMINDER To Submit Your Focus Report Comments #NOPIPE

---------- Forwarded message ---------
From: **Northumberland Strait Sportfishing Association via Change.org** <change@e.change.org>
Date: Tue, Oct 22, 2019 at 2:14 PM
Subject: REMINDER To Submit Your Focus Report Comments #NOPIPE
To: @gmail.com>

change.org

Northumberland Strait Sportfishing Association shared an update on ***Save The Northumberland Strait - Protect our Fisheries, our Tourism and our Health*** Check it out and leave a comment:

PETITION UPDATE



REMINDER To Submit Your Focus Report Comments #NOPIPE

Just like it was your democratic right to vote yesterday, it is your democratic right to tell the Nova Scotia Department of Environment your opinion on Northern Pulp's proposed effluent treatment facility. Make sure you exercise that right.

A proposed effluent pipe into the Northumberland Strait is unacceptable!

Deadline: November 8, 11:59 pm.
Email: EA@novascotia.ca
Copy FONS:...

Read full update

From:	
To:	Minister, Env; Environment Assessment Web Account
Cc:	
Subject:	Replacement Effluent Treatment Facility Project – Northern Pulp Nova Scotia Environmental Assessment – Focus Report
Date:	October 23, 2019 11:04:05 AM
Attachments:	2019 10 23 - Letter to Minister Gordon Wilson - Focus report review time....pdf

Good morning,

Please see attached correspondence to Minister Wilson, dated October 23, 2019 and sent on behalf of our clients, the Friends of the Northumberland Strait.

Kindly acknowledge receipt at your earliest convenience.

Best regards,

Legal Administrative Assistant/Office Administrator | Ecojustice
520-1801 Hollis Street, Halifax, NS B3J 3N4
T: 902-417-1700 | 1-800-926-7744 ext.
F: 902-417-1701

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902-417-1700, ext
File No: 1003

October 23, 2019

The Honourable Minister Gordon Wilson
Department of Environment
Barrington Tower
1894 Barrington Street, Suite 1800
P.O. Box 442
Halifax, NS B3J 2P8
Minister.Environment@novascotia.ca

Environmental Assessment Branch
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8
EA@novascotia.ca

Sent via Electronic Mail

Dear Minister Wilson:

Re: Replacement Effluent Treatment Facility Project – Northern Pulp Nova Scotia Environmental Assessment – Focus Report

We write further to our letter of October 10, 2019 on behalf of our client, the Friends of the Northumberland Strait in relation to the Northern Pulp focus report. In that letter we asked that you:

1. provide additional time for the public comment period on the focus report, pursuant to section 16 of the *Environmental Assessment Regulations*; and
2. give the Administrator an additional 30 days pursuant to section 17 of the *Environmental Assessment Regulations*, to summarize all comments submitted during the comment period.

Our letter explained why, in our clients' view, more time was essential in the circumstances of this environmental assessment process. We also noted that several documents were missing from the public comment package, making it impossible to comment on such materials within the existing timeframe. Finally, we asked that we receive a response to our letter by October 15, 2019, but none has been received to date.

There is very little time remaining to complete a review of this complex package given the short timeframe you have imposed, and there is insufficient time to fully appreciate and address the multitude of issues that are raised in this complex package. We therefore ask for your response forthwith and without further delay.

Sincerely,

Barrister & Solicitor

Barrister & Solicitor

c. Friends of the Northumberland Strait, by electronic mail

From: @unifor.org
To: Environment Assessment Web Account
Subject: Proposed Project Comments
Date: October 31, 2019 2:41:10 PM

** EXTERNAL EMAIL / COURRIEL EXTERNE **
Exercise caution when opening attachments or clicking on links / Faites preuve de prudence si vous ouvrez une pièce jointe ou cliquez sur un lien

Project: replacement_effluent_treatment_facility_project Comments: [A formatted version of this submission is also being sent by e-mail and fax] October 31, 2019 Environmental Assessment Branch Nova Scotia Environment P.O. Box 442 Halifax, NS, B3J 2P8 Re: Northern Pulp Replacement Effluent Treatment Facility Project Focus Report Greetings, We are pleased to have an opportunity to provide comments regarding the Focus Report for the Northern Pulp Replacement Effluent Treatment Facility Project, an essential development for the future of forestry in Nova Scotia. Unifor proudly represents 230 workers at Northern Pulp, 12,000 workers in Nova Scotia, and 23,000 forestry workers across Canada. We are Canadaâ?Ts largest union in the private sector with 315,000 members in every sector of the economy, and regularly advocate for good jobs, sustainable development, and progressive change for a better future. From the outset of discussions concerning the future of the Northern Pulp mill, our union has agreed the Boat Harbour facility must close. We firmly believe there can be a solution that supports good jobs, protects the environment and respects First Nations rights. Our members, and their families, live and work in the communities around the mill and have the highest interest in building a truly sustainable future. The science clearly supports approval Northern Pulpâ?Ts proposed wastewater treatment facility Focus Report follows an extensive period of scientific study. The proposed new treatment facility will see the replacement of the existing plant with a state of the art wastewater treatment facility that will result in a significant improvement in the way treated wastewater is discharged. With the implementation of this new facility, Northern Pulp will become one of the most environmentally responsible mills in North America. The Focus Report provides a science-based review arising from more than twenty different investigations and analyses. These scientific analyses include environmental baseline studies, engineering designs, archaeological investigations, receiving water modeling, and Miâ?Tkmaq Ecological Knowledge Studies, among others. Not only will the new effluent treatment facility meet all requirements of the Nova Scotia Environment Act, it will also comply with several other essential regulations. Project components are designed to meet the federal Pulp and Paper Effluent Regulations, the National Building Code of Canada, the Canadian Standards Association best practices for effluent treatment and pipeline construction, and other design codes and standards. Additionally, all future facility operations would also be conducted under a provincial Industrial Approval. This project will be well regulated to ensure that it meets the highest standards for safe operation and environmental protection. Based on the assessments made previously, and for the Focus Report, no significant adverse residual environmental effects are predicted for the air environment, fresh water environment or marine environment. Additionally, third party environmental experts have assessed that no significant impacts are expected on any fisheries or fish habitat as a result of this project. It is our view that the completion of Focus Report provides the science-based evidence that will enable the environmental assessment to be approved. An excellent record of improved performance Northern Pulpâ?Ts replacement effluent treatment facility is the latest of a long series of investments in environmental improvements at the mill. When acquiring Northern Pulp, Paper Excellence saw it as an opportunity to purchase an older mill and invest in operational and environmental improvements to extend its life, the associated economic activity, and related employment. Understanding the facility needed a considerable amount of work, Paper Excellence took over the mill with a goal to improve safety, efficiency, productivity and to make environmental improvements. More than $70 million has been invested since 2011 toward reducing effluent flow reducing odorous, particulate, and greenhouse gas emissions and to improve air quality monitoring. From the onset of its ownership, Paper Excellence committed to investing in environmental improvements which has led to: â?¢ Reduced odorous emissions by more than 90 on average â?¢ Reduced recovery boiler particulate emissions by 99 on average â?¢ Reduced mill-wide particulate emissions by more than 80 on average and â?¢ Reduced greenhouse gas emissions through the conversion from fuel oil to natural gas. The environmental record of the mill will be improved even further with the proposed replacement effluent treatment facility. Strong regulations in a global industry Canada has world-leading environmental regulation, including some of the most forward thinking and sustainable forestry management legislation and practices in the world. It should be no surprise that Canada leads the world with the highest proportion of our forests officially certified as sustainable. Nova Scotia, like all provinces, has excellent forestry management legislation through the Nova Scotia Forestry Act, and continues to modernize and improve on policy and regulation through the Nova Scotia Code of Forest Practice: A Framework for the Implementation of Sustainable Forest Management. From all perspectives, forest products made in Nova Scotia meet the very highest global environmental standards. Having high standards is exactly the right approach for our natural resource industries. It is also a challenge for commodities that compete in a global market that does not operate on a level playing field. The global kraft pulp market is expected to reach 60 million tonnes this year. While Canada continues to improve our already strong environmental and forestry management regulations, that is not necessarily the case elsewhere. Kraft pulp production is growing at a rapid rate across South America and Asia. Some of the countries with the fastest growing forestry industries, particularly in kraft pulp production, are in parts of the world notorious for weak environmental regulation and enforcement, few labour rights and minimal Indigenous rights. From the broadest environmental and social justice perspective, we should all champion maintaining and expanding forestry production in those nations with strong standards. If Northern Pulp was forced to close, the millâ?Ts share of the global market would rapidly be filled from elsewhere, with high odds that it is produced with far lower environmental, labour and Indigenous rights standards. Northern Pulp performs well compared to other mills There are 89 pulp and paper mills in Canada operating from coast to coast. In most instances these mills discharge treated air emissions, create solid waste and discharge treated wastewater into rivers, lakes or marine environments. In comparison to other mills, Northern Pulp is now very typical in terms of its emissions footprint and processes. The Focus Report provides data on treated effluent collected by the independent organization Forest Products Association of Canada, which was used to compare Northern Pulpâ?Ts effluent performance to Canadaâ?Ts other 22 stand alone Kraft facilities. Additionally, Paper Excellence provided air emissions and solid waste data for its nine other facilities in Canada and France. Keeping in mind that each of these mills already operate in accordance with all existing environmental regulations, the evidence shows that Northern Pulp performs as well, or better, than the majority of the other mills. Compared to the group of 23 kraft mills in Canada, an analysis of five different measures concerning water use, oxygen demand, sediment and chlorine load shows that Northern Pulpâ?Ts average ranking was better than half of the other mills. On these five measures, Northern Pulp ranked in the top third on two, in the top half on two others and in the top two-thirds on one. Similarly, compared to the group of 10 Paper Excellence mills in Canada and France, an analysis of six measures of air emissions and solid waste show that Northern Pulp is right in the middle of the pack, with an average ranking of 5.5 among the ten mills. Moreover, in absolute measurements as opposed to rankings, in no case was Northern Pulp anywhere near the bottom performers. Northern Pulp is operating in one of the jurisdictions with among the very highest environmental standards in the world, and already performs better than the majority of mills in Canada and nearly half of Paper Excellenceâ?Ts mills. By all measures, Northern Pulp lands firmly in the middle of an already highly regulated pack. Of course, the millâ?Ts environmental record will improve even further with the proposed replacement effluent treatment facility. The link between a strong environment and strong economy The Nova Scotia Environment Act is recognized as an essential piece of legislation designed to protect our shared environment, and guide our economic development. The Act rightly spells out its purpose through a set of principles for sustainable development that should guide its application, including: The linkage between economic and environmental issues, recognizing that long-term economic prosperity depends upon sound environmental management and that effective environmental protection depends on a strong economy. It is on this principle that policy-makers need a full understanding of the vital economic role played by Northern Pulp in the broader forestry industry, rural communities and the wider Nova Scotia economy. There is a lot at stake in this approval process, far more than immediately meets the eye. It seems obvious to most that Northern Pulp operations make an important contribution to the economy. What is not always well understood, however, is how big that impact actually is. The mill is the anchor for a much wider industry that stretches across the province, providing good jobs in many smaller and rural communities with high unemployment, and where good jobs are scarce. If the mill is allowed to close, the impact will be devastating not only for the workers at Northern Pulp, their families, and communities, but for the entire province. Earlier this year Unifor commissioned an independent study from Gardner Pinfold Consulting to examine the economic impact of a possible closure of Northern Pulp. Gardner Pinfold is recognized as one of Canadas leading firms in terms of its analytical capabilities and experience related to the economics of natural resource development and management. The purpose of the study was to examine the broad economic impact and contribution the operations of Northern Pulp provides within the Pictou County region, and across the province of Nova Scotia. The study not only examined the impact of the mill as on ongoing business, but also examined forestry sector dependence on Northern Pulp through analysis of the economic impacts under a scenario of a potential mill closure, focusing particularly on the impacts upon sawmills that are highly dependent on the mill. A close look at the community level was also made through an analysis of the impacts of the mill, and related industries, in five of the most affected counties. Through rigorous and independent economic analysis, combined with detailed interviews with representatives from 13 sawmills, forestry harvesters and related suppliers, the study found that: â?¢ Northern Pulp is a key player in rural Nova Scotia, creating a significant number of well-paying jobs in typically high-unemployment areas â?¢ Its unique partnerships with sawmills, forestry contractors and private woodlot owners are critical to its success, and to the rural economy â?¢ Owing to the inter-connected dependence of the forestry sector on the mill, a closure of the mill would result in the closure of several sawmills and forest harvesting businesses â?¢ Northern Pulp spends $279 million annually, with most spent in Nova Scotia â?¢ A supply chain of 1,379 companies support the mill operation â?¢ About 2,679 full-time equivalent jobs are supported by the mill â?¢ Workers throughout the economy gain $128 million annually worth of income â?¢ Approximately $38.4 million in tax revenues is generated annually to the provincial and federal governments and â?¢ A closure of the mill would remove all of these spending, employment, income and tax revenue benefits from the economy. An important choice for the future Canada is a nation rich in natural resources. With this wealth comes great opportunities, but also great responsibilities. We already have among the strongest environmental protections in the world, and should be proud of our record. We also need to understand that a strong economy that provides good jobs, and opportunities for economic development, can go hand in hand with sustainable development that respects First Nationsâ?T rights. Forestry is one of the most sustainable industries we have, with prospects for a bright future, but only if we make the right choices. We have one of those choices in front of us now. We strongly believe that approval of the Northern Pulp Replacement Effluent Treatment Facility Project is the right choice for our members, the broader forestry sector, all stakeholders and rights holders, and the province of Nova Scotia. Sincerely,

@unifor.org Address:
Municipality: TORONTO Postal-Code: Fax: ###
- #### email_message: Privacy-Statement: agree x: 58 y: 23

National Office
205 Placer Court
Toronto, Ontario M2H 3H9

UNIFOR
theUnion | lesyndicat

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205 Placer Court
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Jerry Dias
National President
Président national

Renaud Gagné
Quebec Director
Directeur québécois

Lana Payne
National Secretary-Treasurer
Secrétaire-trésorière nationale

[Submitted online at: https://www.novascotia.ca/nse/ea]

October 31, 2019

N.S. ENVIRONMENT
ENVIRONMENT ASSESSMENT BRANCH
OCT 3 1 2019
RECEIVED

Environmental Assessment Branch
Nova Scotia Environment
P.O. Box 442
Halifax, NS, B3J 2P8

Re: Northern Pulp Replacement Effluent Treatment Facility Project Focus Report

Greetings,

We are pleased to have an opportunity to provide comments regarding the Focus Report for the Northern Pulp Replacement Effluent Treatment Facility Project, an essential development for the future of forestry in Nova Scotia.

Unifor proudly represents 230 workers at Northern Pulp, 12,000 workers in Nova Scotia, and 23,000 forestry workers across Canada. We are Canada's largest union in the private sector with 315,000 members in every sector of the economy, and regularly advocate for good jobs, sustainable development, and progressive change for a better future.

From the outset of discussions concerning the future of the Northern Pulp mill, our union has agreed the Boat Harbour facility must close. We firmly believe there can be a solution that supports good jobs, protects the environment and respects First Nations' rights. Our members, and their families, live and work in the communities around the mill and have the highest interest in building a truly sustainable future.

The science clearly supports approval

Northern Pulp's proposed wastewater treatment facility Focus Report follows an extensive period of scientific study. The proposed new treatment facility will see the replacement of the existing plant with a state of the art wastewater treatment facility that will result in a significant improvement in the way treated wastewater is discharged. With the implementation of this new facility, Northern Pulp will become one of the most environmentally responsible mills in North America.

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The Focus Report provides a science-based review arising from more than twenty different investigations and analyses. These scientific analyses include environmental baseline studies, engineering designs, archaeological investigations, receiving water modeling, and Mi'kmaq Ecological Knowledge Studies, among others.

Not only will the new effluent treatment facility meet all requirements of the *Nova Scotia Environment Act,* it will also comply with several other essential regulations. Project components are designed to meet the federal Pulp and Paper Effluent Regulations, the National Building Code of Canada, the Canadian Standards Association best practices for effluent treatment and pipeline construction, and other design codes and standards. Additionally, all future facility operations would also be conducted under a provincial Industrial Approval. This project will be well regulated to ensure that it meets the highest standards for safe operation and environmental protection.

Based on the assessments made previously, and for the Focus Report, no significant adverse residual environmental effects are predicted for the air environment, fresh water environment or marine environment. Additionally, third party environmental experts have assessed that no significant impacts are expected on any fisheries or fish habitat as a result of this project.

It is our view that the completion of Focus Report provides the science-based evidence that will enable the environmental assessment to be approved.

An excellent record of improved performance

Northern Pulp's replacement effluent treatment facility is the latest of a long series of investments in environmental improvements at the mill. When acquiring Northern Pulp, Paper Excellence saw it as an opportunity to purchase an older mill and invest in operational and environmental improvements to extend its life, the associated economic activity, and related employment.

Understanding the facility needed a considerable amount of work, Paper Excellence took over the mill with a goal to improve safety, efficiency, productivity and to make environmental improvements. More than $70 million has been invested since 2011 toward reducing effluent flow; reducing odorous, particulate, and greenhouse gas emissions; and to improve air quality monitoring. From the onset of its ownership, Paper Excellence committed to investing in environmental improvements which has led to:

- Reduced odorous emissions by more than 90% on average;
- Reduced recovery boiler particulate emissions by 99% on average;
- Reduced mill-wide particulate emissions by more than 80% on average; and
- Reduced greenhouse gas emissions through the conversion from fuel oil to natural gas.

The environmental record of the mill will be improved even further with the proposed replacement effluent treatment facility.

/3

Strong regulations in a global industry

Canada has world-leading environmental regulation, including some of the most forward thinking and sustainable forestry management legislation and practices in the world. It should be no surprise that Canada leads the world with the highest proportion of our forests officially certified as sustainable. Nova Scotia, like all provinces, has excellent forestry management legislation through the *Nova Scotia Forestry Act*, and continues to modernize and improve on policy and regulation through the *Nova Scotia Code of Forest Practice: A Framework for the Implementation of Sustainable Forest Management.* From all perspectives, forest products made in Nova Scotia meet the very highest global environmental standards.

Having high standards is exactly the right approach for our natural resource industries. It is also a challenge for commodities that compete in a global market that does not operate on a level playing field. The global kraft pulp market is expected to reach 60 million tonnes this year. While Canada continues to improve our already strong environmental and forestry management regulations, that is not necessarily the case elsewhere. Kraft pulp production is growing at a rapid rate across South America and Asia. Some of the countries with the fastest growing forestry industries, particularly in kraft pulp production, are in parts of the world notorious for weak environmental regulation and enforcement, few labour rights and minimal Indigenous rights.

From the broadest environmental and social justice perspective, we should all champion maintaining and expanding forestry production in those nations with strong standards. If Northern Pulp was forced to close, the mill's share of the global market would rapidly be filled from elsewhere, with high odds that it is produced with far lower environmental, labour and Indigenous rights standards.

Northern Pulp performs well compared to other mills

There are 89 pulp and paper mills in Canada operating from coast to coast. In most instances these mills discharge treated air emissions, create solid waste and discharge treated wastewater into rivers, lakes or marine environments. In comparison to other mills, Northern Pulp is now very typical in terms of its emissions footprint and processes.

The Focus Report provides data on treated effluent collected by the independent organization Forest Products Association of Canada, which was used to compare Northern Pulp's effluent performance to Canada's other 22 stand alone Kraft facilities. Additionally, Paper Excellence provided air emissions and solid waste data for its nine other facilities in Canada and France. Keeping in mind that each of these mills already operate in accordance with all existing environmental regulations, the evidence shows that Northern Pulp performs as well, or better, than the majority of the other mills.

/4

Compared to the group of 23 kraft mills in Canada, an analysis of five different measures concerning water use, oxygen demand, sediment and chlorine load shows that Northern Pulp's average ranking was better than half of the other mills. On these five measures, Northern Pulp ranked in the top third on two, in the top half on two others and in the top two-thirds on one.

Similarly, compared to the group of 10 Paper Excellence mills in Canada and France, an analysis of six measures of air emissions and solid waste show that Northern Pulp is right in the middle of the pack, with an average ranking of 5.5 among the ten mills. Moreover, in absolute measurements (as opposed to rankings), in no case was Northern Pulp anywhere near the bottom performers.

Northern Pulp is operating in one of the jurisdictions with among the very highest environmental standards in the world, and already performs better than the majority of mills in Canada and nearly half of Paper Excellence's mills. By all measures, Northern Pulp lands firmly in the middle of an already highly regulated pack. Of course, the mill's environmental record will improve even further with the proposed replacement effluent treatment facility.

The link between a strong environment and strong economy

The *Nova Scotia Environment Act* is recognized as an essential piece of legislation designed to protect our shared environment, and guide our economic development. The *Act* rightly spells out its purpose through a set of principles for sustainable development that should guide its application, including:

> *The linkage between economic and environmental issues, recognizing that long-term economic prosperity depends upon sound environmental management and that effective environmental protection depends on a strong economy.*

It is on this principle that policy-makers need a full understanding of the vital economic role played by Northern Pulp in the broader forestry industry, rural communities and the wider Nova Scotia economy.

There is a lot at stake in this approval process, far more than immediately meets the eye. It seems obvious to most that Northern Pulp operations make an important contribution to the economy. What is not always well understood, however, is how big that impact actually is.

The mill is the anchor for a much wider industry that stretches across the province, providing good jobs in many smaller and rural communities with high unemployment, and where good jobs are scarce. If the mill is allowed to close, the impact will be devastating not only for the workers at Northern Pulp, their families, and communities, but for the entire province.

Earlier this year Unifor commissioned an independent study from Gardner Pinfold Consulting to examine the economic impact of a possible closure of Northern Pulp. Gardner Pinfold is recognized as one of Canada's leading firms in terms of its analytical capabilities and experience related to the economics of natural resource development and management.

The purpose of the study was to examine the broad economic impact and contribution the operations of Northern Pulp provides within the Pictou County region, and across the province of Nova Scotia. The study not only examined the impact of the mill as on ongoing business, but also examined forestry sector dependence on Northern Pulp through analysis of the economic impacts under a scenario of a potential mill closure, focusing particularly on the impacts upon sawmills that are highly dependent on the mill.

A close look at the community level was also made through an analysis of the impacts of the mill, and related industries, in five of the most affected counties. Through rigorous and independent economic analysis, combined with detailed interviews with representatives from 13 sawmills, forestry harvesters and related suppliers, the study found that:

- Northern Pulp is a key player in rural Nova Scotia, creating a significant number of well-paying jobs in typically high-unemployment areas;
- Its unique partnerships with sawmills, forestry contractors and private woodlot owners are critical to its success, and to the rural economy;
- Owing to the inter-connected dependence of the forestry sector on the mill, a closure of the mill would result in the closure of several sawmills and forest harvesting businesses;
- Northern Pulp spends $279 million annually, with most spent in Nova Scotia;
- A supply chain of 1,379 companies support the mill operation;
- About 2,679 full-time equivalent jobs are supported by the mill;
- Workers throughout the economy gain $128 million annually worth of income;
- Approximately $38.4 million in tax revenues is generated annually to the provincial and federal governments; and
- A closure of the mill would remove all of these spending, employment, income and tax revenue benefits from the economy.

An important choice for the future

Canada is a nation rich in natural resources. With this wealth comes great opportunities, but also great responsibilities. We already have among the strongest environmental protections in the world, and should be proud of our record. We also need to understand that a strong economy that provides good jobs, and opportunities for economic development, can go hand in hand with sustainable development that respects First Nations' rights.

/6

Forestry is one of the most sustainable industries we have, with prospects for a bright future, but only if we make the right choices. We have one of those choices in front of us now. We strongly believe that approval of the Northern Pulp Replacement Effluent Treatment Facility Project is the right choice for our members, the broader forestry sector, all stakeholders and rights holders, and the province of Nova Scotia.

Sincerely,

BM:LM:lmc/cope-343

From:	info@atlanticchamber.ca
To:	Environment Assessment Web Account
Subject:	Proposed Project Comments
Date:	November 1, 2019 3:28:04 PM

** EXTERNAL EMAIL / COURRIEL EXTERNE **
Exercise caution when opening attachments or clicking on links / Faites preuve de prudence si vous ouvrez une pièce jointe ou cliquez sur un lien

Project: replacement_effluent_treatment_facility_project Comments: November 1, 2019 Re: Replacement Effluent Treatment Facility Project â?" Northern Pulp Focus Report Dear Mr. Minister, This submission is intended to convey appreciation to the Department of the Environment for its stewardship role in protecting Nova Scotiaâ?Ts environment and to submit an opinion on the Northern Pulp Focus study for a proposed upgraded effluent treatment facility in Pictou. The Atlantic Chamber of Commerce has represented the interests of businesses in communities across the region for more than 120 years. As an organization representing business interests, it might be expected that this submission would include a bias for encouraging investment and minimizing regulation of productive business operation. The reality is the majority of business owners acknowledge that consumers and businesses need to reduce emission and make more efficient use of existing and renewable energy. But these are objectives that will be achieved more quickly in a vibrant economy where research, development and investment can be funded more readily. The province therefore has an urgent responsibility to provide the balance between the extremes of balancing protection of the environment versus the economy. In more succinct terms, it cannot and should never be one at the expense of the otherâ?"co-existence is possible. Businesses, large and small, appreciate that improving their environmental performance is a benefit to themselves and society. Northern Pulp has proven this principle and during the last eight years has worked with regulatory authorities to achieve large reductions in odour, particulate matter, and greenhouse gas emissions since acquiring the plant in 2011. Recognizing that the processes required to produce kraft paper for global markets involves production and disposal of waste and by-products, the mill has made great strides in decreasing the environmental footprint of the operation. Assessment of the Focus Report must move beyond the debate and discussions of blame and instead focus on a path forward that contributes to an acceptable solution. The issue at hand is not whether that Boat Harbour facility should close â?" of course, it must â?" but rather, whether the proposed treatment and disposal technology adequately safeguards communities, residents, the fishing industry and the local environment and allows the Northern Pulp to continue to operate profitably and provide employment. It is essential the assessment be tempered by an acknowledgement of the extensive impact of that the mill closure would have on livelihoods across the provinceâ?"well beyond the 340 direct jobs provided in Pictou. Such a closure will impact and potentially force closure of numerous sawmills, woodlot owners, truckers, and incur the loss of the largest shipper out of the Port of Halifax. The loss to the provincial economy has been conservatively estimated at over $300M and is not contained solely to the Pictou County area. The focus report provides additional scientific evidence of the improved environmental impact of constructing a new treatment facility based on proven technology will result in a reduction of waste materials, disposed in a more environmentally favourable manner. Simply put, the quality of the waste water disposed in the Northumberland Strait will be improved over current dispersion â?" far more effectively than the previous facility. Based on the specifications noted by Northern Pulp, the movement of waste water will be executed with an improved leak-resistant pipe with electronic monitoring able to detect minute leaks. The impacts at the proposed diffusion site are estimated to be contained to a very limited area in the Strait, not in close proximity to current fishing locations. The forestry and fishery sectors have co-existed successfully for decades and a better treatment facility should materially improve outcomes that allow both industries to thrive and deliver upon env ironmental protection targets. The Environmental Impact Assessment process is intended to evaluate whether proposed operations fall within the limits imposed by legislation and regulation. The concept of imposing desirable standards of operation, such as zero emissions, is neither realistic nor feasible. If the province wants to attract and retain business investment and development, we must enforce reasonable and predictable environmental standards based on current technologyâ?"with an eye to continuous learning, improvement and innovation for the future. Beyond a certain point, excessive regulation will cause businesses to close and move operations and jobs to other jurisdictions. All that is required to avoid such an occurrence is to allow Norther Pulp to improve the treatment of production waste and alter the location of the waste/emissions disposal. It is also worthy to note reclamation efforts at Boat Harbour will take time. Even if enforcement of the closure occurs in January 2020, it will not result in immediate remediation of the site. Federal and provincial environmental assessments of the clean-up will not be concluded for many months or years, making a short-term extension to the operation of Boat Harbour less impactful on key objectiveâ?" returning Boat Harbour to its original state. We submit that all commercial investments crave predictability in terms of regulation and timeliness. Nova Scotia is well beyond the 11th hour in determining whether Northern Pulp should be allowed to move forward and provide the facility needed to allow Boat Harbour to close. For the good of the province, it is important that the focus report be accepted on its merits and a determination provided by the Department of Environment. Name: Atlantic Chamber of Commerce Email: info@atlanticchamber.ca Address: PO Box 2291 Municipality: Windsor Postal-Code: B0N 2T0 Phone: 902 292-0121 Fax: ### ### - #### email_message: Privacy-Statement: agree x: 91 y: 31

From:
To: Environment Assessment Web Account
Subject: response to Northern Pulp focus report re: pipe into Northumberland Strait
Date: November 3, 2019 2:38:41 PM

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November 3, 2019

The Hon. Gordon Wilson
NS Minister of Environment
1894 Barrington St
Suite 1800 Box 442
Halifax NS B3J 2P8

Dear Mr. Minister,

Save our Seas and Shores is a coalition of fishers, First Nations and concerned activists from NS, NB, PEI, QC and NL who have advocated for protection of the Gulf of St Lawrence for decades. The Gulf of St Lawrence provides global food sources and feeds the coastal communities of 5 provinces and thousands of jobs with its multi billion dollar sustainable fishery and tourism industries.

We are writing today to comment on Northern Pulp's Focus report which details its ill advised, unrealistic scheme to pump 92 million litres of toxic kraft bleached effluent into this exceptionally fragile body of water. This egregious proposal lacks integrity, responsibility and a concrete grip on reality. Our coalition vehemently opposes a pipe dumping toxic pulp mill effluent adjacent to Caribou Harbour or anywhere in the Northumberland Strait and Gulf of St Lawrence. Let us explain why.

1) Six and a half times smaller than the Gulf of Mexico, the Gulf of St. Lawrence is a fragile,

landlocked, semi-enclosed inland sea that completely exchanges its water with the Atlantic Ocean only once a year. As one of the most productive marine regions in Canada and one of the most precious ecosystems on earth, (according to Dr, David Suzuki), it should never be placed in harm's way. Because of its circular, counter clockwise currents, any contamination will be widespread along the Gulf coastlines of Nova Scotia, New Brunswick, Prince Edward Island, Quebec and Newfoundland.This is further exacerbated by winter ice coverage that eliminates wave action that could contribute to oxygenation of the water. This freshwater effluent will raise to the surface and lay under the ice lay for months at a time every winter.

For 50 years, Northern Pulp has dumped 92 million litres of kraft bleached effluent, known to be one of the most toxic marine pollutants on this earth, every single day into this fragile ecosystem where over 2,000 marine species spawn, nurse and migrate annually. Their irrational logic for the continuation of this immoral conduct is that they've done it for fifty years and no harm has been done... so they say.

In reality, as it stands now, the Right whale, Blue whale, leatherback turtle, piping plover and harlequin duck are endangered; while Atlantic salmon, cod, fin whale, humpback whale are in trouble; bass are in sharp decline, as are mackerel and herring; Bluefin tuna are starving and flocking to fishing boats for food – these are just some examples of the disgraceful indicator that in only fifty years, our generation has taken for granted and degraded our Gulf's natural, renewable resources. We have allowed unfettered industrial development and pollution with little regard for the precautionary principle and ecosystem approaches demanded by the United Nations Convention on Biodiversity, supported by Canada in 1992.

In October of 2018, international scientists noted that the Gulf of St Lawrence is one of the most deoxygenating bodies of water on this earth.

https://e360.yale.edu/digest/the-gulf-of-st-lawrence-is-losing-oxygen-faster-than-almost-any-other-marine-environment

The authors of this study also note that protection of the Gulf needs to happen via governments at regional and local levels.

How does NSDOE reconcile this international science with Northern Pulp's irrational logic that a half a century of toxic effluent dumped into spawning waters determines that they should continue to violate our oceans? Northern Pulp's focus report reads as if they are dumping into pristine waters, rather than the deeply degraded fragile ecosystem the Northumberland Strait and Gulf of St Lawrence have now become in 2019.

There is no mention in Northern Pulp's focus report of the current state of de-oxygenation in this body of water. Hence the entire focus report is a farce, not grounded in truth or reality.

2) Northern Pulp plans to build its treatment facility on top of mercury that was buried by previous owners. Any individual is aware that disturbing buried mercury could lead to irrevocable consequences.The enclosed article by investigative journalist Joan Baxter explains this mercury problem in great detail. Yet it is being all but ignored by the NS Dept of Environment. It is disgraceful conduct for a department mandated to protect Nova Scotia's renewable resources to simply ignore and pretend that this monster of a mercury problem does

not exist. Our children deserve better scrutiny and oversight of proposed industrial developments in 2019 when their very future is in peril.

https://www.halifaxexaminer.ca/province-house/nova-scotia-has-a-mercury-problem/

3) Perhaps NSDOE is ignoring this frightening mercury problem because of the conflict of interest you are in, as both owner, operator of the Boat Harbour treatment facility and alleged environmental protector of Nova Scotia's resources. For this reason, our coalition does not have any faith or believe your department can ethically determine this environmental assessment. We believe there should be a full federal assessment under CEAA.

Whatever your reasons for ignoring this looming mercury crisis, and the current de-oxygenation of our precious Gulf and its ongoing decline of marine resources, Save our Seas and Shores reiterates that we are vehemently opposed to any further effluent being dumped by this antiquated mill into the Northumberland Strait.

We are grateful to the Nova Scotia government for its leadership in establishing the Boat Harbour Act. But you must finish what you have started. Re-routing the toxic effluent from Boat Harbour to Caribou Harbour is MOVING the problem.Not solving it.

It is our responsibility as adults to protect the ecosystems that enable resource development for future generations. Up until now, we have failed our children. This must stop. Now. There must be #NOPIPE in the Northumberland Strait.

Respectfully submitted,

Merigomish, NS

on twitter

https://www.saveourseasandshores.ca

https://www.halifaxexaminer.ca/province-house/nova-scotia-has-a-mercury-problem/

https://e360.yale.edu/dest/the-gulf-of-st-lawrence-is-losing-oxygen-faster-than-almost-any-other-marine-environment

From:	
To:	Environment Assessment Web Account
Subject:	RE: Environmental Assessment - Northern Pulp Nova Scotia Corporation Replacement Effluent Treatment Facility Project, Pictou County, Nova Scotia
Date:	November 6, 2019 11:49:12 AM
Attachments:	Environmental Assessment Branch and Minister Wilson.pdf

Dear Sir/Madam:

Please find enclosed correspondence from in relation to the above-noted.

Thank you.

Regards,

MacIsaac Clarke & Duffy
Barristers and Solicitors

195 Foord Street
PO Box 849
Stellarton, Nova Scotia
B0K 1S0
Ph: (902) 752-5143
FAX: (902) 928-1299

N.S. ENVIRONMENT
ENVIRONMENT ASSESSMENT BRANCH
NOV 06 2019
RECEIVED

MacIsaac Clarke & Duffy
Barristers and Solicitors

PO Box 849, 195 N Foord Street
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COVER SHEET

FAX

To	Environmental Assessment Branch – Nova Scotia Environment
Fax #	902-424-6925
Subject	RE: Environmental Assessment - Northern Pulp Nova Scotia Corporation Replacement Effluent Treatment Facility Project, Pictou County, Nova Scotia
Date	Wednesday, 06 November 2019
From	

From the desk of
MacIsaac Clarke & Duffy
PO Box 849, 195 N Foord Street
Stellarton, NS B0K 1S0
Phone (902) 752-5143
Fax (902) 928-1299

MacIsaac Clarke & Duffy
Barristers and Solicitors

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November 6th, 2019

Environmental Assessment Branch
Nova Scotia Environment
P.O. Box 442
Halifax, NS, B3J 2P8
Fax: (902) 424-6925

EA@novascotia.ca

Honourable Gordon Wilson
Department of Environment
1894 Barrington Street, Suite 1800
P.O. Box 442
Halifax, NS
B3J 2P8

Minister.Environment@novascotia.ca

Re: Environmental Assessment - Northern Pulp Nova Scotia Corporation Replacement Effluent Treatment Facility Project, Pictou County, Nova Scotia

Dear Sir or Madam and Minister Wilson:

Please be advised we continue to represent the Harbour Authority of Caribou (hereafter "the Authority"), Pictou County, Nova Scotia.

Located at the mouth of Caribou Harbour, the Authority operates the busiest fishing port in Northern Nova Scotia. It is a hub of fishing activity from April to early December. It is accessed via the 106 branch of the Trans-Canada Highway and is adjacent to the Northumberland Ferries terminal. The facility managed by the Authority is the 'heart' of the commercial fishing industry in northern mainland Nova Scotia. It is also the site of Northern Pulp Nova Scotia's (NPNS) proposed marine effluent pipeline and effluent outfall.

The Authority has again retained our firm to express its continuing concerns regarding Northern Pulp's Focus Report for the Replacement Effluent Treatment Facility Project.

The Authority's position continues to be that Northern Pulp's proposal fails to adequately address critical issues which could result in catastrophic damage to the rich fishing grounds of Caribou Harbour and beyond. On this basis, as detailed below, my client is calling on Minister Wilson to reject Northern Pulp's proposed replacement effluent treatment facility.

This submission will address the following issues of concern to the Authority and its patrons:

1. No leak detection for marine portions of effluent pipe
2. Leak repair to the marine pipe in Caribou Harbour would be virtually impossible in winter months
3. Risk of ice damage to marine pipe
4. Navigation issues
5. No confirmed marine pipe route in Caribou Harbour
6. No definitive plan for marine pipeline construction
7. Risk of siltation in the harbour during construction causing significant harm to marine life and to current users of the harbour
8. Timing of marine pipe trenching and installation conflicts with existing uses of the harbour
9. Effluent will enter Caribou Harbour with significant harmful effects
10. Errors of fact relating to fisheries and presence of fish.

1. There is an absence of leak detection on the marine portions of the effluent pipe.

TOR 3.5 requires Northern Pulp to "Provide viable options including the selected option for leak detection technologies and inspection methodologies ..." Northern Pulp has provided no plan for leak detection on the marine portions of the effluent pipeline. The leak detection systems outlined in Section 3.5 apply only to the on-land portion of the pipeline.

> "A leak detection system as described below will be installed with the effluent pipeline **to monitor for potential leaks in the overland portion of the route between Pictou and Caribou** ..." (FR, Section 3.5, p. 62) (emphasis ours).

In response to questions submitted about potential damage and leaks to the marine pipe, the public is directed to "Refer to section 3.5 for comments concerning pipeline leak detection and enhanced pipeline protection options." (Appendix 1.1, pp. 10 and 18) However, there is absolutely no mention of any leak detection system for the marine portion of the pipe in section 3.5. The marine pipe is explicitly excluded. There is similarly no mention of leak detection in other sections, e.g. section 2.5, Changes to Pipeline, and Appendix 2.5, which address marine pipeline construction.

The absence of attention to leak detection in the marine pipe is a critical omission. Risk of leakage in the marine pipe has been and remains a significant public concern. A leak anywhere along the route of the marine pipe inside Caribou Harbour would result in build-up of effluent in the harbour, with the likely result being catastrophic damage to the marine environment, including juvenile lobster in the Marine Refuge Scallop Buffer Zone 24 and a highly productive rock crab nursery, both of which are critical to the regional fisheries of the Northumberland Strait.

Recommendation #1: Northern Pulp has not fulfilled the requirement of TOR 3.5 in relation to the marine portion of the pipeline. The Minister cannot approve this project without evidence that the project provides the highest level of effluent leak prevention, detection and timely repair to prevent significant and irreparable harm to the marine environment.

2. **Leak repair to the marine pipe in winter months would be virtually impossible.**

Even if effective leak detection technology was planned, in the event a leak developed during the 3- 4 month period when the harbour is ice-covered (with from 1- 5 metres of ice) repair would be nearly impossible. Ice conditions in Caribou Harbour and the Northumberland Strait are so severe that the PEI ferry does not run in the winter, and all fishing boats are taken out of Caribou Harbour.

The question of whether and how timely a repair could be carried out if a leak in the marine pipe occurred during winter months was raised repeatedly in public submissions. Northern Pulp has not addressed this issue, except by saying that burying the pipe will provide sufficient protection from ice scour. Ignoring and failing to address a possible occurrence on the basis that in Northern Pulp's view the event will not occur is not acceptable.

Recommendation #2: The Minister cannot approve this project without evidence that the project provides the highest level of effluent leak prevention, detection and timely repair to prevent significant and irreparable harm to the marine environment. The absence of attention to an acknowledged risk with such severe consequences greatly increases the likelihood of significant and irreversible harm at some point in the project life.

3. **Risk of ice damage to the marine portion of the pipe**

Ice damage to a marine pipe is an acknowledged risk in the Focus Report and accompanying documents, and in earlier reports from Stantec. TOR 2.2 requires Northern Pulp to "Conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must determine the potential impacts of ice scour on the pipeline."

Makai Engineering states that depth of burial for a marine pipe should be determined by survey information and historical data. Historical data has not been provided in the

Focus Report. NP has provided only one year of data on ice scour. Survey information from CSR shows that Caribou Harbour is an area with many ice scour events. One hundred and thirty-three (133) were noted in the survey, which CSR believes were from 2018-2019 alone. The company also notes that scours begin to fill in immediately, (Appendix 2.2, Section 5.5, p. 95) so that the measured scours do not indicate the deepest scour that would have taken place.

The general consensus among local fishermen and divers who have observed ice in the area for decades is that there is high risk of damage to the marine pipe and diffusers from ice even if the pipe is covered by 2-metres of soil. These same individuals note that shifting bottoms could uncover areas of pipe, making it more vulnerable to damage.

The Stantec Preliminary Receiving Water Study prepared for Northern Pulp in August 11, 2017, p. 4.80-4.81 contains this information:

> *It was reported (in ENSR, 1999) that Maritime Telephone and Telegraph (MT&T) performed an ice evaluation in support of an optical communication cable deployment across the Northumberland Strait. Based on MT&T's review, the estimated potential for damage to the cable from ice scour extended to water depths of 12 to 14 m. In 1991 their cable was trenched and buried to a selected depth (depth is unknown) and left on the surface of the sea bottom at greater depths. Unfortunately, the winter of 1991/1992 was severe and the cable was severed by ice keels at a water depth greater than 18 m towards the Woods Island, PEI side of the Northumberland Strait.*

This indicates that ice scour can take place a much greater depths than expected. This is crucial information that should be considered by the Minister in determining likelihood of harm.

Ice scour is not the only source of risk to the marine pipe. There are also risks to the pipe's integrity from structural stresses, as explained in the PEng. to the EARD. "Due to the cyclical nature of the tidal forces and wave action these induced stresses combined with ice loads over time could present fatigue stress issues."

These risks have not been addressed by Northern Pulp and must be fully examined before this project can be approved.

Finally, the Authority notes that there has been no attention given to protection of the marine pipe from ice or storm damage at the point where the proposed pipe would enter Caribou Harbour, before it is buried. This is another serious omission. This is a point where the marine pipe is vulnerable to moving ice as well as strong storm and wave action. Damage at this point could have the same catastrophic results as outlined above.

Recommendation #3: Northern Pulp has not fully addressed the issues to confirm the viability of the marine route in relation to ice or other stresses. They have not established that ice scour and other conditions do not present significant risks to the marine pipeline. Northern Pulp has not considered or responded to information submitted by local diver based on direct experience, nor to the issues of potential structural damage from ice pressure raised by professional engineer in his submission. They have not considered historical information on ice scour in the area.

Damage to the marine portion of the pipe would result in significant and irreversible harm to the entire Caribou Harbour ecosystem. A break or leak in the marine effluent pipe in an iced-over marine environment with minimal flushing capacity could continue for an extended period before detection – at the rate of 62 million litres per day.

We ask the Minister to reject this proposal. Northern Pulp has not provided sufficient information to conclude that a marine effluent pipe installed as described will not be at risk.

4. Navigation issues

NPNS completely fails to address the navigational concerns raised in our earlier submission. The Authority is very concerned that its patrons, both commercial and recreational, will have their navigational abilities under the *Navigational Protection Act* restricted. NPNS has responded only that "Impact to navigation is not anticipated. A Navigational waters review will be required before construction begins, at this time adjustments will be made as necessary."

In our submission this is not an adequate response.

The Authority's earlier submission pointed out that the patrons of the Authority, in particular seventy plus (70+) commercial fishermen, navigate directly across the path of the proposed pipe route in Caribou Harbour, on a daily basis, during regular fishing seasons of lobster, crab, herring and scallop, from April through November.

Any interference with existing navigation routes could cost individual fishermen hundreds of miles of additional travel every season for the lifetime of the project, with corresponding costs in time and fuel, and increased emissions to the environment.

My client also has serious concerns about interference with navigation during the proposed construction timeline of 84+ days, detailed below.

Recommendation #4: The Authority's position is that all navigation concerns must be addressed satisfactorily prior to any approval. The minister, in making his decision, must consider how the proposed project will impact existing uses of the area. Northern Pulp has not provided sufficient information to ensure that the proposal will not substantially interfere with existing navigational uses of the area during construction and in the long-term.

5. **There is no confirmed marine pipe route in Caribou Harbour.**

NPNS has not presented a confirmed marine pipe route for Caribou Harbour. The only specific information provided about the route are the co-ordinates for the entry point of the marine pipe and the outfall location. This is in notable contrast to the detailed drawings and plans presented for the on-land portion of the pipe. Marine survey information was gathered from a corridor 200 metres wide, within which NPNS presumable plans to locate the marine pipe.

Recommendation #5: This project cannot be approved before a specific pipe route is presented for evaluation and input from the public and government departments. The minister cannot accurately evaluate whether there will be significant and irreversible harm in the absence of a detailed marine pipe route.

6. **There is no definitive plan for marine pipeline construction.**

Northern Pulp is required by TOR 2.5 to "Provide any proposed changes to the pipeline construction methodology and other associated pipeline construction work, related to the potential changes to the marine portion of the pipeline route (e.g., infilling, trenching, temporary access roads, excavation, blasting, disposal at sea, and others where applicable).

Northern Pulp has not fulfilled TOR 2.5. They have not provided a detailed plan for marine pipeline construction. The Focus Report states, "Appendix 2.5 provides the details of the current proposed construction." (Section 2.5, p. 39). This is not accurate. Appendix 2.5 **does not provide this information**. Makai Ocean Engineering Inc. which prepared the report for Appendix 2.5 writes, "This report provides an opinion of the likely construction methods and design features of the pipeline, based on the available data and standard practices for marine pipelines." They also state, "The exact method used for dredging will be determined by the selected marine contractor based on schedules, costs, and available equipment resources." (Executive Summary, p. 1)

Makai states clearly that, "While Makai has extensive experience with HDPE pipeline installations and has taken considerable efforts to consider the site specifics and likely approaches for this project, **the actual means and methods and construction processes will remain the responsibility of the Marine Contractor, and may vary from this approach."** (Introduction) (*emphasis ours*)

We note some, but not all, of the issues relating to TOR 2.5 where no concrete plan has been presented:

- **No plan for how excavated material will be dealt with during construction**: Neither the Focus Report Section 2.5 and Table 2.5-1, p.18 nor Appendix 2.5

provide a definitive plan for how excavated material will be dealt with during the construction process, (sidecast, removed to barge or other.) Options are presented, but no definitive plan is presented.

- **No plan for spoils disposal:** The question of potential disposal at sea is raised explicitly in TOR 2.5. NPNS downplays the issue of spoils and their disposal. The Focus Report states, "It is anticipated that spoils from the excavation will be repurposed as fill to cover over the trenched pipeline once placed. Excess spoils may be (sic) require disposal and will be subject to regulatory approval and permitting." (Section 2.5, p. 43)
  NPNS has provided no explanation of how spoils will be disposed of. They have not addressed the question of they will be looking at disposal at sea.
  The Harbour Authority notes that it appears physically impossible that there will not be a significant amounts of spoils requiring disposal in some way, given that 6" of gravel and a 36" diameter pipe will replace excavated soil for the 4 km distance of the trench.
- **Some of the excavated soil may exceed contaminant guidelines**. Contaminant levels beyond guidelines in some soils are identified in the Focus Report documentation. NPNS has not addressed this issue except to say that it will be dealt with at a later time.
- **There is no clear plan for how the trench will be finished.** "Once the trench is covered in soil, it could either be graded down using a towed grader bar, or left to the elements if local currents and sediment transport is agreeable." (Appendix 2.5, p.18) The possible use of armour stone in some places is mentioned. There has been insufficient attention given to the strong tides and currents that could expose the pipe to ice damage.
- **Blasting very unlikely**. In response to TOR 2.5, NPNS says only that blasting is "very unlikely." The Authority is very concerned with leaving this issue unresolved. My client's position is that sufficient information should have been gathered and provided in the Focus Report to determine whether blasting is proposed as part of this project or not, in order that this issue can be fully considered in terms of assessing potential impacts. Use of blasting could have significant consequences.
- **Siltation during construction**. See point 7 below regarding potential impacts of siltation during the 84+ day proposed construction period.

Recommendation #6: The Harbour Authority of Caribou believes that Northern Pulp has not provided sufficient information to fulfill the requirements of TOR 2.5. NPNS has presented a number of possible scenarios, but no plan that can be evaluated for potential impacts. The missing information is not available in earlier documentation, i.e. the EARD or in Appendix F to the EARD.

The Harbour Authority is very concerned that, *"The exact method used for dredging will be determined by the selected marine contractor based on schedules, costs, and available equipment resources."* (Appendix 2.5, p. 1) Decisions based on schedules, costs and available equipment do not prioritize prevention of environmental harm to the

Harbour or impacts on present users of Caribou Harbour and do not ensure protection of the delicate harbour environment.

My client asks the Minister not to approve this project without a detailed construction plan subject to scrutiny and input from the public, including our patrons, who have detailed knowledge of the actual conditions of the area and the potential for harm. NPNS has not provided the Minister with the information needed to determine whether construction of the marine pipeline can be done without causing irreparable, long-term harm to Caribou Harbour and the nearby Northumberland Strait, including the marine life within it, both plant and animal, and current users.

7. **Siltation in the harbour during construction may cause significant harm to marine life and current users of the harbour.**

The Authority and our patrons have great concern about the impact of siltation on the Harbour and surrounding waters during construction and for an unknown period afterwards. No attention has been given to the potential effect of excavation of over 80,000 cubic metres of silty bottom over a period of 84+ days, (Focus Report, Table 2.5-1) in a shallow, tidal area. Caribou Harbour experiences tidal changes of up to 5 feet, twice daily. During a construction period of this length, storm conditions are almost inevitable. Storm surges can raise waters by 6 feet over normal conditions, with high winds and crashing waves. Northern Pulp has only addressed this issue by saying that silt curtains and isolating work areas will be used to reduce turbidity. This is completely insufficient for an issue which could have significant impacts on all life in the harbour.

Is it viable to isolate up to 4 km of trench and up to 80,000 cubic metres of sidecast soil effectively, without interfering with navigation and existing uses of the harbour? What amount of silt would be contained by these methods, what would be released? Conditions inside Caribou Harbour, with depths of between 0 and 8 metres, are significantly different than in many open ocean areas, where dispersion of silt would take place more effectively. What would be the impact of siltation under both normal and storm conditions on eel grass beds, on plankton, on juvenile lobster and crab and other forms of marine life, on the seabed itself? This issue must be fully examined based on the actual conditions in Caribou Harbour prior to approval being given for the project.

There are 70+ fishers, buyers and a nearby fish plant employing 140 people, that all need clean water for multiple purposes. During the months of May and June in Caribou Harbour at our wharf and at North Nova Seafood's, there is a minimum of 100,000 to 150,000 thousand pounds of live lobster, 'floating' every day. This means the lobsters are submerged in containment pens or 'cars' in seawater, in 100-pound crates. The lobsters are reliant on clean, oxygenated water. So are the oysters in the 4 oyster leases in the harbour, and the juvenile rock crab, lobster and other species. Fishers use seawater to spray down their catches as they fish, to keep them cool. They use seawater to wash down their boats and traps. That water must be clean.

Over 84+ days construction, with unpredictable weather, the Harbour Authority has serious doubts about whether installation of 4km of marine pipe can be carried out without significant, long-term harm. Certainly, Northern Pulp has not provided sufficient information to show that it can be done without such harm.

Recommendation #7: The Minister cannot approve this proposal until the potential impacts of siltation in the Harbour during the 84+ day proposed construction period is fully evaluated.

8. Timing of proposed marine pipe trenching and installation and existing uses of the harbour

The Authority's position is that there is no 84+ day construction window that would not severely interfere with existing activities. There is ice in the harbour from late December until April. Lobster season and the related storage/navigation/fishing from end of April to end of June. Major recreational activities occur throughout July, August and September, with rock crab season running from early August to November. Include the herring fishery in the Northumberland Strait from early September until later October, of which Caribou Harbour is the epicenter. Tuna fishing in August, September and October, then scallop fishing from early November to mid- December. Complicate that with the beginning of fall storms and high winds. Ice can close in by early December. Then add in the Northumberland Ferries running from May 1st until mid- December in a narrow channel only slightly larger than the vessels themselves.

Recommendation #8: Caribou Harbour is used for activities central to the economy of the area for all months of the year when it is ice-free. There is need for a full evaluation of the potential impacts of proposed pipeline construction on existing uses prior to any approval of the project.

9. Effluent will enter Caribou Harbour

Northern Pulp's proposal relies on a receiving water study (RWS) prepared by Stantec. This study indicates that there will be minimal flow of effluent discharged into Caribou Harbour. The Authority reasserts its position that this conclusion is erroneous, and does not reflect what its fishers know from working the waters of Caribou Harbour year-round for many decades.

a) The receiving water study does not take into account conditions familiar to fishers in the area, including storm surges/surge tides or sustained, heavy onshore winds from the northeast or northwest that can last for several days and 'hold' the tide in.
b) There is a bottleneck effect at the mouth of the Harbour between Munroe's Island and Caribou Island caused by the deeper water, (the proposed location for the outfall and diffusers), meeting the shallow water adjacent to the sandbar at the mouth of the harbour. This is the actual narrow, marked

channel the Prince Edward Island and Northumberland Ferry navigates to exit Caribou Harbour, which averages a depth of 25 feet. (This channel needs to be dredged every so often to maintain a safe depth for the ferry to navigate in and out of the harbour.) A rising tide basically, especially with onshore winds, funnels in from the proposed diffuser location.

c) Under storm conditions, the water level in Caribou Harbour sometimes rises in excess of 2 meters. There is nowhere for this excess to come from but the mouth of the harbour, where the effluent outfall is proposed to be.

d) A local knowledge submission containing detailed information about the tides, currents and winds in the Caribou Harbour area was submitted as a response to the EARD by Caribou fishers It contains important information that does not appear to have been considered in the revised RWS.

e) We draw your attention to the expert opinion of of Stanford University, an oceanographer with expertise in numerical modelling of coastal dynamics. Dr. reviewed the Stantec RWS in the EARD and concluded that errors of modeling lead,

> "to the incorrect conclusion that the environmental impacts will be negligible because the effluent concentrations are predicted to be unphysically low. **Instead, correct implementation of the models with more conservative and physically realistic scenarios would show that effluent concentrations in the region could be much larger and that effluent accumulation in Pictou and Caribou Harbours is likely.** (emphasis added) (p. 1, Appendix 1, Ecojustice Response to EARD)

Dr. also states that Stantec's use of the two-dimensional Mike 21 model is inappropriate as it fails to take into account local dynamics caused by wind, river inflows, offshore currents, ice, waves and storm surge. (p. 7)

Recommendation #9: We are aware that Dr. is preparing an updated submission on the revised RWS. We ask the Minister, and government departments reviewing the NPNS proposal, to give Dr. past and updated submissions their full attention, and to give attention and respect to the local knowledge of fishers submitted previously and to this review.

The RWS is a key element of NPNS's conclusion that no harm will be done by the release of an average of 62 million litres of treated effluent daily into the Northumberland Strait at the mouth of Caribou Harbour. If the information on which the RWS modeling is based is not correct or complete, the results will not be correct. Likewise, if the methodology is not correct. The RWS is not an area where mistakes can be allowed; there is too much at stake.

The Harbour Authority and its patrons are not experts in modelling. Dr. is an independent expert, and we note that his conclusions were consistent with our fishers' local knowledge. We note that there are many errors of fact in NPNS' focus report in relation to fisheries and the presence of fish. We have listed some of these errors in point 10 below. Fisheries and fish are subjects on which the fishers of the Authority do consider themselves experts. The multiple errors on these subjects (see point 10 below) in the Focus Report and attached documents do not give us confidence that NPNS has provided accurate information in other areas.

10. Errors of fact relating to fisheries and the presence of fish.

Due to limitations of time for public comments, my client is unable to fully respond to errors of fact relating to fish and fisheries that may exist in Northern Pulp's documents. However, we would like to point out some which are apparent to the Harbour Authority and its patrons.

a) Appendix 7.3, p. 68, erroneously states that rock crab are not found at depths greater than 10 m. To give an idea as to how inaccurate this is, you simply need to understand that most fishermen have 35 to 60 meters of buoy line to fish rock crab. Rock crab are fished as deep as 35 to 50 m in the Strait. Depending on the time of year they congregate at different depths.
b) Appendix 7.3, p. 68 also states that rock crab are not fished near the proposed outfall. This is false. The area is extensively fished for rock crab. The vast majority, if not all, fishers in Caribou who participate in the rock crab fishery have fished rock crab in the direct vicinity of the diffuser location.
c) Figure 7.3-3, p. 130 of the Focus Report, titled Northumberland Strait Lobster Buoy Locations, gives a highly inaccurate picture of the presence and amount of lobster fishing directly in the vicinity of the diffusers. The entire harbour and channel area including the vicinity of the proposed diffuser is fished for lobster. Lobster fishing effort and locations change sometimes on a daily basis. They are dependent on many factors, including water temperatures, molt cycles, and annual migration inland to molt, spawn and feed.
(In fact, Northern Pulp's own information contradicts itself. Figure 7.3-4 Lobster Distribution and Harvest Area indicates that lobster fishing takes place much closer to the proposed diffuser than the representation in Figure 7.3-3)
d) Figure 3-12 (Appendix 7.3, p.66) suggests Atlantic Herring resources in the LAA are limited to the outer Caribou Harbour / Northumberland Strait where depths approach 10 m and greater. This is false and completely in error. The adjacent Pictou Banks, (middle ground), Caribou Point and northwest to Pictou Island, all are basically less than 10 meters depth and extensively fished for Atlantic Herring.
Atlantic Herring converge in the exact location of the channel and proposed diffuser to spawn there and in the adjacent banks. Northern Pulp says herring are generally located outside the zone of discharge (Appendix 7.3, Section 4.1.3.6, p. 4.2) and pass through this area on their way to spawning grounds. (Appendix 7.3, Appendix D, last page, no page #) This is incorrect. This entire area including the area of the diffuser is the spawning ground for Atlantic Herring.

e) Mackerel is fished extensively in the exact location of the channel and proposed diffuser location. Mackerel feed on juvenile herring and herring spawn and basically are in abundance when the herring come to this area to spawn. The greater depth of the channel allows for more line in the water, which enables more hooks to fish mackerel effectively at the exact diffuser location and all along the channel.

f) Northern Pulp states that the proposed marine pipe intersects the scallop buffer zone and that the diffuser is not within the scallop buffer zone. (Appendix 2.5, p. 8) This is incorrect. The entire 4 km proposed pipe including outfall location is within a Scallop Buffer Zone, SFA 24. The buffer zone is measured 1 nautical mile (1.1 miles) from any land.
These zones are part of a marine refuge for American Lobster and are part of Canada's Marine Refuge program, which contributes to Canada's marine conservation targets. Consider that part of the considerations given for the marine refuge is that 'no human activities that are incompatible with the conservation of the ecological components may occur or be foreseeable within the area'. This entire proposed pipe and associated effluent is not compatible with the intent of a Marine Refuge. Marine refuges contribute to Canada's marine conservation targets.

The Harbour Authority submits for your attention Appendix 1, consisting of signed documentation from 65 fishers who fish lobster, rock crab and/or herring in the vicinity of the diffusers. This information is submitted to correct inaccurate information in Appendix 7.3 of Northern Pulp's Focus Report, which represents the area around the proposed outfall as free from fishing.
Sixty-five (65) fishermen and women indicated that they fish for either lobster, rock crab or herring in the vicinity of the proposed outfall. Thirty-eight (38) state that they fish one or more of these species within 300 metres of the proposed effluent outfall. Forty-three (43) state that they fish one or more of these species within 1 km of the proposed outfall.
This information was gathered in Pictou, Nova Scotia, on November 1 and November 4, 2019. Due to time constraints, this information represents some, but not all, of the fishers who fish in the vicinity of the proposed effluent outfall. It does not include information from fishers who fish other species in the immediate vicinity of the outfall.

Recommendation #10:

My client is disturbed by the many errors of fact regarding the presence of fish and fisheries in the area of the proposed outfall, including continued misrepresentation of the relationship of the 4 km pipeline and outfall to marine refuge SFA 24. Fishermen have presented information about the presence of fish and fisheries to Northern Pulp from the very first meeting almost two years ago. Northern Pulp has not reflected this information in their Focus Report. As noted, the short time for public input limits our ability to fully review the documents for errors in these areas. We ask the Minister to take into consideration the repeated errors of fact, which raise significant questions about potential inaccuracies in other information, and must limit confidence in the conclusions drawn by NPNS that the project will cause no significant, residual harm.

11. Conclusion and Final Recommendation:

The Authority's position is that the Minister must reject Northern Pulp's proposed new ETF. Northern Pulp's Focus Report response contains errors of fact and lacks information on critical issues. It lacks key protective measures. Northern Pulp has failed to address the Terms of Reference adequately and they have failed to address realistic and legitimate concerns raised by ourselves and other members of the public. Critical scientific studies have not been done, including lobster larvae studies recommended by NPNS's own consultants. Northern Pulp has drawn the conclusion that this project will cause no significant, irreversible harm without providing the science to back up this conclusion.

There is credible evidence of significant, long-term of risks to the marine environment presented by ourselves and others. There is also evidence of the devastation caused by pulp effluent to Boat Harbour. The Authority does not want to see this repeated in Caribou Harbour.

Because of these errors and omissions, and because of credible evidence of risk, we believe the Minister cannot approve this project. The Minister does not have a basis to conclude that the project can be undertaken without likelihood of serious consequences and irreparable harm to Caribou Harbour and the marine ecosystem that the Authority and its patrons rely on to earn a decent and moderate living. We ask that this proposal be outright denied based on these very realistic and legitimate concerns.

Yours truly,
MACISAAC CLARKE & DUFFY

cc Client
Minister of Environment and Climate Change
Minister of Fisheries Oceans and the Canadian Coast Guard
Canadian Environmental Assessment Agency NS Regional Office

Appendix 1

Submission of Caribou Harbour Authority

November 6th, 2019

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓		✓	
	✓	SCALLOPS	✓	
	✓		✓	
	✓		✓	
		✓	✓	
	✓	✓	✓	
	✓		✓	

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	✓		✓	
			✓	
	✓	✓	✓	
	✓		✓	
			✓	
	✓		✓	

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	✓	✓	✓	
	✓	—	—	
	✓		✓	
	✓	✓	✓	
	✓	✓	✓	
	—		—	

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	✓	✓	✓	
	✓	—	—	
	✓		✓	
	—	—	—	
	✓	✓	✓	
	✓		✓	

The proposed effluent outfall is at: 14307.6
29812.2
Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
			✓	
		✓	✓	
	✓	✓	✓	
			✓	
	✓	✓	✓	
		✓	✓	

The proposed effluent outfall is at: 14307.6
29812.2
ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	Less than 100 ✓	Less than 100 ✓	✓	
			✓	
			✓	
			✓	
	✓	✓	✓	
	✓			

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	✓	✓	✓	
	✓	✓	✓	
	groundfish			
	✓		✓	
	✓	✓		
			✓	

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
		✓	✓	
	✓	✓	✓	
	✓	✓	✓	
	✓		✓	
	✓	✓		
			✓	

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓		✓	
			✓	
	✓			

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
	✓		✓	
			✓	
	✓	✓	✓	
		✓	✓	

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓		✓	
	✓		✓	
			✓	
	✓		✓	
			✓	
			✓	
			✓	

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
	✓			

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	✓	✓	✓	
	✓			
	✓	✓	✓	
	✓	✓	✓	
			✓	
			✓	

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished with

Name - Print	Lobster	Rock Crab	Herring
		✓	✓
	✓	✓	✓
			✓
	✓	✓	✓
	✓	✓	✓
	✓	✓	
	✓		✓

From: @gmail.com
To: Environment Assessment Web Account
Cc: Colwell, Hon. Keith (DFA); Mike.Kelloway@parl.gc.ca; sean.fraser@parl.gc.ca; Lenore.Zann@parl.gc.ca; Serge.Doucet@dfo-mpo.gc.ca; pictouwestmla@bellaliant.com; '
Subject: Focus Report GNSFPB submission
Date: November 6, 2019 5:43:35 PM
Attachments: GNSFPB Focus Report Submission.pdf

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Good afternoon,

The GNSFPB respectfully submits the attached review in response to the Northern Pulp Focus Report submitted on Oct 2, 2019. The GNSFPB represents over 600 multi-species harvesters in the Gulf of Nova Scotia. As you will find in our report, we maintain that we have significant concerns related to the data gaps, broad assumptions and general lack of scientific evidence provided by Northern Pulp Nova Scotia.

Please confirm receipt of this review.

Gulf Nova Scotia Fleet Planning Board
@gmail.com

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Honourable Minister Gordon Wilson
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8

Re: Northern Pulp Nova Scotia, Focus Report, Replacement Effluent Treatment Facility

Dear Hon. Minister Gordon Wilson,

The Gulf Nova Scotia Fleet Planning Board has reviewed the Focus Report submitted by Northern Pulp Nova Scotia (NPNS) on Oct 2, 2019. Due to limitations in time and resources, the comments below only cover the portions of the Focus Report relevant to the fisheries and marine environment. The Gulf Nova Scotia Fleet Planning Board represents over 600 multi-species license holders in the Gulf of Nova Scotia and is part of a fishermen's working group which represents the interests of over 3000 commercial fishing licenses and 215 communal commercial licenses in New Brunswick, Prince Edward Island, Gulf Nova Scotia and Pictou Landing First Nation.

The GNSFPB has been engaged since the beginning of this process and has reviewed the previously submitted registration and Environmental Assessment documents. We still have significant concerns that the Focus Report has failed to adequately respond to the Terms of References outlined by the Minister. NPNS has failed to present relevant and adequate evidence to prove that the fishery, considering the biological and economic components, will not be seriously harmed as result of the proposed effluent treatment facility. The Focus Report inadequately addresses the impacts of the construction of the pipeline and discharge of effluent on key fisheries life stages, habitat and general population level health. The Focus Report does not provide the necessary contextual background that identifies the Southern Gulf of St. Lawrence as an ecologically significant area, which is currently undergoing climactic shifts in ambient water quality, considering temperature and oxygen levels. The ongoing changes in the Southern Gulf are altering the ecosystem resilience and baseline tolerance thresholds for environmental conditions. There are major gaps and assumptions made throughout this Focus Report which do not sufficiently meet the terms of reference assigned by the Minister of Environment.

American Lobster Biology

7.0 Fish and Fish habitat TOR: *Conduct additional impact assessment for treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodology must first be agreed upon by NSE in consultation with relevant federal departments.*

7.5 Fish and Fish Habitat TOR: *Clarify what contingency measures will be in place to mitigate potential impacts (e.g., thermal shock to fish) due to potential large and rapid fluctuations in water temperature in the winter at the diffuser location during low production or maintenance shut down periods.*

There are significant concerns regarding the potential for negative population level impacts on American lobster from the effluent discharge, specifically the presence of dioxins, furans and phenols. In addition to the presence of chemicals, there are concerns about the impacts of altering the pH, temperature, oxygen level and salinity in the receiving environment.

Considering water quality and effluent composition, we have several key concerns with the information presented by NPNS and the potential impacts on lobster health. First, NPNS predicts that effluent will have a temperature range of 25-37°C. DFO temperature probes throughout the Gulf of NS have shown annually that even during the warmest months, the average temperature does not go above 15-20°C. The effluent temperature is significantly higher than the ambient temperature in the receiving environment, and in the winter months, the thermal shock from heated effluent will be even greater. The Canadian Water Quality Guidelines for the Protection of Aquatic Life state that "Human activities should not cause changes in ambient temperature of marine and estuarine waters to exceed ±1°C at any time, location, or depth. The natural temperature cycle characteristic of the site should not be altered in amplitude or frequency by human activities. The maximum rate of any human-induced temperature change should not exceed 0.5°C per hour" (CCME 2003). NPNS only outlines the contingency methods to keep the effluent within the 25-37°C temperature range but does not describe how they will meet the guideline for rate of change, or elaborate on any biological impacts resulting from the expected temperature range.

In addition to this, the near and far-field modelling was completed for a 30-day tidal cycle to identify how and where the effluent will concentrate, given tidal condition and seasonal ice cover. The model only accounts for 30 days of effluent discharge during two seasonal conditions; and does not indicate what the entrainment and dilution rates would be over months or years of accumulation. Figure 4.2-4: Simulated Effluent Concentration by End of One-month Simulation Period in February shows that after 30 days there is accumulation in the North East corner of Caribou Island. The graph supplied is difficult to analyze, but it appears that there are concentrations at least at 2.00-2.25 mg/L after just 30 days. Dilution ratios are expected to change over the winter months, with increased accumulation rates from annual ice cover from January to April. An accumulative model is necessary to predict the accumulation of parameters of concern; parameters such as resin acids, fatty acids, AOX, PAH, and TDF which are known to bioaccumulate in sediment, tissues of invertebrates, vertebrates (El-Shahawi 2010, Lander 1990).

American Lobster Habitat Concerns

7.2 Fish Habitat Baseline Survey TOR: *Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada*

The proposed effluent treatment facility will cause extensive habitat displacement or destruction during the construction phase. NPNS conducted Underwater Benthic Habitat Surveys to understand the habitats and benthic communities that are present along the proposed pipeline corridor and diffuser area. The UBHS was conducted for a very limited period of only 5 days from May 3 to May 7, 2019. This limited sample window does not allow for a fulsome picture of the marine and benthic environment. The marine environment, including plant communities, benthic communities and planktonic composition fluctuate significantly on a seasonal cycle. Results from a study by Mutsamaki (2015) shows that “the patterns observed in one depth zone or season cannot be directly extrapolated to larger areas and that drawing meaningful conclusions on the small-scale distribution in the fish assemblage structure require sufficient replication of sampling in space and time”. This indicates the evidence presented in the UBHS should not be considered as a ‘meaningful’ representation of the full benthic and invertebrate communities.

The results of the limited UBHS show that there is valuable lobster habitat in all 3 areas studied (Pictou Harbour, Caribou Harbour and Diffuser Area). Lobster require different types of habitat throughout their life cycle; and DFO research indicates that availability of appropriate habitat types is a limiting factor for lobster population viability. Following the larval stage, stage IV lobsters will begin to settle on the ocean floor. Stage IV lobsters seek gravel, cobble and larger sediment to provide shelter. Younger stage IV lobsters may also use sand or silty environments to bury themselves to provide protection. As lobsters grow and mature, they are able to use multiple habitat types to create shelter. NPNS does not present any adequate plan to mitigate habitat loss or effectively replace habitat.

The Focus Report states that there is a potential effect on marine fish habitat by “direct removal, disturbance of existing substrates utilized by multiple species and their life stages due to the staging, excavation, pipe placement and material backfilling” (Table 7.3-2 Summary of Marine Impacts, Mitigation Measures and Overall Significance). The Focus Report does not provide any description of mitigation measures, including how they will replace the existing habitat or how they will design a staged timing protocol to “incorporate fisheries timing windows to avoid sensitive life stages, periods of adverse weather or spring tides to reduce turbidity and sedimentation”. NPNS repeatedly applies a vague blanket statement that they will time the in-water work to consider a multitude of factors (life stages, weather, tides, fisheries activity) while still meeting practical requirements. In order for NPNS to meet the TOR above, and for the Minister to make an informed decision on the effectiveness of proposed mitigation measures, NPNS must provide a detailed plan on these mitigation activities (ex: staged timing of work, Erosion and Sediment Control Plans). Mitigation measures must be assessed by their specific merits and ability to reduce or eliminate harm. It cannot be sufficient to state that a plan will be developed in the future.

Atlantic Herring Vulnerability

7.3 – Impact Assessment for Marine Fish TOR: *Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodologies must first be agreed upon by NSE in consultation with relevant federal department.*

Beyond the 8 ‘important fisheries’ identified for commercial, recreational and Aboriginal value, NPNS has recognized three “key indicator species” that warrant further investigation due to their importance in commercial and Indigenous harvests occurring within the LAA: American lobster, rock crab and Atlantic herring. Upon review of potential impacts on the herring fishery, NPNS has ignored a fundamental component related to the vulnerability of the herring population to impacts from the construction of the pipeline and discharge of effluent. The proponent only refers to the direct interaction with harvest activities, with no regard for the potential biological impacts.

There are two spawning stocks of herring in the Southern Gulf, Spring Spawning (SS) and Fall Spawning (FS). The SS stock has been in the critical zone since 2004, and the FS stock has been in the cautious zone since 1999 (Surette 2016). The Fall Spawning stock has 5 major spawning grounds in the Gulf of St. Lawrence; one of these few remaining spawning grounds is located near the mouth of Pictou Harbour, directly adjacent to the proposed project area (Figure 1, Surette 2016). DFO is currently developing rebuilding plans for both Spring and Fall Spawning stocks. DFO states that “Elevated fishing mortality, during the mid-1990s to 2010, declines in weights-at-age, and low recruitment rates are contributing to declines in SSB, further impeding the rebuilding of the stock.” (DFO 2018). Given DFOs mandate to support the protection of habitat and fish stocks using the Precautionary Approach, NPNS must provide further evidence that the pipeline construction and discharge of effluent will not further inhibit the rebuilding of this critically important fish stock; including sublethal effects on reproduction and recruitment rates in order to meet the TOR for fish health.

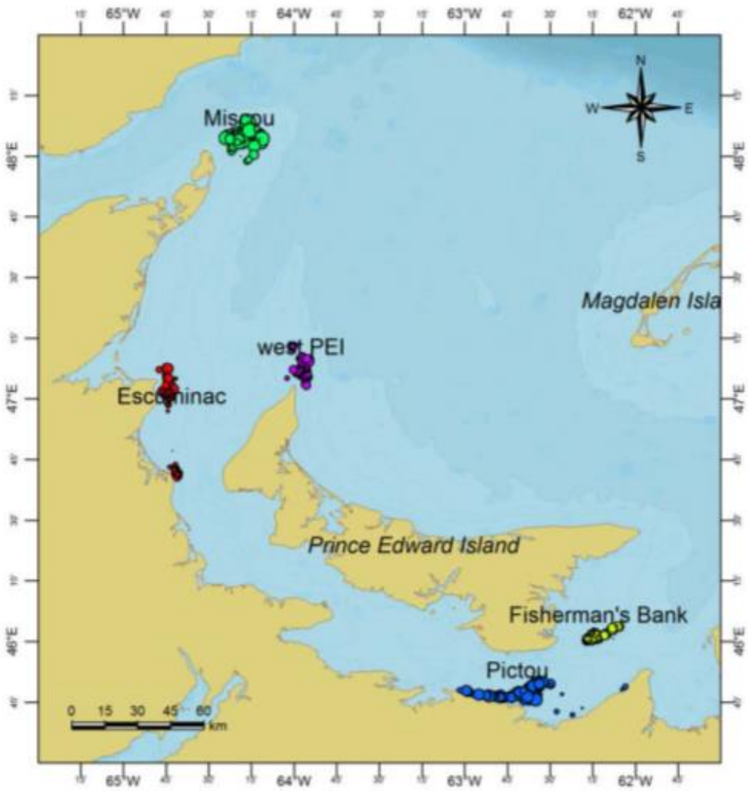

Figure 1: Herring Spawning grounds from 'Estimation of local spawning biomass of Atlantic Herring from acoustic data collected during fall commercial gillnet fishing activities in the southern Gulf of St. Lawrence' (NAFO Div. 4T). (Surette et al., 2016).

Unique and Vulnerable Habitat Concerns

7.3 – Impact Assessment for Marine Fish TOR: *Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodologies must first be agreed upon by NSE in consultation with relevant federal department.*

In addition to the general habitat concerns above, NPNS also proposes the pipeline to be placed directly through a federally protected marine refuge, Scallop Buffer Zone 24. The Department of Fisheries and Oceans has established SFA 24 to conserve important juvenile American lobster habitat, as it is essential to the life cycle of the species. DFO states that "no human activities that are incompatible with the conservation of the ecological components of interest may occur or be foreseeable within the area" (DFO List of Marine Refuges, 2019). The construction and operation of a marine pipeline is directly incompatible with the conservation of the identified conservation objectives of SFA 24.

The presence of eelgrass is also identified by NPNS to be valuable in the life cycle of a variety of species, especially as a nursery shelter to provide protection in sandy and silty bottom types. In Table 7.3-2 Summary of Marine Impacts, Mitigation Measures, and overall significance, NPNS states that there is potential for "direct removal, disturbance of highly important habitat type for multiple species and their life stages due to the staging, excavation, pipe placement and material backfilling". The effects are expected to be "long-term, reversible", with the only mitigation method listed to "avoid direct removal of eel grass beds where feasible". NPNS fails to define the extent of 'reversible' impacts, and does not provide an estimate of the extent to which they can feasibly avoid eel grass beds throughout Caribou Harbour. Considering the Terms of Reference, NPNS has not assessed the impact of the loss of valuable and unique habitat to the overall health of the key marine species.

Ice Scour

2.2 Marine Geotechnical Survey TOR: *Conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must determine the potential impacts of ice scour on the pipeline.*

The risk of ice scouring is also present throughout the proposed area (Focus Report Section 2.2 Marine Geotechnical Survey). The marine geotechnical survey identified 146 ice scour features within the survey area. NPNS states that burying the pipeline 3 m under the seabed is appropriate to avoid scour impacts. This conclusion is based on limited information; NPNS relies on one sample from 2019 and does not consider any additional research or evidence.

Environmental Effects Monitoring

7.3 – Impact Assessment for Marine Fish: *Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodologies must first be agreed upon by NSE in consultation with relevant federal department.*

NPNS acknowledges that there is potential for the following impacts: changes to water quality, increase in sound and vibration, disturbance to benthic habitat, disturbance to highly important nursery habitat and spawning grounds, direct mortality (of marine shellfish, benthic invertebrate community) (Table 7.3-2). Despite these impacts, they predict that "no significant residual impacts to marine water quality are expected to arise on any fisheries or fish habitat as a result of this project" (7.0 Fish and Fish Habitat). In order to confirm this conclusion, that there will be no significant residual impacts, NPNS states that they will follow up with the federally-regulated Environmental Effects Monitoring program. Given the predicted conditions, the EEM would NOT require NPNS to conduct a fish community study component or a benthic invertebrate community study. NPNS would have zero mandated requirements to monitor impacts on the fish or benthic communities. Considering for a moment just the impacts on the lobster population, negative effects will not be fully observed until a full life cycle (6-7) has reached the commercial size. Without thoughtful, frequent and thorough monitoring, there could be catastrophic ecosystem level impacts where it is too late to intervene.

Fishing Activity, Human Health and Market Access

9.1 Baseline Study Marine Survey: *Complete baseline studies for fish and shellfish tissue (via chemical analysis) of representative key marine species important for commercial, recreational and Aboriginal fisheries in the vicinity of the proposed effluent pipeline and diffuser location.*

The proponent is required to conduct impact assessments on the key marine fish species important for commercial, recreational and Aboriginal fisheries. In order to verify that there will be no negative impact on fisheries, NPNS must understand and take measures to mitigate interactions with physical fishing activities. NPNS uses a visual observation of lobster buoys in 2019 as a proxy for the exact location of lobster fishing activities (Figure 7.3-3: Northumberland Strait Lobster Buoy Locations). The graphic only shows buoy “clusters” observed on 3 different dates throughout the regular lobster fishing season. This attempt to pinpoint the location of fishing effort lacks relevant information in terms of the number of harvesters/vessels that fish within the area, how many buoy/lines are represented within each ‘cluster’. Generally, this shows that there was a lack of effort from NPNS to understand the most basic facts of the lobster fishing efforts in the area. The graphic fails to show that there are 20 vessels that fish lobster within 300 meters of the proposed marine outfall.

Under the TOR for the Human Health Risk Assessment portion of the Focus Report; NPNS is required to consider the impacts of human consumption of fish, other seafood and other exposure pathways. Of equal importance to the physical and biological impacts on the marine ecosystem, harvesters are concerned with the potential for challenges in marketability and the global reputation of pristine, healthy Canadian lobster. The Canadian lobster industry has an extensive export market, supplying international markets with much of our landed seafood. Canadian seafood harvesters, and the entire lobster sector, are fulfilling food security needs while providing a healthy, pristine renowned product.

NPNS states that there is a risk for tainting of seafood due to the chemical parameters identified in the effluent characterization (9.0 Human Health). NPNS compared the concentration of the parameters to the guidelines for taste and odour in water to identify the risk for tainting. There is potential for tainting under the following pathways: Total Iron, Catechol, 2-Cholrophenol, 2,3 Dichlorophenol, 2,6 Dichlorophenol, 3,4 Dichlorophenol, 2, 3, 4, 6 Tetrachlorophenol, 2,4,5 Trichlorophenol (9.0 Human Health). In addition to the physical risks of consuming tainted product, there will be detrimental impacts to the global reputation of Canadian lobster (and other seafood) products. Market perceptions of poor product quality (by tainting) can persist even if the results show safe exposure levels for consumption. This persistent perception will prolong and deepen the impacts for harvesters and other industry stakeholders. The magnitude of this impact should not be underestimated; this a 'Canadian lobster' issue, not just a Pictou or Caribou Harbour issue.

Throughout several areas of the Focus Report, NPNS uses proxy data and conditions from other Paper Excellence Mills, including Howe Sound and Crofton kraft mills in British Columbia. NPNS considers factors such as operating temperature and sedimentation rates to act as a surrogate for expected effluent quality at the proposed ETF. Upon investigation, there are challenges related to seafood tainting and contamination throughout the BC coastline. First, in fishing areas 28-1, 28-3; consumption of crab hepatopancreas should not exceed 55g/week due to dioxin contamination. Secondly, there is a permanent prohibition of all species of bivalve molluscs across the entire coastline and connected water sources of British Columbia. The closure is due to the widespread presence of biotoxins. While these closures are not solely attributable to the Pulp and Paper Mills; NPNS is unable to prove that there would not be similar closures as a result of the increase in dioxins or biotoxins from their proposed effluent.

In closing, the GNSFPB would like to reiterate that NPNS has failed to adequately address the Terms of Reference outlined in section 7.0 Fish and Fish Habitat, 9.0 Human Health and 2.0 Project Description. Due to limitations in time and capacity, this report only reviewed the information that was relevant to the fisheries. Northern Pulp relies on major assumptions and blanketed statements to suggest that there will be no harm to the marine environment, including fish and fish habitat. There are gaps in the evidence presented, including but not limited to: impact on lobster development and population health, incomplete or non-existent commitment to follow up monitoring, lack of evidence to protect vulnerable populations or habitat such as fall spawning herring, other SARA (Cod, White Hake), Scallop Buffer Zone 24, eel grass beds, limited understanding of the seasonal impacts of ice cover and ice scouring. The importance of the global optics of the Canadian seafood brand can not be undervalued or excluded from this Environmental Assessment approach.

All of the above is respectfully submitted to the Nova Scotia Minister of Environment, the Honourable Gordon Wilson, within the 30-day public comment period for consideration of the Northern Pulp Effluent Treatment Facility Focus Report.

Sincerely,

Gulf Nova Scotia Fleet Planning Board

Works Cited

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From:	
To:	Environment Assessment Web Account
Subject:	Northern Pulp - Comments from Save our Seas and Shores PEI
Date:	November 7, 2019 11:23:29 AM
Attachments:	SOSSPEI - Northern Pulp - November 2019.pdf SOSS NS Letter Northern Pulp November 2019.pdf

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Save our Seas and Shores PEI,
81 Prince St, Charlottetown, PE
C1A 4R3

November 5, 2019

Honourable Gordon Wilson, Minister of Environment
1894 Barrington St, Suite 1800
Box 442
Halifax NS B3J 2P8

Dear Minister Wilson,

Save our Seas and Shores PEI is a coalition of Prince Edward Island groups and individuals advocating for protection of the Gulf of St Lawrence. Our sister organization, Save our Seas and Shores Nova Scotia, has written to you to express its opposition to Northern Pulp's plan to release effluent from its mill into the Northumberland Strait. We want to say that we are in full agreement with that position, and with the attached letter which was submitted by on behalf of SOSS-NS.

This is an issue that crosses provincial boundaries, affecting the residents of Prince Edward Island, especially those who make their living in the fisheries. We know the Strait is already affected by heavy concentrations of nitrates, and, as point out in their letter, there has been an alarming depletion in oxygen in the Gulf in general. Many species of whales, fishes and birds are endangered or threatened. All of these factors point to the importance of exercising the precautionary principle in making decisions.

We urge you to respect the wishes of the many people and organizations, the fishers, the environmentalists, members of the First Nations and of communities on both sides of the Strait who have spoken out in opposition to Northern Pulp's plan.

Save our Seas and Shores PEI

November 3, 2019

The Hon. Gordon Wilson
NS Minister of Environment
1894 Barrington St
Suite 1800 Box 442
Halifax NS B3J 2P8

Dear Mr. Minister,

Save our Seas and Shores is a coalition of fishers, First Nations and concerned activists from NS, NB, PEI, QC and NL who have advocated for protection of the Gulf of St Lawrence for decades. The Gulf of St Lawrence provides global food sources and feeds the coastal communities of 5 provinces and thousands of jobs with its multi-billion dollar sustainable fishery and tourism industries.

We are writing today to comment on Northern Pulp's Focus report which details its ill-advised, unrealistic scheme to pump 92 million litres of toxic kraft bleached effluent into this exceptionally fragile body of water. This egregious proposal lacks integrity, responsibility and a concrete grip on reality. Our coalition vehemently opposes a pipe dumping toxic pulp mill effluent adjacent to Caribou Harbour or anywhere in the Northumberland Strait and Gulf of St Lawrence. Let us explain why.

1) Six and a half times smaller than the Gulf of Mexico, the Gulf of St. Lawrence is a fragile, landlocked, semi-enclosed inland sea that completely exchanges its water with the Atlantic Ocean only once a year. As one of the most productive marine regions in Canada and one of the most precious ecosystems on earth, (according to Dr, David Suzuki), it should never be placed in harm's way. Because of its circular, counterclockwise currents, any contamination will be widespread along the Gulf coastlines of Nova Scotia, New Brunswick, Prince Edward Island, Quebec and Newfoundland.This is further exacerbated by winter ice coverage that eliminates wave action that could contribute to oxygenation of the water. This freshwater effluent will raise to the surface and lay under the ice lay for months at a time every winter.

For 50 years, Northern Pulp has dumped 92 million litres of kraft bleached effluent, known to be one of the most toxic marine pollutants on this earth, every single day into this fragile ecosystem where over 2,000 marine species spawn, nurse and migrate annually. Their irrational logic for the continuation of this immoral conduct is that they've done it for fifty years and no harm has been done... so they say.

In reality, as it stands now, the Right whale, Blue whale, leatherback turtle, piping plover and harlequin duck are endangered; while Atlantic salmon, cod, fin whale, humpback whale are in trouble; bass are in sharp decline, as are mackerel and herring; Bluefin tuna are starving and flocking to fishing boats for food – these are just some examples of the disgraceful indicator that in only fifty years, our generation has taken for granted and degraded our Gulf's natural, renewable resources. We have allowed unfettered industrial development and pollution with little regard for the precautionary principle and ecosystem approaches demanded by the United Nations Convention on Biodiversity, supported by Canada in 1992.

In October of 2018, international scientists noted that the Gulf of St Lawrence is one of the most deoxygenating bodies of water on this earth.

https://e360.yale.edu/digest/the-gulf-of-st-lawrence-is-losing-oxygen-faster-than-almost-any-other-marine-environment

The authors of this study also note that protection of the Gulf needs to happen via governments at regional and local levels.

How does NSDOE reconcile this international science with Northern Pulp's irrational logic that a half a century of toxic effluent dumped into spawning waters determines that they should continue to violate our oceans? Northern Pulp's focus report reads as if they are dumping into pristine waters, rather than the deeply degraded fragile ecosystem the Northumberland Strait and Gulf of St Lawrence have now become in 2019.

There is no mention in Northern Pulp's focus report of the current state of de-oxygenation in this body of water. Hence the entire focus report is a farce, not grounded in truth or reality.

2) Northern Pulp plans to build its treatment facility on top of mercury that was buried by previous owners. Any individual is aware that disturbing buried mercury could lead to irrevocable consequences. The enclosed article by investigative journalist Joan Baxter explains this mercury problem in great detail. Yet it is being all but ignored by the NS Dept of Environment. It is disgraceful conduct for a department mandated to protect Nova Scotia's renewable resources to simply ignore and pretend that this monster of a mercury problem does not exist. Our children deserve better scrutiny and oversight of proposed industrial developments in 2019 when their very future is in peril.

https://www.halifaxexaminer.ca/province-house/nova-scotia-has-a-mercury-problem/

3) Perhaps NSDOE is ignoring this frightening mercury problem because of the conflict of interest you are in, as both owner, operator of the Boat Harbour treatment facility and alleged environmental protector of Nova Scotia's resources. For this reason, our coalition does not have any faith or believe your department can ethically determine this environmental assessment. We believe there should be a full federal assessment under CEAA.

Whatever your reasons for ignoring this looming mercury crisis, and the current de-oxygenation of our precious Gulf and its ongoing decline of marine resources, Save our Seas and Shores reiterates that we are vehemently opposed to any further effluent being dumped by this antiquated mill into the Northumberland Strait.

We are grateful to the Nova Scotia government for its leadership in establishing the Boat Harbour Act. But you must finish what you have started. Re-routing the toxic effluent from Boat Harbour to Caribou Harbour is MOVING the problem.Not solving it.

It is our responsibility as adults to protect the ecosystems that enable resource development for future generations. Up until now, we have failed our children. This must stop. Now. There must be #NOPIPE in the Northumberland Strait.

Respectfully submitted,

Merigomish, NS B0K 1G0

Save Our Seas and Shores, PEI
81 Prince St.,
Charlottetown PE
C1A 4R3

Save our Seas and Shores PEI,
81 Prince St, Charlottetown, PE
C1A 4R3

November 5, 2019

Honourable Gordon Wilson, Minister of Environment
1894 Barrington St, Suite 1800
Box 442
Halifax NS B3J 2P8

Dear Minister Wilson,

Save our Seas and Shores PEI is a coalition of Prince Edward Island groups and individuals advocating for protection of the Gulf of St Lawrence. Our sister organization, Save our Seas and Shores Nova Scotia, has written to you to express its opposition to Northern Pulp's plan to release effluent from its mill into the Northumberland Strait. We want to say that we are in full agreement with that position, and with the letter submitted by on behalf of SOSS-NS.

This is an issue that crosses provincial boundaries, affecting the residents of Prince Edward Island, especially those who make their living in the fisheries. We know the Strait is already affected by heavy concentrations of Nitrates. And, as point out in their letter, there has been an alarming depletion in oxygen in the Gulf in general. Many species of whales, fishes and birds are endangered or threatened. All of these factors point to the importance of exercising the precautionary principle in making decisions.

We urge you to respect the wishes of the many people and organizations, the fishers, the environmentalists, members of the First Nations and of communities on both sides of the Strait who have spoken out in opposition to Northern Pulp's plan. There is far too much at risk to warrant giving Northern Pulp permission to execute their plan.

Save our Seas and Shores PEI

From:
To: Environment Assessment Web Account
Cc:
Subject: nern Pulp
Date: November 7, 2019 11:25:15 AM
Attachments: NP Letter Nov 7th, 2019.pdf
vcf

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Good Morning

Honorable Gordon Wilson

Attached is a letter regarding the environmental assessment of the proposed effluent treatment facility for Northern Pulp. Boilermakers Local 73 represent 931 members in the maritime provinces. Thanks for you consideration of our letter.

Assistant Business Manager/Dispatcher

International Brotherhood of
BOILERMAKERS • IRON SHIP BUILDERS

NEW BRUNSWICK OFFICE
345 King William Road
Saint John, New Brunswick E2M 7C9
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LODGE 73

BLACKSMITHS, FORGERS & HELPERS

NOVA SCOTIA OFFICE
124 Parkway Drive
Truro Heights, Nova Scotia B6L 1N8
Tel: (902) 897-7306 • Fax: (902) 897-7305

November 7, 2019

Honorable Gordon Wilson
Minister of Environment
Nova Scotia Environment
PO Box 442
Halifax, NS
B3J 2P8

Dear Honorable Wilson:

My name is I represent the members of the International Brotherhood of Boilermakers Local 73. Boilermakers in Nova Scotia have been maintaining and upgrading industrial sites in the Maritimes and across Canada for generations. Our organization is committed to the environment and solutions to the climate change concerns all over the world. We have been major players in Carbon Capture & Storage (CCS) in heavy industries in Canada and in Europe.

I am contacting you today to give you my feedback and insight on the Northern Pulp Environmental assessment in regards to their proposed waste water treatment facility. I have looked through the focus report on Paper Excellence website and communicated with many of our members and contractors. The vast majority of our members would like to see the mills treatment facility constructed. If the findings in the focus report are accurate, I think the major concern that was addressed was the fishing industry. According to the report there will be no significant impact on any fisheries. This is very important to many of our members, although we are tradespeople many of us are recreational and commercial fishermen & women.

Another key thing noticed from the focus report is water quality where effluent will be discharged in the Northumberland Strait. I wouldn't expect the Province of Nova Scotia to approve Northern Pulps plan if it didn't meet or exceed Canadian Marine Regulations. Having environmental experts review the plans and address these concerns are very important to all Nova Scotians.

The impact on a treatment facility being built would be very beneficial to our organization and create jobs for many tradespeople in Nova Scotia. This would create a significant boost in the Pictou County economy. Year after year, there is a surge of business in the area when Northern Pulp does its annual maintenance work. Hotels are full, restaurants are busy and local businesses are seeing a transient workforce arrive in the area and spend a portion of the good and fair wages which Northern Pulp is responsible for.

We recognize your work and the work of the Provincial Government. You have been instrumental in a number of bills regarding the environment like Bill 152 & 163. The Boilermakers, like yourself can find common ground in protecting the environment, our members being the boots on the ground. We were the main trade union in the construction of major pollution control devices on industrial sites in the province. A few examples would be the precipitator upgrade at Northern Pulp in 2014 through 2015. Construction of the Bag House at Trenton Power Unit 5 to help reduce particulate that was being discharged from the stacks in 2008 through 2009, just to name a few.

Understanding the 3rd party evaluation and findings, our members would like to be a part of this project. We are willing, capable and ready to be a part of any construction to help the residents of Pictou County & Nova Scotia. We support the approval of the treatment facility as it will be a world class effluent treatment plant. We would be proud to have it on a list of our construction achievements.

Respectfully,

Assistant Business Manager
Boilermakers Local 73

From:
To: Environment Assessment Web Account
Cc:
Subject: Northern Pulp Focus Report comments
Date: November 7, 2019 1:36:40 PM
Attachments: NSSA ASF Northern Pulp Focus Report Response - November 7, 2019.pdf

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Hello,

Please find attached a joint submission from the Atlantic Salmon Federation and the Nova Scotia Salmon Association responding to the Focus Report for Northern Pulp's proposed effluent treatment facility. If you have any questions or require a hard copy submission I would be happy to oblige.

Sincerely,

Atlantic Salmon Federation / Fédération du Saumon Atlantique

Atlantic Salmon Federation Fédération du Saumon Atlantique

@asf.ca

Nova Scotia Salmon Association
107 Farmers Dairy Lane,
Bedford, NS B4B 2C9

Atlantic Salmon Federation
Fédération du Saumon Atlantique
202 Cloverville Rd. Antigonish, Ns B2G 2M8

November 7, 2019

Replacement Effluent Treatment Facility Project
Environmental Assessment Branch
Nova Scotia Environment
P.O. Box 442
Halifax, NS, B3J 2P8

To Whom It May Concern:

We are writing on behalf of the Nova Scotia Salmon Association (NSSA) and the Atlantic Salmon Federation (ASF) in response to the environmental assessment focus report released by Northern Pulp Nova Scotia Corporation (NPNS) for their proposed replacement effluent treatment facility. While the NSSA and ASF have a good working relationship with the proponent, NPNS have been supportive of our salmon recovery work through numerous in-kind contributions; and we feel that some of the environmental assessment data gaps were addressed in the focus report; we still have some concerns and reservations about the proposed project and its potential effects on wild Atlantic salmon.

Atlantic Salmon are an ecological keystone species that provide insight and perspective to the status of other foundational fish like gaspereau and smelt and ecosystem parameters such as water quality. Therefore, the health of salmon populations is a general indicator of overall ecosystem health. In this region, Atlantic Salmon have been assessed as a *species of special concern* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and identified by the proponent as a species of conservation concern (SOCC). As the primary advocates for wild Atlantic Salmon both the NSSA and ASF have a duty to evaluate the potential impacts of projects and to ensure that the strongest possible protections are put in place for this species and its habitat.

During our initial review of the environmental assessment documents we identified five deficiencies, which we described in our submission dated March 5, 2019. The deficiencies were the spatial and temporal overlap of the proposed outfall impact zone with critical marine habitat, the assumptions used in receiving water studies and modelling as it pertains to species like salmon, the capacity of the new facility to hold untreated effluent during maintenance periods and emergencies, the lack of information on effluent system transition and monitoring, and the effect that localized physical oceanographic conditions would have on diffuser performance. While the focus report provided more information and clarity on some topics, we do not feel that our concerns were completely addressed.

Our biggest concern is with the lack of information about the overlap of the proposed outfall impact zone with critical marine habitat over appropriate spatial and temporal scales appropriate to wild salmon. The proposed effluent facility will rely on environmental mixing and dilution to reduce the treated effluent to acceptable levels. While use of an impact zone is permissible under specified conditions within the existing regulations and NPNS has including modelling in both the initial environmental impact documents and the focus report to determine if adequate mixing will occur, the location of this impact zone with respect to critical marine habitat has not been adequately investigated. If the impact zone overlaps with critical marine habitat (spatially or temporally) then there could be negative consequences for SOCC such as Atlantic salmon (e.g. lethal/sub-lethal effects).. Another important aspect of the mixing zone that needs to be considered is what happens if a prolonged treatment failure occurs and untreated effluent is discharged. Understanding the impact zone is perhaps even more important on that risk management and emergency planning level.

The Focus Report did attempt to investigate this potential risk but fell short in several important areas. Appendix 7.3 - Impact Assessment on Marine Fish predicts that the pipeline, diffusers and effluent will have physical, acoustic, and water quality effects on Atlantic Salmon and that there will be a continuous frequency of disturbance through construction, operation, and decommissioning of the facility. Despite this the appendix concludes that these effects are not important since the effects are likely reversible once the effluent treatment facility is decommissioned and since the geographic area is relatively small. We take issue at this dismissal of the potential impacts as decommissioning of the facility would not occur for many years, meaning there will be an impact on Atlantic Salmon for the foreseeable future, and because the impact zone despite being a small geographic area has a significant potential to impact Atlantic Salmon migrating to and from local rivers. In Appendix 7.1 - Fish Habitat Survey (A7.1, page 37) the proponents indicated that "The timing of acclimation in the estuary and seaward migration of Atlantic Salmon (sic) adults is not well known for any of the rivers in the study area. Potential for Atlantic salmon is also identified the marine habitats." Surveys of local resource users presented in the focus report found 10% had harvested Atlantic Salmon in the study area within the past year, and Appendix 7.3 identifies salmon as migratory species with low to medium chance of being in the localized assessment area (impact zone). Therefore, the proponents know Atlantic Salmon use habitat in the vicinity of the impact zone, but self admittedly do not have enough baseline data to dismiss the fact that the impact zone could overlap with critical marine habitat for Atlantic Salmon. There is a real risk of this type of overlap because Atlantic Salmon like other important anadromous species require areas within estuary and along the coast to transition between freshwater and saltwater. These transitions are known to be sensitive time periods in their life histories where increased mortality occurs. Potential overlap of the impact zone of this effluent treatment facility these habitats spatially or temporally has the potential to significantly disrupt the life history and decrease fitness and/or survival.

Within the focus report there are also detailed habitat assessments and the authors attempted to correlate these assessments with potential usage by species such as Atlantic Salmon, however their methodology was not based on applicable data. For example, one of their primary references used in this process Rondeau et al. 2016, did not look at any salmonid species nor make any conclusions about salmon other than to say they were not included in their study. Rondeau et al. also for the most part focused on deeper water habitats that does not pertain to impacted area. In addition, many of their other references utilized in this section were not up to the acceptable standard for a scientific based risk assessment (Master's thesis, personal websites, errors in referencing).

We were disappointed upon seeing Northern Pulp's EA filing that deficiencies identified ahead of time were not addressed and there does not appear to be a plan to do so. This is a major oversight that needs to be corrected before any consideration of releasing the project from the assessment process. Given the potential for negative impacts, the threats currently faced by wild salmon, and what they represent within the ecosystem, we cannot afford to have this or any other operation cause unintended negative consequences. It is therefore essential to the ongoing environmental assessment process that proper baseline data is collected over the appropriate spatial and temporal scale. It is only with proper baseline data that the extent of potential impacts can be assessed, that effective monitoring can occur, and that mitigation and adaptive management plans can be developed and implemented as necessary.

We also had concerns about the assumptions used in the receiving water study and marine impact assessment portions of the focus report. Predicted dispersion patterns used to establish the most likely impact zone and draw conclusions about risk associated with this design utilized modeling assumptions based on conditions likely to be experienced in July. While this set of assumptions and thus model and its conclusions may be apt for many species, they are not valid for migratory species such as Atlantic Salmon that are not expected to be present in the impact zone at this time of year. The environmental conditions of the receiving water during migratory periods (spring and fall) could be substantially different. For example, temperature profiles of the Northumberland Strait during the fall migration would be much cooler, meaning the impact zone would contain a significantly warmer plume than ambient that would disperse differently than modelled. This is potentially significant because Atlantic Salmon adapted to cold temperatures at this time of year would not be physiologically able to adapt to this warm plume without compromising their health and so will either be forced to avoid the area or suffer compromised health. Therefore, without more complete modelling it is not possible to accurately determine the size or significance of the impact zone on migratory species like Atlantic Salmon.

We also had concerns about the holding capacity for untreated effluent in this new treatment facility. It is essential that the new facility have enough capacity to hold untreated effluent to allow for maintenance and emergency situations. The old facility had an extremely long holding capacity (30 days) compared to the new facility (8-12 hrs.). This is a substantial decrease. The focus report did partially address this concern as it identified several engineering changes made to facility design that should help increase holding capacity and facility functionality. However, given the size, age, and complexity of the mill we are still concerned that there may not be enough capacity within the system to prevent discharge of untreated effluent in the case of prolonged failures in the treatment system. We are concerned that the proponent has not put forward emergency management plans that would confirm that the new facility has enough safeguards in place to ensure there is no scenario which would see untreated effluent released into the receiving water.

Our fourth set of concerns was around the lack of information on effluent system transition, standards, and monitoring. The transition in effluent systems from the current Aerated Stabilization Basin treatment (ASB) system to the proposed biological Activated Sludge Treatment (AST) system comes with some inherent risk. While these newer systems have shown they can provide higher BOD reduction efficiency, they are more susceptible to settling issues and disruption to the biological community that is central to this effluent treatment process. The disruption to the carefully cultivated microbiological community that drives the decomposition and detoxification process or "biological upset" as it is referred to by operators of these types of systems can occur regularly if not carefully managed by experienced operators. Therefore, this new system will require more highly trained operators and more rigorous procedures to maintain effluent below legally required levels. In the environmental impact and focus report documents there is a lack of information concerning training, operational and emergency procedures, and how the transition between systems will be implemented. The focus report does discuss environmental monitoring that is compliant with the current regulations, however this is a reactionary process that only detects issues after they have appeared in the receiving environment. Therefore, failures in effluent treatment process and procedures could lead to untreated effluent being pumped into Northumberland Strait, relying only on voluntary transparency by the proponent and the federally mandated monthly testing to detect the issue after the fact. We see this as a significant failure in risk management that is unacceptable risk to sensitive species such as Atlantic Salmon. More information is required before an informed decision can be reached on this project.

The fifth concern that we had previously identified was the effect that localized physical oceanographic conditions would have on diffuser performance. The focus report provided much more detailed information on the substrate composition and habitat around the proposed diffuser locations. The report also provided more information about diffuser performance monitoring. Although we are still concerned about how substrate composition and habitat in the area will shift over time, we feel that based on the information provided in the focus report that NPNS is able to adequately monitor and respond to this concern.

On behalf of NSSA, ASF, our affiliates, associated members, and volunteers we urge the NS Environmental Assessment Branch to require that this project be subject to the most rigorous standards to ensure that this highly sensitive and ecologically important area is protected. As the proposal currently stands, we feel there is insufficient information to conduct an effective and thorough project risk assessment, as it pertains to wild Atlantic salmon. We remain committed to our objectives of ensuring that the best interests of the ecosystem and of salmonids are represented and protected throughout this process. We welcome any opportunity to meet with the proponent or regulators to discuss our concerns and work together towards solutions.

Sincerely,

President
Nova Scotia Salmon Association

Program Director for NS and PEI
Atlantic Salmon Federation

From:	@forestns.ca
To:	Environment Assessment Web Account
Subject:	Proposed Project Comments
Date:	November 7, 2019 1:37:16 PM

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Project: replacement_effluent_treatment_facility_project Comments: Forest Nova Scotia Submission â?" Norther Pulp NS â?oReplacement Effluent Treatment Facility Projectâ? EA and Focus Report Commentary. November 2019 On behalf of the 600 members of Forest Nova Scotia, I submit the following comments on this EA application and Focus Report, regarding the ETF replacement project for Northern Pulp. After reviewing the EA application and Focus Report data â?" Forest Nova Scotia supports an approval of the EA application, and encourages the Government to allow work to commence immediately on this facility replacement project. Everything humans do has an impact on the environment around us. From building a house, to driving to work, to heating our homes, to growing our food, to making products we sell, to using that new technology device â?" with each decision we make, we must weigh the acceptable level of risks and impacts they will have. This project is no different. There was significant 3rd party, independent expertise used to compile the data contained and analyzed in the focus report and EA application. The assurances provided by these experts indicates that no significant adverse residual environmental impacts have been predicted for the projectâ?Ts construction or future operation. In particular, no significant impacts on any fisheries or fish habitat will be realized as a result of this project. The results of the focused report indicate that the risks risk= hazard x exposure, on several parameters, associated with building this new facility are well within or under acceptable levels and should inform a path forward to a new treatment facility for the mill. Specifically, modelling data provided in the focus report regarding a potential spill or leak in/near the Town of Pictous watershed area indicates that distances from the wells, along with the fact that any such treated water would flow away from the watershed field due to the shape of the landscape answers questions raised about the impact of this possibility. Interesting to note on further reading on the topic that untreated municipal sewage waste currently crosses the Pictou watershed via pipeline, contrary to the commentary that indicates a watershed is no place for a pipeline. Through computer modelling, the focus report also looked at residual effects in water quality both near and far from the outflow location for the proposed pipeline - both resulting in no anticipated adverse environmental impacts. This, along with the many other data points and research contained in them, tell us the focus report and initial EA application submission provide the information needed for approval of this project to proceed, and â?" again â?" we would encourage the Minister to approve the project and allow work to commence.

Executive Director Forest Nova Scotia Name: Email: @forestns.ca Address: Truro NS Municipality: Truro Postal-Code:

From: @Unifor.org
To: Environment Assessment Web Account
Subject: Proposed Project Comments
Date: November 7, 2019 3:26:10 PM

Project: replacement_effluent_treatment_facility_project Comments: Greetings, We are submitting these comments as a neighboring Unifor local. As a social union we care about the lives, communities and the wellbeing of all people not just our own members. Northern Pulpâ?Ts replacement effluent treatment facility project can continue to support thousands of good jobs across the province, protect the environment and respect the first nations. Our Local supports this project most importantly because it is the right thing to do. The third party environmental experts have concluded the proposed diffuser will meet all environmental guidelines and the company is prepared to make the investment. Canada is a world leader in forestry regulations and enforcement, there 88 other pulp and paper mills across the country coexisting and supporting their communities. This will further provide an opportunity to restore and maintain future respect with Pictou Landing First Nations. The forestry sector in Nova Scotia is essential in our economy, providing a 2.1 billion in annual economic impact, 11,500 direct and indirect jobs, is the second largest source of employment among good-producing sectors and the third largest exporter. Around the world, forestry is increasingly recognized as a renewable green industry with a potential for a strong future as part of a sustainable economy. We represent members in the banking, hospitality, education, food services and health care sectors from Wolfville to Antigonish and if this project is not approved our members will be negatively impacted in EVERY sector. Whether it is a decrease in loans at the credit union or decrease in tax revenue to support our social infrastructures and service like health care there is no question the widespread negative impacts will be great. To conclude the company addressed every concern raised in the initial consultation comments and answered every question asked by the Nova Scotia environment. The science is clear and the project is sound investment we as a province need to approve this facility for the betterment of all Nova Scotians. Respctfully, Unifor Local 2107 Name: Unifor Local 2107 Email: @Unifor.org Address: Municipality: Antigonish Postal-Code:

From:	
To:	Minister, Env
Subject:	opposition to continuing Northern Pulp pollution of air, land and water
Date:	November 7, 2019 1:28:33 PM

The Honourable Gordon Wilson,
Minister of the Environment

Members of KAIROS Halifax are greatly concerned about Northern Pulp wanting to continue their toxic legacy by proposing to have a pipeline that will pump up to 90 million litres of toxic pulp effluent a day into the Northumberland Strait.
We support the rights and needs of the people of Pictou Landing First Nation for the closure of Boat Harbour as an industrial waste dump as legislated on January 31st, 2020.
We are against Northern Pulp's plan to pump effluent into the Strait. The Mi'kmaq are against it; the fishers in the area are against it; and we are against it.
Thank you for listening and responding to the voices and health and safety needs of the people of NS.

on behalf of KAIROS Halifax

From:
To: Environment Assessment Web Account
Subject: Northern Pulp"s Focus Report-Replacement Effluent Treatment Facility Project
Date: November 8, 2019 9:12:51 AM
Attachments: Nothern Pulp letter of support.pdf

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Hon. Gordon Wilson; Minister of Environment,
Please refer to the attached letter of support for Northern Pulp's replacement effluent treatment facility.
Thank you

Canadian Woodlands Forum
Office:
Mobile:
www.cwfcof.org

Canadian Woodlands Forum
FORUM
Forum canadien
des opérations forestières

Hon. Gordon Wilson
Minister of Environment
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8

Dear Minister,

With reference to the Environmental Assessment focus report now before your department concerning the Northern Pulp wastewater treatment facility, I would like to first thank you for your department's diligence and thorough review of the facts and information in rendering a decision.

As someone who has worked in the forestry sector for over 38 years, I have been able to contribute to Nova Scotia's forestry sector and have enjoyed a very rewarding and worthwhile career as a professional forester supporting my family here in NS.

Currently I work for the Canadian Woodlands Forum which is a not for profit membership based forestry association; we work and provide knowledge exchange services to the members of the fiber supply chain, including forestry contractors, suppliers of equipment and the forest product companies in order to maintain a profitable and competitive forestry sector. I outline this to remind you of the significance and importance that Northern Pulp provides to the economy and the integrated wood fiber supply chain in the province. The level of concern to what will happen to Northern Pulp by our members, especially the small forestry contractors and landowners across the Atlantic region is at an all time high; it has suppressed investment and created an extreme sense of uncertainty among the business owners in this province. In short, I ask that you accept the Focus Report for the proposed state-of-the-art wastewater treatment facility that will reduce the environmental footprint, create and sustains jobs, deliver significant economic benefits locally and provincially, and ensures the continued operation of Northern Pulp.

The Focus Report submitted to your department highlights that the proposed wastewater treatment facility will be industry leading and significantly reduce their environmental footprint.

The fact that the treated wastewater from Northern Pulp has been flowing into the Northumberland Strait for over 50 years, supporting a vibrant fishery speaks to the ability to find common solutions for all sectors to co-exist. With their plan to re-route the treated wastewater to a different location further out into the Strait, third party environmental experts have assessed that no significant impacts are expected on any fisheries or fish habitat as a result of this project.

I would ask that you approve Northern Pulp's Environmental Assessment so we can continue to build a sustainable forest industry here in Nova Scotia.

Thank you for your time and consideration,

Sincerely,

Canadian Woodlands Forum

From:	@tcchamber.ca
To:	Environment Assessment Web Account
Subject:	Proposed Project Comments
Date:	November 8, 2019 11:19:53 AM

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Project: replacement_effluent_treatment_facility_project Comments: November 7, 2019 Re: Northern Pulp Focus Report Dear Minister Gordon Wilson, Thank you for the opportunity to comment on the Northern Pulp focus report for its proposed effluent treatment plant in Pictou County. The Truro Colchester Chamber of Commerce represents 470 member businesses and organizations in Truro and Colchester region and has been the voice of business for this area for nearly 130 years on matters of economic, political and social significance. Our membership represents multiple sectors including dozens of businesses directly and indirectly linked to the forestry industry in the province of Nova Scotia. The Chamber applauds your Department of the Environment for its stewardship role in protecting Nova Scotiaâ?Ts environment, however, there is an undeniable fact that if Northern Pulp were to cease its operations in the province there will be far reaching impacts on the industry. While considering the Focus Report, there must be an acknowledgement of the extensive impact of that the mill closure would have on livelihoods across the provinceâ?"well beyond the 340 direct jobs provided in Pictou. Accounts Payable from the Northern Pulp mill are higher in Colchester than any other county in the province. Such a closure will impact sawmills, woodlot owners, truckers, and incur the loss of the largest shipper out of the Port of Halifax. The loss to the provincial economy has been conservatively estimated at over $300M. Those within the industry who would be potentially impacted by the uncertainty over the future of the millâ?Ts operation in the province need answers to plan for the future as well. Many sectors of the provincial economy are on pause awaiting direction from the government while further weighing the uncertainty of a potential mill closure. Businesses are already foregoing investment impacting our economy. We ask your government to show leadership on this issue which is paramount to offer business confidence to invest in the province. Your department has provided Nova Scotians 30 days to share their comments as part of the environmental assessment process. We applaud your government for not extending this period to receive public comments to keep the process moving forward without more delays. On behalf of the Truro Colchester Chamber of Commerce and its membership, we ask you to not delay making a decision on the proposed effluent treatment plant, providing a determination on this issue within the allotted time frame after the public comment period ends. We would welcome the opportunity to speak directly with you on this issue. Name: Truro Colchester Chamber of Commerce Email: @tcchamber.ca Address: Truro, Nova Scotia Municipality: Truro Postal-Code: Fax: ### ### - #### email_message: Privacy-Statement: agree x: 55 y: 24

From:	UA Local 244
To:	Environment Assessment Web Account
Subject:	Fw: Northern Pulp Focus Report
Date:	November 8, 2019 1:16:01 PM
Attachments:	npfocusreporteanov2019.pdf npeafocusmarch2019.pdf 2019.docx focusreportea.docx nppremiereanov2019.pdf

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Please see attached UA Local 244's support for Northern Pulp's replacement Effluent Treatment Facility.

From: UA Local 244
Sent: Friday, November 08, 2019 1:09 PM
To:
Subject: Northern Pulp Focus Report

UNITED ASSOCIATION
of Journeymen and Apprentices of the
Plumbing and Pipe Fitting Industry of
the United States and Canada

Founded 1889

Mark McManus
General President

Patrick H. Kellett
General Secretary-Treasurer

Michael A. Pleasant
Assistant General President

UA Local Union:

Letters should be confined to one subject

Subject:

St. Andrews
Antigonish County, Nova Scotia,
Phone /Fax
Email: @ns.sympatico.ca

Hon. Gordon Wilson
Minister of Environment
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8
EA@novascotia.ca

November 6/2019

Honourable Mr. Wilson,

Re: Northern Pulp Replacement Effluent Treatment Facility.

Attachments:
UA Local 244 March 9/2019
January 22/2019
- Submission on Focus Report
Premier McNeil Letter of Concern February 18/2019
(attachments included to avoid repetition)

After reviewing the Focus Report we are impressed with the amount of hours and expertise that went into producing this document. Northern Pulp and their Contractors have done an excellent job on this Focus Report for the Replacement Effluent Treatment Facility.
Veolia, the Swedish Company supplying this process equipment and technology is a world leader in effluent treatment.

Please add this letter to support Northern Pulp's proposals on Effluent Treatment and other improvements outlined in the Project Overview.

The new Effluent Treatment Facility is an 18 month to 2 year project for the Construction Industry. This would be a very welcomed Project for the Tradespeople in Northeastern Nova Scotia.

Currently there are no Industrial Construction Projects in Nova Scotia and very few in the rest of Canada.
British Columbia is struggling to save the Forest Industry in that Province with more than twenty mills currently shutdown or in major layoff positions. The Forest Industry is in a crisis.

The nature of the Construction Industry is for Tradespeople to travel to any Province that has work.
With environmentalists declaring war on all Industrial Projects in Canada big Projects are almost non-existent.
Alberta and Saskatchewan are prime examples of artificial crises modes with their inability to get pipeline access to the East and West Coasts.
Canada could be booming from Coast to Coast.

Meanwhile in the great Province of Nova Scotia we are trying to close a viable Pulp Mill with nothing to replace it but Employment Insurance, Welfare and Poverty.

A crisis is a lot easier to create than prosperity is . You just have to review the dismal record of Government sponsored make work projects over the past 50 years.
Speaking of compounding the crisis mode, Suppliers to the only other operating mill in Nova Scotia were informed that if Northern Pulp goes down there will be across the board cuts at the other Mill**. No competition.**

One can only hope that this information package will satisfactorily address all the questions and concerns the Environmental Assessment Branch may have.
Northern Pulp deserves the required permits to proceed with cleaning up the Mill.

I was surprised that there is no mention of the required extensions on the use of Boat Harbour.
Without an extension there will be a severe economic hardship with the Forest Industry being the first victim.

The way I see it, the choices will soon have to be made by Premier McNeil and Chief Paul.
We all know that sometimes you have to be careful for what you wish for.
Big decisions have an attached level of blame for financially unpopular decisions.

I wouldn't want to be the one to get the blame for the hard times and poverty that will ensue if Northern Pulp is forced to close for any reason.

In closing, the Environmental Process was designed to provide a balance between Industry, the Environment and the Economy.
The low point on the scale was over 50 years ago. The high point started when Northern Pulp purchased the Abercrombie Mill and proceeded to clean it up.

Here is to a WIN WIN outcome on your deliberations.

Sincerely,

UA Local 244

UNITED ASSOCIATION
of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada

Founded 1889

Mark McManus
General President

Patrick H. Kellett
General Secretary-Treasurer

Michael A. Pleasant
Assistant General President

UA Local Union:

Letters should be confined to one subject

Subject: **Antigonish County, Nova Scotia,**

Email: @ns.sympatico.ca

March 9/2019

Environmental Assessment Branch
Nova Scotia Environment
P.O. Box 442
Halifax, NS, B3J 2P8
Fax: (902) 424-6925

Replacement Effluent Treatment Facility Project.

<u>Attachments</u>

- Term Employees Employed at Northern Pulp 2018
- No Plan B Possible Forestry Sector - Northern Pulp/Paper Excellence Canada

The following comments are submitted on behalf of the Membership of UA Local 244 Antigonish Plumbers, Pipefitters, Welders, Instrument Technicians and Apprentices.

Our comments include concerns of the entire Construction Industry Management and Labour.

My name is of UA Local 244.

I am a Red Seal Steamfitter - Pipefitter by Trade.

My first Industrial Job was the Pulp Mill currently owned by Northern Pulp.

Most of our comments will refer to negative socio economic issues.

Northern Pulp is a Company that puts 2.1 Billion Dollars Per Year into the Provincial Economy.

We have an experienced Construction Industry to build the new Effluent Plant.

We will leave technology and scientific comments to the Professionals in those areas.

The Construction Industry has not been included in any of the negatively affected Groups, that would lose jobs.

The attached "Term Employees" indicates Trades People who worked directly for Northern Pulp during 2018 when extra help was needed inside the Mill.

That totals 180 Employees and $1,409,715.52 for the year. This has continued over the 52 years that Mill has been there and in most years the numbers were much greater . This number does not include other Trades People and Employees of Contractors who were employed in the Mill. The new Effluent Plant would be an 18 Month Project.

A Brief History

Many of the Senior Nova Scotia Tradespeople worked at the Mill in 1965-66-67 during Construction.

Fishing was so bad up in River John, Tatamagouche, Wallace and Pugwash Areas that many fisherman from the Area joined the Construction Unions and only a very few left the Mill during Construction to go fishing .

The hourly rate for Pipefitters at the time as $3.80 per hour and that was more than a Lobster Fisherman could make at the time.

To this day a large number of Fisherman are Tradespeople in the Construction Industry when Fishing Seasons are closed.

For about the first 30 years or more the effluent was black going into Boat Harbour and black going out into Pictou Harbour from where it went out into the Strait. Not that it was a good thing but the Fishing Industry has been thriving during the past 52 years without negative effects from the Mill.

Recently a Fisherman Friend told me that the prevailing water flow in the Strait goes up and around Prince Edward Island. That would mean the effluent from the Mill would also be going the same direction and there has been record lobster catches up around the Prince Edward Island Causeway in recent years.

Plan B - There is none!

Any long term Nova Scotia Taxpayer would remember how successive Governments of all the Party's spent massive amounts of Taxpayer money on "Make Work Projects" that produced little or nothing. Probably in the billions.

Northern Pulp wants to Clean Up the mess they inherited when they bought the Mill in 2011. Whether it was previous Owners or previous Governments that wanted to run Boat Harbour. None of it should of happened the way it did.

That is all in the past and Northern Pulp is not responsible for it.

Everyone needs to face up to the fact that Rural Nova Scotia has not been doing well for many years. Northern Pulp is the Key Player in a highly integrated supply and demand system that the whole economic system benefits from.

Everyone loses when a major Industry shuts down.

Even those who would think of it as a win would soon realize:

- their taxes are going up,
- they can't sell their property for half of what it is worth,

- Hospitals will become First Aid Stations,
- Schools would close because the last of your Family Members will have to move away to find work.
- Poverty, Employment Insurance and Welfare will all dramatically increase.

I repeat THERE IS NO PLAN B and there never has been one.

There is a Plan A however. Leave good enough alone!

Grant Northern Pulp an extension on the use of Boat Harbour until the new Effluent Plant is up and running. The Nova Scotia Government should pay the Natives in Pictou Landing a negotiated amount for their inconvenience.

There is a Win Win Solution for every problem if enough effort is put forward.

I agree that the Residents of Pictou Landing and Surrounding Area have been negatively affected by the whole Boat Harbour fiasco for Fifty Two years. I also agree that it should be closed but to me it looks like successive Governments have signed up to be responsible for everything. The current Government has taken an aggressive approach with Northern Pulp by cancelling a legal agreement with Northern Pulp to operate Boat Harbour until 2030.

The cancelling of that Agreement in 2014 reduced the length of the Lease by 10 years and 11 months.

In 2015 the Government tried to force and unrealistic Industrial Approval on Northern Pulp. Northern Pulp appealed and it went to Supreme Court. On the first day of Court the Government backed off on the issues under appeal, however this would of cost the Company many hundreds of thousands of dollars in legal fees and preparations.

The Boat Harbour Act also became Law in 2015 along with the five year deadline.

Most if not all of this was done with no consultation with the Mill. Without getting into all the details Northern Pulp has had their hands tied by several Branches of Government before the arbitrary deadline was put in place and it still continues with the Government pointing the finger at Northern Pulp that you should be ready.

My take on the cancellation of the Boat Harbour Lease to Northern Pulp Ten Years and Eleven Months early could leave the Nova Scotia Government fully responsible for all expenses and lost profit incurred by Northern Pulp.

Not to mentions the complete demolition and cleanup if Northern Pulp is forced out of Business.

At one of the earlier Open House meetings Chief Andrea Paul spoke about the closure of Boat Harbour. Some of the Environmentalists in the room started pushing for the closure of Northern Pulp. Chief Andrea Paul got up and said we never asked for the Mill to be Shut Down we just want Boat Harbour cleaned up.

I have no idea how this has evolved to a point where two people, Premier Stephen McNeil and Chief Andrea Paul have the authority to Shut Down a huge portion of a very fragile economy.

The best solution for everyone would go something like this..

The only way to avoid Northern Pulp from being shut down is to grant an extension of the operation of Boat Harbour until the new effluent plant at Northern Pulp is up and running.

The Government of Nova Scotia signed off on a deal to close Boat Harbour and dictated a date of closure without consulting the Industries effected.

The Government has been in negotiations in regard to compensation for the closure of Boat Harbour so they are on the hook.

The Agreement on the closure date for Boat Harbour was made between the Government and Pictou Landing Chief Andrea Paul.

I know Pictou Landing is not a rich community and they do deserve to be compensated if the Government does not live up to the closing date of January 31/2020.

THE NOVA SCOTIA GOVERNMENT IS LIABLE

The question is, do they want to be liable for destroying several Industries with the Shut Down of Northern Pulp or pay Pictou Landing Residents what it is worth to extend the Boat Harbour closure date until the new effluent plant is complete.

Either way the Natives would see the closure of Boat Harbour.

The new effluent plant proposed by Northern Pulp will have a positive effect on the Environment as well as Employment and the socio economic situation in the Province.

In a CBC Interview with the Premier in Sydney over Christmas there was some suggestion that if Northern Pulp closed we would still have one Mill in the Province. That other Mill has already cut Producers to the bare bone as it is, just imagine if there was no competition. I expect the Forest Industry will speak for themselves on that issue.

It is time that common sense comes to the table. Northern Pulp wants to clean the Mill up to world class standards.

Sincerely,

UA Local 244

January 22/2019

To Whom It May Concern,

I am a Member of UA Local 244 Plumbers, Pipefitters and Welders Antigonish.

Since its beginning, myself and Members of our Local Union have had many opportunities for employment whether it was construction upgrades or the yearly shutdowns at the Mill, Northern Pulp. Our Local was also involved in the original build.

Many Families of all Trades can say the same thing about the economic benefits of working there.

Years ago they began dumping effluent into Boat Harbour which was much more likely to have negative impacts on the surrounding waters. Over the years, the effluents became less harmful as protests against the mill mounted. Today, the latest technology allows the effluent to be treated to the point where if held in a glass bottle is almost "clear" compared to the black discharge of 50 years ago. My point is, instead of protesting against Northern Pulp, why not applaud them for the attempts at bettering the effluent being released. Hundreds of millions in tax dollars have been collected each year by our Government from the operation of this Mill. Imagine the billions of dollars that have been generated Provincially and Federally since day one which benefitted almost every single person in this Province.

I ask our elected members where do you get hundreds of millions in lost wages and tax dollars if this Mill closes.

Maybe the protestors would sing a different tune if elected officials announce a 5 or 10 % tax increase to supplement the loss of Northern Pulp to go along with the loss of revenue from Sable Offshore.

Help this Province and our Country by supporting our Pulp Mills and also Alberta by endorsing Mills and Pipelines. You all know the economic benefits.

In closing, I do want to stress that protesting isn't a bad thing. Maybe instead of protesting to close plants and stop pipelines from being built they could help find ways to improve how they are built working with Companies instead of against them.

A Country does not run without money or resources. It is time we open our eyes and grasp what is before us.

Regards,

There is no doubt that all human endeavours have an impact on our environment. Human beings, and all mammals, for example take in air and remove the oxygen from it thus increasing the percentage of CO_2 in the atmosphere.

Every industry has an effect on the environment. We cannot shut down an industry simply because there are perceived negative effects on the environment. Agriculture and yes fishing and all food production has some negative effect, in someone's view, on their environment.

What we need to strive for is improvement not an unattainable perfection.

From what I have seen this "old" mill is vastly improved from where it was when this company took over.

I remember just 3-4 short years ago driving from Truro to New Glasgow and coming over Mt. Thom and seeing the plume from the pulp mill stretching from the mill to my left to as far as I could see to the right. That is now a thing of the past. The only visible plume from the stack now does not appear to extend beyond the pulp mill property. It will be noticed that on colder days the plume will be marginally longer. This is the nature of steam condensing. Steam is water in another form i.e. non toxic to organisms.

So one major issue dealt with very effectively at a cost of I believe some 37 million dollars. That is equivalent to over a month's production at this mill, not a month's profit but simply the gross value of the finished product.

I would love to see this mill running with a zero or even positive effect on the environment. I would also like to give my granddaughter a unicorn for her birthday.

Lets face reality the current effluent system needs to be modernized to improve how it impacts the environment. (See above re improvement vs perfection)

I am shocked that the government broke a contract by legislating new terms unilaterally. Legal and correct and just are not interchangeable terms. Negotiations on a change to the contract should have been done in an honest, honourable, and legitimate manner.

Boat Harbour Act S, 4 (2)
The enactment of this Act is deemed not to be a repudiation or anticipatory repudiation by Her Majesty in right of the Province of the lease agreement dated

December 31, 1995, between Her Majesty in right of the Province and Scott Maritimes Limited, as extended by a lease extension agreement dated October 22, 2002, between Her Majesty in right of the Province and Kimberly-Clark Inc.

Essentially what this section says is "This is not a brown bear, it is a bear which is brown.

I call on the Pictou Landing First Nation to work at correcting this injustice. All of the First Nations peoples of Canada and indeed all of the Americas have endured a too long history of broken promises.

Given this history, I do not believe that any First Nation should support a situation where what was, and in fact is still being done in many ways to their Nations and peoples is done to any other party.

Too many people look at changing the way things are done as a process much like turning on a light. I have been a small part of many large projects and one thing I have learned is that there are essentially two ways of doing projects.
1. Do it fast and hope for luck or
2. Take a reasonable time and do it right.

I commend Northern Pulp and all of the associated contractors for following #2 despite the knowledge that they risked a total mill shutdown.

This matter could have been negotiated properly in 2015 rather than hastily enacted legislation 18 days to be exact. A midpoint of the contract and the legislation would have been, if my math on dates is still working, 31 July, 2022.

I strongly suggest that the Province of Nova Scotia negotiate a repeal of the Boat Harbour Act and negotiate a reasonable amendment to the contract entered into freely.

I understand the frustrations of the Pictou Landing First Nation. They just want to look forward to a future without this blight on their lands. That being said I sound to them a warning. A severely economically depressed Pictou County does not serve their long term interests. Secondly, by supporting the government on the Boat Harbour Act they have put in jeopardy any and all agreements they may have now or in the future with the Province of Nova Scotia and possibly even any agreements with the Federal Government. To paraphrase a famous saying; First they came for Northern Pulp but I was not Northern Pulp so I did nothing, then...

When we allow our governments to rip up legal contracts in 18 days with a single page document which contains phrase which is an oxymoron our entire society is at risk. If we allow this to stand no one is in any position to plan for the future of either ourselves or our children or our children's children.

In summary the Boat Harbour Act is a farce of epic proportions.

This effluent treatment plant will be a vast improvement over the current status quo.(Again see above re: improvement vs perfection. It meets or exceeds the requirements in all but the virtually unattainable.

I hereby request that the Pictou Landing First Nation become seriously involved in a reasonable resolution of the current untenable situation. Lest you be next and a precedent of dishonoured contracts is used by this or some future government to the long term detriment to your Nation.

The planning has been essentially complete, there is no way that this improvement can be implemented in the next 3 months. We are at a stage where reasonable negotiation involving The Corporation, the Government, and the First Nation and the subsequent repeal of the Boat Harbour Act will lead to a win/win and a return to the rule of the Law of Equity.

I would be happy to assist in any way to assist in an equitable resolution.

Respectfully submitted

Harold (Hal) James Legere
2nd Class Power Engineer
and proud Nova Scotian
Do not remove my name from this submission

UNITED ASSOCIATION

of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada

Founded 1889

Letters should be confined to one subject

UA Local Union:

Subject:

St. Andrews
Antigonish County, Nova Scotia,

Email: @ns.sympatico.ca

Premier McNeil
One Government Place, 7th Floor
1700 Granville Street
Halifax, Nova Scotia
B3J 1X5

February 18/2019

Dear Premier McNeil,
The attached Letters are signed by individuals mostly from the Guysborough, Antigonish and Pictou Countys who are concerned about the potential loss of Northern Pulp.

The Mill has been a Major Employer for the Construction Industry every year for the past 54 years.

The proposed effluent Plant is an 18 month project for us.

The Forestry Industry in this Province involves every Sector of the Economy.

Northern Pulp wants to clean up the Mill with an 18 Month Industrial Construction Project.
Please remove all roadblocks and Grant and Extension so they can start Construction.

Sincerely,

CC EA Assessment

UA Local 244

From: @ns.sympatico.ca
To: Environment Assessment Web Account
Cc: Houston, Tim; Burrill, Gary; MLA West Hants;
Subject: CAPE response to Replacement Effluent Treatment Facility for NPNS
Date: November 8, 2019 1:16:49 PM
Attachments: CAPE response to Replacement Effluent Treatment Facility.odt

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November 8, 2019
Environment Assessment Branch
Nova Scotia Environment
PO Box 442
Halifax, NS, B3J 2P8
Good afternoon Minister Wilson,
Please find attached comments from Citizen Action to Protect the Environment (CAPE) regarding the Replacement Effluent Treatment Facility Project for Northern Pulp Nova Scotia Corporation.
Please confirm receipt of this letter.
Thank you,

CAPE

Citizen Action to Protect the Environment

Hants Co., NS

November 8, 2019

Environment Assessment Branch
Nova Scotia Environmental
PO Box 442
Halifax, NS, B3J 2P8

Good afternoon Minister Wilson,

Thank you for the opportunity to respond to the proposed Replacement Effluent Treatment Facility Project for Northern Pulp Nova Scotia Corporation. The following comments are on behalf of members of the registered Hants County-based society, Citizen Action to Protect the Environment (CAPE). We advocate for the protection of our environment and the wise use of our natural resources.

We have numerous concerns about the lack of specific details in several sections of this proposal, but due to time constraints we have focused our comments on three main topics. Our primary areas of concern are: Contaminants of Potential Concern (COPCs), Tourism, and Forestry.

Contaminants of Potential Concern

Although our CAPE members, who reside mainly in Hants County, don't live in the immediate vicinity of Northern Pulp, we have a vested interest in the outcome of this proposal. We have to agree with the fishermen that there is serious concern about the safety of water in the Strait if this effluent is allowed to be dispersed through the pipe. There are already pollutants in the proposed discharge area and it is important to recognize the cumulative effects of adding the toxins from NPNS's effluent. We find it unacceptable to consider adding an estimated 25 billion liters of toxic effluent into the Northumberland Strait every year. Instead we believe our government should be working with industries and municipalities to decrease the chemical and nutrient inputs from industries, agriculture and municipal wastewater systems.

After reviewing the Human Health Risk Assessment...Section, we believe there is a need to include PFAS in the list of contaminants of potential concern (COPCs). We recently became more aware of this large group of synthetic chemicals/pollutants called per- and polyfluoroalkyl substances (PFAS) with the potential to impact health, and their link to paper mills in the US. Environment Canada and Health Canada concluded that PFAS chemicals are highly persistent, mobile in the environment, can accumulate in living organisms, and also have the potential to cause immediate or long-term harmful effects on human health and the environment. Some of the potential health effects of PFAS exposure include probable links with high cholesterol, thyroid disease, pregnancy-induced hypertension, ulcerative colitis, and kidney and testicular cancer. There is also a positive association between exposure and dyslipidemia, immunity, and renal function in children.

In December 2018, Health Canada set new guidelines and Maximum Acceptable Concentration (MAC) levels for two of these PFAS chemicals in drinking water- perflourooctane sulfonate (PFOS) and perfluoroctanocic acid (PFOA) at 0.0006 mg/L or 0.6 ug/L.[1]

To provide a margin of protection from exposure to PFOA and PFOS from drinking water, the US Environmental Protection Agency (EPA), has established the health advisory levels at 70 parts per trillion, or 0.07ug/L.[2] The Australia Department of Health has a similar standard. It also specifies that when PFOS co-occurs with perfluorohexane sulfonate (PFHxS), the drinking water quality value should be applied to the sum of the concentration of PFOS and PFHxS.

The authors of a recent (Nov, 2018) review of pathways of human exposure to PFAS cites the European Food Safety Authority (EFSA) as estimating that "fish and other seafood" account for up to 86% of dietary PFAS exposure in adults. [3]
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6380916/

Recently through a Freedom of Information Act (FOIA) request to FDA, Environmental Defense Fund obtained documents previously not made public that show US paper mills using PFASs may be a significant source of contamination to water and potentially to air and compost.[4] While this may not be the case here in NS, testing for PFAS needs to be a requirement before any effluent is discharged.

We consider that if the effluent is dispersed through the pipe as proposed, the risk for fish and/or seafood in the Northumberland Strait to be contaminated is enormous. We would not only be jeopardizing a $3 billion industry, but at the same time losing a major source of food, a source of nutrition that has been depended upon for centuries. We find it unbelievable to consider putting it at risk!

It seems common knowledge that guidelines for maintaining a healthy environment are constantly changing and becoming more stringent as we become better informed about the detrimental effects of certain substances (e.g. lead in drinking water). It is extremely difficult and expensive, if not impossible, to repair an ecosystem after the damage has occurred. Preventing illnesses and diseases is easier and more cost-effective that trying to cure chronic conditions and cancers that have developed over time.

Our NS Environment Act states in Section 2(b)(ii) "the precautionary principle will be used in decision -making so that where there are threats of serious or irreversible damage, the lack of full scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation." Since crucial information about the safety and effects of the effluent on both habitat, and short and long-term well-being of marine, plant, and human life is lacking or unknown, this requires that the precautionary principle be used.

1] https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-perfluorooctane-sulfonate/document.html

2] https://www.epa.gov/ground-water-and-drinking-water/drinking-water-health-advisories-pfoa-and-pfos

3]Sunderland, E.M., Hu, X.C., Dassuncao, C. *et al*. A review of the pathways of human exposure to poly- and perfluoroalkyl substances (PFASs) and present understanding of health effects. *J Expo Sci Environ Epidemiol* **29,** 131–147 (2019) doi:10.1038/s41370-018-0094-1

4] http://blogs.edf.org/health/2018/05/21/pfas-paper-mills/

Tourism

The tourism industry in NS has great potential. It is currently worth more than $2.5 Billion and growing. Nova Scotia has recently been praised as a unique destination by Travel Lemming Destination Awards. It is ranked 2nd on the list of the top 30 for 2020 and number one of North American destinations. It received praise as “full of natural beauty, historical buildings, and some of the **best seafood** you'll find anywhere” (The Chronicle Herald, Nov.6/19).
This potential should not be risked by adding pollutants to the marine life habitat with disposal of effluent through the pipe, nor by burning toxic sludge that we believe would increase the presence of air emissions from the NPNS mill.

Forestry

The possible closure of the Northern Pulp mill due to the effluent disposal crisis has resulted in the defense that the government cannot permit the loss of high paying mill jobs, forest harvest contractors and trucker jobs. The argument reduces to a conflict between environmental protection versus economic concerns. We have been disappointed that past decisions have valued economics over the environment.

Both the Bancroft-Crossland Report and the Lahey Report have concluded that the scientific and logical position that the current industrial extraction model of forest management is unsustainable, and that these practices must be halted in order to reset forest practices. Both reports call for regime changes. The closure of the mill, if it were to occur, or if restrictions were placed on NPNS’s harvesting, would provide the space and the impetus for such change.

There is a precedent for such restrictions. The fishing industry in Nova Scotia, also a natural resources extraction industry, has gone through such a transformation (regime shift): the cod moratorium. Many hundreds of plant-based processing jobs and fishing jobs were lost. Many communities lost their major employers. The years have passed and fishing remains a viable and even healthier industry than it was. It is a different industry now and still evolving. Some fisheries have earned environmentally sustainable certification status.

This regime shift in forestry would give more value to ecological benefits. Forests, that are truly sustainably managed, could be a strong tool in addressing our Climate crisis. This is a much better legacy to be leaving our children and grandchildren, than another situation with unexpected ramifications like Boat Harbour. We have confidence that closing the mill won't be the end of the forestry industry. In fact, having fewer clearcuts might entice more tourists and over time result in increased economical benefits.

We stand in solidarity with the Pictou Landing First Nation and the fishing and tourism industries of the Gulf of St. Lawrence and Northumberland Strait in opposition to the proposed Northern Pulp Replacement Effluent Treatment Facility Project and call on the Nova Scotia Government to reject this plan outright.

Respectfully submitted,

CAPE

From:
To: Environment Assessment Web Account
Subject: Re: Northern Pulp NS Fleet Planning Board LOS
Date: November 8, 2019 3:28:14 PM
Attachments: GCIFA LOS for Fleet Planning Board.doc

Good afternoon,
Please accept the attached letter of support from Guysborough county Inshore Fishermen's Association. The letter address concerns the fishing industry in Chedabucto Bay area which shares the waterway through the Canso Causeway with Northern Pulp and the NS fleet Planning board.
Thank you and please feel free to contact myself at any time to further discuss our concerns.

For

Canso, NS

Guysborough County Inshore
Fishermen's Association
Ph: 902-366-2266/Fax: 902-366-2679

Box 98
990 Union Street
Canso, N.S.
B0H 1H0

Nov 8th, 2019

Honourable Minister Gordon Wilson
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8

Re: Letter of support : Northern Pulp Nova Scotia, Focus Report, Replacement Effluent Treatment Facility

Dear Hon. Minister Gordon Wilson,

Northern Pulp Nova Scotia has submitted a Focus Report to the province on October 2, 2019. It is proposing a new treatment facility that will discharge 70-90 million litres of contaminated effluent into the Northumberland Strait every day. A Federal government study conducted a few years ago concluded that, even when meeting federal regulations, 70% of pulp mills in Canada continue to have harmful effects on aquatic life and habitat, and 55% are having harmful effects on the larger environment. The Northumberland Strait is part of the rich and vital fishing industry of our province. The reputation of our industry, and our brand, is built on seafood harvested from clean, cold, pristine waters off our province's rugged coastline. A threat to this reputation is a threat to the industry throughout Nova Scotia, Guysborough County and Cape Breton and in neighboring provinces

The Northern Pulp Nova Scotia (NPNS) Focus Report was reviewed by the Gulf Nova Scotia Fleet Planning Board in detail. The GCIFA supports the conclusions made in the review, namely:

> *In closing, the GNSFPB would like to reiterate that NPNS has failed to adequately address the Terms of Reference outlined in section 7.0 Fish and Fish Habitat, 9.0 Human Health and 2.0 Project Description… Northern Pulp relies on major assumptions and blanketed statements to suggest that there will be no harm to the marine environment, including fish and fish habitat. There are gaps in the evidence presented, including but not limited to: impact on lobster development and population health, incomplete or non-existent commitment to follow up monitoring, lack of evidence to protect vulnerable populations or habitat such as fall spawning herring, other SARA (Cod, White Hake), Scallop Buffer Zone 24, eel*

grass beds, limited understanding of the seasonal impacts of ice cover and ice scouring. The importance of the global optics of the Canadian seafood brand can not be undervalued or excluded from this Environmental Assessment approach.

Unfortunately, Northern Pulp has failed to assure our fishing industry that our brand and our livelihoods are not at risk. In fact, all evidence points to the proposed pipe and its discharging effluent having harmful effects on marine species. Mill officials and their consultants provided no hard science on the impact on fisheries and fish habitat, yet insist that discharge into the Northumberland Strait is their only option. Northern Pulp appears satisfied to have the fishing industry assume 100% of the risk of their proposed new treatment facility. This is not acceptable to the fishing industry of Atlantic Canada. We hope that your department will take these comments seriously and consider our vital fishing industry in making your final decision.

Thank you for your attention to this very serious matter,

GCIFA

From:	
To:	Environment Assessment Web Account
Cc:	
Subject:	Oceans North's comments on the Focus Report for the Northern Pulp's Replacement Effluent Treatments Facility Project
Date:	November 8, 2019 3:57:33 PM
Attachments:	Oceans North submission Replacement Effluent Treatment.pdf

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Please see attached Oceans North's comments on the Focus Report for the Northern Pulp's Replacement Effluent Treatments Facility Project for environmental assessment, in accordance with Part IV of the Environment Act.

OCEANS NORTH | oceansnorth.org

1533 Barrington Street, Suite 200
Halifax, NS
B3J 1E6

Environmental Assessment Branch
Nova Scotia Environment
P.O. Box 442
Halifax, NS, B3J 2P8
Fax: (902) 424-6925
EA@novascotia.ca

November 8, 2019

On behalf of Oceans North, we are writing to submit comments on the Focus Report for the Northern Pulp's Replacement Effluent Treatments Facility Project for environmental assessment, in accordance with Part IV of the *Environment Act.*

Oceans North is a non-profit organization that fosters science and community-based conservation in the Arctic and Atlantic regions of Canada. We support sustainable fisheries, management measures that aim to rebuild fish populations and place-based measures to protect marine diversity and traditional access. Our goal is to promote policies and programs that address the unprecedented environmental changes taking place in the North and Atlantic regions and ensure that their waters are protected within the framework of sustainable management and indigenous knowledge, rights and consultation.

We urge the province to remain committed to the *Boat Harbour Act* and to the January 31, 2020 deadline as a first step in making up for years of environmental racism faced by Pictou Landing First Nations. With respect for the Focus Report regarding the Replacement Effluent Treatment Facility Project, we strongly conclude that this Minister should **reject** this undertaking due to its strong potential for environmental, economic and social damage.

The Focus Report does not meet the required Terms of Reference because it lacks sufficient information on many of the items required. The concordance table does not adequately address many of the public concerns it is supposed to, particularly with respect to "Total Suspended Solids" (TSS). The Mi'kmaq Ecological Knowledge Study also was not submitted as part of the Focus Report.

The Federal Pulp and Paper Effluent Regulations (PPER) is a very low bar for environmental regulation, shown to be inadequate and does not protect the marine environment over the long term to any great extent. Indeed, the PPER is currently being consulted on for modernization[1]. Some the main shortcomings of the existing regulations as described by Environment and Climate Change Canada include:

[1] https://www.canada.ca/content/dam/eccc/documents/pdf/PPER%20Modernization%20-%20Detailed%20Proposal.pdf

- "Environmental effects monitoring (EEM) studies required by the PPER have shown that the effluents from 70% of pulp and paper mills are impacting fish and/or fish habitat, and that the impacts at 55% of these mills pose a high risk to the environment."
- "What is achievable through process control and wastewater treatment has improved since 1992 when the PPER were put in place, and best technologies and techniques are well documented."

The Northumberland Strait is a very different marine environment than most marine discharge pulp mills in Canada that sit in fjords and as a result requires unique consideration which is not taken into account from the PPER or Northern Pulp's Replacement Project. We are most concerned with total suspended solids (TSS), the effluent of pulp mills made up mainly of short cellulose fibres too small for pulp / paper production. These fibres are extremely refractive in aquatic environments (especially in saltwater where effluent will go) and can take a very long time to degrade. In short, the TSS load from the planned discharge may spread and settle many kilometers away and build in size over years. The deposits can be several meters thick, and smother anything on the bottom in a black anoxic envelope. Northern Pulp is still planning to discharge thousands of kg of TSS per day. Releasing this volume of TSS will be a chronic issue with the potential for large geographic scale damage in Northumberland Strait. With the plan to discharge into open waters the problem faced in Boat Harbour is simply exported into a larger marine area where impacts will be more difficult to discern and track.

I. Overall Concern for the Marine Environment

The Northumberland straight is a unique and biodiverse marine ecosystem that provides livelihoods for thousands of Maritimers. But alarmingly this ecosystem is under compounding stressors due to climate change, weakening the ability of system to respond and adapt to new threats.[2] We are concerned about the pipeline construction and effluent impacts on a number of commercially important fish species, many of which are already depleted, including: American lobster, Atlantic herring (critical zone), rock crab, winter flounder, American Plaice (threatened), White Hake (endangered), Winter Skate (endangered), Atlantic bluefin, Atlantic mackerel (critical zone).

The Focus Report mentions that no studies were conducted on the impact of lobster larvae or herring eggs. The pipeline project threatens juvenile lobster in the Northumberland Straight and thus the health of lobster and the lucrative and important fishery in the region for both commercial and indigenous fisheries. The lobster fishery is valued at approximately $750 million dollars in Nova Scotia alone. Fishermen previously made sacrifices to their valuable scallop fishing areas by protecting important habitat zones from scallop dragging to protect juvenile lobster. The pipeline construction and effluent threaten not only to undue this sacrifice and good will but jeopardize the livelihood of thousands of fishermen.

An important herring spawning area in the Northumberland Straight is also jeopardized by the pipeline. Herring support important fisheries and processing facilities in Atlantic Canada and are used as bait for the lobster industry. Within the ecosystem, their role is paramount. As a forage fish, herring support energy transfer through the food chain, as food for larger organisms like whales and tuna and by eating smaller organisms like zooplankton. These herring are currently at critically low levels[3] and the threat that that is posed by the pipeline effluent could jeopardize this important fish from ever recovering. This threatens the fishery jobs as well as the ecosystem role that herring play.

2 https://report.ipcc.ch/srocc/pdf/SROCC_FinalDraft_FullReport.pdf
3 https://waves-vagues.dfo-mpo.gc.ca/Library/4071309x.pdf

We are also concerned about the project's impact on important eelgrass beds. The recent IPCC Special Report on the Ocean and Cryosphere in a Changing Climate[4] stressed the critical role that coastal habitats such as eelgrass can play in buffering against some of the impacts of climate change. The damage to the important function of eelgrass beds through direct removal and disturbance will only weaken the ecosystem's ability to respond to climate change.

II. Detailed comments on the Focus Report

OVERVIEW SECTION

The Focus Report reiterates that the new effluent treatment facility will be designed to meet the federal pulp and paper effluent regulations (PPER). This is a very low environmental bar as explained above.

page XXXVI – We note that the proposed effluent treatment facility will have a daily annual average flow of 62,000 m^3 / day; peak flow 85,000 m^3/ day.

page XXXVIII - "The receiving water study at the existing Boat Harbour dam discharge into the Northumberland Strait undertaken to assess environmental impacts has concluded that existing dilution factors are low and insufficient for effluent mixing with the ambient water. A diffused outfall outside of Caribou Harbour in the Northumberland Strait is considered to have much less potential effluent impact on the receiving environment and represents an improvement." - This is the entire crux of the problem where effluent mixing in the near shore is insufficient, and this becomes the excuse for dumping material offshore rather than considering the real impacts of dumping offshore.

CONCORDANCE TABLE (responses to original replacement ETF project proposal) - page 1 of Focus Report

There are a number of instances where the listed concern is not responded to correctly in the table (e.g. a concern about wastewater being responded to as an air quality issue).

It is very clear that air pollution problems faced by the public are long-standing, yet the industry response is 'we are meeting regulations'. It is time for a proper Federal Environmental Assessment on Northern Pulp that takes into account the fact that existing environmental regulations are not working, and local conditions need to be taken into account to correct those regulations and permits.

Page 27 of Appendix 1.1 cites the concern of DFO that the proposed effluent pipe will discharge directly into an existing Marine Refuge Scallop Buffer Zone, which "forms part of DFO's Other Effective Area Based Conservation Measures that contribute toward Canada's 2020 Marine Conservation Targets". Also "If a new activity such as the effluent discharge is permitted in or around this area and later deemed incompatible with the stated conservation objectives, loss of Marine Refuge status may occur, in whole or in part." and finally "It should be noted that, it is probable that the marine portion of the effluent pipe construction will travel through, and discharge inside the Marine Refuge." The response comment to this concern was simply to see section 7.3 of the focus report. ** That section of the report mentions the scallop buffer zone but actually says nothing about its importance as a conservation measure or how the planned discharge may cause loss of marine refuge status. Northern Pulp is essentially saying, we are planning to discharge into a conservation area and are not going to do anything about it.

Many of the comments regarding impacts on marine fish and fish habitat were not answered directly in the focus report, but rather set aside to be answered by a future environmental effects monitoring

4 https://www.ipcc.ch/srocc/home/

program. In other words, the new waste treatment facility will be up and running before serious concerns regarding impacts can be answered – and the only source of answers will be a future EEM program which may or may not be up to the task. This line of reasoning will only be effective if EEM results can be used to alter permit conditions for the mill, including complete revamping of the effluent treatment system if necessary.

Appendix 1.1 page 22 (of 125, the appendix page numbering restarts, oddly unnecessary) - an individual concern about the amount of solids per day that will enter the Marine environment with the new system of effluent treatment. The response comment to this concern was to refer to section 4.3 of the focus report.

Other concerns regarding the total suspended solids issue are also listed. The response comment is almost always to refer to section 4.3.

Appendix 1.1 page 36 (of 125) - The Ecology Action Centre also mentioned the solids issue "Total Suspended Solids (TSS) largely consists of cellulose fibers. Although the document states that 85 to 95% of the lignin, cellulose, sodium sulphide and sodium hydroxide will be removed from the sludge via biological activity in treatment, there is no information provided about the 5-15% which survives treatment - the cellulose. Cellulose fibers are refractory, meaning that they don't degrade quickly or decompose well in water, especially seawater. The registration document provides, in section 5.2.2.9 on Effluent Quality, that the effluent annual average flow will have an anticipated TSS concentration of 48 mg/l of effluent which equates to a total 3053 kg of TSS per day, i.e., a full dump truck load each day in equivalent tonnage. These fibers have the potential to settle into a deep hole or depression, smothering the bottom and causing anoxia in the underlying sediment." The focus report response comment is to refer to section 4.3.

NOTE: When you actually read section 4.3 of the Focus Report, the above concerns on TSS are not addressed, and the section actually concludes with a false and very misleading statement (see below).

Ice scour and subsequent limited chances for the proposed pipeline's survival are mentioned numerous times in the Appendix 1.1 listing. The response comment was usually to refer to section 2.2 of this focus report.

PROJECT DESCRIPTION

2.2 Marine geotechnical survey - page 18 (And appendix 2.2)

"Conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must determine the potential impacts of ice scour on the pipeline."

The planned trench depth is up to 3 m (Page 21). However, the report notes here that the bedrock depth is not known and could be quite shallow.

Estimated ice scour depth in the sediments is a key issue in this portion of the focus report. Numerous ice scours were observed by surveys and they occurred to depths of 9 m. The ice scours were observed to penetrate into the sediment 0.3 to 0.4 m at most. (page 23). This is presented as justification for a trench depth of 3 m.

Appendix 2.2 has numerous figures indicating survey track lines for surveying underwater sediments and evidence of ice scours. It should be noted that the proposed pipeline route near the Pictou causeway was not surveyed for approximately 200 m beyond the Northern Pulp property. This is a shallow water area right near shore which could be impacted strongly by ice scours. The proposed pipeline route next to the causeway is quite shallow overall, only about 2 m deep or less (Figure 5.1.1 in appendix 2.2).

About half of the proposed pipeline route in the Caribou Harbour channel is also quite shallow (figure 5.1.4 in appendix 2.2).

2.3 Characterization of effluent – page 23 (and appendix 2.3)

"Submit data regarding the complete physical and chemical characterization of NPNS' raw wastewater...."

Page 25 of the Focus Report reminds us that most of the suspended solids in the effluent is 'mainly fibres and lime'. We are also told that the federal pulp and paper effluent regulations only protect against acute toxicity (Page 26). Once again, this is a very low bar of environmental protection.

Table 2.3 -3 in the Focus Report shows total suspended solids concentration in treated effluent is presently 29 mg/l. The proposed new biological treatment system will not control total suspended solids to any great degree, the same table indicating the concentration will remain above 20 mg/L. This simply highlights the fact that cellulose fibres are quite refractory and effluent treatment is not likely to remove them unless very specialized methods are employed such as centrifugal hydrocyclones. Suspiciously, the numbers regarding total suspended solids presented in the Focus Report are much lower than the value that was submitted in the original Northern Pulp EA paper, which was expected to be 48 mg/L with the proposed new effluent treatment system. How did this happen?

Appendix 2.3 page 6 - "Numerous studies have firmly established that concentrations of PCDDs, PDCFs and polychlorophenols in effluents from ECF bleaching are close to or below the level of detection ..." this is a completely spurious argument frequently used by industry when talking about harmful toxins in their effluent. A toxic compound 'below the level of detection' is still toxic. A laboratory using inexpensive methods to detect toxins will not find them, the results will be below the level of detection. If that same laboratory uses more expensive (more refined) methods of detection, the detection limit will be lowered and the toxic compound will be more likely to be found even at very low concentrations. The detection limit employed must be linked back to the concentration of the toxic substance which causes harm. There is no point in having a laboratory detection limit in milligrams per litre if the substance is toxic in micrograms per litre.

We are left to hunt through individual lab report sheets at the end of the appendix to get some idea of what is going on. One sheet (Dioxins and Furans by HRMS) lists a reportable detection limit of 9.48 pg/l for most dioxins and furans; and most samples turned out ND. An IJC water quality objective for one of the dioxins is 10 parts per quadrillion, or 10 per 10^{15}. 9.48 pg/l = 0.00948 pg/g = 9.48 per 10^{15}. In other words, the detection limit chosen by the laboratory analyzing the pulp mill effluent is actually very close to a guideline above which harm is possible.

Appendix 2.3 page 9, table 1 - 2, total suspended solids is again provided as 29 mg/L at the present outflow while we see that at the Caribou Harbour overflow it is only 2.5. This reinforces the hypothesis the Caribou Harbour is presently holding back many thousands of tons of total suspended solids in the form of cellulose fibers. The harbour is presently acting as a huge settling basin, and there will be no such ability to settle out solids in a controlled manner once the new proposed effluent pipe discharge is active.

The same table illustrates the detection limit issue mentioned above. Total phosphorus concentrations are provided in mg/l and we see the effluent presently is around 1.5 mg/l at discharge, while in Caribou Harbour the value is listed as ND. Even a very eutrophic lake will have a typical TP concentration of about 0.1 mg/l or less, only going to around 0.5 during peak bloom conditions. The TP values presented in Table 1-2 are extraordinarily high, so what was the detection limit they used for the Caribou Harbour samples? Once again, digging deep into the laboratory analysis sheets we find reported detection limits of 0.02, 0.1 to 1.0 mg/l for total phosphorus. The latter two detection limits are not useful from an environmental impact perspective in Canadian freshwaters, so why were they used?

Similar detection limit issues can be found in almost every single table in this appendix. One last example - Table 1-3 lists metal concentrations. A value of 0.022 ug/l is provided for Total Mercury at discharge point C. That value is very close to the CCME guideline of 0.026 ug/l for freshwater. Yet all other values for total mercury at other sample collection points are listed as ND. What detection limit was used by the laboratory? Hunting deep in the report pages, we find an RDL of 0.013 ug/l for the mercury analysis - only half the value of the actual guideline. From an impact assessment perspective this is unacceptable, we need values that are lower than this RDL.

2.4 Treated effluent characterization – page 32 (and appendix 2.4)

"Submit a complete physical and chemical characterization of NPNS's expected effluent following treatment by the proposed technology..."

Page 34 of Focus Report, Chemical Oxygen Demand discussion. "Many organic compounds, including colour compounds and fibres, which are not easily biodegradable, along with any inorganic chemicals will show up as pCOD." (bolded emphasis mine). pCOD = particulate chemical oxygen demand. Also: "Total COD is the typical industry measurement in Canada, referred to as tCOD in the lab report, which is a combination of the biodegradable sCOD fraction and the not easily biodegradable pCOD. The focus of the laboratory trial was the removal of sCOD at different flow rates and loadings." Here we finally have an admission that the fibres in the effluent are not readily biodegradable, they are refractory. Moreover, the proposed effluent treatment system will not even attempt to work on these fibres and reduce their load in the effluent.

Page 39, Table 2.4-3. Note t hat TSS loadings are still expected to be thousands of kg per day. The bulk of this material will be cellulose fibres which do not degrade readily, they will simply accumulate on the marine bottom and smother sediments. (The associated appendix to this section of the Focus Report has nothing else to add).

2.5 Changes to pipeline – page 39 (and appendix 2.5)

"Provide any proposed changes to the pipeline construction methodology and other associated pipeline construction work, related to the potential changes to the marine portion of the pipeline route...."

This section does not provide much in the way of any analysis that would be particularly helpful. Appendix 2.5 does mention pipeline armour - again this just assumes that ice scours will not become any deeper as time goes by.

FACILITY DESIGN, CONSTRUCTION AND OPERATION AND MAINTENANCE

3.1 Treatment Technology Specifications - page 44 (And appendix 3.1)

“Submit treatment technology specifications (e.g., optimal performance range of the technology) and an assessment of the efficacy of the proposed treatment technology...”

We see on page 44 that the Pulp and Paper Effluent Regulations allow over 10,000 kg per day of total suspended solids which is outrageous. We are shown a calculated value of 1875 kg per day of total suspended solids discharged with the proposed effluent treatment system - and since this is far lower than the PPER allows, “the new ETF will be able to provide adequate treatment”. Once again, since the PPER is completely inadequate to the task of protecting the marine environment over the long term - the pulp mill gets away with it discharge plans. Appendix 3.1 does not add to this argument.

3.3 Effluent discharge parameters - page 50 (And appendix 3.3 - which is blank)

“Effluent discharge parameters must be updated (where necessary) based upon the results of the effluent characterization...”

The estimated total nitrogen loading of around 400 to 500 kg per day is very high. This could represent a significant nearshore marine eutrophication risk.

“TSS at 48 mg/L at the design flow of 85,000 m^3/day equates to 4,080 kg/day, while the Veolia guarantee for TSS is ≤ 1,875 kg/day and the 2018 BHETF annual average discharge was 1,717 kg/day.” - once again, discharging thousands of kilograms per day of total suspended solids comprised mostly of refractory cellulose fibres is not a good idea.

3.4 Spill Basin - page 56 (And appendix 3.4)

“A spill basin is not a regulatory requirement...” but “ NPNS has made the decision to include one because it is considered a best practice in the design of an ETF.”

The appendix describes plans for a standard earthen basin with a plastic liner. This type of spill basin is at the low end of reliability.

3.5 Effluent pipeline leak detection - page 60 (And appendix 3.5, which is blank)

“Provide viable options including the selected option for leak detection technologies and inspection methodologies...”

Page 62 in this section notes “...selected systems have demonstrated success in detecting leaks as small as 60 L/hr.” This means that chronic small leaks in the pipeline, especially in the near shore, could go on for months without being detected. This could lead to localized impacts which would not be detected by routine monitoring programs.

MARINE WATER AND MARINE SEDIMENT

4.1 baseline marine studies- page 69 (And appendix 4.1)

“Conduct baseline studies for the marine environment (such as marine water quality and marine sediment) in the vicinity of proposed marine outfall location.”

Page 72 - now suddenly the contracted laboratories are able to detect lower concentrations of total Dioxins and Furans (see discussion above) and we see a background water quality of 3.213 picograms per litre in Table 4.1-2. It would have been nice to have that low detection limit when discussing the actual mill operations and effluent.

Page 78-the Northumberland Strait samples indicate sediment with a high proportion of sand. Depending on the grain size composition of the sand the sediments might be quite mobile. There is imagery in other sections of the report and in the appendices indicating this potential movement of sand. This may or may not cause problems for the pipeline.

The baseline marine studies recorded here appear to be only about water quality and sediment. There's nothing on organisms.

Appendix 4.1 has a long listing of chemical analysis of sediment and soil samples in the area. There's quite a bit of evidence here to indicate existing contamination of sediment and soils from past industrial practice. These results may be helpful for suggesting future contamination of marine sediments if the proposed outfall is put in place.

4.2 receiving water study- page 82 (And appendix 4.2)

"Update the receiving water study to model for all potential contaminants of concern in the receiving environment...."

Fig. 4.2-1 shows a series of deeper (>20m) 'holes' near the proposed outfall location which may become depositional sites for TSS.

Fig. 4.2-3 - note how the modelled particles seem to accumulate in the same general area as the deep holes. This figure should have had an overlay of depth contours to aid in interpretation. The same comment applies to figure 4.2-4.

Figure 4.2-6 - dilution factor rather than particle concentration this time but note how heterogenous the results are. This simply highlights the fact that particles will settle out in clumped distributions in the marine environment. Impacts from the proposed outfall will be localized. However, it is the extent and number of these localized impacted areas that will lead to chronic harm to the marine environment.

4.3 sediment transport modelling - page 97 (And appendix 4.3)

"Provide results of sediment transport modelling work to understand the impacts of potential accumulation of sediment within near-field and far-field model areas..."

Page 100 - "a significant percentage of the particles are very fine colloidal-type material, with greater than 90% of the particles smaller than 75 µm (0.003 inches) in diameter (for comparison, human hair is between 50-70 µm). Both their low density and their small size prevented these particles from settling out in the secondary clarifiers after more than 11 hours in that calm environment."

The above quote refers to the fact that the total suspended solids released by the planned diffuser will be primarily composed a very fine plant fibres. The secondary clarifiers cannot handle this material, which is why I'm suggesting that they use centrifugal hydrocyclones. The mill must do more to prevent these fine plant fibres from being released.

Page 102 - "As indicated above, effluent particles are not readily settleable and are likely to travel significant distances far from the diffuser." - yes, and this is exactly the problem! And just after the above quote we find: “Total suspended solid particles are largely organic and biodegradable. They are a food source for other marine organisms and as such are not expected to build up and deposit in areas away from the diffuser.” **this is a patently false and misleading statement** - the report itself has stated that the particles mentioned here will be refractory material that does not readily degrade!

FISH AND FISH HABITAT

7.2 Fish habitat baseline survey - page 119 (And appendix 7.2)

“Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada.”

The video methods employed here were reasonable. The video quality was reasonable but not particularly good. However, video methods alone do a very poor job of capturing the full diversity of our nearshore benthos. SCUBA and grab sample methods should have been employed as well.

Unfortunately, the taxonomic analysis performed here resemble something that a poorly trained undergraduate student would put together. Taxonomic authorities should've been present for each ID. I particularly question the algal identifications, as there are numerous filamentous forms which add to diversity but are almost impossible to ID via video. *Laminaria longicuris* is no longer a valid taxon - the entity is now called *Saccharina latissima*. *Fucus spiralis* is mentioned several times, this is an unlikely ID unless the vessel went into very shallow water at a peak high tide.

Overall, the results of this fish habitat baseline survey are completely inadequate for actually describing the true taxonomic diversity of the area. The report just lists a handful of species that are readily seen by an untrained observer. A more thorough analysis (especially grab samples in sediment, and trap nets for fish) could have provided far more detail. There may be far more diversity in these areas than suggested by this very limed overview survey.

7.3 impact assessment for marine fish - page 122 (And appendix 7.3)

“Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information....”

Page 123- “Based on testing, modelling and the incorporation of mitigation activities, no significant residual impacts to marine water quality are expected to arise on any fisheries or fish habitat as a result of this project.”

This statement far overextends the truth from the evidence presented. Northern Pulp is just meeting the PPER, that’s it. There are going to be plenty of ‘residual impacts’ against that preposterously low bar of environmental protection.

Quote immediately following the one listed above “To confirm these predictions, NPNS will continue with a federally-regulated Environmental Effects Monitoring (EEM) program and additional EA Follow-up monitoring.”

This procedure is very concerning. Any potential impacts are only going to be discerned by a preplanned monitoring program. EEM is a fairly rigorous regulatory process between the mill and the Federal government. EEM may or may not allow the inclusion of third-party observations of harm outside of the planned EEM a monitoring area or program. Furthermore, those third-party observations may or may not lead to changes in Mill operations. We need some assurance that third-party observations can influence how this Mill produces paper and what its effluent standards become.

Page 123 - “Marine Regional Assessment Area (RAA) – The area inclusive of Pictou Harbour, Caribou Harbour, and the south-eastern portion of the Northumberland Strait adjacent to the Marine Local Assessment Area.” This proposed large scale assessment area is very poorly defined by this statement. We need a much tighter definition which includes an area at least within 20 km of the plant outflow. Any observations of harm by any third-party must be addressed if they occur within the planned RAA.

Appendix 7.3, section 3.6.3- the entire indigenous fisheries section here is blank, this is very worrying.

7.4 updated environmental effects monitoring program - page 148 (And appendix 7.4)

“Submit an updated Environmental Effects Monitoring (EEM) program..”

The EEM process is a regulatory one. The Focus Report emphasizes this by including the PPER EEM regulations as appendix 7.4.

- effects on benthic invertebrate community or fish population is only measured against ‘exposure area’ and ‘reference area’ - the difference being exposed to effluent or not. We are not given any guidance on exposure other than 1% concentrations of effluent. Any measurements of distance are given in a few hundred meters - nothing about having impacts km away.
- most effects measurements are quite coarse, tissue residue, tumours, etc.

So from the beginning EEM is not designed to detect subtle effects, especially at long distances. It's mainly about detecting harm close to the pipe.

The Focus Report in this section of course highlights the regulatory obligation. Page 150 - “If the mill demonstrates that the effluent concentration is <1% at a distance of 250 m, then the EEM does not require a fish community study component. Likewise, if the mill demonstrates that the effluent concentration is <1% at 100 m from the discharge, then a benthic invertebrate community study is not required. At present, the three-dimensional (3D) modelling of the area in the local study area as part of the updated RWS indicates that dilution to less <1% effluent will occur at approximately 20 m from the discharge location (Stantec, 2019).”

“The predictions in the most recent RWS indicate there will be no requirement for NPNS to conduct either a fish community or benthic community study near the discharge.” Once again, the PPER and its associated EEM regulations are completely inadequate to detect the major issue of cellulose fibres being released into the marine environment.

Interestingly - “Although not regulated as part of the PPER, some the fish and benthic component studies are still warranted as part of the EA Follow-up and monitoring program that is described original EARD (EcoMetrix, 2018b) and it is intended that they will be completed by a third party consultant for the current project.” We are not certain whether the public will have any input into those studies.

HUMAN HEALTH

9.1 baseline study marine survey - page 165 (And appendix 9.1)

"Complete baseline studies for fish and shellfish tissue (via chemical analysis) of representative key marine species important for commercial, recreational and Aboriginal fisheries in the vicinity of the proposed effluent pipeline and diffuser location."

Interesting tissue residue analysis which may or may not become important in the future. Toxic effects from the mill will have to be extreme to detect a change here which is concerning.

9.2 human health risk assessment - page 166 (And appendix 9.2)

"Commence a Human Health Risk Assessment (HHRA) to assess potential project-related impacts on human health..."

The entire section and associated appendix screens potential toxins against a series of risk assessments and then just mentions regulations and guidelines that may or may not be present.

INDIGENOUS PEOPLE'S USE OF LAND AND RESOURCES

11.1 Mi'kmaq Ecological Knowledge Study - page 188 (And appendix 11.1)

The study is not included as part of the Report. The description that is provided does not adequately explain how the concerns raised through the study would be addressed.

III. Compliance with Bill C-68

On June 21, 2019, Bill C-68[5] the modernized Fisheries Act, reached royal assent and became law in Canada. There are several provisions of this law which need to be considered by Fisheries and Oceans Canada (DFO) with the Replacement Effluent Treatment project that are not currently addressed.

1. The definition fish habitat:

    "fish habitat means water frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas"

    The above definition allows DFO to follow a broad ecosystem approach when dealing with industrial impacts on fish habitat. DFO has a mandate under Bill C-68 to investigate and assess industrial impacts on fish habitat in an unconstrained manner based upon science.

2. The purposes of the Fisheries Act in Bill C-68 now include "the conservation and protection of fish and fish habitat, including by preventing pollution." This is a clear statement that DFO has a role in the Northern Pulp issue and industrial impacts on fish habitat in general.

3. "When making a decision under this Act, the Minister may consider, among other things" (a selected list is provided here):

    a. the application of a precautionary approach and an ecosystem approach;

    b. scientific information;

5 https://www.parl.ca/DocumentViewer/en/42-1/bill/C-68/royal-assent

c. Indigenous knowledge of the Indigenous peoples of Canada that has been provided to the Minister;

d. community knowledge

4. "The Minister may establish standards and codes of practice for":

   a. the avoidance of death to fish and harmful alteration, disruption or destruction of fish habitat;

   b. the conservation and protection of fish or fish habitat; and

   c. the prevention of pollution.

5. Bill C-68 adds Ecologically Significant Areas to the Fisheries Act regulatory toolbox.

DFO needs to carefully assess the potential impacts of the project on the scallop buffer zone as an ecological significant area as it currently protects juvenile lobster.

6. The Act refers to the deposit of a "deleterious substance" in water frequented by fish. This will need to be examined in the context of the TSS that Northern Pulp will be releasing. A high proportion of that discharge will be refractory cellulose fibers – and no-one knows where that material will end up in the Strait. We do know that cellulose fibers degrade slowly in marine waters, and they can accumulate on the bottom and adversely affect sediment biota. The term 'deleterious substance' is applicable.

IV. Conclusion

We conclude that this project poses unprecedented risk to the marine environment and surrounding communities and that the Minister should reject the undertaking.

Sincerely,

Oceans North

Oceans North

From:	
To:	Environment Assessment Web Account
Subject:	Comments on Northern Pulp
Date:	November 8, 2019 4:45:10 PM
Attachments:	Northern Pulp CBFHA to NSE Nov 7 2019.pdf

Please find attached our comments Northern Pulp review.

Thank you!

Cape Breton Fish Harvesters Association (formerly LFA27 Management Board)
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Website: www.capebretonfish.com

November 7, 2019

Honourable Minister Gordon Wilson
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8

Re: Northern Pulp Nova Scotia, Focus Report, Replacement Effluent Treatment Facility

Dear Hon. Minister Gordon Wilson,

Northern Pulp Nova Scotia has submitted a Focus Report to the province on October 2, 2019. It is proposing a new treatment facility that will discharge 70-90 million litres of contaminated effluent into the Northumberland Strait every day. A Federal government study conducted a few years ago concluded that, even when meeting federal regulations, 70% of pulp mills in Canada continue to have harmful effects on aquatic life and habitat, and 55% are having harmful effects on the larger environment. The Northumberland Strait is part of the rich and vital fishing industry of our province. The reputation of our industry, and our brand, is built on seafood harvested from clean, cold, pristine waters off our province's rugged coastline. A threat to this reputation is a threat to the industry throughout Nova Scotia, Cape Breton and in neighbouring provinces.

The Northern Pulp Nova Scotia (NPNS) Focus Report was reviewed by the Gulf Nova Scotia Fleet Planning Board in detail. The CBFHA supports the conclusions made in the review, namely:

> *In closing, the GNSFPB would like to reiterate that NPNS has failed to adequately address the Terms of Reference outlined in section 7.0 Fish and Fish Habitat, 9.0 Human Health and 2.0 Project Description… Northern Pulp relies on major assumptions and blanketed statements to suggest that there will be no harm to the marine environment, including fish and fish habitat. There are gaps in the evidence presented, including but not limited to: impact on lobster development and population health, incomplete or non-existent commitment to follow up monitoring, lack of evidence to protect vulnerable populations or habitat such as fall spawning herring, other SARA (Cod, White Hake), Scallop Buffer Zone 24, eel grass beds, limited understanding of the seasonal impacts of ice cover and ice scouring. The importance of the global optics of the Canadian seafood brand can not be undervalued or excluded from this Environmental Assessment approach.*

Unfortunately, Northern Pulp has failed to assure our fishing industry that our brand and our livelihoods are not at risk. In fact, all evidence points to the proposed pipe and its discharging effluent having harmful effects on marine species. Mill officials and their consultants provided no hard science on the impact on fisheries and fish habitat, yet insist that discharge into the Northumberland Strait is their only option. Northern Pulp appears satisfied to have the fishing industry assume 100% of the risk of their proposed new treatment facility. This is not acceptable to the fishing industry of Atlantic Canada.

We hope that your department will take these comments seriously and consider our vital fishing industry in making your final decision.

Thank you for your attention to this very serious matter,

Cape Breton Fish Harvesters Association

From:
To: Environment Assessment Web Account
Subject: Fisheries Industry Submission on NPNS Focus Report
Date: November 8, 2019 5:46:09 PM
Attachments: Fisheries Industry Submission, NPNS EA, Nov 8, 2019.pdf

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To Whom it May Concern:

Please find attached a submission on NPNS's Focus Report from the Gulf Nova Scotia Fleet Planning Board, the Fishermen's Association of PEI, and the Maritime Fishermen's Union.

Please send confirmation of receipt at your earliest convenience.

Best regards,

--

Juniper Law
ph:

Juniper Law

Fergusons Cove, NS
@juniperlaw.ca

The Honourable Minister Gordon Wilson
Nova Scotia Environment
Barrington Tower, 1894 Barrington St., Suite 1800
P.O. Box 442
Halifax, NS B3J 2P8

November 8th, 2019

Dear Minister Wilson:

I am counsel for three fishing industry organizations representing the fishing industry in the Northumberland Strait: Gulf Nova Scotia Fleet Planning Board, PEI Fishermen's Association, and Maritime Fishermen's Union. These organizations represent some 3,000 fishers working in this region, and have been active participants in the environmental assessment process for Northern Pulp Nova Scotia's (NPNS) proposed effluent treatment system since the project was proposed.

Please find herein the submissions on behalf of these fishing industry associations, including concerns expressed by these three industry associations and four independent expert technical reports regarding the environmental, social and economic impacts of NPNS's proposed effluent treatment system.

We note that the 30-day public comment period is hardly adequate to enable a robust assessment by the public, including the fishing industry, given the volume of materials submitted by NPNS.

Furthermore, we are deeply concerned that there is an appearance of bias on part of the Province in this matter given, as the Nova Scotia Court of Appeal noted in Pictou Landing First Nation v Nova Scotia (Minister of Aboriginal Affairs), that the Province is attempting to be both investor in and regulator of the Effluent Treatment System. Given the Province's contractual approval of and payment for the ETS design, how can we have any confidence that the Province will provide an impartial assessment of the environmental impacts of the ETS?

In summary, based on the review conducted by these associations and the independent technical reviews, it is clear that NPNS has failed to provide a complete response to the terms of reference for the required Focus Report, and furthermore, that information provided by NPNS, incomplete as it is, raises concern for significant and unacceptable adverse impact risks for the Northumberland Strait marine ecosystem, local communities and the fishing industry sector. The health of the marine environment and the region's seafood export market hangs in the balance.

We urge you to exercise your authority under Nova Scotia's *Environment Act* and associated *Environmental Assessment Regulations* to (a) reject this project due to the significant adverse effects and/or environmental effects that cannot be mitigated that this project will likely cause, or in the alternative, (b) require an environmental-assessment report given the incomplete nature of NPNS's Focus Report and Environmental Assessment Registration Documents. If you permit NPNS's project to proceed, you are putting the Atlantic Canada seafood products, and the fishing industry that provides these products, at risk, as well as the health of the Northumberland Strait marine environment.

on behalf of
Gulf Nova Scotia Fleet Planning Board
PEI Fishermen's Association
Maritime Fishermen's Union

TABLE OF CONTENTS

EXECUTIVE SUMMARY

We urge the Minister to review in detail the technical review provided by the fishing industry association and the expert reviews provided by Dr. Laura Braden, Dr. Arnault Le Bris, Dr. Andrea Battison, and NEXUS Coastal Resource Management Ltd. Each of these reports provide unique, detailed, and nuanced critiques of Northern Pulp Nova Scotia's proposed effluent treatment system, in terms of both the inadequate information provided to determine the full potential impact of the project on the Northumberland Strait, and the likely adverse effects and environmental effects that cannot be mitigated. Following is a summary of key findings of these reports.

1. **Bleached Kraft Pull Mill Effluent (BKPME) negatively impacts reproduction ability, immune system function, and liver function of marine life, and toxic elements of the effluent accumulate over time**

As detailed in Dr. Braden's expert report, BKPME is a complex mix of chemicals, many of which are known to be toxic to a variety of aquatic life, and some of which are known to persist and accumulate in the receiving environment for decades. NPNS has not addressed the substantial volume of scientific literature documenting the detrimental impacts of BKPME on fish health, and nor has NPNS conducted tests to determine the potential sub-lethal impacts of their effluent on fish health.

Furthermore, NPNS has based its assessment of potential negative impacts on the marine environment on a modelling study covering a mere one-month time period. Northern Pulp's one-month modeling exercise shows that parameters of its effluent are predicted to increase, but what are the impacts beyond one month? As such, Northern Pulp ignores the potential for long-term increase in concentration of toxic components of the effluent, and the resultant impact on marine life in the Strait.

NPNS must provide a long-term accumulation model for the various parameters of the effluent, before the Minister can reasonably conclude that there is no serious risk of harm to marine life in the Strait.

Furthermore, NPNS did not consider the impact of aluminum, barium, copper, iron, manganese, mercury, phosphorus, and zinc on the health of marine life in the impacted area. Metals, especially copper, are acute toxins to lobster and other marine crustaceans.

> *"The exclusion of many metals from the list of COPC [Chemicals of Public Concern] and minimal information on bioaccumulation is concerning as metals are known to be toxic to American Lobster."*
>
> Dr. Battison, Expert Report Submission

NPNS assumes that (a) there is no accumulative effect of their effluent over time on fish health, (b) there is no sublethal effect of diluted effluent on fish, (c) their modelling of effluent dilution is accurate, and (d) the characteristics of the actual effluent will be consistent with the predicted effluent. Given that NPNS has provided no assurance that these assumptions are valid, the Minister cannot reasonably rely on NPNS's assurances that their effluent will not adversely affect the marine environment in the Strait.

> *"The negative physiological effect of BKPME [Bleached Kraft Pulp Mill Effluent] has been well described on fishes, including depressed immunity, altered reproduction and decreased overall resilience…. [furthermore] there is no description or characterization of the potential for components of the predicted BKPME for bioaccumulation, despite the large body of evidence for*

bioaccumulation of several toxic components such as chlorinated organic compounds and wood extractives."

Dr. Braden, Expert Report Submission

"My major concern is that the one-month simulation period is not sufficient to evaluate the cumulative impacts of effluent waters released continuously for several years, possibly decades. … the focus report does not adequately address the risks of bioaccumulation of toxins in the marine environment."

Dr. Le Bris, Expert Report Submission

"Consensus within the scientific and technical community is that COPC [Chemicals of Public Concern] disposal, particularly those identified as endocrine disruptors and persistent … pollutants in marine environments is of mounting concern… and that conventional treatment options (including activated sludge processes as proposed in this ETF) are considered to be insufficient to address concerns regarding commercial fisheries. This is particularly in light of mounting concerns over the need for more stringent attention to cumulative effects and consideration of increasing stress indicators of ocean health. [refs. omitted]"

NEXUS Expert Report Submission

"In my professional opinion, given the information presented in the focus report and associated documents, it is impossible to conclude that the proposed work won't lead to harmful alteration, disruption, or destruction of fish habitat."

Dr. Le Bris, Expert Report Submission

2. NPNS has not provided empirical characterization of the effluent it intends to release into the Strait

As Dr. Braden states in her Expert Report, "There is limited-to-no information regarding the true chemical characteristics of the proposed effluent." The Minister cannot blindly approve the project without a full understanding of what NPNS intends to release into the Northumberland Strait.

3. NPNS's baseline study is inadequate to enable a full evaluation of the project's potential environmental effects and to enable an accurate environmental effects monitoring program

NPNS's marine water quality study was conducted over two days, which is too short a period to provide useful baseline information. Water quality in the impact area is dynamic; it has strong seasonal cycles in nitrogen, phosphorus, oxygen demand and phytoplankton bloom. Thus, a two-day sampling period is inadequate to gain an understanding of the receiving waters into which NPNS intends to release its effluent, and therefore it is impossible to know, based on the information provided by NPNS, how their project will impact marine waters in the area.

Furthermore, NPNS's fish and fish habitat survey was wholly in adequate to determine the diversity of fish that will be impacted by the effluent. NPNS considered impacts only on those species which it observed during a limited sampling exercise and an inadequate literature survey. NPNS ignores the potential impacts of their project on species at risk known to reside in the area to be impacted by their project, including American plaice, lumpfish, porbeagle and Atlantic sturgeon. It is unreasonable for the Minister to conclude that the project will have no adverse impacts when NPNS has not addressed the potential impacts of their project on species at risk in the impacted area.

Likewise, NPNS did not consider impacts on Atlantic halibut, perhaps because NPNS relied on outdated studies and did not account for recent changes in the population abundance and distribution of Atlantic halibut.

Without a proper baseline survey, it will be impossible to evaluate what impacts the effluent will have on the impacted area. In the words of Dr. Le Bris from his Expert Report submission, *"*the baseline surveys are insufficient to evaluate the impacts of the effluent on the marine environment in the future."

> *"The short duration [fish habitat] survey … was unable to capture seasonal variation in fish communities and fish habitat; therefore, it has limited value as a baseline survey."*
>
> Dr. Le Bris, Expert Report Submission

> *"[NPNS's Underwater Benthic Habitat Survey] was conducted using a towed camera and was designed to survey benthic substrate. This is not a proper methodology to survey highly mobile species such as fin-fish, because they can easily escape the camera field of view."*
>
> Dr. Le Bris, Expert Report Submission

> *"the focus report failed to recognize that the regional assessment area for this project is one of the regions with the historical highest diversity of fish species in the southern Gulf of St. Lawrence…"*
>
> Dr. Le Bris, Expert Report Submission

4. **NPNS's Focus Report contains errors with respect to background concentrations of metals**

NPNS's Focus Report contains inconsistencies with respect to background concentrations of metals in Caribou Harbour, in that it appears that actual concentrations are at least ten times lower than the concentrations listed by NPNS. The source of these inconsistencies could not be found due to missing raw data and associated quality assurance information.

The upshot of the background concentrations errors is that the distance from the diffuser by which ambient conditions are reached may have been significantly underestimated, and thereby the negative impacts of NPNS's effluent may be farther-reaching than reported by NPNS. The Minister must request NPNS to provide the missing data so that NPNS's assertions concerning the dilution zone can be independently verified.

5. **NPNS has not adequately addressed the risk to the marine portion of the pipe due to ice scour**

NPNS considered ice scouring from only a single year; there is no indication whether this was an average year for ice scouring, or what the range of extreme ice scouring might be. Without this information, the Minister cannot reasonably conclude that the proposed three-metre burial depth for the pipeline would be sufficient to avoid effluent spills due to ice damage.

The lack of leak detection technology in the marine portion of the proposed pipe is unacceptable.

6. **NPNS has not adequately assessed the risk of sedimentation to fishing grounds within the impacted area**

NPNS indicated that 90% of Total Suspending Solids (TSS) released with the effluent will be deposited somewhere between 1 and 21 kilometres from the diffuser. Given the wide range of this estimate, and given that much of the TSS are not easily biodegradable, we are concerned that the project poses an unacceptable risk of damage by sedimentation to fishing grounds in the region of the diffuser.

NPNS's only assurance that such risk is minimal comes from examples of other mills operating in other regions. This is cold comfort given that the nature of TSS settling is highly dependent on the nature of the specific receiving waters system.

> *"The potential effect of TSS is dependent on the type of raw material introduced to the natural environment and the nature of the receiving environment. Therefore, comparison of models using effluent from mills in other regions is irrelevant and can lead to inaccurate conclusions."*
>
> NEXUS Expert Report Submission

Honourable Minister Gordon Wilson
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8

Re: Northern Pulp Nova Scotia, Focus Report, Replacement Effluent Treatment Facility

Dear Hon. Minister Gordon Wilson,

The Gulf Nova Scotia Fleet Planning Board (GNSFPB), the Prince Edward Island Fishermen's Association (PEIFA) and the Maritime Fishermen's Union (MFU), including its subsidiary R&D company Homarus Inc., have reviewed the Focus Report submitted by Northern Pulp Nova Scotia (NPNS) on Oct 2, 2019. The report is visually appealing and gives some new information about the potential impacts of the project on many fronts. However, it lacks many details that would have been necessary to answer several of the concerns that we have with regards to the project. Due to limitations in time and resources, the comments below only cover the portions of the Focus Report relevant to the fisheries and marine environment. These three organizations along with Pictou Landing First Nation represents the interests of over 3000 commercial fishing licenses and 215 communal commercial licenses in New Brunswick, Prince Edward Island, Gulf Nova Scotia and Pictou Landing First Nation. Value of landed lobster in 2018 for LFA 26A on PEI alone was $59,977,775.00 (personal communication with the Province of PEI).

The GNSFPB, PEIFA and MFU have been engaged since the beginning of this process and have reviewed the previously submitted registration and Environmental Assessment documents. We still have significant concerns that the Focus Report has failed to adequately respond to the Terms of References outlined by the Minister. Northern Pulp Nova Scotia (NPNS) has failed to present relevant and adequate evidence to prove that the fishery, considering the biological and economic components, will not be seriously harmed as result of the proposed effluent treatment facility. The Focus Report inadequately addresses the impacts of the construction of the pipeline and discharge of effluent on key fisheries life stages, habitat and general population level health. The Focus Report does not provide the necessary contextual background that identifies the Southern Gulf of St. Lawrence as an ecologically significant area, which is currently undergoing climactic shifts in ambient water quality, considering temperature and oxygen levels. The ongoing changes in the Southern Gulf are altering the ecosystem resilience and baseline tolerance thresholds for environmental conditions. There are major gaps and assumptions made throughout this Focus Report which do not sufficiently meet the terms of reference assigned by the Minister of Environment.

Biology

7.0 Fish and Fish habitat TOR: *Conduct additional impact assessment for treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodology must first be agreed upon by NSE in consultation with relevant federal departments.*

7.5 Fish and Fish Habitat TOR: *Clarify what contingency measures will be in place to mitigate potential impacts (e.g., thermal shock to fish) due to potential large and rapid fluctuations in water temperature in the winter at the diffuser location during low production or maintenance shut down periods.*

There are significant concerns regarding the potential for negative population level impacts on American lobster from the effluent discharge, specifically the presence of dioxins, furans and phenols. In addition to the presence of chemicals, there are concerns about the impacts of altering the pH, temperature, oxygen level and salinity in the receiving environment.

Considering water quality and effluent composition, we have several key concerns with the information presented by NPNS and the potential impacts on lobster health. First, NPNS predicts that effluent will have a temperature range of 25-37°C. DFO temperature probes throughout the Gulf of NS have shown annually that even during the warmest months, the average temperature does not go above 15-20°C. The effluent temperature is significantly higher than the ambient temperature in the receiving environment, and in the winter months, the thermal shock from heated effluent will be even greater. The Canadian Water Quality Guidelines for the Protection of Aquatic Life state that "Human activities should not cause changes in ambient temperature of marine and estuarine waters to exceed ±1°C at any time, location, or depth. The natural temperature cycle characteristic of the site should not be altered in amplitude or frequency by human activities. The maximum rate of any human-induced temperature change should not exceed 0.5°C per hour" (CCME 2003). NPNS only outlines the contingency methods to keep the effluent within the 25-37°C temperature range but does not describe how they will meet the guideline for rate of change, or elaborate on any biological impacts resulting from the expected temperature range.

In addition to this, the near and far-field modelling was completed for a 30-day tidal cycle to identify how and where the effluent will concentrate, given tidal condition and seasonal ice cover. The model only accounts for 30 days of effluent discharge during two seasonal conditions; and does not indicate what the entrainment and dilution rates would be over months or years of accumulation. Figure 4.2-4: Simulated Effluent Concentration by End of One-month Simulation Period in February shows that after 30 days there is accumulation in the North East corner of Caribou Island. The graph supplied is difficult to analyze, but it appears that there are concentrations at least at 2.00-2.25 mg/L after just 30 days. Dilution ratios are expected to change over the winter months, with increased accumulation rates from annual ice cover from January to April. An accumulative model is necessary to predict the accumulation of parameters of concern; parameters such as resin acids, fatty acids, AOX, PAH, and TDF which are known to bioaccumulate in sediment, tissues of invertebrates, vertebrates (El-Shahawi 2010, Lander 1990).

Northern Pulp Nova Scotia's report states that monitoring would continue, which would supply data for required contingency plans. This concept of monitoring is useful in some projects, but in this case it is being proposed to monitor possible, unknown changes that **will be caused** by the effluent. This is a major gap in the data in the project. By the time a monitoring project picks up on changes it will be too late. The negative effects will have taken place and there is no timeline/predictions possible to show if it could be reversed or how long it would take.

It takes lobster 6-7 years to reach a size at maturity, meaning that effluent may flow for 6-7 years before we see any problems. If monitoring picks this up after 6-7 years and changes begin to be made, it's too late to reverse the 6-7 years of damage that is already done. Also, work done by Laufer et al, 2012 concludes **"that alkylphenols are endocrine disruptors to lobster larvae at metamorphosis because they possess juvenile hormone activity. They also delay molting, reduce growth, and are toxic at relatively low concentrations."** According to Appendix E of Appendix 7.2 (Underwater Benthic Habitat survey of Caribou Harbour Pipeline corridors), concentrations of all phenols measured in the effluent are greater than background concentrations at the proposed diffuser location. This is an unacceptable risk to take when dealing with the key fishery in the Southern Gulf of St. Lawrence.

Furthermore, the requirement here was to conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. A sentence stating that future studies "could include" specific testing shows this testing has not been completed and that it may not be in the future. This is not a path forward, it is a concept, but not a plan.

Within table 7.3-2 (labelled incorrectly as 7.3-1 in the body of the report) it states: *"Potential Effect - Water Quality – changes to water quality due the discharge of treated effluent to the Northumberland Strait at the diffuser outfall location Residual Effect - Meeting industry design standards for effluent treatment and design of the effluent diffuser to* ***maximize dilution*** *of effluent in the marine environment, effects will ensure that* ***any changes to water quality in the receiving environment are minimized to a small area*** *(within 5 m of the outfall) prior to water quality meeting background or CCME guidelines for the protection of aquatic life. Overall Significance -* ***Overall effects are considered to be generally minor, localized and generally reversible*** *- Not Significant"*

What are the expected minor, localized effects? If the proponent has done this work and knows there will be "expected minor, localized effects" they should be shared with in this document. Decreased dissolved O_2 , a change in temperature, salinity, etc. would effect species differently and should not be generalized. Increased temperature is more significant to scallops than lobster, but this is not portrayed in the table. In fact this data is not provided at all.

Sea Scallop - "Mortality will occur at temperatures of 23.5ºC or greater and mass mortality of scallops has occurred historically in portions of the southern Gulf" (DFO, 2011).

Lobster - "In lobsters, there is a complex relationship between temperature, growth and reproduction. Molting is inhibited below 5°C, and growth rate is proportional to temperature between approximately 8 and 25 °C" (Crossin, et al. 1998).

Both species would be affected by changes to their environment, but in different ways. NPNS has not laid out contingency plans to describe how damage to each species would be mitigated. There is also no definition of the phrase “generally reversible”. What does this mean and how is it going to be accomplished? Simply stopping the release of effluent will not reverse the damage done.

American Lobster Habitat Concerns

7.2 Fish Habitat Baseline Survey TOR: *Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada*

The proposed effluent treatment facility will cause extensive habitat displacement or destruction during the construction phase. NPNS conducted Underwater Benthic Habitat Surveys to understand the habitats and benthic communities that are present along the proposed pipeline corridor and diffuser area. The UBHS was conducted for a very limited period of only 5 days from May 3 to May 7, 2019. This limited sample window does not allow for a fulsome picture of the marine and benthic environment. The marine environment, including plant communities, benthic communities and planktonic composition fluctuate significantly on a seasonal cycle. Results from a study by Mutsamaki (2015) shows that “the patterns observed in one depth zone or season cannot be directly extrapolated to larger areas and that drawing meaningful conclusions on the small-scale distribution in the fish assemblage structure require sufficient replication of sampling in space and time”. This indicates the evidence presented in the UBHS should not be considered as a ‘meaningful’ representation of the full benthic and invertebrate communities.

The results of the limited UBHS show that there is valuable lobster habitat in all 3 areas studied (Pictou Harbour, Caribou Harbour and Diffuser Area). Lobster require different types of habitat throughout their life cycle; and DFO research indicates that availability of appropriate habitat types is a limiting factor for lobster population viability. Following the larval stage, stage IV lobsters will begin to settle on the ocean floor. Stage IV lobsters seek gravel, cobble and larger sediment to provide shelter. Younger stage IV lobsters may also use sand or silty environments to bury themselves to provide protection. As lobsters grow and mature, they are able to use multiple habitat types to create shelter. NPNS does not present any adequate plan to mitigate habitat loss or effectively replace habitat.

The Focus Report states that there is a potential effect on marine fish habitat by "direct removal, disturbance of existing substrates utilized by multiple species and their life stages due to the staging, excavation, pipe placement and material backfilling" (Table 7.3-2 Summary of Marine Impacts, Mitigation Measures and Overall Significance). The Focus Report does not provide any description of mitigation measures, including how they will replace the existing habitat or how they will design a staged timing protocol to "incorporate fisheries timing windows to avoid sensitive life stages, periods of adverse weather or spring tides to reduce turbidity and sedimentation". NPNS repeatedly applies a vague blanket statement that they will time the in-water work to consider a multitude of factors (life stages, weather, tides, fisheries activity) while still meeting practical requirements. In order for NPNS to meet the TOR above, and for the Minister to make an informed decision on the effectiveness of proposed mitigation measures, NPNS must provide a detailed plan on these mitigation activities (ex: staged timing of work, Erosion and Sediment Control Plans). Mitigation measures must be assessed by their specific merits and ability to reduce or eliminate harm. It cannot be sufficient to state that a plan will be developed in the future.

Atlantic Herring Vulnerability

7.3 – Impact Assessment for Marine Fish TOR: *Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodologies must first be agreed upon by NSE in consultation with relevant federal department.*

Beyond the 8 'important fisheries' identified for commercial, recreational and Aboriginal value, NPNS has recognized three "key indicator species" that warrant further investigation due to their importance in commercial and Indigenous harvests occurring within the LAA: American lobster, rock crab and Atlantic herring. Upon review of potential impacts on the herring fishery, NPNS has ignored a fundamental component related to the vulnerability of the herring population to impacts from the construction of the pipeline and discharge of effluent. The proponent only refers to the direct interaction with harvest activities, with no regard for the potential biological impacts.

There are two spawning stocks of herring in the Southern Gulf, Spring Spawning (SS) and Fall Spawning (FS). The SS stock has been in the critical zone since 2004, and the FS stock has been in the cautious zone since 1999 (Surette 2016). The Fall Spawning stock has 5 major spawning grounds in the Gulf of St. Lawrence; one of these few remaining spawning grounds is located near the mouth of Pictou Harbour, directly adjacent to the proposed project area (Figure 1, Surette 2016). DFO is currently developing rebuilding plans for both Spring and Fall Spawning stocks. DFO states that "Elevated fishing mortality, during the mid-1990s to 2010, declines in weights-at-age, and low recruitment rates are contributing to declines in SSB, further impeding the rebuilding of the stock." (DFO 2018). Given DFOs mandate to support the protection of habitat and fish stocks using the Precautionary Approach, NPNS must provide further evidence that the pipeline construction and discharge of effluent will not further inhibit the rebuilding of this critically important fish stock; including sublethal effects on reproduction and recruitment rates in order to meet the TOR for fish health.

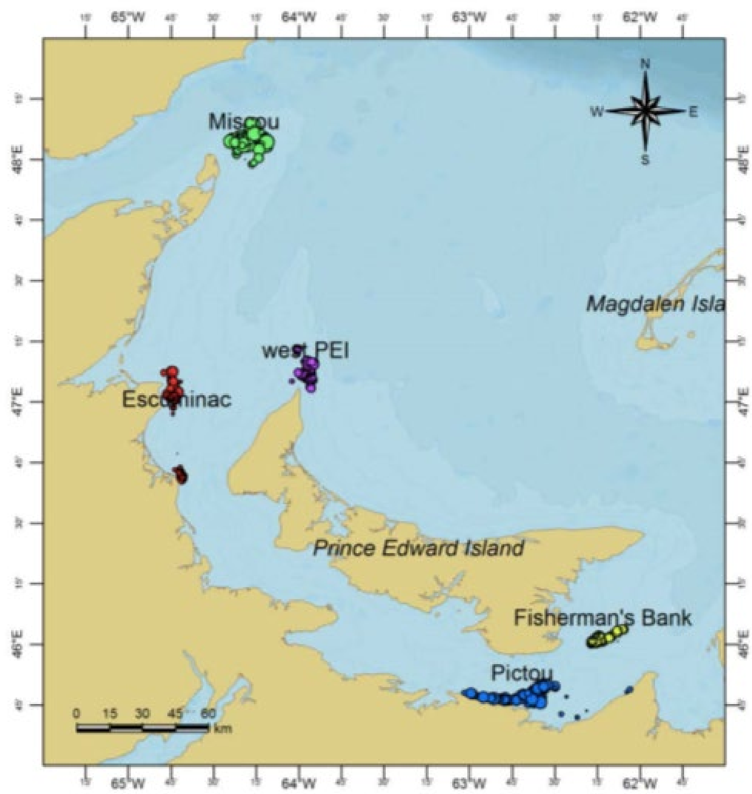


Figure 1: Herring Spawning grounds from 'Estimation of local spawning biomass of Atlantic Herring from acoustic data collected during fall commercial gillnet fishing activities in the southern Gulf of St. Lawrence' (NAFO Div. 4T). (Surette et al., 2016).

Unique and Vulnerable Habitat Concerns

7.3 – Impact Assessment for Marine Fish TOR: *Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodologies must first be agreed upon by NSE in consultation with relevant federal department.*

In addition to the general habitat concerns above, NPNS also proposes the pipeline to be placed directly through a federally protected marine refuge, Scallop Buffer Zone 24. The Department of Fisheries and Oceans has established SFA 24 to conserve important juvenile American lobster habitat, as it is essential to the life cycle of the species. DFO states that "no human activities that are incompatible with the conservation of the ecological components of interest may occur or be foreseeable within the area" (DFO List of Marine Refuges, 2019). The construction and operation of a marine pipeline is directly incompatible with the conservation of the identified conservation objectives of SFA 24.

The presence of eelgrass is also identified by NPNS to be valuable in the life cycle of a variety of species, especially as a nursery shelter to provide protection in sandy and silty bottom types. In Table 7.3-2 Summary of Marine Impacts, Mitigation Measures, and overall significance, NPNS states that there is potential for "direct removal, disturbance of highly important habitat type for multiple species and their life stages due to the staging, excavation, pipe placement and material backfilling". The effects are expected to be "long-term, reversible", with the only mitigation method listed to "avoid direct removal of eel grass beds where feasible". NPNS fails to define the extent of 'reversible' impacts, and does not provide an estimate of the extent to which they can feasibly avoid eel grass beds throughout Caribou Harbour. Considering the Terms of Reference, NPNS has not assessed the impact of the loss of valuable and unique habitat to the overall health of the key marine species.

Ice Scour

2.2 Marine Geotechnical Survey TOR: *Conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must determine the potential impacts of ice scour on the pipeline.*

The risk of ice scouring is also present throughout the proposed area (Focus Report Section 2.2 Marine Geotechnical Survey). The marine geotechnical survey identified 146 ice scour features within the survey area. NPNS states that burying the pipeline 3 m under the seabed is appropriate to avoid scour impacts. This conclusion is based on limited information; NPNS relies on one sample from 2019 and does not consider any additional research or evidence.

Redistribution of Contaminants

7.3 – Impact Assessment for Marine Fish: *Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodologies must first be agreed upon by NSE in consultation with relevant federal department.*

The working group has concerns around redistribution of metals during digging to install pipe along Pictou Causeway.

"A baseline marine environmental effects monitoring (EEM) program (including fish tissue analysis [using crab or lobster hepatopancreas tissue chemistry and mussel or oyster tissue chemistry], sediment and water quality, etc.) should be established in the Northumberland Strait marine receiving environment prior to remediation or disturbance of Boat Harbour sediments" (Romo et. al. 2019)

Considering levels of arsenic, cadmium, and other heavy metals along the causeway, there is concern that these heavy metals will be redistributed during the installation process. The report does not include mitigation measure being put in place to avoid the redistribution of dangerous metals. What is being done to mitigate this?

Contaminant Bioaccumulation and Potential Fisheries Closures

7.3 – Impact Assessment for Marine Fish: *Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodologies must first be agreed upon by NSE in consultation with relevant federal department.*

4.1 – Marine Water and Marine Sediment: *Conduct baseline studies for the marine environment (such as marine water quality and marine sediment) in the vicinity of proposed marine outfall location.*

4.2 - Marine Water and Marine Sediment: *Update the receiving water study to model for all potential contaminants of concern in the receiving environment (based on the results of the effluent characterization and/or other relevant studies such as Human Health Risk Assessment). Baseline water quality data for Caribou harbour must be applied to this study. Refer also to Addendum 3.0.*

As mentioned in previous communications from fishing industry and others, the cumulative effects of the proposed receiving water contaminants on locally important commercial species such as lobster, herring and scallops, to cite but a few, are a major concern. The report provides details on the composition of the proposed receiving water (p.55 - Table 3.3.1) and models the dispersion of the effluent in the receiving water study (RWS). However, a bioaccumulation model backed by scientific references and adapted to the special ecosystem parameters of the Northumberland Strait should have been produced.

Our concerns about bio-accumulation have still not been addressed by this latest report. For example, in British Columbia the bioaccumulation effect of contaminants discharged into the marine ecosystem (dioxins, furans, etc.) by local paper mills (ex: Port Mellon) have been the cause of important area fishing closures (Howe Sound area – bioaccumulation in Dungeness Crab hepatopancreas). Thus, the potential for fishery area closures in the Northumberland Strait remains.

Environmental Effects Monitoring

7.3 – Impact Assessment for Marine Fish: *Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodologies must first be agreed upon by NSE in consultation with relevant federal department.*

7.4 Environmental Effects Monitoring *Submit an updated Environmental Effects Monitoring (EEM) program based on the results of various relevant baseline studies and an updated receiving water study. Refer also to Addendum item 4.0*

NPNS acknowledges that there is potential for the following impacts: changes to water quality, increase in sound and vibration, disturbance to benthic habitat, disturbance to highly important nursery habitat and spawning grounds, direct mortality (of marine shellfish, benthic invertebrate community) (Table 7.3-2). Despite these impacts, they predict that "no significant residual impacts to marine water quality are expected to arise on any fisheries or fish habitat as a result of this project" (7.0 Fish and Fish Habitat). In order to confirm this conclusion, that there will be no significant residual impacts, NPNS states that they will follow up with the federally-regulated Environmental Effects Monitoring program. Given the predicted conditions, the EEM would NOT require NPNS to conduct a fish community study component or a benthic invertebrate community study. NPNS would have zero mandated requirements to monitor impacts on the fish or benthic communities. Considering for a moment just the impacts on the lobster population, negative effects will not be fully observed until a full life cycle (6-7) has reached the commercial size. Without thoughtful, frequent and thorough monitoring, there could be catastrophic ecosystem level impacts where it is too late to intervene.

The federally-regulated EEM is insufficient in providing consistent baseline data according to Romo et al. 2019 in their review of the documents in consideration of the remediation of Boat Harbour. "**Selection of species, contaminants of concern and sampling locations were ad hoc**

and often inconsistent with environmental effects monitoring requirements under the Canadian federal Pulp and Paper Effluent Regulations"

The PEI Legislative assembly, standing committee on fisheries and agriculture invited representatives from Environment and Climate Change Canada, to discuss the proposed effluent treatment facility. Geoff Mercer, Regional Director General at ECCC stated in his opening remarks "Compliance rates with the regulations is high and based on the self-reported data, over 97% attest that mills across the country conduct are compliant with the regulations. **Despite this high level of compliance with the existing effluent standard, the environmental effect studies have shown that the effluents from 70% of the pulp and paper mills across the country are having an effect on fish and/or, depending, fish habitat."**

Both of these points show clearly how flawed the current system is and that this is not a reliable method to monitor changes. There is clearly data missing from the baseline study to consider it complete.

Fishing Activity, Human Health and Market Access

9.1 Baseline Study Marine Survey: *Complete baseline studies for fish and shellfish tissue (via chemical analysis) of representative key marine species important for commercial, recreational and Aboriginal fisheries in the vicinity of the proposed effluent pipeline and diffuser location.*

7.0 Fish and Fish habitat TOR: *Conduct additional impact assessment for treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodology must first be agreed upon by NSE in consultation with relevant federal departments.*

The proponent is required to conduct impact assessments on the key marine fish species important for commercial, recreational and Aboriginal fisheries. In order to verify that there will be no negative impact on fisheries, NPNS must understand and take measures to mitigate interactions with physical fishing activities. NPNS uses a visual observation of lobster buoys in 2019 as a proxy for the exact location of lobster fishing activities (Figure 7.3-3: Northumberland Strait Lobster Buoy Locations). The graphic only shows buoy “clusters” observed on 3 different dates throughout the regular lobster fishing season. This attempt to pinpoint the location of fishing effort lacks relevant information in terms of the number of harvesters/vessels that fish within the area, how many buoy/lines are represented within each ‘cluster’. Generally, this shows that there was a lack of effort from NPNS to understand the most basic facts of the lobster fishing efforts in the area. The graphic fails to show that there are 20 vessels that fish lobster within 300 meters of the proposed marine outfall.

Under the TOR for the Human Health Risk Assessment portion of the Focus Report; NPNS is required to consider the impacts of human consumption of fish, other seafood and other exposure pathways. Of equal importance to the physical and biological impacts on the marine ecosystem, harvesters are concerned with the potential for challenges in marketability and the global reputation of pristine, healthy Canadian lobster. The Canadian lobster industry has an extensive export market, supplying international markets with much of our landed seafood. Canadian seafood harvesters, and the entire lobster sector, are fulfilling food security needs while providing a healthy, pristine renowned product.

NPNS states that there is a risk for tainting of seafood due to the chemical parameters identified in the effluent characterization (9.0 Human Health). NPNS compared the concentration of the parameters to the guidelines for taste and odour in water to identify the risk for tainting. There is potential for tainting under the following pathways: Total Iron, Catechol, 2-Cholrophenol, 2,3 Dichlorophenol, 2,6 Dichlorophenol, 3,4 Dichlorophenol, 2, 3, 4, 6 Tetrachlorophenol, 2,4,5 Trichlorophenol (9.0 Human Health). In addition to the physical risks of consuming tainted product, there will be detrimental impacts to the global reputation of Canadian lobster (and other seafood) products. Market perceptions of poor product quality (by tainting) can persist even if the results show safe exposure levels for consumption. This persistent perception will prolong and deepen the impacts for harvesters and other industry stakeholders. The magnitude of this impact should not be underestimated; this a 'Canadian lobster' issue, not just a Pictou or Caribou Harbour issue.

Throughout several areas of the Focus Report, NPNS uses proxy data and conditions from other Paper Excellence Mills, including Howe Sound and Crofton kraft mills in British Columbia. NPNS considers factors such as operating temperature and sedimentation rates to act as a surrogate for expected effluent quality at the proposed ETF. Upon investigation, there are challenges related to seafood tainting and contamination throughout the BC coastline. First, in fishing areas 28-1, 28-3; consumption of crab hepatopancreas should not exceed 55g/week due to dioxin contamination. Secondly, there is a permanent prohibition of all species of bivalve molluscs across the entire coastline and connected water sources of British Columbia. The closure is due to the widespread presence of biotoxins. While these closures are not solely attributable to the Pulp and Paper Mills; NPNS is unable to prove that there would not be similar closures as a result of the increase in dioxins or biotoxins from their proposed effluent.

Using proxy data is an assumption and does not meet the terms of reference which states: "Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information"

The socio-economics of a loss to the fishery for both commercial harvesters and First Nation harvesters is worth an assessment with updated information that it will be consistent with current discharge as the methodology behind treating the effluent is completely different. The fact that the discharge will meet all provincial and federal discharge quality limits does not equate to the effluent being safe for the fish, benthic communities, and human health; as stated by Geoff Mercer, Regional Director General at ECCC during his appearance at the PEI Legislative assembly, standing committee on fisheries and agriculture on February 1, 2019: “Despite this high level of compliance with the existing effluent standard, the environmental effect studies have shown that the effluents from 70% of the pulp and paper mills across the country are having an effect on fish and/or, depending, fish habitat.”

Northern Pulp sent a team to visit mills in Sweden as well. These mills run systems similar to what is being proposed at the NPNS mill and is again used as a proxy. This makes it appear that meeting future regulations is the main concern and because it is being done successfully in Sweden it can be done successfully in Canada. The Harvesters and Pictou Landing First Nation are concerned with negative effects to the fish and benthic communities and not just if the mill is meeting regulation. There was a report completed by a group in Sweden regarding the Södra Mill; Biologisk recipientkontroll vid Södra Cell Värö Årsrapport för 2013 by Peter Ljungberg and Björn Fagerholm. This document shows that the fish community in the area of the Södra mill is completely different than in the Northumberland Strait. Trawl surveys were completed to look at species in the area and 66% of the catch is a species of flatfish. It’s all sandy/silt bottom with very few crustaceans. The assumption is that both areas can be compared but in actuality the ecosystems are different. The few Norway lobsters in the area of the Södra mill are declining in the area of effluent release over the last 10 years. This has not been directly attributed to the mill but the reason for the decline is also not stated. There are some species increasing in the area of the diffuser as well, but the report states; "The fact that an individual fish species is increasing need not only be positive for a society, it can also cause problems for other species in terms of competition or predation, factors that in turn lead to changes in the entire ecosystem"

Parameters measures and monitored by the regulatory authority in Sweden are TOC, nitrogen, phosphorus and suspended material. This is insufficient information based on what we have heard from Environment and Climate Change Canada regarding the requirement for changes to the Canadian Pulp and Paper Effluent Regulations.

On the human health risk question, there is only talk about doing an eventual study on the subject. This important question should have been discussed more broadly in the report and answered with best available science and modelling. Therefore, even if areas remain open there remains the potential for negative impacts on market access for products coming from areas adjacent to the mill and the Northumberland Strait due to perceived health risks by general consumers.

Sub-lethal effects and insufficient science references

In section 4, there should have been more discussions backed by scientific literature or studies. In particular, there is no discussion of potential sub-lethal effects of the proposed effluents on economically important species such as lobster, herring and scallops even though there exists scientific work and literature on the subject. Instead, the report provides water dispersion modeling accompanied by affirmations based on opinion alone.

Ecosystem Concerns

7.2 Fish Habitat Baseline Surveys: *Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada.*

The Department of Fisheries and Oceans is currently starting to incorporate an eco-system approach to their stock assessments. To better understand the fluctuations in populations of each species the department is incorporating aspects that effect the population such as: temperature, timing of prey availability, predator abundance, etc. NPNS's proposed effluent release has the potential to affect every species in the surrounding area including but not limited to mackerel, herring, scallops, and lobster directly and indirectly. There are numerous examples of population declines in the Gulf of St. Lawrence due to the change in timing of a species' prey. Changing ocean temperatures are causing phytoplankton and zooplankton to bloom earlier in the year resulting in lower food availability for those species relying on it. This has been shown for small mackerel which rely mainly on calanus copepods as a main prey source. According to NPNS's report, the dominant open water species found is calanoid copepods. Northern Pulp is proposing to release large amount of hot fresh water year-round. This will effect the timing of the copepods reproduction resulting in a mis-matched timing of food for the young mackerel in the area. Lack of food availability results in decreased condition of the mackerel and decreased recruitment to the fishery.

Mackerel are not the only species that rely on phytoplankton and zooplankton for growth and survival, herring, bivavles and even North Atlantic Right Whales all rely on these microscopic organisms for survival.

Understanding possible shifts in phytoplankton and zooplankton blooms is essential to baseline studies for a marine ecosystem. This portion of the baseline survey is incomplete; "Further studies in the area of the proposed diffuser location have begun in the summer of 2019, with **additional studies to be scheduled prior to any construction activities**. These studies aim to provide a baseline of phytoplankton and zooplankton presence, diversity and relative abundance."

Northern Pulp states that eelgrass and eel grass beds are present in Caribou Harbour. DFO has listed eelgrass as an ecologically significant species. It is important to understand what the loss of eelgrass will mean for the area, but this has been listed as "not significant" by Northern Pulp (page 146).

According to DFO (2009): "Loss of eelgrass and other seagrass populations is a worldwide phenomenon largely associated with anthropogenic stresses. Eelgrass populations have been lost in virtually all areas of intense human settlement. Eelgrass plays an important role in the physical structuring of the nearshore marine environments by filtering the water column, stabilizing sediment, and buffering shorelines. Eelgrass meadows have extremely high levels of primary production, ranking among the most productive ecosystems on the planet. Eelgrass adds spatial complexity above and below the substrate creating a three- dimensional habitat that contributes to higher densities and different species compositions than in unstructured habitats, particularly mud/sand flats. Numerous species across several phyla (seaweed, invertebrates, fish) utilize the support structures of eelgrass and / or benefit from lower predation rates in vegetated habitat compared to unvegetated areas. There are no substitute structuring organisms with the same function as eelgrass that can grow on the sand/mud flats of intertidal and subtidal areas within the salinity ranges occupied by eelgrass. Eelgrass (*Zostera marina*) in eastern Canada has characteristics which meet the criteria of an Ecologically Significant Species. If the species were to be perturbed severely, the ecological consequences would be substantially greater than an equal perturbation of most other species associated with this community."

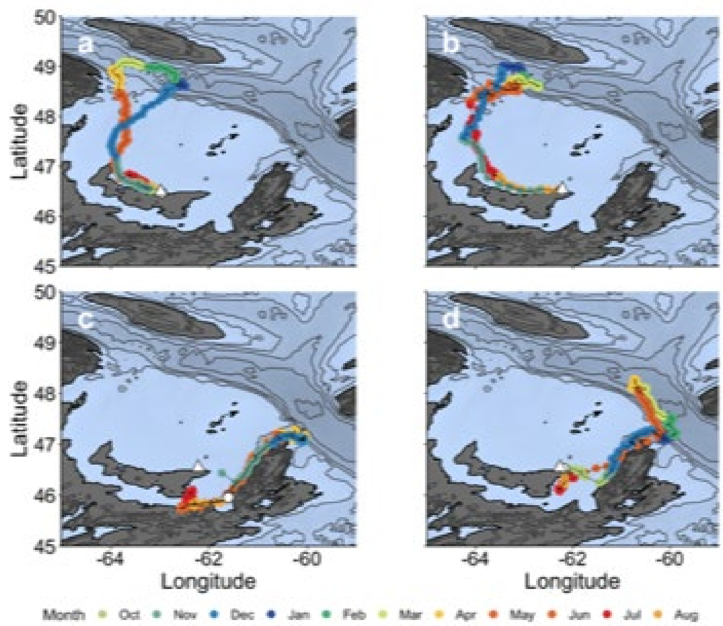
Loss of this species in any capacity should be considered significant and more data should be collected to assess the impacts to the entire eco-system. Loss of eel grass beds has the potential to disrupt and displace numerous species in the area. Sufficient data was not collected for the focus report to understand the fallouts of the loss of eel grass beds in the area.

Species Distribution

7.2 Fish Habitat Baseline Surveys: *Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada.*

Northern Pulp reported that they completed underwater video transects to determine benthic habitat from May 3-7, 2019. Although is seem obvious, the majority of marine life is capable of mobility. Looking at an area for 4 days in May is not representative of activity in an area for an entire year. Temperature changes and food availability shift which species inhabit which areas at different times of the year, but this is not accounted for while looking at only 4 days of video feed. According to Comeau and Fernand, 2002 in a review of movement studies of American lobster, *Homarus americanus* (American Lobster) move on average between 2 and 19 km depending on depths. The fact that no lobsters were seen during this survey is not representative of year-round benthic habitat but merely a snapshot of a few days in the year. This is insufficient data to be considered a baseline survey.

American lobster is not the only species present in the area but unaccounted for. The figure below shows Atlantic halibut that was satellite tagged in 2014 and the approximate path it took over the next several months. This publication has been submitted for peer review (James, et al 2019). Image C shows, an Atlantic Halibut in the area of the proposed diffuser site in June of 2015. This highlights a gap in baseline data because Northern Pulp was looking at only 4 days with a video transect which is insufficient to capture all species in the area at any given time throughout the year.



"The proposed project will interact with the Rock Crab resource along the proposed pipeline corridor (Figure 7.3-7) but not at depths greater than 10 m or near the diffuser location." This is a flaw in the report because the data is blatantly incorrect. Rock Crabs are in depths greater than 10 m: "Rock crab (Cancer irroratus) is distributed along the Atlantic coast, from South Carolina to Labrador, from the intertidal zone to a depth of 575 meters" (DFO 2008). This underestimates the effect the proposed pipeline will have on Rock Crab.

In closing, our three fishing organizations (GNSFPB, PEIFA and MFU) would like to reiterate that NPNS has failed to adequately address the Terms of Reference outlined in section 7.0 Fish and Fish Habitat, 9.0 Human Health and 2.0 Project Description. Due to limitations in time and capacity, this report only reviewed the information that was relevant to the fisheries. Northern Pulp relies on major assumptions and blanketed statements to suggest that there will be no harm to the marine environment, including fish and fish habitat. There are gaps in the evidence presented, including but not limited to: impact on lobster development and population health, incomplete or non-existent commitment to follow up monitoring, lack of evidence to protect vulnerable populations or habitat such as fall spawning herring, other SARA (Cod, White Hake), Scallop Buffer Zone 24, eel grass beds, limited understanding of the seasonal impacts of ice cover and ice scouring. The importance of the global optics of the Canadian seafood brand can not be undervalued or excluded from this Environmental Assessment approach.

Our conclusion following the review of the report remains that some of the major concerns brought forth by commercial harvesters have still not been appropriately answered. Therefore, until these concerns have been met, Nova Scotia, Prince Edward Island and New Brunswick harvesters find unacceptable the pursued development of Northern Pulp's currently proposed effluent treatment facility.

All of the above is respectfully submitted to the Nova Scotia Minister of Environment, the Honourable Gordon Wilson, within the 30-day public comment period for consideration of the Northern Pulp Effluent Treatment Facility Focus Report.

The report is the collaborative effort of science staff from all three organizations. These are professionals with years of experience working and researching directly on the waters of the Northumberland Strait.

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PRINCE EDWARD ISLAND FISHERMEN'S ASSOCIATION

Sincerely,

Gulf Nova Scotia Fleet Planning Board

Maritime Fishermen's Union

Prince Edward Island Fishermen's Association

CC:

MP Sean Fraser
MP Mike Kelloway
MP Lenore Zann
Hon. Keith Colwell
MLA Karla MacFarlane

Finfish Health in Relation to the Proposed Northern Pulp Nova Scotia Effluent Treatment Facility

A Scientific Report

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1.0 Definitions

BKPME – Bleached kraft pulp mill effluent
NPNS – Northern Pulp Nova Scotia
ETF – Effluent treatment facility
AOX – Adsorbed organohalides
TN – Total nitrogen
TP – Total phosphorous
DO – Dissolved oxygen
BOD – Biological oxygen demand
COD – Chemical oxygen demand
ASC – Antibody secreting cells
ROS – Reactive oxygen species
RWS – Receiving water system
MFO – Hepatic mixed-function oxygenase
EROD – Ethoxyresorufin-*o*-deethyase
VTG – Vitellogenin

2.0 Foreword – Statement of Qualifications

Laura Marie Braden, PhD, holds a doctorate in Molecular Immunology, with a focus on Aquatic Animal Health. With over a decade in experience in her field, Dr. Braden has over 10 publications in peer-reviewed journals, has presented her research at over 40 national and international conferences, 15 of which where she was an invited speaker. She sits on the editorial board as an external reviewer for many journals, including *Journal of Fish Diseases*, *Parasites & Vectors*, *Aquaculture*, *Fish & Shellfish Immunology*, and *Developmental & Comparative Immunology*. She currently leads the Molecular Genetics and Biotechnology Program at AquaBounty Canada and is an Adjunct Professor in the Department of Veterinary Medicine at the Atlantic Veterinary College. A *curriculum vitae* for Dr. Braden can be found in Appendix I.

3.0 Executive Summary

The following report includes a scientific review of the available information pertaining to the negative effects of bleached kraft pulp mill effluent (BKPME) on health of finfish. Specifically, this report attempts to summarize the scientific consensus on the physiological effects of BKPME on freshwater and marine finfish, and how those data pertain to the potential risks associated with the proposed effluent treatment facility (ETF) of Northern Pulp Nova Scotia ("the Proponent"; NPNS), which aims to discharge 85 million litres of BKFME per day into the Northumberland Strait.

Although improvements in treatment of BKPME have certainly decreased acute lethality to finfish, effluent from pulp and paper mills continues to release chemicals that affect physiological systems. Potential effects on fishes from exposure to BKPME can be generalized into two main categories; 1.) Direct effects, such as those impacting physiological processes including reproduction, immunity and hepatic function, and 2.) Indirect effects, including ecosystem alteration in habitat and food availability. The identity of the compounds associated with these effects remain to be elucidated; however, the scientific consensus is that these effects are mill-specific and must be considered in the context of environmental and ecological effects (1–5).

This report will first attempt to summarize the available scientific literature on the direct effects of BKPME exposure on finfish, and by doing so, will demonstrate significant deficiencies in the conclusions drawn by the Focus Report (FR), specifically related to the findings of no significant impact by the proposed effluent treatment facility on physiological parameters and fitness of fish populations in the receiving water system (RWS).

These deficiencies are summarized in the following document and include, a.) an assessment of the major findings and conclusions expressed by NPNS, b.) an assessment of the reliability of the underlying research relied upon to create these findings and conclusions, c.) identification of information gaps in the materials of the Focus Report, d.) impacts of these gaps on the reliability of the conclusions made in the Focus Report, and e.) a description of assumptions that are relied on in the Focus Report that drove the main conclusions filed by the Proponent.

Taken altogether, this assessment of the available data pertaining to the proposed ETF with respect to potential negative effects on finfish in the RWS concludes that there is insufficient evidence to support the overall claim by NPNS that there are no potential negative impacts on finfish health. For example, there is no empirical data characterizing the effluent that is predicted to enter the RWS, nor is there any empirical data demonstrating the physiological effects of this effluent on finfish that reside in the RWS, specifically, the Northumberland Strait.

Despite the lack of information or evidence presented by the Proponent in the EARD and the subsequent FR, where only predictions and modeling were used to assess impact to fish populations in the RWS, the Proponent reaches a firm conclusion that there is no expected impact to fish populations. This conclusion is not appropriate for the following reasons:

1.) *The Proponent does not provide adequate evidence to support a conclusion that there is no potential significant impact on finfish*
2.) *The Proponent does not supply critical information concerning effects of their predicted effluent on finfish reproduction, immunity, or liver function – three systems known to be affected by BKPME*
3.) *The Proponent claims that any damage will be "minimal" but not substantiated by data present in the report, nor is it substantiated by the pertinent scientific literature*
4.) *There is no evidence that the receiving water system (i.e., the Northumberland Strait) will be able to absorb and disperse the volume of effluent proposed by the ETF*

Given these described deficiencies, further studies (acute, sublethal, and generational) on the effects of the proposed BKPME on finfish residing in the RWS are required.

4.0 Scope of Review

This current critical review focuses on all areas of both the Environmental Assessment Registration Document (EARD) and subsequent Focus Report (FR) that pertains to the potential negative physiological consequences of exposure to the predicted effluent on finfish health (freshwater and marine).

Within the 245-pg FR, this review focuses specifically on Sections 3-4 and 7, with associated data found in Appendices 3, 4 and 7, and associated documents.

The FR attempts to address Terms of Reference delivered to NPNS after consultation with public stakeholder groups. The conclusions and recommendations are based primarily on the information provided in the FR and how it relates to published data on pulp and paper mills and BKPME, and how BKPME effects finfish, rather than a global review of the potential effects to marine species. Furthermore, this current report addresses the main points within the Terms of Reference pertaining to finfish health and whether these terms were addressed by the FR.

4.0 Background Review

4.1 Pulp and Paper Mills

The pulp and paper industry convert natural wood resources or recycled fibre into a wide variety of paper products. Canada is the world's largest exporter of pulp and newsprint, and the pulp and paper industry is a fundamental pillar of the economy and natural resource sector exporting over $13 billion CDN in 2013 (6). In order to manufacture paper products, wood chips or other plant fibres must be converted to pulp to create thick fiberboard that is later processed in a paper mill. The pulp and paper industry is the sixth largest polluting industry, discharging a variety of gaseous, liquid and solid wastes into the environment. The processes used to produce pulp are water intensive (50-60 m3 of water to produce a ton of paper; (1)) and generate large quantities of effluent which is comprised of > 240-250 different chemicals with varying degrees of toxicity to aquatic ecosystems (1,7). Due to the large-scale environmental degradation associated with this industry, it is imperative that a strict science-based approach be utilized to mitigate negative effects to both ecosystems and human health.

Resultant pulp only constitutes about 40% of the original weight of the wood, which results in a considerable proportion of organic matter as waste in effluents. These have potential for considerable damage to the receiving water system (RWS) if discharged as untreated due to high concentrations of biological oxygen demand (BOD), chemical oxygen demand (COD), adsorbed organohalides (AOX), suspended solids, fatty acids, tannins, resin acids, lignin and derivatives, sulfur and sulfur compounds (1). Both naturally occurring and xenobiotic compounds are present in effluent, with variable levels of persistence (8), and with acute and chronic toxic effects of varying severity (9). Further to this complexity is the assertion that no two paper mills will discharge identical effluents due to operational differences. Thus, every pulp and paper mill is a large, complex, highly interactive operation with mill-specific effluent that should be characterized fully to understand the degree of toxicity (1).

4.1.2 Pulp Mills in Canada

As of 2019, there were 89 pulp mills across Canada, primarily located in British Columbia, Ontario, and Quebec (6,10), of which a majority operated on chemical pulping processes. Chemical pulp mills use two processes: either sulfate (kraft) or sulphite processes, both of which rely on high temperatures to break down lignin. Pulp produced from these processes are used for fine paper products. The kraft process involves treating wood chips with white liquor (sodium hydroxide and sodium sulfide) to break down and remove hemicelluloses and lignin, resulting in strong cellulose fibres. In contrast, the sulphite process results in weaker cellulose fibres, but creates pulp that is easier to bleach (i.e., bleached kraft pulp mill; BKPM). Alternative methods include thermomechanical and chemi-thermomechanical pulp mills, which apply steam to refine or pre-treat input wood chips with weak chemical solutions. All the above processes are known to produce considerable pollutant loadings to land, air, and water (11). For example, Canadian pulp, paper and paperboard mills released 302 tonnes of pollution onto land, 166,613 tonnes of air emissions, and 5,955 tonnes of wastewater in 2013 (6).

In 1992, regulations pertaining to the discharge of pulp and paper mill effluents (*Pulp and Paper Effluent Regulations*; *PPER*) were revised in Canada and included stricter control for discharge of BOD, TSS and acute lethality. Moreover, the revised regulations were paired with the establishment of the EEM program, which examines the effects of effluent on wild fishes. Data from the first several cycles of the EEM program showed that BKPME was causing general eutrophication in the receiving environments in addition to a national pattern of metabolic and physiological disruption in fish (4,12).

4.1.3 Northern Pulp Bleached Kraft Pulp Mill

The Northern Pulp Nova Scotia Corporation (NPNS) Bleached Softwood Kraft pulp mill is located at Abercrombie Point adjacent to Pictou Harbour in Pictou County, Nova Scotia. NPNS is a typical bleached kraft pulp and paper mill that has been operating in Pictou County, Nova Scotia, since 1967 and manufactures ca. 275,000 t of bleached kraft pulp annually (10). Effluent wastewater from NP has been treated by retention in settling and aerated ponds in a tidal lagoon known as Boat Harbour, in the Pictou Landing First Nation (PLFN), under a provincial agreement that expired in 2015. Since that time, the mill has been tasked with finding or developing an alternate facility to treat and dispose of wastewaters.

The Replacement Effluent Treatment Facility Project proposed by NPNS was registered February 7, 2019 for environmental assessment (EA). The EA Registration Document (EARD) was deemed insufficient by the Minister of Environment and a Focus Report was required to address a Terms of

Reference (TOR) document. The TOR included requests for more details on many deficiencies of the project, including:

1.) Public, Mi'kmaq and government engagement
2.) Project description
3.) Facility design, construction and operation and maintenance
4.) Marine water and marine sediment
5.) Fresh water resources
6.) Air quality
7.) Fish and fish habitat
8.) Flora and fauna
9.) Human health
10.) Archaeology
11.) Indigenous people's use of land and resources

With respect to the overall subject of this current review, there were many questions raised by reviewers of the EARD pertaining to potential impacts on fish and fish habitat. The TOR specifically requested documentation of these potential impacts. However, the Focus Report is extremely deficient in providing those details. In fact, there is no data showing effects of proposed effluent on fish, nor does the report acknowledge pre-existing data of the effects of BKPME on fish health. The following section attempts to summarize these effects.

4.2 Effects of Bleached Kraft Pulp Mill Effluent on Aquatic Animal Health

Bleached kraft pulp mill effluent (BKPME), like the effluent produced by NPNS, is a complex mixture of chemicals that possess environmentally active properties and are known to be toxic and mutagenic to a wide variety of aquatic organisms (2,9,13). The process of pulping and bleaching generates dissolved lignin, cellulose degradation products, and other wood extractives such as terpenoids, resin acids (RAs), phytosterols, and chlorophenolic compounds, some of which that are known to persist in the receiving environment for > 30 years (e.g., RAs; (8,14)). Wastewater discharge can include solids and dissolved organic matter which increases the biological oxygen demand (BOD) in receiving waters; ammonia, nitrates, phosphorus, and sulfur compounds, which cause nutrification of receiving waters; and heavy metals such as arsenic, cadmium, hexavalent chromium, lead, manganese, selenium and zinc; and finally, chelating agents, chlorates, and organochlorine compounds, known toxicants (6,9). The use of elemental chlorine for bleaching in kraft mills has historically results in elevated levels of organochlorine compounds such as polychlorinated dibenzo-*p*-dioxins (PCDD) and dibenzofurans (PCDF) in receiving environments. In Canada, *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations* issued under the *Canadian Environmental Protection Act* (CEPA), require mills using a chlorine bleaching process to discharge effluent with dioxin and furans below measurable levels due to the closing of several fisheries.

However, despite the move away from elemental chlorine, organochlorines have not been eliminated from discharges (9), and detectable levels of toxicologically chlorinated dioxins and dibenzofurans have been detected in effluents from mills that use ECF technology, including that of NPNS (10). This is attributable to the co-generation of molecular chlorine from chlorine dioxide generators, as well as the liberation of chlorine from chemical reactions during pulp bleaching (1,15). Thus, there remains a certain level of AOX-associated toxicity in BKPME regardless of the elimination of elemental chlorine in bleaching processes. This has been demonstrated for both aquatic invertebrates (16), and vertebrates (17).

Despite several decades of research, pulp mill effluents are poorly described, and there is limited progress in identifying agents responsible for disrupting fish physiology due to complexity and variability of effluents (18). Notwithstanding, there are several parameters of BKPME that have consistently correlated with negative outcomes, including AOX, BOD, COD, RA, phytosterols and TSS loading. These toxic effects have been exhaustively explored over the last 20 years on both receiving aquatic ecosystems and organisms that reside within. With respect to wild fish populations residing in areas receiving pulp mill effluent, there are a variety of negative physiological impacts, including compromised immunity (19–22), altered endocrinology and reproductive parameters (4,5,15,17,23–30), organocellular damage (31,32), genotoxicity (13,33–35), altered hepatic retinoid storage (14), hepatic sex steroid ligand availability (36), and altered hepatic enzymatic activity (37,38). The following sections attempt to summarize some of the scientific data associated with these negative impacts on immunocompetence, reproduction and hepatic enzyme activity.

4.2.1 Effects on Immunocompetence

Negative impacts on fish immunity is strongly associated with exposure to BKPME, such as decreased numbers and activity of lymphocytes in fishes exposed to effluent including perch (39), roach (21), and mummichog (40). Changes in hematology may reflect a more profound effect on lymphocyte maturation and migration, which may indicate general immunosuppression. An immunosuppressive effect was reported for roach exposed to BKPME and this was correlated with lower numbers of circulating lymphocytes and circulating antibodies (20), and numbers of antibody secreting cells (ASCs) are reduced in laboratory exposure studies (21). Moreover, macrophage function was shown to be reduced in effluent-exposed mummichog (40). With respect to disease susceptibility, macrophages play a key role in detection and clearance of pathogens and are critical in orchestrating immune responses of fish (41). Thus, reduction in macrophage activity in BKPME-exposed fish suggests these animals are more susceptible to disease. Indeed, another study observed significantly higher burdens of a ciliate protozoan, *Ichthyophthirius multifiliis*, in fish residing in a BKPME-contaminated lake (20). In the freshwater fish, *Channa punctatus*, immunotoxicity due to BKPME exposure was elevated compared to controls and was exacerbated as a function of temperature (19). Interestingly, there was a biphasic effect which was dependent on the time of exposure. For example, there was a stimulatory effect on ASCs after a short-term effluent exposure, while after long-term exposure there was an inhibitory effect. Santos *et al.* (42) observed significant oxidative damage due to activation of circulating phagocytes in European eel (*Anguilla anguilla*) gill, a tissue known to be susceptible to oxidative damage in response to BKPME exposure (43). Oxidative stress associated with activation of macrophages in fish exposed to BKPME has been reported, with incongruent results related to exposure times and distance from the discharge source (42). Thus, it is clear that chemicals present in BKPME significantly alters normal immune function, and furthermore, that these effects must not be considered in the absence of environmental (e.g., temperature, pathogen load) effects.

4.2.2 Effects on Reproduction

Decades of studies demonstrating a range of effects have shown that a major concern with respect to effects on fish physiology is the potential for BKPME to alter fish reproduction and fertility as observed by delayed sexual maturation, reduced circulating gonadotropins, smaller gonads and reduced secondary sexual characteristics (reviewed in (5,18,44–46)). These effects have been reported in North American, Scandinavian, New Zealand, and Chilean studies, where effluents from all types of mill processes, wood furnishes, and treatments are capable of impairing fish reproduction from the molecular to the individual or population level (17,18,47). Despite intense research efforts, the precise mechanisms underlying these adverse reproductive outcomes are not clear and the identification of bioactive substances have proven challenging. Research has concentrated on biologically active sex steroids in response to effluent exposures. Most of these studies have focused on estrogenic (48,49) and androgenic (29) pathways. While there is certainly strong evidence that these pathways are affected, they are not the only pathways that could be involved in the reproductive effects caused by pulp and paper mill effluents. In fact, many effluents have strong anti-reproductive activities but are neither strictly estrogenic nor androgenic in standard assays (18). Of the constituents of wood (‘‘wood extractives”), the plant sterol β-sitosterol is one of the most common one present in effluents (50), and is known to cause several endocrine effects in fish, including vitellogenin (VTG) induction altered plasma sex hormone levels and gonadal steroidogenesis (51). Table 1 attempts to summarize the known reproductive effects on finfish due to BKPME exposure.

Table 1. Examples of reproductive effects due to BKPME exposure in teleost fishes (reviewed in (18)). As can be observed, deleterious reproductive effects are still observed despite the substitution for chlorine dioxide in ECF bleaching. NPNS has described its processes as "typical" in this category (10).

Test fish	Country	Treatment[1]	Toxic effect	References
White sucker (*Catostomus commersoni*)	Canada	ECF	Reduced gonad size, circulating sex hormones, and fecundity; delayed	(25)

Test fish	Country	Treatment[1]	Toxic effect	References
			sexual maturity; changes in secondary sex characteristics	
Goldfish (*Carassius auratus*)	Canada	ECF, TMP	Depressed sex steroids; Neuroendocrine pathways affected	(24,52)
Fathead minnow (*Pimephales promelas*) Zebrafish (*Danio rerio*)	Canada	ECF	Suppression of egg production; Induction of reproductive pathways	(53,54)
Mummichog (*Fundulus heteroclitus*)	Canada	ECF	Depression of testosterone production	(55)
Rainbow trout (*Oncorhynchus mykiss*)	Canada, Brazil, New Zealand, Chile	EC/ECF	Estrogenic effects; Increased gonad size and early maturation	(5,56,57)
Redbreast sunfish (*Lepomis auritus*)	USA	EC/ECF	Reduced estradiol, increased incidence of atretic vitellogenic oocytes	(58)
Largemouth bass (*Micropterus salmoides*)	USA	EC/ECF	Reduced gonad size lower plasma sex hormones, reduced vitellogenesis	(59)
Mosquitofish (*Gambusia holbrooki*)	USA	-	Masculinization of females	(28,60,61)
European perech (*Perca fluviatilis*) Roach (*Rutilus rutilus*)	Finland	ECF	Decreased size of gonad, reduction in plasma sex steroids	(39)
Eelpout (*Zoarces viviparous*)	Sweden	ECF	Significantly higher males in population	(59,62)
Shortfin eel (*Anguilla australis*)	New Zealand	ECF	Increased plasma estradiol and testosterone	(63)

[1]Treatment process refers to either elemental chlorine (EC), elemental chlorine free (ECF) bleaching, or thermomechanical pulping (TMP)

As previously stated, the exact chemical compounds involved in the effects on reproduction are ambiguous; however, they are known to occur in the absence of elemental chlorine bleaching such as the ECF processes utilizing chloride dioxide (15), similar to the processes performed at NPNS. Given the wide variety of reproductive effects observed, it is unlikely that there is a single chemical involved in anti-reproductive effects. The observation that neuroendocrine pathways are affected by BKPME exposure (24,64), in addition to the contribution of endocrine signalling in both androgenic and estrogenic pathways, implies that many different chemical compounds interact with neuroendocrine systems. However, many effluents have strong anti-reproductive activities but are neither strictly estrogenic nor androgenic in standard assays (18). Thus, there is clearly a multitude of mechanisms contributing to these effects that are a product of the mill-specific processes.

4.2.4 Effects on hepatic enzymatic activity

BKPME is known to induce mixed-function oxygenase (MFO) in finfish. Induction of MFO enzymes in fish is a consistent indicator of the presence and bioavailability of polyaromatic compounds such as polynuclear aromatic hydrocarbons (38), some plant hormones (65), and chlorinated dioxins and furans (66). For BKPME, MFO induction can be used as a proxy for potency of the chemical constituents within, but the identity, concentration and ecological hazards of the individual compounds requires further analysis.

The elimination of elemental chlorine in the pulp bleaching process through new regulations led to a major reduction of toxic AOX-associated compounds in BKPME, and subsequently resulted in substantive decrease in the presence of these compounds in the receiving environment and associated organisms (11). However, negative impacts on fish are still observed despite improvements, including MFO induction (38) and increased liver size (67). It is thought that wood extractives are a major cause of this effect (66,68), and key molecules involved have been identified as chlorinated lignin-derivatives (37). Resin acids (RAs) and phytosterols are consistently found in pulp mill effluent and are capable of inducing liver damage via MFO enzymes. A well-established method for determined the activity of these enzymes is via the standard bioassay using rainbow trout where the activity of ethoxyresorufin-*o*-deethylase (EROD) is measured (66). Using this method, many researchers have demonstrated substantial induction of MFO in fishes exposed to BKPME, both in chlorine-based processes, and ECF-based processes similar to the one employed by NPNS (10,38,65).

5.0 Proposed Replacement Effluent Treatment Facility Project

The proposed project will consist of the development of a new effluent (wastewater) treatment facility (ETF) constructed on Northern Pulp property, and a transmission pipeline that will carry treated effluent overland and in the marine environment and discharge via an engineered diffuser (marine outfall) (10).

The proposed new ETF will employ the AnoxKaldnes BAS™ Biological Activated Sludge process purchased from Veolia Water Technologies, which combines Moving Bed Biofilm Reactor (MBBR) technology with conventional activated sludge. Once treated onsite at Northern Pulp's facility, effluent will be sent through an approximately 15 km long pipeline. The pipeline will enter the south side of Pictou Harbour and make landfall on the north side of the harbour roughly following Highway 106 right-of-way to Caribou, and then re-enters the marine environment adjacent to the Northumberland Ferries marine terminal and continues for approximately 4.0 km through Caribou Harbour to the Northumberland Strait, terminating at an engineered marine outfall.

As stated in the EARD, "*the effluent is anticipated to meet compliance with federal PPER*" (pg 84), and furthermore, that effluent "*will meet ambient water quality at the edge of a standard mixing zone*" (pg 84).

The quality of this effluent entering the RWS will be described in the following section.

5.1 Predicted Effluent Quality

Expected daily maximum water quality characteristics of the treated effluent were used to conduct modelling for simulated concentrations over a one-month period (10). Table 1 compares those data with the background water characteristics of the RWS. What can be observed is the significant increase in concentration of all metrics. However, this data does not consider any long-term accumulation of various parameters of the effluent. For example, AOX and RA are known to be recalcitrant to degradation and persist in the environment (3,8,69), and as such, an accumulative model is necessary to predict environmental concentrations over extended periods of time. Additionally, these values are predicted and do not represent the actual chemical characterization of the ETF BKPME, therefore, it is unclear what the actual increase or decrease of these metrics will be upon discharge of the effluent.

Table 2. Comparison of background quality with proposed ETF effluent water quality in receiving water system (Caribou Harbour). Parameters with empirical evidence for negative physiological effects on aquatic organisms are denoted with an asterisk (*).

		Average Value		
PARAMETER	**Unit**	**Background[1]**	**Average Velocity (2018)[2]**	**Fold change[3]**
AOX*	mg/L	n/a	7.8	7.8x
TN*	mg/L	0.17	6.0	35x
TP*	mg/L	0.5	1.5	3x
Colour	TCU	4.5	750	167x
COD*	mg/L	n/a	725	725x
BOD_5*	mg/L	ND	48	48x
TSS*	mg/L	2.5	48	19x
DO*	mg/L	9.7	>1.5	-6.5x
pH*	-	7.8	7.0-8.5	-1.1x – 1.1x
Temperature (summer)*	°C	16.8	37	2.2x
Temperature (winter)*	°C	1	25	25x
TDS	g/L	30	2	-15x
Cadmium	µg/L	0.084	1.03	12.2x
TDF*	pg/L	3.213	3.675	1.14x
PAH*	µg/L	0.01	0.044	4.4x
TRA*	mg/L	0.06	0.57	9.5x
TFA*	mg/L	0.07	0.335	4.8x
TPh*	µg/L	ND	6.13	6.13x

[1]Daily background water quality of the receiving water system (Caribou Harbour), obtained from Table 4.2-3 in the Focus Report (10)
[2]Daily effluent water quality during average velocity operations, obtained from Table 4.2-4 in the Focus Report (10)
[3]Calculated fold-change increase or decrease (-) of components taken as the ratio of effluent/background measurements

As can be observed in **Table 2**, all of the measured analytes will be altered in the RWS to varying degrees; however, the analytes that are of highest concern with respect to impact on fish health and fitness include concentrations of AOX, COD, BOD_5, TSS, pH, DO, TDF, PAH and TRA. Most studies evaluating negative physiological effects of BKPME exposure looks at the effluent as a complex mixture. Some of the available scientific evidence addressing components on an individual in reference to observable effects on fishes is summarized in **Table 3**.

Table 3. Summary of effects of the major harmful BKPME components on finfish health, including the predicted discharge from NPNS, effects that have been documented, the species and accompanying references.

Analyte	Expected daily discharge[1] (kg/day)	Effect(s)	Species	Reference(s)
Adsorbed organic halides (chlorinated compounds)	663	MFO induction; MFO induction, genotoxicity	Rainbow trout; Chinook salmon	(35,37)
Chemical Oxygen Demand	61,625	-	-	-
Biological Oxygen Demand	4,080	Reproductive anomalies, infertility	Fathead minnow	(4)
Suspended Solids	4,080	-	-	-
Dioxins and Furans	NP	Masculinization; Genotoxicity; Immunotoxicity; Anti-estrogenic	Mosquitofish; Smallmouth bass; Spotted snakehead	(19,28,34,70)
Resin Acids	NP	Altered vitellogenin, sex steroids in females; Depleted hepatic retinoic acid levels; Testosterone depression	Zebrafish; White sucker, Rainbow trout; Mummichog	(14,55,71)
Fatty Acids	NP	-	-	-
Phenols	NP	Testosterone depression	Mummichog	(55)
Polyaromatic hydrocarbons	NP	MFO induction; Altered testosterone; VTG induction	Rainbow trout; Mummichog; Rainbow trout	(23,37,51,65,68)

[1]Based on data provided in the FR

5.2 Findings of EARD/FR pertaining to Impacts of ETF and BKPME on Finfish (Freshwater and Marine)

In short, both the EARD and FR conclude that there are no potential significant impacts on either freshwater or marine fish or fish habitat.

These are described in detail below.

5.2.1 Freshwater

In the EARD, the Proponent summarizes the residual adverse effects and environmental effects (Section 8.6 and pg. 535). In this, during all three Construction, Operation and Maintenance Phases of the project, the conclusion was:

> *"No significant residual environmental effects identified with planned and standard mitigation implementation, authorization, and environmental protection measures".*

Similar to the EARD, the FR prepared by NPNS reported a summary of no significant impact due to operations (included effluent discharge):

> *"Once the project is operational, no impacts are anticipated to freshwater fish and fish habitat during the operation and maintenance phase*" (pg. 220)

5.2.2 Marine

In the EARD, the Proponent summarizes the residual adverse effects and environmental effects (Section 8.12 and pg 588). In this, during all three Construction, Operation and Maintenance Phases of the project, the conclusion was that there would be no significant impact:

> *"Overall, based on the results of this EA Registration, it is concluded that, with planned mitigation and the implementation of best practices to avoid or minimize adverse environmental effects, the residual environmental effects of the project, including the effects of accidents, malfunctions and unplanned events as well as cumulative environmental effects, during all phases are rated not significant"*

Similar to the EARD, the FR prepared by NPNS provided the following summary of the assessments conducted on marine fish and fish habitat (pg. v – Executive Summary):

> "*Potential impacts to these marine VECs were evaluated in light of minor adjustments to the marine pipeline route and the updated receiving water assessment and comparison to the current outfall. Based on the receiving water study results and with identified mitigation… no significant residual adverse environmental effects were identified… A diffused outfall near outside of Caribou Harbour in the Northumberland Strait is considered to have much less potential effluent impact on the receiving environment and represents an improvement."*

With respect to water quality of the RWS, the EARD and FR concludes that there is unlikely to be significant residual effects as a result of BKPME discharge. However, this conclusion was drawn after a **one-month modelling** of effluent discharge and **fails to take cumulative effects** of recalcitrant chemicals present in BKPME. Furthermore, the chemical characteristics of the BKPME are projected and do not represent the actual effluent. In the absence of empirical data, it seems unlikely that NPNS can make any conclusions about the potential negative impacts.

5.2.3 Assessment of Major Findings

The Proponent concludes that **there are no significant impacts anticipated** by either construction or the operational phases of the ETF, on either freshwater or marine fish or fish habitat. This assertion is based on the notion that the predicted BKPME will be at background levels within 2 m of the diffuser port and will therefore not pose a risk to finfish in the RWS. There are several key assumptions that play a critical role in the validity of these conclusions:

1.) The dilution of effluent is as predicted, and major harmful components of the effluent will be diluted to ambient by 2 m past the diffusers.
2.) The characteristics of the actual effluent is consistent with the predicted effluent
3.) The 85,000,000 L/day of effluent that will be discharged by the diffuser will act in a way that is accurate to models
4.) There is no accumulative effect of the effluent over time on health or habitat of finfish
5.) There is no sublethal effect of the diluted effluent on finfish in the RWS

Identified issues with Major Findings:

1.) As per **Table 1**, there is a substantive change in the concentration of many components of concern in the predicted BKPME. The buffering capacity of the RWS to reduce any negative effects of this volume of BKPME is a dangerous, and unsubstantiated, presumption. For example, COD in the immediate effluent is predicted to be 725x higher than ambient. That represents an extremely high gradient that is proposed to be reduced to 0 within 2 m (~ 7 ft) from the diffuser. This assertion does not seem credible and cannot be properly assessed using a modeling approach. Empirical evidence to support this predicted discharge and assumed dilution of discharge (over time) must be included.
2.) It is well documented in the literature that there are recalcitrant chemicals present in BKPME. These chemicals – namely, resin acids, fatty acids, AOX, PAH, and TDF – are extremely slow to degrade in the environment and **have a propensity to bioaccumulate in sediment** (72) or in tissues of invertebrates (73) and vertebrates (74). All the modeling data in the EARD and FR looks at the discharge and flow of effluent over a one-month period. Even with very small initial concentrations of these chemicals into the RWS, **it is inconceivable to assume there will be no accumulation over time or space**. Furthermore, this potential accumulation will be under influences of seasonal variation in tidal and current flow. It is unclear how the Proponent reaches the conclusion that there will be no effect when these parameters have not been addressed in the models.
3.) **Without sublethal testing of their proposed effluent**, it is unclear how the Proponent can conclude there will be no effects to finfish health. Due to the substantial variation both in terms of chemical characterization and effects on fish reproduction (reviewed in 7), it is necessary to test individual mills and their effluents for the potential to negatively affect aquatic organisms (46,75). As part of the effort to better understand these effects, several laboratory exposure and bioassay models have been developed. For example, a short-term

laboratory test assessing egg production by the fathead minnow (*Pimephales promelas*) is a consistent and sensitive indicator of overall reproductive status of how fish respond when exposed to mill effluent (25,76).

4.) Overall, both the EARD and the FR appear to have **omitted a science-based review on the available literature pertaining to the effects of BKPME on finfish health**. There is an exhaustive body of literature available, and only 1 reference (11) was mentioned in the references. To conclude the EA with a finding of no significant impact on fish health after all the primary data associated with the subject is not acknowledged lacks scientific credibility and is, frankly, unacceptable.

5.2.3 Addressing the Terms of Reference in the FR

The purpose of the FR was to address issues brought up during public consultation and review of the EARD by relative stakeholders. With respect to the focus of the current review, i.e., finfish health, the following sections of the TOR were assessed: 2.3, 2.4, 4.1, 4.2, 7.3, 7.4, and 7.5.

These terms of reference, including the data submitted in the FR and resultant conclusions drawn by the review herein are described below:

Project Description (2.3-2.4) – Regarding Effluent

The Proponent was asked to submit data regarding the complete physical and chemical characterization of the raw wastewater (pp 23-32 of FR; Appendix 2.3). The Proponent was also asked to submit a complete physical and chemical characterization of the expected effluent entering the RWS (pp 32-39; Appendix 2.4)

Assessment after review:

The Proponent refers to the 2018 Effluent Characterization (Table 2.3-3) to represent the predicted effluent. However, it is unclear how this conclusion is valid, as the 2018 Effluent is based off the old system, which differs on several different levels, including the "polishing" phase. In contrast, the predicted effluent will not undergo this "polishing" phase.

The Proponent consistently refers to the PPER as a guidance for justification of toxin levels in their effluent. At no point does the Proponent indicate they are moving towards a progressive and science-based approach. The PPER have been criticized for not setting higher standards for effluent treatment (4). For the Proponent to rely on these regulations only considering "*acute lethality to fish*" as an important indicator of toxicity is careless and demonstrates no consideration for the finfish communities residing in the RWS, many of whom are listed as threatened or endangered by COSEWIC (77–82).

Importantly, the data provided in 2.3-2.4 are based on predicting effluent characteristics and subsequent modelling. As stated on pp 33, "*Based on Veolia's **anticipated** performance of the proposed ETF, it is **expected** that the proposed replacement ETF will provide performance that is comparable to other mills*".

Considering the significant potential for negative impacts on several species of fish (see Section 6.0), a speculative and predictive approach is not justified. Empirical evidence is required to validate these claims.

Marine Water and Marine Sediment (4.1-4.2)

The Proponent was asked to perform baseline studies on marine water quality and sediment quality in the vicinity of the proposed marine outfall location (pp 82; Appendix 4.1). Furthermore, the Proponent was asked to update the receiving water study to model for all potential contaminants of concerns in the RWS (pp 82-96; Appendix 4.2).

Assessment after review:

The Proponent only demonstrates data for effluent modelling for a period of 30 days. As this project is projected to last for longer than 30 days and in months other than July and February, it is unclear why modelling results over a period of 365 days were not obtained. This data essentially ignores any potential for accumulation over time and space, which is extremely likely to occur given the volume and masses of effluent proposed to be discharged by the ETF. This fact is particularly concerning for refractory chemicals that are known to exist in BKPME (8).

This modeling data is extremely deficient and lacks reasonable credibility for the above reasons. Furthermore, there is a clear inconsideration for potential effects over time.

Fish and Fish Habitat (7.3-7.5)

The Proponent was asked to conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational, and Aboriginal fisheries. This must be based on updated information, additional studies and/or an understanding of expected movement of contaminants (pp 122-; Appendix 7.3). The Proponent was also asked to submit an updated EEM program based on results of various relevant baseline studies and an updated receiving water study (pp). Finally, the Proponent was asked to clarify what contingency measures will be in place to mitigate potential impacts due to potential large and rapid fluctuations in water temperature in the winter at the diffuser location during low production or maintenance shut down periods.

Assessment after review:

The Proponent did not conduct any additional studies to help provide evidence that might support their initial claims of "no impact" in the EARD. What would have been expected would have included sublethal toxicity testing of the predicted effluent as is a common practice for understanding effects on fish health.

In contrast, the Proponent simply conducted review of their own studies (while ignoring the body of scientific data) and concluded "*no significant residual impact to marine water are expected to arise on any fisheries or fish habitat as a result of this project*". They go on to describe all of the studies that could be performed after approval, *"Future studies could include toxicity testing, specifically on larval lobster and herring eggs to evaluate sublethal effects on these species".*

In contrast to the findings of the FR, the current review of the literature identified 6 species of finfish listed as "endangered", with 4 listed as "threatened" and 2 of "special concern". The Proponent fails to identify American plaice (endangered), lumpfish (threatened), porbeagle (endangered), and Atlantic sturgeon (threatened). They only consider a fish as potentially impacted by the project if they were observed during the sampling. This is extremely concerning, particularly with so many species in fragile population status. Atlantic sturgeon is known to inhabit the waters of Pictou and is particularly vulnerable to anthropogenic disturbances due to its longevity and age to reproduction (83). It is unacceptable for the Proponent to assume this species will not be affected by the project just because they did not observe it during their limited marine fish survey.

6.0 Impacts of Proposed ETF on Finfish considering Empirical Evidence

In contrast to the Proponent's conclusion that there are no significant impacts expected on freshwater or marine fish or fish habitat, **there is a substantial body of literature that documents the negative physiological effects of pulp and paper mill effluent at various concentrations on aquatic organisms, and in particular, finfish**. This body of literature is largely absent from the EARD and FR, so it is plausible that the Proponent was simply unaware of the scientific consensus. Notwithstanding, the data is quite clear and demonstrates that components of effluent, whether they be derived from chlorine- or chlorine-free treatment processes (such as NPNS), fundamentally alter fish reproductive and immune systems, and by doing so, significantly impact overall fitness of these organisms. It is worthwhile to mention that much of the research concedes that the chemical(s) ultimately involved in these effects are not well characterized (11). Differential treatment processes in pulp and paper mills across Canada, and from different locations around the world, discharge complex and variable effluent, and these effluents are in a dynamic state of flux with respect to their characterization (2,4,11,17). Thus, it is not a clear-cut mechanism of effect that can be generalized to any one mill. Because of this confounding factor, it becomes even more prudent to critically examine BKPME on an individual mill basis to fully understand potential impact, which would include using laboratory models such as the fathead minnow reproductive test or comparators (53).

With respect to the specific fish populations of the Northumberland Strait, there is an extreme paucity of data pertaining to the physiological impact of BKPME. Moreover, there is limited-to-no information regarding the true chemical characteristics of the proposed effluent. Thus, identification of true effects and potential impacts are limited to using a comparative approach (**Table 4**).

Table 4. Species of fishes known to inhabit the freshwater tributaries or marine waters of Northumberland Strait, their known habitat and COSEWIC status, the proposed impact by the EARD, and the potential impact of BKPME exposure as determined by scientific studies.

Species[1]	**Proposed Impact[2]**	**COSEWIC Status**	**Comparator Species[3]**	**Effect[4]**
Atlantic mackerel (*Scomber scombus*)	None	Secure	-	Unknown
American plaice (*Hippogloissoides platessoides*)	None	Threatened	Winter flounder (*Pleuronectes americanus*)	Skin lesions, increased parasite abundance, hepatic lesions, increased EROD (67)
Atlantic salmon (*Salmo salar*) Brook trout (*Salvelinus fontinalis*)	None	Special Concern – Endangered; Sensitive	Rainbow trout (*Oncorhynchus mykiss*) Chinook salmon (*Oncorhynchus tshawytscha*)	Altered retinoic acid receptors (14); Increased gonad size, early maturation (84); Intersex characteristics (57); Genotoxicity (35); Induction of EROD (38)
Rainbow smelt (*Osmerus mordax*)	None	Secure	-	Unknown
Blueback Herring (*Alosa aestivalis*)	None	Sensitive	-	Unknown
Gaspereau (*Alosa pseudblueoharengus*)	None	Sensitive	-	Unknown
Atlantic halibut (*Hippoglossus hippoglossus*)	None	Secure	Winter flounder (*Pleuronectes americanus*)	Skin lesions, increased parasite abundance, hepatic lesions, increased EROD (67)
Atlantic herring (*Clupea harengus*)	None	Special concern	-	Unknown
Atlantic sturgeon (*Acipenser oxyrinchus*)	None	Threatened	-	Unknown
Atlantic striped bass (*Morone saxatilis*)	None	Threatened	Largemouth bass (*Micropterus salmoides*)	Reduction in fry survival, endocrine disruption (27); Decreased lymphocytes, neutrophilia (85)
Atlantic bluefin tuna (*Thunnus thynnus*)	None	Endangered		

American eel (*Anguilla rostrata*)	None	Threatened	European eel (*Anguilla anguilla*)	Gill damage due to oxidative stress (42); Reduced immunity (42)
Atlantic cod (*Gadus morhua*)	None	Endangered	-	Unknown
Winter Skate (*Leucoraja ocellate*)	None	Endangered	Winter flounder (*Pleuronectes americanus*)	Skin lesions, increased parasite abundance, hepatic lesions, increased EROD (67)
Winter Flounder (*Pleuronectes americanus*)	None	Secure	Winter flounder (*Pleuronectes americanus*)	Skin lesions, increased parasite abundance, hepatic lesions, increased EROD (67)
Lumpfish (*Cyclopterus lumpus*)	None	Threatened	-	Unknown
Porbeagle (*Lamna nasus*)	None	Endangered	-	Unknown
Spiny dogfish (*Squalus acanthias*)	None	Special concern	-	Unknown
White hake (*Urophycis tenuis*)	None	Endangered	-	Unknown

[1]Species as listed by the EARD and FR
[2]Proposed impact by EARD and FR
[3]Comparator species; there has been no evidence pertaining to the effects of BKPME on the species of the RWS, thus, scientific studies that investigated these effects in closely related species are list. If there was no appropriate comparator, then (-) was recorded
[4]Physiological impacts as determined by the associated reference

Marine fish, and their habitat, are closely linked to the surrounding physical environment, including water and sediment quality – all of which could be impacted by the proposed ETF. The main commercial fisheries of importance include lobster, sea scallop, herring, mackerel and rock crab, however, the Northumberland Strait is an important migration corridor for many other species including Atlantic salmon, Atlantic bluefin tuna, American eel, winter skate, and Atlantic cod (86). Furthermore, nearshore habitats populated with eel grass are known nurseries for juvenile fishes (e.g., Atlantic salmon), or habitat for benthic species including that of the American eel (*Anguilla rostrata*). The American eel plays an important role in Canada's aquatic biodiversity. It has the greatest range of any fish species in North America and has supported major commercial, recreational, and Aboriginal fisheries (citation). Enlisted as threatened, it is thought that declines in abundance are due to habitat degradation, especially in light of pollution (77). Furthermore, introduction of an exotic parasite, *Anguillicoloides crassus*, that infects the swim bladder of American eels, is thought to be imposing an additional pressure on the species (87). Others have linked the collapse of the European eel to *A. crassus*, as heavy infections can lead to hemorrhagic lesions, swim bladder fibrosis or collapse, skin ulceration, decreased appetite, and reduced swimming performance (88). It is well documented that exposure to BKPME reduces immune competence in fishes, and this has been associated with higher parasite burdens in some populations (20,22). Therefore, the additive effects of *A. crassus* infection with exposure to BKMPE may present a serious concern for populations of American eel and needs to be studied further. In addition to American eel, several other species of fish known to inhabit the RWS are listed as endangered by COSEWIC, including Winter Skate (89), Atlantic Salmon (82), Atlantic Sturgeon (83), Atlantic Cod (81), Atlantic Bluefin Tuna (79), Porbeagle (90), and White Hake (78).

The Northumberland Strait is home to 15 salmon-bearing rivers, and the populations of Atlantic salmon in that area are in decline. As ecological keystone species, the health of salmon populations can be viewed as an indicator of overall ecosystem health. The potential impacts of BKPME discharged by the proposed ETF are simply not understood, however, in other systems the negative impacts on reproduction and immunity are well documented in salmonids (e.g., (26)). The Proponent failed to produce any scientific evidence on the effects of their effluent on salmon.

The Proponent consistently states that their proposed ETF and associated effluent is treated to "*a level that is non-toxic and meeting regulated (PPER) effluent discharge parameters*" (example, page 66, (10)). However, there is no empirical evidence characterizing the true chemical properties of the effluent. It is unclear how the Proponent can make any informed or accurate predictions on the potential environmental impacts on the RWS or the organisms that reside there. Furthermore, it is important to note that these regulations are antiquated and are currently undergoing a major revision as recent EEM studies indicate that 70% of pulp and paper mills in Canada are impacting fish (91). Thus, although they may be true in stating they are within PPER *per se*, this will certainly not be the case in the future. Furthermore, the PPER are designed to prevent effluents that cause "*acute lethality*", and do not consider effects of long-term chronic exposure. Given the extremely high level of concern regarding the potential impacts on fish populations in the RWS, there should be an avoidance of harm, disruption or destruction, not simply "*acute lethality*". For example, there are known effects in fish that are not observed for years subsequent to initial BKPME exposure that would seriously impact the health of fish populations in the RWS (e.g., 53).

Irrespective of that fact, applying a science-based approach, as was claimed by the Proponent, would imply the most current available information would be used to inform decisions on effluent treatment and discharge. However, this is not the case. For example, a recent publication by Martel *et al.* (2017) discussed recommendations by experts in the field regarding the limits of BOD in BKPME that should be followed to prevent deleterious effects on fish populations (4). Therein, the authors prescribe a maximum BOD_5 of > 20 mg/L as having the greatest probability of no effect on finfish reproduction. The study was intended to provide insights for best management practices that could be incorporated into mill-specific strategies for achieving minimal or no impact on fish reproduction (4). These best practices recommendations should be included in the design or development of any new pulp and paper mill. It is inappropriate for the Proponent to ignore recommendations made by scientific consensus.

The true impacts of the projected effluent should be evaluated using independent laboratory exposure studies for all major important species. Furthermore, upon close examination of the body of literature cited by both the EARD and FR, it is apparent that the Proponent did not consider the large and comprehensive available datasets produced across time and space, where a general consensus has been reached on the toxic effects of BKPME to finfish health.

7.0 Summary

The installation of secondary effluent treatment processes across Canada has substantially improved effluent quality through reductions of compounds producing acute toxicity, including organochlorine discharges and AOX compounds. However, BKPME released in aquatic receiving environments still contains bioactive compounds that affect fish metabolism, reproduction, and health. Investigations into the substances involved in these negative effects has indicated that wood constituents are partly to blame, but that many unidentified and uncharacterized substances in the effluent are involved. Thus, despite the improvement in effluents, pulp and paper mills continue to exact negative physiological effects on aquatic organisms, and furthermore, a more comprehensive understanding of the complete chemical profile of BKPME and associated bioactive properties needs to be completed.

With respect to the project in question, **there is simply not enough supporting documentation to support the conclusion that there will be no negative effects on aquatic animals and the associated ecosystem of Caribou Harbour and the Northumberland Strait**. The negative physiological effect of BKME has been well described on fishes, included depressed immunity, altered reproduction and decreased overall resilience. While effluent plume modelling may have some success in predicting the concentration of effluent in receiving waterways, they do not provide accurate accounts of the organisms in those waterways, as many are migratory. Furthermore, the relative importance of habitat is dynamic over time and space. For example, sensitive habitats of near-shore environments represent critical nursery areas for many larval fishes during certain times of the year (e.g., post-emergence of salmonid smolts), while for other organisms that are sedentary (e.g., mussels), avoidance of deleterious environmental stimulants is not possible. **Additionally, the predictive modeling fails to account for accumulation of BKPME components over a period longer than a month which severely limits any predictive power.** And finally, there **is no description or characterization of the potential for components of the predicted BKPME for bioaccumulation, despite the large body of evidence for bioaccumulation of several toxic components such as chlorinated organic compounds** (69)**, and wood extractives** (8)**.**

8.0 Conclusion

There are numerous issues and concerns that are raised in the above document pertaining to the effluent characterization and associated impacts to marine fish and fish habitat. For example, there is a lack of baseline environmental data, effluent composition data, or data on toxicity of proposed effluent to fishes that reside in the RWS. The Proponent appears to ignore the massive body of literature on the deleterious physiological impacts of BKPME on finfish, as well as the very real potential for bioaccumulation of toxic compounds in the RWS. Furthermore, the FR does not acknowledge the most up-to-date scientific recommendations on limits of effluent components (i.e., BOD limits), that are necessary to reduce potential harm to fishes. With respect to the fish species potentially at risk, there are 4 species residing within this RWS that are listed as “threatened”, and 6 species residing within this RWS that are listed as “endangered” by COSEWIC. Additive effects involving already stressed populations due to climactic variability and habitat loss, combined with the known impacts (e.g., compromised reproductive and immunological systems) of exposure to BKPMEs pose a real and significant concern for these species of fish.

In conclusion, it is of my professional opinion that this Focus Report is deficient in the necessary supporting documentation and empirical data regarding the potential impacts of the proposed ETF by NPNS on finfish in the Northumberland Strait.

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Appendix I – *Curriculum vitae,*

Expert witness report on the Focus Report for the Northern Pulp Nova Scotia Replacement Effluent Treatment Facility

November 7, 2019

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Introduction

Context of this report.

On October 2, 2019, Northern Pulp Nova Scotia Corporation (NPNS) submitted a focus report for the replacement effluent treatment facility project for environmental assessment. This focus report was requested by Nova Scotia Environment as additional information to support a final decision regarding the approval of the environmental assessment for the construction and subsequent operation of a new effluent treatment facility including a pipeline to transport treated effluent for discharge into the Northumberland Strait.

Public comments on the focus report can be made until November 8, 2019. In this context, the Gulf Nova Scotia Fleet Planning Board, Prince Edward Island Fishermen's Association, and Maritime Fishermen's Union solicited my expert opinion via Barrister and Solicitor, Jamie Simpson of Juniper Law. This report presents my objective, unbiased opinion on the potential impact of the new effluent treatment Facility project proposed by NPNS.

Content of this report.

The report provides first a short summary of my analysis of the focus report. Given my expertise in biological Oceanography and Fish Ecology, I conducted an in depth reviewed of parts 4. Marine Water and Marine Sediment and 7. Fish and Fish Habitat of the focus report. This second part of my report documents the series of issues that I identified with parts 4 and 7 of the focus report and relevant appendices (Appendices 4.1, 4.2, 4.3, 7.2, 7.3, and 7.4).

Finally, a general discussion addressing two main questions is provided:

- Does NPNS's submitted materials adequately address the potential risks of bioaccumulation of toxins in the marine environment, and if not, what these risks may be?
- Is NPNS's assertion that the effluent released into the Strait through the proposed treatment system will be less harmful than the effluent currently entering the Strait via the current Boat Harbour treatment system (particularly with respect to the release of metals) valid?

The response to these questions rely on my analysis of the entire focus report, with particular attention to parts 2.3 and 2.4 (because of their relevance to the second question listed above) and with an in-depth review of parts 4 and 7.

Summary

The results of the focus report in terms of impact of the replacement effluent treatment facility to the marine environment are highly dependent on the results from the receiving water study. The receiving water study is based on two modelling exercises. The credibility of the results from any modelling exercises depends mainly on 1) the robustness of the models, 2) the implementation of the models. Reviewing the robustness of these two models is outside my expertise; therefore, I did not review the structure of these two models. However, given my modelling skills and general knowledge of physical oceanography, I was able to review the implementation of these two models. I found a potentially significant issue with the implementation of the far-field model: **it assumes that the one-month simulation period is enough to represent dilution processes that will occur over the several decades of effluent discharge from the proposed outfall location**. This is an issue, because effluent concentrations are likely to increase over time, which will affect future dilution. More details on this issue and other potential issues with the receiving water study are provided in the part 4 of this report.

The terms of reference for the focus report included baseline surveys of the marine fish and fish habitat as well as an impact assessment of treated effluent for key marine species important for commercial, recreational and Aboriginal fisheries. These surveys and impact assessments are especially important given the great concern expressed by the public and the government for the potential impact of the proposed work on the value environmental component (VEC) "Marine Fish and Fish Habitat". Indeed, according to the concordance tables showed in the focus report (pages 2 and 3, Dillon 2019), 195 public comments (2nd highest number) and 34 government comments (4th highest number) were related to the VEC "Marine Fish and Fish Habitat".

On June 21, 2019, Bill C-68, an act to amend the Fisheries Act and other Acts in consequence has received Royal Assent and is now law. This enactment amends the fisheries act to "provide measures for the protection of fish and fish habitat with respect to works, undertakings or activities that may result in the death of fish or the harmful alteration, disruption or destruction of fish habitat". An important question related to item 7.2. of the terms of reference is thus: Can the proposed work lead to the harmful alteration, disruption, or destruction of marine fish habitat?

In my professional opinion, given the information presented in the focus report and associated documents, **it is impossible to conclude that the proposed work won't lead to harmful alteration, disruption, or destruction of fish habitat.** Indeed, I found that baseline fish and fish habitat surveys for the marine environment were incomplete and had numerous gaps. No surveys of the intertidal zone and of the extent and structure of eelgrass meadows were conducted. Furthermore, as described in the focus report and appendix 7.2, the methodology used for marine fish habitat surveys is not reproducible, which will prevent future comparison if environmental monitoring programs are conducted.

Review of part 4. Marine Water and Marine Sediment

4.1 Baseline Marine Studies

Conduct baseline studies for the marine environment (such as marine water quality and marine sediment) in the vicinity of proposed marine outfall location.

Marine water quality

A baseline water quality study was completed to enable future monitoring of the impact of the effluents on water quality and also to be used in the water quality receiving study. Water samples were taken on May 24 and 25, 2019 at varying depth and tide cycles. The analysis of the water samples that were collected are robust and the concentrations are reliable. However, despite proper chemical analysis of collected water samples, the current baseline study of water quality is of limited use for future comparison because of its short temporal extent.

Issue 4.1.1. The marine water quality study was conducted over a period of time too short to provide a useful baseline.

The biochemical properties of marine waters in the southern Gulf of St. Lawrence, including the area of study, are highly dynamic in time and show strong seasonal cycles (Strain et al. 1998, Blais et al. 2018). For instance, concentrations in nitrogen and phosphorus, and oxygen demand show strong variation in response to seasonal plankton blooms (Blais et al. 2018). These seasonal cycles vary in their timing from year to year and any comparison of chemical properties of marine water through time needs to capture these seasonal cycles. The marine water quality baseline study conducted as part of the focus report does not provide sufficient temporal information to enable future monitoring of change in water quality.

Suggestion. Conduct a new study of the chemical properties of marine water in the proposed work area with sample collection extended throughout the year

Sediment quality

A baseline study of the sediment chemical composition was conducted to characterize the materials that may be excavated and potentially permanently sidecast or disposed of during the construction phase. Sediment samples were collected along the length of the proposed pipeline corridor and in the vicinity of the preferred outfall location.

Issue 4.1.2. The sediment in Pictou Harbour showed concerning levels of harmful chemical concentrations.

Results indicated that many chemical concentrations exceed levels of Canadian Environmental Protection Act Disposal at Sea for Pictou Harbour. This included Total PAH, 2-Methylnaphthalene, acenaphthene, fluorine, naphthalene, arsenic, and cooper. This raises concerns for the future excavation of the sediment in Pictou Harbour.

Because of the lack of baseline data (Romo et al. 2019), it is difficult to affirm that these elevated concentrations **of Total PAH, 2-Methylnaphthalene, acenaphthene, fluorine, naphthalene, arsenic, cooper and lead are related to the past and ongoing effluents discharged from Boat Harbour.** However, given the results from the far field modelling study, which indicates that effluent from the existing dam discharge at Boat Harbour can accumulate in Pictou Harbour (Figure 4.2-6 of Focus Report, Dillon 2019), there is a high likelihood that these elevated concentrations of harmful chemicals are related to current effluent discharge in Boat Harbour. This is a significant concern for any future effluent discharge in the Northumberland Strait, and supports the adoption of the precautionary approach.

4.2 Receiving Water Study

Update the receiving water study to model for all potential contaminants of concern in the receiving environment (based on the results of the effluent characterization and/or other relevant studies such as Human Health Risk Assessment). Baseline water quality data for Caribou Harbour must be applied to this study. Refer also to Addendum 3.0.

The receiving water study is a key component of the focus report and the results from this study are used in section 7.3. to evaluate the potential impacts of the proposed work on marine fish and fish habitat. If the results are inaccurate then conclusion in section 7.3 of the focus report needs to be revised.

The receiving water study was conducted using a far-field hydrodynamic model (Mike 21) and a near-field hydrodynamics model (Cormix). Results from the far-field hydrodynamic model were then used into the near-field model. Evaluating the robustness of these models is outside my area of expertise and would require a professional physical oceanographer familiar with these two models. Even if a model is robust, the accuracy of the results depends heavily on the proper implementation of the models. Given with my expertise in biological modelling and my general knowledge of physical oceanography, I was able to review the implementation of the far-field model and of its results.

I identified three issues that require clarifications. Issue 4.2.1 and potentially 4.2.2 could have serious implications for the credibility of the results of the receiving water study.

<u>Issue 4.2.1.</u> Concern that a one-month simulation is not sufficient to capture cumulative impacts of effluent waters over many years.

One specific objective of the receiving water study was to model the dispersion of effluent characteristics in order to evaluate potential for cumulative effects. This was done using a far-field hydrodynamic modelling using the MIKE 21 model. Model simulations were conducted for a period of one month (simulation time) and the reported results show effluent concentrations at the end of this one-month simulation period (Figures 4.2-3 and 4.2-4 of focus report). **My major concern is that the one-month simulation period is not sufficient to evaluate the cumulative impacts of effluent waters released continuously for several years, possibly decades.** On figure 41 of Appendix 4.2 of the focus report, we can notice positive trends in simulated effluent concentrations at the 8 locations located at 100 m from the outfall (Figure 1 of this report). These trends suggest an accumulation. As stated by the focus report, the concentration remains low at the end of the simulation period. However, one can ask given trends observed in Figure 41, what would the final concentrations after a simulation period of several months or several years? **This question needs to be addressed given its implication for future monitoring of potential impacts on marine life.**

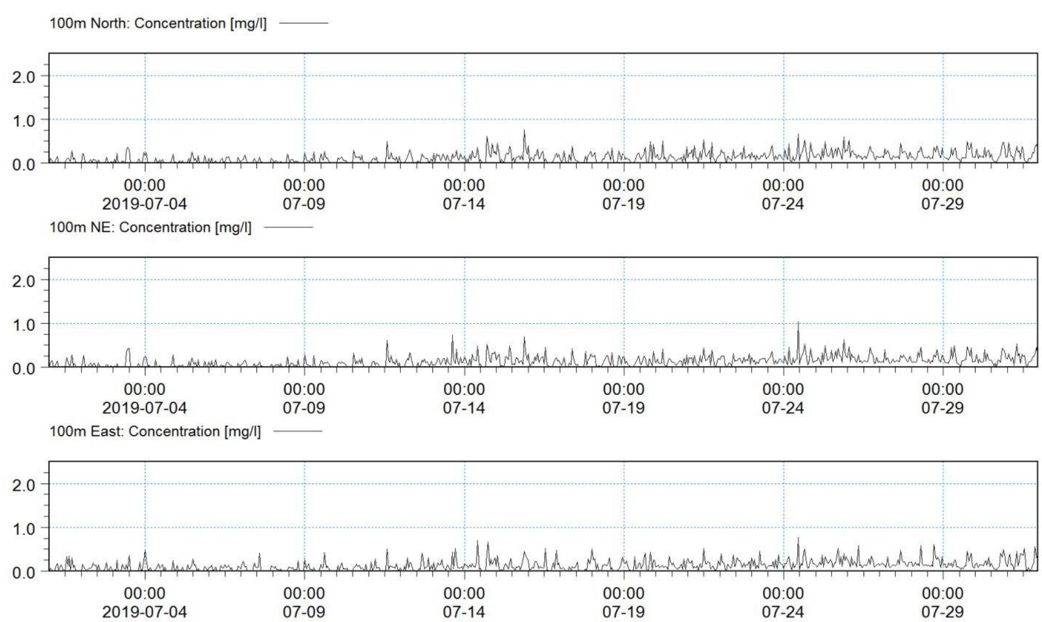

Figure 1. Simulated effluent concentrations at three locations at a 100 m radius of the Outfall Discharge in July. Figure 41 from Stantec (2019). The time series of simulated concentrations show positive trends through time, which indicates accumulation. Only 3 of the 8 model locations are shown here, but increasing trends in concentration are visible at the 8 locations in Figure 41 in Stantec (2019).

Issue 4.2.2. It is not clear how the discharge is incorporated into the model.

The flow parameter is clearly specific (85,000 m^3 / day), but it is unclear how the discharge is released. One would expect that a discharge of ~3,542 m^3 is released at every time step (60 minutes) of the model. However, this is not mentioned in the description of the model implementation. This issue aligns with a previous comment from the reviewer from ECCC that the "explanatory details provided on far-field simulations are very brief and do not permit a full appreciation of the model's robustness or the credibility of its results" (page 4 of Addendum 3.0). The figures provided in the report and in appendix 4.2 do not capture the continuous nature of the discharge of effluent water. This casts some doubts on the model implantation and credibility of results. This is especially concerning in the light of comment on page 8 of focus report on which it is written that the model assumes that "no background concentrations are present". Does that mean that background concentration from a previous time step or resulting from accumulation over months or years is not considered?

Issue 4.2.3. Conditions during the months of February and July are unlikely to reflect year-round conditions.

The focus report included a simulation for the month of February in response to comments from Environment and Climate Change Canada (ECCC) and Nova Scotia Environment (NSE) – Addendum 3.0. The concern was that the presence of ice in the winter modifies stratification of water column and thus could affect dispersion rates. The appendix 4.2 of focus report now states on page 2.28 that the two scenarios (July and February) "will be able to envelope the year-round physical oceanographic and hydrodynamic environments for modeling effluent dispersion". However, given that wind is a main driver of ocean circulation and that winds vary drastically in both their direction and amplitude across seasons in the study area, we can expect that simulations for the months of July and February are unlikely to reflect spring and fall conditions. This is especially true for the fall season, during which winds are generally stronger.

4.3 Sediment transport modeling

Provide results of sediment transport modelling work to understand the impacts of potential accumulation of sediment within near-field and far-field model areas. This should include chemical and physical characterization of the solids proposed to be discharged by NPNS as well as a discussion of how these solids will interact with the marine sediments and what the potential impact will be on the marine environment as a result.

The focus report was tasked with discussing how the solids discharged by NPNS can impact the marine environment. Based on the modeling results and observed currents in the area, the focus report concluded that "effluent sedimentation is not likely to occur in the proposed diffuser area". Therefore, effluent sediment will not have a significant impact on the marine benthic environment" (page 102, Dillon 2019). The focus report only looked at the risks of sedimentation of total suspended solids (TSS) and potential subsequent impacts on the benthic environment. They omitted to evaluate other impacts that TSS can have such as light attenuation in the water column.

Issue 4.3.1. The report does not discuss potential impacts that release of total suspended solids may have on light attenuation and subsequently on the growth of eelgrass and seaweed in the local and regional assessment area.

Light and temperature are the two main parameters controlling the growth of marine flora such as eelgrass and seaweed. Eelgrass beds have been shown to be very sensitive to change in light intensity as a result of human disturbance (Larkum et al. 2006). Given that the dredging of marine sediments will result in an increase in the TSS in the water column, this will reduce light intensity, which has the potential to impact eelgrass meadows adjacent to the proposed work area. However, the NPNS environmental impact assessment and focus report did not consider the potential impacts that added TSS in the water column can have on eelgrass and seaweed beds.

Review of part 7. Fish and Fish Habitat

7.1 Conduct fish and fish habitat baseline surveys for the freshwater environment, to the satisfaction of Fisheries and Oceans Canada.

Conduct fish and fish habitat baseline surveys for the freshwater environment, to the satisfaction of Fisheries and Oceans Canada.

I reviewed the freshwater Fish and Fish habitat surveys and did not find any significant issue.

7.2 Fish Habitat Baseline Survey

Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada.

Environmental impacts of a development project are best evaluated using before-after-control-impact (BACI) design studies. Baseline surveys conducted before project construction are thus necessary to enable future evaluation of the environmental impacts by the company or by any other groups who wish to do so. To be useful, data from baseline surveys need to be collected in a thorough and reproducible manner.

An underwater benthic habitat survey (UBHS) was conducted from May 3 to 7, 2019 in Caribou Harbour and Pictou Harbour. The objectives of the survey were: i) to identify what habitat types are present; ii) to identify what benthic (bottom) communities are present; iii) to determine if eelgrass is present; and iv) to describe what vegetation species are present (Dillon 2019). As well as this, a side-scan survey was conducted to characterize substrate in the proposed project area. ***I found numerous issues with the Fish Habitat Baseline Survey.*** These issues are described below.

Issue 7.2.1. The baseline survey is too short to capture seasonality in species distribution, growth and life-history.

The fish habitat baseline survey was conducted over a very short period of four days from May 3 to 7. In regions with strong seasonal fluctuations in climate such as the proposed work area, seasonality is a prominent feature governing many aspects of marine species life, including distribution, growth, survival, and recruitment. For instance, lobster larvae are released in the water column during the summer and settled to the bottom late summer / fall (Annis 2005). Similarly, juvenile Atlantic cod and other groundfish adopt a bottom life style in September – October and thus density of juvenile cod and other groundfish is higher in nearshore water in the fall (Methven and Bajdik 1994). Growth of eelgrass is maximal during warmer summer months and thus the extent of eelgrass meadows is maximal in early fall before winter die-offs (Larkum et al. 2006). Some migratory benthic fish species such as halibut migrate from winter deep spawning areas to summer shallow feeding areas (Le Bris et al. 2019). Those are a few examples of how seasonality governs life-history of fish and fish habitat Atlantic Canada. To be useful, baseline surveys need to capture this seasonality. **Because of its very short duration, the fish and fish habitat baseline survey conducted as part of the focus report did not capture the seasonal variation in fish communities and fish habitat; therefore, it has limited value as a baseline survey.**

Suggestion. Conduct a fish habitat baseline survey at multiple times of the year to capture seasonal variations.

Issue 7.2.2. The extent (surface area) of eelgrass meadows in the vicinity of proposed work was not measured. As well as this, the methodology used in the marine baseline habitat surveys does not provide the necessary information to enable future comparison as part of an environmental monitoring program.

The underwater benthic habitat survey indicated that eelgrass was present in Caribou Harbour in the vicinity of the proposed work (Dillon 2019). Eelgrass (*Zostera marina*) is the only seagrass species (*i.e.* marine flowering plants) found in Canada. Seagrass meadows are among the most productive ecosystems on the planet (Cullen-Unsworth and Unsworth 2018). For instance, seagrass meadows sustain global fisheries production (Unsworth et al. 2019) and are responsible for more than 10% of global carbon sequestration annually (Fourqurean et al. 2012). Consequently, the global decline in seagrass extent has been a great concern for ocean health (Cullen-Unsworth and Unsworth 2018, Orth et al. 2006, Waycott et al. 2009). In Canada, eelgrass is considered an ecologically significant species because a disturbance to eelgrass meadows has substantially greater ecological consequences than a disturbance of equal magnitude on most other species in the community (DFO 2009). Eelgrass has been shown to be particularly important for juvenile fish, including juvenile Atlantic cod, because it offers shelter from predators, thus reducing predation risks (Gorman et al. 2009). A complete survey of eelgrass meadows adjacent to any coastal development or new human activities should be included in marine fish habitat baseline surveys.

It has long been demonstrated that excessive nutrient inputs can reduce growth, density, and biomass of eelgrass meadows (Short et al. 1995). Furthermore, eelgrass has minimum light requirements to grow and it is thus highly sensitive to change in turbidity (Larkum et al. 2006). Therefore, in order to evaluate in the future if the effluent is impacting eelgrass meadows in the area, it is necessary to properly measure:

- The extent of the eelgrass meadows (i.e. surface area).
- The percentage cover of the meadows in a given area.
- The density of the eelgrass meadows (density of shoot).
- The canopy height (average leaf length).

Measuring the above characteristics can be relatively easily done through snorkelling / SCUBA Diving survey and analyses of satellite imagery (Wilson et al. 2019) or of aerial photography taken by planes or by drones (Duffy et al. 2018). The work conducted as part of the fish habitat baseline surveys for the marine environment only recorded the presence / absence of eelgrass along video transect lines. This is insufficient to enable future monitoring of the potential impacts on eelgrass meadows of the proposed project.

Suggestion. A complete survey of eelgrass meadows adjacent to the proposed work area should be completed. This should include eelgrass meadows that can be impacted by either the transport of effluent materials or by the physical work that will be conducted to install the pipeline and which could result in re-suspension of sediment and thus reduction in light intensity. Eelgrass meadows potentially located along Caribou Island, Munroes Island and along the coast outside Pictou Harbour should be surveyed. Such survey should follow the methodology developed by the Global Seagrass Monitoring Network (www.seagrass.net) in addition to measuring the full extent (surface areas) of each meadow encountered.

<u>Issue 7.2.3</u>. The methodology used to analyze images from the underwater benthic habitat video survey is not well detailed and sometimes subjective, which will impede comparison of results with potential future monitoring studies.

The detailed video analysis presented in Appendix 7.2. quantified the percent cover of each substrate categories at each transect. The methodology used to estimate percent cover is not explained. An approach that can be used to limit observer bias when quantifying percent cover from images or videos is to divide the image frame in numerous grid cells using and count the presence / absence in each grid cell. Because of the lack of mythological explanation in focus report and Appendix 7.2, it is unclear if the percent cover analysis was done using a grid on the images or not. As well as this, to quantify percent cover from videos require to stop the video at specific time interval (e.g. every minute). Unfortunately, no details are provided on how video images were analyzed. Finally, distribution of macro faunal species was estimated using a semi-quantitative approach (page 6 of Appendix 7.2.). A quantitative approach could have been easily employed by, again, dividing the images in numerous grid cells and counting the presence / absence in each grid cell. Such approach would have provided more reproducible results.

Suggestion. More details on the video analysis methodology should be provided to enable an evaluation of the performance of the marine fish habitat survey and, most importantly, to evaluate if the survey is reproducible in the future. A more quantitative approach should be used for the estimation of substrate percent cover and for distribution of macro faunal species.

<u>Issue 7.2.4.</u> Only a survey of the benthic habitat was conducted. No survey of the pelagic (in the water column) and intertidal zones (zone between low and high tide mark) was conducted.

Fish habitat is defined in subsection 2(1) of the Fisheries Act to include “all waters frequented by fish and any other areas upon which fish depend directly or indirectly to carry out their life processes”. Based on this definition, not only the bottom but the entire water column should have been surveyed, including the intertidal zone. Water quality analyses were conducted in section 4 of the focus report but no survey of the biological communities (phytoplankton, zooplankton and ichtyoplankton) was provided. These are important species communities at the base of the food web that drives future recruitment of marine fish species important for commercial, recreational and Aboriginal fisheries. As well as this, no survey of the intertidal zone was conducted. The intertidal zone is home to communities of species specifically adapted to this environment and that constitute important food source for many coastal fish species. Without proper surveys of the intertidal and pelagic zones, the future impact of the proposed work will be impossible to monitor because of the lack of baseline information.

Other minor issues:

- The justification for the choice of the classification scheme for substrate type was not provided (Appendix 7.2, page 6). There is also one size class missing between "Boulder (>25 cm)" and "Cobble (3-13 cm)".
- The term "high-level video analysis" is used on numerous occasions in the report on the marine fish habitat baseline survey (Appendix 7.2) without being defined. The superlative "high" is subjective.

7.3 Impact Assessment for Marine Fish

Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodology must first be agreed upon by NSE in consultation with relevant federal departments.

The focus report conducted an additional impact assessment of treated effluents on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. Despite the presence of numerous fish species in the area, including species important for commercial, recreational and Aboriginal fisheries, the focus report concluded that "*no significant residual impacts to marine water quality are expected to arise on any fisheries or fish habitat as a result of this project*" (page 123, Dillon 2019). **This conclusion is driven uniquely by the results of the receiving water modelling study, which indicated that beyond a zone < 5 m from the diffuser, water parameters will match marine baseline data in the Northumberland Strait.** If the predictions from the receiving water study are inaccurate, then the conclusion of the focus report regarding potential impacts on marine life is not valid. As noted above, there is some doubt regarding the credibility of the results of the modelling studies. Regardless of the type of model, any results from modelling studies should be taken with caution given that modelling exercises always require assumptions – and the precautionary approach principle must be applied.

On top of the potential issues with the receiving water study, **I noticed several issues in the study of distribution of marine fish species in the proposed work area**. These issues are presented below.

Issue 7.3.1 The "Distribution of Marine Fish and Fish Habitat in Study area" part of the section 7.3. is insufficient.

The focus report only uses the results from the Underwater Benthic Habitat Survey (UBHS) to describe the distribution of marine finfish in the study area and stated that “marine invertebrates and marine fin-fish species sightings were rare and were not found in any abundance” (page 127, Dillon 2019). This survey was conducted using a towed camera and was design to survey benthic substrate. This is not a proper methodology to survey highly mobile species such as fin-fish, because they can easily escape the camera field of view.

As well as this, the focus report failed to recognize that the regional assessment area for this project is one of the regions with the historical highest diversity of fish species in the southern Gulf of St. Lawrence and that the region is considered as an Ecologically and Biologically Significant Area (Rondeau et al. 2016).

Issue 7.3.2. The mitigation measures proposed in table 7.3-2 are often vague and not specific to each indicator and / or potential effect.

For instance, one mitigation measure for the physical disturbance of plankton diversity and abundance is to stage the work according to fisheries timing windows. This does not make sense because there is no fishery for planktonic species. Similarly, the same mitigation measure is proposed to reduce impact on lobster and avoid sensitive stages. Sensitive stages are not defined. They could include larvae stages, young of the year, or egg-bearing females. Clarification on how mitigation measures will address each species indicator and potential effects are required.

Issue 7.3.3. Atlantic halibut (*Hippoglossus hippoglossus*) is not evaluated in the potential impacts to important fisheries of commercial, recreational, and Aboriginal value within the project area and the likelihood of occurrence of Atlantic halibut in the LAA should be revised from low to medium-high.

Atlantic halibut is a species of growing commercial value in Atlantic Canada. Its value has increased from 6.6 million dollars in 1995 to 59.8 million dollars in 2017 and it is now the third most valuable fin-fish fishery in the country (https://www.dfo-mpo.gc.ca/stats/commercial/sea-maritimes-eng.htm). Accompanying the growth in population abundance, the population has expanded its distribution (Boudreau…) and halibut is now commonly present in the eastern part of the Northumberland Strait. Indeed, figures from the most recent halibut stock assessment report (DFO 2019) show that halibut is commonly caught in scientific surveys (Figure 2) and in commercial catches (Figure 3) in the eastern Northumberland Strait in the vicinity of the Marine Regional Local Assessment Areas. Finally, recent tracking of halibut using pop-up satellite archival tags has revealed that a halibut tagged in on the northeast side of Prince Edward Island (46.543°N; 62.218°W) on November 11, 2014, for which the tagged popped-up near Port Hood Nova Scotia (46.956°N; 62.608°W) on August 20, 2015 spent several days from June 18, 2015 to June 30, 2015 inside the regional assessment area and the local assessment area (Figure 4). This indicates that the area of interest is a summer feeding area for Atlantic halibut. Tracking of other Atlantic halibut using pop-up satellite archival tags in the same region revealed that other tagged Atlantic halibut used the eastern part of the Northumberland strait as a summer feeding area (James et al. In Review).

The focus report did not consider the Atlantic halibut fisheries in its review because the likelihood of occurrence of Atlantic halibut in the LAA was evaluated as low. The likelihood of occurrence of Atlantic halibut in the LAA was evaluated as low because it was based on information from one study with data up to 2013. **Thus the evaluation did not consider the recent changes in Atlantic population abundance and distribution.** Based on information provided here, the likelihood of occurrence in the LAA in the Appendix 7.3 should be revised from low to medium. Atlantic halibut should be included in the list of species likely to Inhabit the study area (table 3-11 of Appendix 7.3) and in the Commercial, Recreational and Indigenous Fisheries Resources and Use in the Study Area part of the focus report.

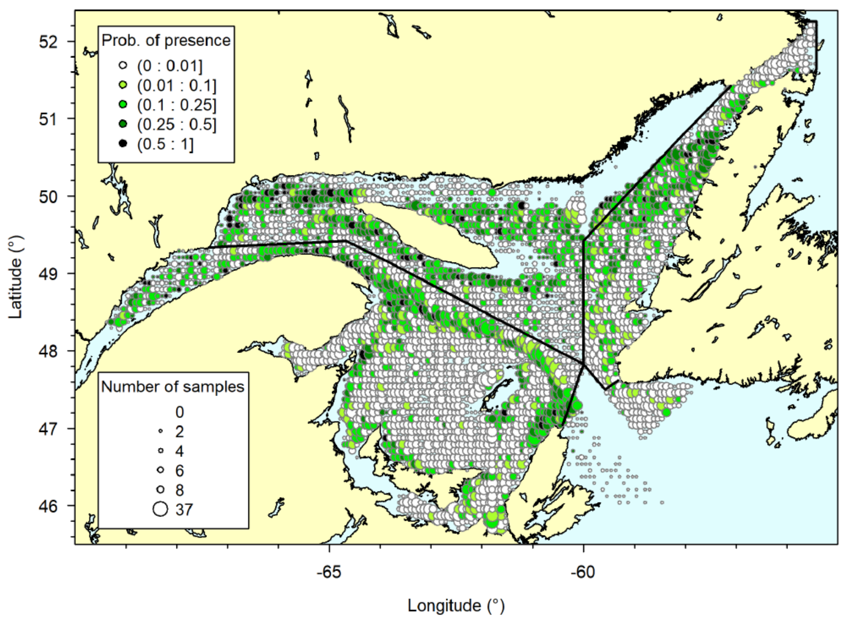

Figure 2. Probability of occurrence of Atlantic halibut in catches made during mobile gear research surveys, per 5-minute square. Figure from DFO (2019).

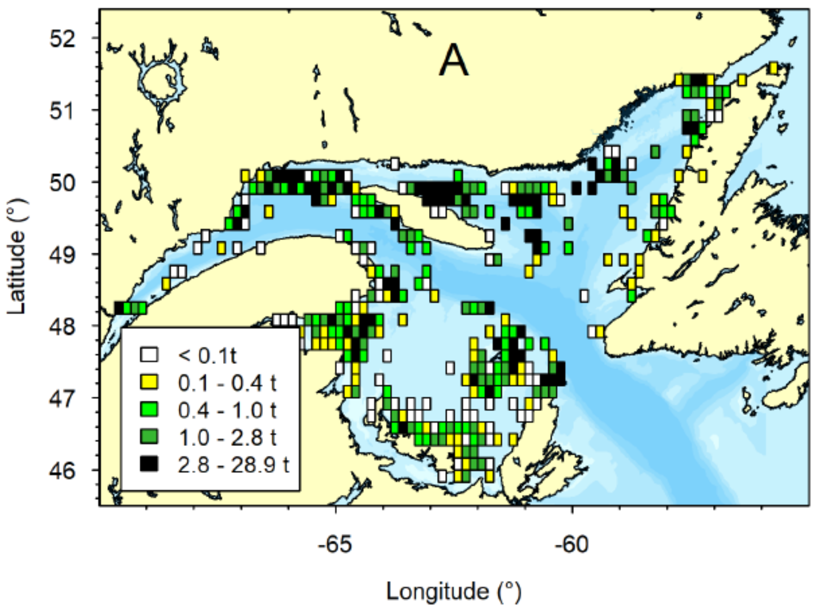

Figure 3. Distribution of Atlantic halibut catches per 10-minute square for the 2017-2018 and 2018-2019 fishing seasons combined. Figure from DFO (2019).

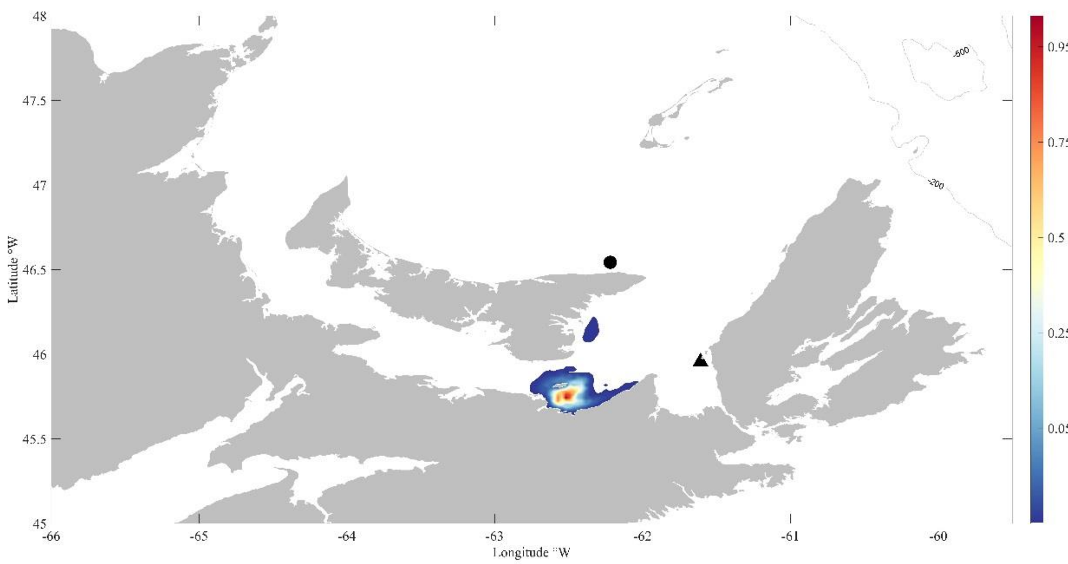

Figure 4. Probability distribution of Atlantic halibut equipped with pop-up satellite archival tag #14P0060 between June 18 and June 30, 2015. Black circle and triangle indicates tagging and tag pop-up locations, on November 11, 2014 and August 20, 2015, respectively. Data from James et al. (In review).

Other minor issues.

- In the summary of section 7.3., the additional work listed on page 122 is incorrect. No survey of benthic, planktonic and fish species was done in section 4.1. or 7.1. as indicated.
- Plaice (*Hippoglossoides platessoides*) is often referred to as Atlantic Plaice (pages 132, 133 and 142 of focus report and 3.29, 3.37, 4.22, and Appendix D of Appendix 7.3.). The proper common name is American plaice.

7.5 Clarify what contingency measures will be in place to mitigate potential impacts (e.g., thermal shock to fish) due to potential large and rapid fluctuations in water temperature in the winter at the diffuser location during low production or maintenance shut down periods.

This question is more related to the engineering part of the project and is outside the scope of my expertise.

Discussion and Conclusions

The first question that I address here is: **Is the Northern Pulp's assertion that the effluent released into the Strait through the proposed treatment system will be less harmful than the effluent currently entering the Strait via the current Boat Harbour treatment system (particularly with respect to the release of metals) is valid?**

The comparison of the treated and untreated effluents from current Boat Harbour treatment system and predicted effluents from new proposed treatment system suggested that they will have similar characteristics regarding Total Suspended Solid, Total Nitrogen and Total Phosphorus. However, no information is provided on the concertation of metals (i.e. arsenic, lead, manganese, cadmium, etc.) that will be released in the new treatment facility in comparison to the current Boat Harbour treatment system. The new treatment facility will increase the dilution of the effluent in the Strait because it is located in a zone with more intense currents; however, **it cannot be concluded that it will be less harmful to the environment because we do not have information on the concentrations of metals that will be released with the new treatment facility**.

The second question that I address here is: **Does the materials submitted by Northern Pulp adequately address the potential risks of bioaccumulation of toxins in the marine environment?** In my opinion, the focus report from NPNS does not adequately address the potential risks of bioaccumulation of toxins in the environment.

The evaluation of the risks of bioaccumulation of toxins in the marine environment in the focus report relies mostly on the results from the receiving water study. A major assumption of the receiving water study is that the one-month simulation conducted in the far-field modelling is representative of the entire time period (possibly several decades) during which effluent will be discharged. The model assumes that no background effluent concentrations are present at the start of the one-month simulation period. By the end of the one-month simulation period, effluent concentrations are still low; however, we can notice an increase in these concentrations through time (see details above in part 4.2). Thus an important question is: **what would be the values of effluent concentrations and dilution factors if the simulation period was extended to several years**? This is a very important point that aligns with the focus report addendum point 3.0, which requires clarification on potentially overestimated dilution ratios and distances.

A second assumption is that climatic and oceanographic conditions in July and February are representative of the full year, and that conditions observed in 2019 are representative of future climatic and oceanographic conditions. This assumption is unlikely to be met given the seasonality in climatic and oceanographic conditions in the region with predominant storms in the late summer and fall, and given the risks for an increase in the frequency and intensity of storms with climate change. No uncertainty around predictions are provided with the results of the receiving water study, and little sensitivity analyses of the input parameters such as temperature, salinity, wind forcing were conducted. Modelling exercises always have limitations and characterizing uncertainty and conducting sensitivity analyses are required to gain trust of the results of any modelling study. Without in depth uncertainty characterization and thorough sensitivity analyses, the precautionary principle should apply.

To conclude,

i) the focus report does not demonstrate that the new effluent treatment facility will be less harmful to the environment that the current Boat Harbour treatment system (**medium confidence**)
ii) the focus report does not adequately address the risks of bioaccumulation of toxins in the marine environment (**medium confidence**)
iii) the baseline surveys are insufficient to evaluate the impacts of the effluent on the marine environment in the future (**high confidence**).

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Appendix Attached. Curriculum Vitae

7-

CRUSTIPATH

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Review of the Northern Pulp Nova Scotia's Focus Report Replacement Effluent Treatment Facility from an Animal Health Perspective with a Focus on Crustaceans

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November 7, 2019

DISCLAIMER

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Executive Summary

CrustiPath was engaged by Juniper Law on behalf of the Gulf Nova Scotia Fleet Planning Board, PEI Fishermen's Association, and Maritime Fishermen's Union to review the October 2019 Focus Report provided by Northern Pulp Nova Scotia (NPNS) on its proposed replacement effluent treatment facility and provide opinions, within the limits of their expertise, on the potential environmental impacts of the proposed project on fisheries and the marine environment within the Northumberland Strait.

Inconsistencies were noted in NPNS's Focus Report regarding the reporting of the Reportable Detection Limits (RDLs) and summary statistics for metals in the Caribou Harbour background water samples and associated summary statistics in Appendices B-1 (n =14) and B-2 (n = 5) of Appendix 7.3 and Appendix 2.3 (n = 6). These inconsistencies could not be investigated completely as portions of the raw data and associated quality assurance information could not be found within the Focus Report documents or the EARD. Review of available data and quality assurance information from other water sampling sites (Raw Water, Point 'A', Point 'C') suggests that the background concentration of many metals in Caribou Harbour are 'not detectable', as reported in Appendix 2.3, and so are at least 10—fold lower than the concentrations indicated in Appendix 7.3, Table 4-3 and Table 7.3-1 '*Marine Water Quality COPCs and Estimated Dilution'*. If these much lower background values are confirmed, then the values for '*Distance (m) from Diffuser Ambient Condition is Reached based on Dilution Ratios*' in Table 7.3-1 will need to be reviewed and possibly revised. This could be significant if some of the revised values are greater than the Local Assessment Area (LAA) which is defined in the Focus Report, in part, as a 200 m radius around the effluent discharge point.

From a crustacean health perspective, it is concerning that of the nine metals (aluminum, barium, cadmium copper, iron, manganese, mercury, phosphorus, zinc) which had higher concentrations in the effluent than background water, all but cadmium were dropped from the screening process for Chemicals of Potential Concern (COPC) with respect to water quality due to a lack of Canadian Water Quality Guidelines. If many background water metal levels are confirmed to be 'not detectable', the list of metals in effluent higher than background water will likely expand. Metals, especially copper, are recognised as acute (short term) toxins to American lobster and other marine crustaceans. There is insufficient information in the literature, the Focus Report or the EARD on the effects of sub-acute (medium term) or chronic (long-term) exposure to low levels of metals, directly or through bioaccumulation, on the American lobster. The Focus Report indicates custom toxicity tests have been developed for lobster larvae. It would be preferable to see an unequivocal commitment to use them in any future effluent toxicity testing. Inclusion of chronic exposure of adults, eggs and generational testing is also encouraged.

Anthropogenic noise (seismic testing, mechanical) is increasingly recognised as potentially harmful to marine life, including warm water lobster species, with even short exposures having long term negative effects on behaviour or increasing mortality levels. Exposure to high intensity sound is listed as a recognised interaction during the construction (three months) and operation and maintenance (several decades) phases of the project. These interactions were not considered significant as the exposures were short. Assessment of the potential for negative effects on larval, juvenile and adult American lobsters and eggs exposed to high intensity sounds is warranted.

No reference to the potential impact, if any, of the high temperature effluent in the 4 km of pipeline might have on the temperature of the overlying sediment or water column was found. This may be relevant as larval lobster drifting in the water column are susceptible to high temperatures. The movements of juvenile and adult lobsters on the ocean floor could be modified as they would likely move to avoid temperatures above their tolerance limits.

Overall, there were reporting errors noted that need to be evaluated for any effect on 'distance from diffuser that ambient conditions are reached' and screening for COPCs. The exclusion of many metals from the list of COPC and minimal information on bioaccumulation is concerning as metals are known to be toxic to American lobster. A stronger commitment to the inclusion of developed custom lobster larval effluent toxicity assays in EEM and long-term adult and generational studies is encouraged. Further evaluations on the potential effects of exposure to high intensity sounds and thermal effects, if any, from the 4 km of pipeline, during the life of the project are recommended.

EXPERTISE

SCOPE OF REVIEW

A general review of the pertinent sections of the Focus Report and associated Appendices (1.2, 2.3, 2.4, 4.1, 4.2, 7.3, 7.4, 9.1, and 9.2) and EARD was completed with a specific interest on potential effect of the treated effluent on crustaceans. Provided references in the Focus Report and Appendices, as available, were reviewed. This led to a focus on metal concentrations in the current treated effluent as these are meant to be surrogates for metal concentrations in the proposed treated effluent and background water quality. Inconsistencies in reporting were noted in the raw data summary tables for metals in Caribou Harbour (background). These were followed up in detail including how inconsistencies might affect other tables and calculations and implications as carried through the associated Appendices and the Focus Report. This represents the bulk of the material presented in this report given time constraints. Information on the known toxic effects of metals on American lobsters and other crustaceans and, short- and long-term effects of seismic testing on plankton and adult warm water lobsters, respectively is also provided.

GLOSSARY

CMC	Criterion Maximum Concentration
CCC	Criterion Continuous Concentration
CCME	Canadian Council of Ministers of the Environment
CWQG	Canadian Water Quality Guidelines
COPC	Chemicals of Potential Concern
DACVP	Diplomate American College of Veterinary Pathology
Dataset	the numbers, or values, used for evaluation
DVM	Doctor of Veterinary Medicine
EARD	Environmental Assessment Registration Document
EEM	Environmental Effects Monitoring
Maximum	the largest value in a dataset
Mean	the average value in a dataset (sum of all values / number of values)
Median	the middle value of set of values arranged in ascending order
Minimum	the smallest value in a dataset
MVSc	Master of Veterinary Science
n	The number of values in a dataset
ND	*"A non-detect value is a laboratory assigned concentration that indicates the concentration of that parameter in the sample is below the level that could be detected or reliably quantified by the laboratory using a particular analytical method*."
NG	not given
NPNS	Northern Pulp Nova Scotia
PPER	Pulp and Paper Effluent Regulations
Range	the difference between the largest and smallest values in a dataset
RDL	reportable detection limit; the lowest value that an assay/test can detect in a sample
Standard Deviation	a measure of the amount of variation in a dataset

INCONSISTENCIES NOTED IN THE PROVIDED DATA BY SECTION

Throughout the Focus Report, tables often reported means without standard deviations and/or reported medians without a range or did not indicate if a mean or median value was being presented. Attempts were made to examine the raw data to better understand which values were being reported in the tables; however, some of the data could not be found in the Appendices. As metals e.g., copper, cobalt, cadmium and zinc, are recognised toxins for American lobsters and other crustaceans (Johnson & Gentile, 1979; Maharajan, Rajalakshmi, Vijayakumaran, & Kumarasamy, 2012; Maharajan et al., 2011; McLeese, 1974; Mercaldo-Allen & Kuropat, 1994) the raw data for tables with information on metal concentrations in water were examined in the most detail.

1. **Focus Report Section 2. 'Project Description'**
   In Section 2.3 of the Focus Report 'Characterization of the Effluent' and its associated Appendix 2.3, neither the raw data for the indicated May 29, 2018 Point C (treated effluent) nor the data collected during annual testing by NPNS since 2015 could be located. Appendix E-2 of Appendix 7.3 suggests sampling dates of Feb 25, 2015, Oct 2, 2016 and Feb 23, 2017. Consequently, verification or determination of range (max and min) or standard deviations was not possible. Providing standard deviations and range in addition to the average, or mean, values would have provided a better indication of the variation in the data.

Table A. Summary of water quality and effluent samples that were indicated as collected for use in the focus report and those for which raw data could be found.

Freshwater 'Raw'		**Point 'A'**		**Point 'C'**		**Caribou Harbour**	
Sampled	**Data Available**	**Sampled**	**Data Available**	**Sampled**	**Data Available**	**Sampled**	**Data Available**
Apr 24/18	Yes	May 29/18	Yes	May 29/18	Not found	May 24/19 13:00 (CH-BOF 1-2 outfall, flooding, bottom 20m)	Yes
May 14/19	Yes	May 14/19	Yes	May 14/19	Yes	May 24/19 13:30 (CH-BOF 1-1 outfall, flooding, surface 0.5 m)	Yes
				July 17/19	Yes	May 25/19 17:00 Caribou Seawater 1 (Caribou Harbour, ebbing, surface 0.5m)	Yes
				Annual testing data collected since 2015 (dates in Appendix E-2, of Appendix 7.3 suggest *n* = 3)	Not found	May 25/19 17:00 Caribou Seawater 2 (Caribou Harbour, ebbing, bottom 3m)	Not found
						May 25/19 18:15 (CH-B 2-1 outfall, ebbing, surface 0.5m)	Yes
						May 25/19 18:15 (CH-B 2-2 outfall, ebbing, bottom 21m)	Yes
						May 25/19 18:15 (2-W1) Not defined in Table 4.1-1	phenol results only
						October 2018 for chemical characterization at diffuser site?	Not found
						June 2019 for chemical characterization at diffuser site?	Not found

Water quality data for 'May 25/19 17:00 Caribou Seawater 2', October 2018, and June 2019 could not be located. Only phenol data were available for site labelled '2-W-1, Caribou Harbour, May 25, 2019'. These findings are summarised in Table A of this report.

Table 1-3 'Analytical Results, Metals', in Section 1.3.2 'Metals' of Appendix 2.3 ($n = 6$) reports some metal concentrations in Caribou Harbour as ND, defined in Table 2.3-2 of the Focus Report as "*ND = Non-Detect. A non-detect value is a laboratory assigned concentration that indicates the concentration of that parameter in the sample is below the level that could be detected or reliably quantified by the laboratory using a particular analytical method*." This is consistent with results from the five May 2019 samples which are available for review. This contrasts markedly with results presented in Table 4-3 'Marine Water Quality COPCs and Estimated Dilution' of Appendix 7.3 (which also appears as Table 7.3-1 in the Focus Report) where the 'Median Background Quality' values for 2019 are reported. Here, median background levels for metals are 10-fold greater than their reportable detection limits (RDLs) (see item 2, following).

Table 1-3: 'Analytical Results, Metals' also has a footnote for the Caribou Harbour cadmium results *"Cadmium of 0.12 µg/l was detected in one Caribou Harbour sample, all others were below the 0.1 µg/l detection limit*." The actual detection limit for cadmium appears to be 0.01 µg/l (see item 2, following).

2. **Appendix 7.3, Section 3. 'Existing Environment'**

Section 3.1.1 'Background Water Quality' indicates that water samples were collected for chemical characterisation in October 2018, May 2019, and June 2019 (eight within Caribou Harbour along the pipeline and 14 within the effluent mixing zone). The summary and individual values are supposed to be found in Appendix B. No individual data or quality assurance data were found other than that for the five May 24 and May 25, 2019 samples at the end of Appendix 2.3 'Raw and Treated Effluent Characterisation' under 'Caribou Harbour' (see Table A, this report). Summary data for **'Background Water Quality at Diffuser Location (2018-2019)** are provided in **Appendix B-1** (with 1 - 14 samples evaluated depending on parameter = 'count'; all metals indicate $n = 14$). Summary data for '**Background Water Quality at Pipeline Corridor (2018 – 2019)**' (from 1 - 5 samples evaluated, depending on the parameter; $n = 5$ for all metals) are presented in **Appendix B-2**.

All (14/14 and 5/5) values for copper in Appendices B-1 and B-2, respectively, were recorded as below their RDL in the column 'Count (<RDL)'. According to the quality assurance data in Appendix 2.3, water quality results for other sites, and suggested by a value of <0.5 µg/l appearing in the minimum value column in Appendix B-1, the RDL for copper is assumed to be 0.5 µg/l. Yet, Appendix 7.3, Section 3.1.6 'Metals', states that "*Two metals (copper and nickel) were reported in one or more surface water samples, taken along the pipeline route or diffuser location, above the EPA chronic screening level criteria (3.73 µg/L and 8.28 µg/L, respectively*)." A value of 3.73 µg/l is above the apparent reprotable detection limit (RDL) and so the result for column 'Count (< RDL)' should be either 13/14 for Appendix B-1 or 4/5 for Appendix B-2 depending on where the sample was collected. It is also unclear why the median and maximum values would be reported as < 5 µg/l when the RDL appears to be 0.5 µg/l (see item 3, following).

3. **Appendix 7.3, Appendices B-1 and B-2**

   Some of the raw data and quality assurance data for Appendices B-1 and B-2 could not be found (see item 1 above, Table A). The May 2019 water samples had RDLs provided in their quality assurance data (found in Appendix 2.3). These RDLs, rather than the value presented in the result tables, will be assumed to be correct.

   Inconsistencies in the reporting for metals are noted when low, non-detectable (ND) values are encountered, particularly evident in Appendix B-1. While it is not incorrect that e.g., a value that is less than 0.5 µg/l is also less than 5.0 µg/l, it is not as accurate as it could be. The convention would be to report a non-detectable value as less than the reportable detection limit (RDL) for the parameter (as done in the results for 'Raw Water', Point A, and Point C, Table 3-1 in Appendix 2.3, and the minimum value column in Appendix B-1, Appendix 7.3). This is particularly important for the median values as these are carried forward to Table 4-3 of Appendix 7.3 (Table 7.3-1 in the Focus Report) for comparison to the modelled values for COPCs to determine the distance from the diffuser where dilution reaches ambient conditions.

   As an example, values for ***copper*** are reported as < 0.5 µg/l (minimum) but < 5 µg/l (median and maximum) in Appendix B-1. The RDL is reported as 0.5 µg/l in the accompanying Quality Assurance information in all but one water quality assessment report for Raw water, all Point A and Point C sites. As all values for copper are reported as being less than the RDL (column 'count < RDL'), which is similar to 'not detected' or ND, in Appendices B-1 and B-2, all values (minimum, median, and maximum) should be reported as < 0.5 µg/l or ND (as in the tables in Appendix 2.3). As a result, a median value of < 5.0 µg/l rather than < 0.5 µg/l (a minimum 10-fold increase) for copper in background water at Caribou Harbour is carried through to Appendix E-1 '*Step 1 in Screening Process: Comparisons of Concentrations in Treated Effluent (represented by current treated effluent concentrations) to Background Concentrations (represented by concentrations at the location of the proposed diffuser)*'and Table 4-3 in the Appendix 7.3 and the Focus Report Table 7.3-1. Note that even with a value for copper of 3.73 µg/l (see item 2 above) in Appendix B-1 or B-2, this would not affect the median (or middle) value for copper as the rest were < RDL.

   This occurs with all metals (***aluminum***, ***barium***, ***iron***, ***manganese***, ***zinc***) where values are below the RDL e.g., median cadmium concentrations reported as < 0.1 µg/l *vs* < 0.01 µg/l. These changes are summarised in Table B of this report.

   A cursory screen of the minimum and median values for the '***Dioxin and Furans'*** category also reveals variability in the reporting of what appears to be the RDL. No obvious patterns were recognised. This was not investigated further in the current report.

   The values reported for ***mercury***: minimum (<0.002 µg/l), median (<0.00225 µg/l), and maximum (<0.013 µg/l) in Appendix B-1; and, minimum (<0.002 µg/l), 5th percentile (<0.00202) 50th percentile, (0.0034 µg/l), 95th percentile (<0.013 µg/l) and maximum (<0.013 µg/l) are not consistent with the available raw data, values in the 'count < RDL column', nor the RDL of 0.013 µg/l as shown in the quality assurance data. When the RDL of an assay is 0.013 µg/l, values less than that cannot be reported. Such values should have been listed as < 0.013 µg/l or ND. Two of 14 results in Appendix B-1 and two of five results in Appendix B-2 are indicated as being above the RDL. As a result, values of 0.013 µg/l or greater should have been reported as the maximum value in each table but both are shown as < 0.013 µg/l. A result of 0.013 µg/l is reported in the May 25, 2019 18:15, CHB 2-1 raw data for Caribou Harbour. With 3/5 and 12/14 values below the RDL in Appendix B-1 and B-2 respectively, the minimum and median values would have to be reported as ND or < 0.013 µg/l. Of note, the averaged or mean (not median) value for mercury in the effluent (Point C) presented in Table 1-3 of Appendix 2.3 'Raw and Treated Effluent Characterization' is 0.022 µg/l while the result for Caribou Harbour is ND.

For ***manganese***, Appendix B-2 indicates only 4/5 values were below the RDL but the maximum value is reported as less 20 µg/l. (note that the RDL is reported as 2.0 µg/l for other sites and suggested as 2.0 µg/l in Appendix B-1, minimum value for manganese)

4. **Appendix 7.3, Appendix E-1 'Step 1 in Screening Process: Comparison of Concentrations in Treated Effluent (represented by current treated effluent concentrations) to Background Concentrations (represented by concentrations at the location of the proposed diffuser)**

   The column 'Median Background Concentrations (Proposed Diffuser Location)' contains values generated in Appendix B-1 of Appendix 7.3. The 'less than' symbol '<' has been dropped from all values with the consequence that a median value that was e.g., <10 µg/l (includes values from 0 - 10 µg/l) becomes 10 µg/l. This error is compounded by the fact that median values for most metals in Appendices B-1 and B-2 suggest RDL values which are at least 10-fold higher than shown in the quality assurance data. For example, copper was reported as ND in all available background water sample data and in Appendix 2.3. Using the RDL from the quality assurance data for the copper assay, all values including the median value, were less than 0.5 µg/l (includes 0.0 – 0.49 µg/l) or ND rather than 5.0 µg/l as shown in Appendix E-1. This represents at least a 10-fold increase. The median background levels for cadmium are reported as 0.1 µg/l and should be reported as either less than 0.01 µg/l (includes 0.00 – 0.009 µg/l) or ND. Similar minimum 10-fold increases are noted for aluminum, iron, manganese, and zinc. The median background level for mercury should be less than 0.013 µg/l (includes 0.00 – 0.012 µg/l) or ND, rather than 0.00225 µg/l.

5. **Appendix 7.3, Table 4.3 'Marine Water Quality COPC and Estimated Dilution'**

   Assuming that the numbers used to populate the column 'Median Background Quality' are drawn from Appendix B-1 (*n*=14) only and that the available quality assurance data is the best indicator of the RDLs, and results in Appendix 2.3 are correct, the median levels for ***copper***, ***iron***, ***manganese*** and ***zinc*** are more correctly reported as either ND or as less than their RDLs which are 0.5 µg/l, 50 µg/l, 2.0 µg/l, and 5 µg/l, respectively as all values for all four metals were reported as less than their RDLs (<RDLs) in Appendix B-1. For ***aluminum***, the median value should be

reported as ND or less than 5 µg/l, not 50 µg/l, as 13 of 14 values were less than the RDL of 5 µg/l. The median value for mercury should be ND, as 12 of 14 values were ND, or less than 0.013 µg/l.

Multiple inconsistencies are noted for background water quality for ***cadmium*** where 13 of 14 values were reported as ND in Appendix B-1 subsequently, the median value should also be ND or less than 0.01 µg/l. Appendix 7.3, Table 4-3 currently shows a value of 0.084 µg/l for both the median background concentration and for the concentration at 100 m based on dilution ratios. Table 4.1-2, Focus Report '***Background Water Quality at Caribou Harbour used in RWS'*** also shows a value of 0.084 (median or average not specified) for cadmium, with the accompanying text indicating that the value was derived from the May 2019 water samples. All but one (0.12 µg/l) of these results (raw data on five of six samples are available in Appendix 2.3) were ND or, less than the RDL of 0.01 µg/l. The median value would be ND or less than 0.01 µg/l. An averaged value of 0.084 µg/l is shown in Table 14 'Background Water Quality' of Appendix 4.2 'Receiving Water Study' and described in the text as "*water quality data for Northumberland Strait around the CH-B location collected in May and June 2019*". Water quality data for June 2019 could not be found in the Focus Report documents to verify this result. It is noted that values for many metals and other compounds at 100 m are identical to the currently reported 2019 median background levels in Table 4.3, Appendix 7.3.

The maximum value for **cadmium** in effluent at Point C should be 1.4 µg/l (see raw data for cadmium in Appendix E-2 of 0.66, 0.73, 0.898, 1.11, and 1.4 µg/l). The value shown is 1.03 µg/l which is also the value shown in Appendix 2.3, Table 1-3 'Analytical Results, Metals' and is described as the average value using data from the current study and "*test data collected during annual testing done since 2015*".

The values for ***mercury*** at Point C, and 5 m and 100 m from the diffuser are all 0.028 µg/l suggesting no dilution is occurring with increasing distance from the diffuser. This is likely an entry error. The values for aluminum, barium, copper, zinc are also the same for 5 m and 100 m from the diffuser suggesting either no dilution is occurring with increased distance or, a table entry or calculation error.

The final column in Table 4-3 shows the 'Distance (m) from Diffuser Ambient Condition is Reached Based on Dilution Ratios'. The dilution ratios used to determine the distances are taken from Table 4-4 'Dilution Ratios at Distance'. As the median background, or 'ambient', levels, shown in Appendix 2.3, Table 1-3 as ND, have decreased by a factor of at least 10-fold for most metals if the RDLs from the available quality assurance data are used or, need to be adjusted for reasons mentioned above, the 'Distance from Diffuser Ambient Condition is Reached based on Dilution Ratios' should be recalculated to determine if the values currently listed (most at less than 2 m) remain valid. As all background medians for metals are less than their RDLs, any distance values calculated using the RDLs would be minimum distances. The table currently shows values of 0.028 µg/l for mercury at both 2 m and 100 m from the diffuser, neither of which are below the current reported median background value of '0' µg/l or the RDL of 0.013 µg/l. The value of <2 m as the distance from diffuser ambient condition is reached is therefore incorrect. Using the values currently presented in Table 4-3 it should be >100 m.

It is unclear why the 'Distance from Diffuser Ambient Condition is Reached based on Dilution Ratios' is often reported as <2 m while column heading indicates 'Concentration at 5 m from Diffuser based on Dilution Ratios'.

Values for total Dioxans and Furans, Phenanthrene (PAH), Total Resin Acids, Total Fatty Acids, Total P&P Phenols and other water quality parameters presented in Table 4-3 were not evaluated for the purposes of this report.
Table B summarises the points raised in items 1 – 5 above.

6. Appendix 7.3. Figure 3-7: Benthic Invertebrate Relative Abundance in Representative Substrate Types

These values represent EEM cycles 3, 4, 5, and 7 spanning a 14-year period from 2002 through 2016. The data is presented as pie charts. The accompany text does not indicate whether these are averaged values or medians. Results from the most recent cycle in 2016 would be more representative of the current situation. Of interest, would be a presentation of changes, if any, that have occurred from 2002 to 2016.

Table B. Partial replication information presented in Table 4-3 of Appendix 7.3 (presented in the Focus Report as Table 7.3-1) and Appendix 2.3, Table 1-3, showing the effects of reporting median background levels of metals as less than the Reportable Detection Limit (RDL) derived from the available quality assurance information for the parameter. Shaded and outlined boxes contain values of particular interest discussed in the accompanying text.

Parameter	unit	RDL[1] from Quality Assurance Data	CWQG [2] (marine)	Median Background (Caribou Harbour) Quality		Appendix 2.3 Average Caribou Harbour Results (*n* = 6)	Maximum Effluent Quality Point C – original values (*n* = 6?[3])	Maximum Effluent Quality Point C – corrected values (*n* = 6)	Fold Increase Point C over Revised Median Background Quality	Concentration at 5 m from Diffuser based on Dilution Ratios	Concentration at 100 m from Diffuser based on Dilution Ratios	Distance (m) from Diffuse Ambient Condition is Reached based on Dilution Ratios - Original	Distance (m) from Diffuse Ambient Condition is Reached based on Dilution Ratios – Revised[7]
				2019 Original Value (*n* =14)	2019 Revised Value (*n* = 14)								
Aluminum	µg/l	5.0	NG[4]	50	<5.0 (ND)[5]	ND	2330	nc[6]	≥466	50	50	<2 m	?
Barium	µg/l	1.0	NG	10	<1.0 (ND)	13	450	nc	≥450	10	10	<2 m	?
Cadmium	µg/l	0.01	0.12	0.084	<0.01 (ND)	ND	1.03	1.4	≥140	0.1	0.084	<2 m	?
Copper	µg/l	0.5	NG	5	<0.5 (ND)	ND	7.5	nc	≥15	5	5	<2 m	?
Iron	µg/l	50	NG	500	<50 (ND)	ND	718	nc	≥14.36	≤500	≤500	<2 m	?
Manganese	µg/l	2.0	NG	20	<2.0 (ND)	ND	2800	nc	≥1400	54	19	≈50 m	?
Mercury	µg/l	0.013	0.016	0	<0.013 (ND)	ND	0.028	nc	≥2.15	0.028	0.028	<2 m	?
Zinc	µg/l	5	NG	50	<5.0 (ND)	ND	160	nc	≥32	50	50	<2 m	?

[1] RDL = Reportable Detection Limit
[2] CWQG = Canadian Water Quality Guidelines
[3] dates in Appendix E-2, of Appendix 7.3 suggest *n* = 6 total (cadmium), includes the 'annual testing data since 2015' (Feb 25, 2015; Oct 2, 2016; Feb 23, 2017)
[4] NG = not given
[5] ND = not detectable
[6] nc = no change

POTENTIAL ENVIRONMENTAL IMPACTS OF NORTHERN PULP NOVA SCOTIA'S PROPOSED PROJECT ON FISHERIES AND THE MARINE ENVIRONMENT WITHIN THE NORTHUMBERLAND STRAIT

METAL CONCENTRATIONS IN CARIBOU HARBOUR

Appendix 2.3 states "*Other metals, such as cobalt, titanium, copper, zinc and aluminum are also likely coming from the pulping process as non-process elements in the wood itself. As described earlier, these non-process elements are regularly purged from the system, either via the effluent or solid waste, in order to protect the integrity of the equipment and the process. Except for aluminum, which is used as alum (aluminum sulphate) in the treatment of raw water from Middle River, none of these metals are components of additives used in the pulping process.*"

While 'naturally' occurring from the wood itself these metals are still toxic to crustaceans. A 1994 report summarises acute and subacute effects on American lobsters of a wide range of contaminants including metals (Mercaldo-Allen & Kuropat, 1994).

Lack of a CCME, Canadian Water Quality Guideline for the Protection of Aquatic Life resulted in all of metals that were found in higher levels in the effluent than in the background water, but cadmium, being dropped from the review process for COPC in Appendix 7.3 Section 4.1.3.2 'Potential Effects Arising from Project-Related Emissions' , Figure 4-1 'Overview of Process for Identifying COPCs in Treated Effluent.

The maximum values for copper at Point C (7.5 µg/l) and modelled values at 100 m (5 µg/l) (Table 7.3.1 and Appendix E-1) are below reported acute toxicity levels 48 µg/l (larvae) and 56 – 100 µg/l (adults) (Johnson & Gentile, 1979; McLeese, 1974) but are above the US Environmental Protection Agency list of National Recommended Water Quality Criteria levels of 4.8 µg/l , acute CMC (criterion maximum concentration) and 3.1 µg/l, chronic CCC (criterion continuous concentration) (US EPA, 1994.). This was also mentioned in Appendix 7.3, Section 3.1.6. Susceptibility to copper increases with increasing water temperature (McLeese, 1974) which may prove relevant in a world of increasing water temperatures and climate change. Subacute copper toxicity levels for *H. americanus* were not found. Levels of 9.55 µg/l and 19.1 µg/l over 28 days, caused damage to muscle, hepatopancreas, gills and heart tissue and chromosomes in the spiny lobster *Panulirus homraus* (Maharajan et al., 2012, 2011).

Cadmium has been associated with moult inhibition in the crab, *Chasmagnathus granulatus* and *Daphnia magna,* and inhibition of ovarian growth in fiddler crabs (*U. pugalotor*) exposed for two weeks (Rodríguez et al., 2007). Changes (transient increases (hyperglycemia) in acute exposures, decreases in chronic exposures) in hemolymph (blood) glucose levels in response to metal exposure have been documented in crayfish and in the shrimp *Palaemon elegans* exposed to mercury, cadmium, and copper (Rodríguez, Medesani, & Fingerman, 2007). Heavy metal exposure can also inhibit food intake by small crustaceans (Rodríguez et al., 2007).

Acute, lethal concentrations (LC-50 at 96 hours) of cadmium, copper, and mercury for stage I *Homarus americanus* larvae were determined to be 78 µg/L, 48 µg/L, and 20 µg/L, respectively (Johnson & Gentile, 1979) and 56 to 100 µg/L for copper in adult American lobsters, depending on temperature (McLeese, 1974). Although the current maximal effluent and modelled levels at 100 m of these metals are below the few toxic levels known for American lobsters, and PPER Guidelines do not require it, it would be advisable to regularly monitor the level of all metals in the sediment, water, plant and animal life during the anticipated life of the mill project as part of an EEM program were the project to go ahead. The information available on the longer term, or subacute, toxic levels of these metals in American lobsters is limited and more studies would be advisable. The potential for bioaccumulation was not addressed in the Focus Report but is of concern given the anticipated lifetime of 'several decades' for the mill and the potential for change in the system.

NEED FOR ENVIRONMENTAL EFFECTS MONITORING

If 'Distance (m) from Diffuser Ambient Condition is Reached based on Dilution Ratios' values are changed, an EEM program could be required. In Appendix 7.3, Section 5.1 'Environmental Effects Monitoring Program' states:

> *"Within the regulations there are provisions for the removal of the requirements for specific components of the EEM program based on the dilution of effluent to <1%. If the mill demonstrates that the effluent concentration is <1% at a distance of 250 m then the EEM does not require a fish community study component. Likewise, if the mill demonstrates that the effluent concentration is <1% at 100 m from the discharge then a benthic invertebrate community study is not required. The most recent 3D modeling of effluent dispersion in the local study area as part of the updated receiving water study (RWS) indicates that dilution to less <1% effluent will occur at approximately 20 m from the discharge (Stantec ,2019).*"

The importance of lobster is recognised, and it is indicated that "*custom tests have been developed that can be completed using larval lobster and herring embryos. The tests will include Stage I-IV larval lobster and include a live-dead (acute) assessment of the various stages, as well as the assessment of sublethal effects on moulting time and growth.*" This is very encouraging. Of concern is the preceding statement of "*NPNS will continue to <u>investigate the feasibility</u> of performing toxicity testing to determine both potential acute and sublethal effects on immature stages of lobster and herring*". Given the major economic value of lobster to the region, it would be preferable to see that NPNS has committed to run these tests unequivocally. As the tests have been developed, it is regrettable that they were not performed over the summer of 2019 when larvae were present. It is possible that the tests were being developed during this time, however. Inclusion of chronic exposure of adults and generation testing would also be encouraged.

Section 4.2, 'Receiving Water Study' presents information on one month simulated spatial distribution studies in July and February showing only a few traces of highly diluted effluent in the region (Figures 4.2-3 and 4.2-4). It would be preferable to see simulated distributions of effluent at 12-, 24-, 36-months or 'decades' of operation of the mill. This might provide information on the risk of bioaccumulation.

HIGH INTENSITY SOUNDS

Seismic testing is used to examine the sea floor when doing oil and gas exploration. A 2017 paper describes the dramatic, deadly and widespread effect on plankton within 1.2 km a test site (McCauley et al., 2017). A two- to three-fold increase in number of dead larval (included decapod larvae) and adult plankton was detected. Larval lobster, decapods, are part of the plankton community. In a separate study, noise from seismic testing was shown to have prolonged (>365 days and a moult) damaging effect to the sensory hairs of the statocyst (a structure involved in coordinating body position and movement) and a delay in righting reflex in adult rock lobsters, *Jasus edwardsii*, (Day, McCauley, Fitzgibbon, Hartmann, & Semmens, 2019). The study also discusses how other anthropogenic noises can negatively impact behaviour in other crustaceans. The plain language summary section of Appendix 7.3 mentions exposure to high intensity sounds as seismic testing for three months during construction and as part of Operations and Maintenance for several decades commencing 2021. Section 4.1.6 'Consideration of Significant Residual Effects', Table 6 does not include noise in Potential Physical Effects. Further study to identify what effects, if any, the expected high intensity sounds might have on life stages of American lobster is warranted.

SEDIMENT AND WATER TEMPERATURE CHANGES ASSOCIATED WITH THE BURIED PIPELINE

Modelling of water temperature of effluent (35 ^{o}C) at the diffuser outflow site anticipates that the temperature of the receiving water will reach background summer levels of 17.2 ^{o}C and 16.8 ^{o}C at 5 m and 100 m from the diffuser, respectively. These temperatures are below the reported 31.1 ^{o}C – 29.1 ^{o}C range of lethal temperatures, for exposures of one to 24 hours, for larval lobsters and the sublethal temperatures of 20 ^{o}C - 26 ^{o}C, for short and long term exposures, as summarised by Quinn (Quinn, 2017).

The project proposal indicates 4 km of buried pipeline carrying water of around 35^{o}C. Information on what, if anything, this might do to the temperature of the 4 km of overlying sediment and surrounding water column was not found in the Focus Report. Adult lobster can easily move away and avoid or go around an area if the temperature proves inhospitable while larval stages cannot. Information on expected temperature effects on associated sediment and water column, including any anticipated effects on baseline water temperatures due to climate change over the expected lifetime of the project (several decades), could be relevant.

CONCLUSIONS & RECOMMENDATIONS

- The missing raw and associated quality assurance results for Appendices B-1 and B-2 in Appendix 7.3, should be provided so that the values listed can be verified.

- Minimum, median, maximal, and percentile values should be reported as less than the RDL values where appropriate (will also provide consistency with summary tables for other sample sites) and Appendices B-1 and B-2 updated.

- Values in Table 4-3 of Appendix 7.3 and Table 7.3-1 in the Focus Report should be updated as required and the values for 'Distance (m) from Diffuse Ambient Condition is Reached based on Dilution Ratio' revised as needed.

- There is inadequate information available on the acute, chronic and generational toxic effects of metals on crustaceans, particularly American lobster. Further studies are warranted given all life stages may be exposed to diluted effluent over several decades should the project be approved.

- It would be preferable to see simulated distributions of treated effluent at 12-, 24-, 36-months or 'decades' of operation of the mill. This might provide information on the risk of bioaccumulation.

- There is inadequate information available on the acute, chronic and generational effects of marine noise on crustaceans, particularly American lobster. Further studies are warranted given all life stages may be exposed to seismic and mechanical noise for months and over several decades, respectively, should the project be approved

- There is inadequate information on the temperature effects, if any, the hot effluent travelling in the 4 km of buried pipeline might have on the overlying sediment and water column. Further studies are warranted as warmer temperatures could potentially present a mobility barrier to adult lobster or heat stress to larvae.

- The language for inclusion of lobster larval assays for determining effluent toxicity in any future EEM program is not as strong as it could be. Given the economic importance of lobster to the region, lack of CWQG values for most metals in marine waters and known toxic effects of metals to larval and adult crustaceans, close monitoring of these populations would be advisable. Inclusion of chronic exposure of adults and generation testing would also be encouraged.

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APPENDIX

Resume for

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REVIEW OF NORTHERN PULP'S FOCUS REPORT

PREPARED FOR:
GULF NOVA SCOTIA FLEET PLANNING BOARD, PEI FISHERMEN'S ASSOCIATION AND MARITIME FISHERMEN'S UNION

NEXUS Coastal Resource Management Ltd. | November 2019

NEXUS COASTAL

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1 INTRODUCTION

NEXUS Coastal Resource Management Ltd. (NEXUS) was contracted by on behalf of Gulf Nova Scotia Fleet Planning Board, PEI Fishermen's Association and Maritime Fishermen's Union to undertake a comprehensive review of the Focus Report regarding the Replacement Effluent Treatment Facility Project proposed by Northern Pulp Nova Scotia Corporation (NPNS).

1.1 EXPERTISE

NEXUS has assembled a group of experienced professionals and academics for this work. The following provides an overview of the qualifications of our team to provide this expertise.

Name	Education	Qualifications/Experience	Contributions to this Report
Chris Milley	M.M.M., M.Sc., B.Sc.	• Specialization in oceanography, chemical oceanography, fisheries, fisheries management, fisheries economics, environmental impact assessments, socio-economic analysis, stakeholder engagement methods/practices	Senior Review of all Sections Sections 1.3, 2.1, 2.2, 2.3, 2.4, 2.5
Dr. Ian Stewart	Ph.D., M.A., B.Sc.	• Research specialization in environmental science, science policy and public dimensions of science, environmental impact assessments	Section 2.1, 2.2, 2.3, 2.4, 2.5
Chris DeBow	CAPM, MDE, B.Comm	• Specialization in economic analysis, socio-economic analysis, fisheries economics	Section 2.3, 2.4, 2.5
Maria Delesalle	M.M.M., B.A.	• Specialization in stakeholder engagement methods/practices, socio-economic analysis	Section 1.3, 2.1, 2.2, 2.3, 2.4, 2.5

1.2 ISSUES ADDRESSED

The following summarizes the key issues NEXUS was asked to address during our review of Northern Pulp's Focus Report.

1. NEXUS specifically addressed the following areas of the EA, including the bio-physical, social and economic impacts of the project on fisheries in the Northumberland Strait.
    a. Major findings and conclusions expressed in the materials filed by Northern Pulp

b. Reliability of the underlying research relied upon in reaching the findings and conclusions
c. Information gaps within the materials filed by Northern Pulp
d. Impacts on the reliability of conclusions made in the materials filed by Northern Pulp
e. Assumptions that were relied upon in the materials filed by Northern Pulp and their reliability of these assumptions and their impact on conclusions made in the materials

2. Review of the Focus Report and associated supporting documentation, including but not limited to the Terms of Reference for the Focus Report, and relevant sections of the EA registration documents;
3. Desktop research to compile relevant knowledge and supporting experience from other jurisdictions and similar projects to support analysis and preparation of recommendations.

1.3 Approach

NEXUS used the following principles and questions to guide our review of the Focus Report:

Principles:

1. The review is unbiased. Efforts were made to avoid positional perspectives such that NEXUS did not undertake the review in an attempt to prevent or promote the NPNS project.
2. To provide honest, transparent and useful advice.

Questions:

Efforts were made to answer the following questions for each section of the Focus Report reviewed.

1. Is the information in the Focus Report complete?
2. Is the information in the Focus Report reasonable?
3. Are the assumptions made in the Focus Report valid?
4. Are there outstanding issues that should be considered or addressed, particularly from the perspective from the Fishermen's Organizations?
5. Based on the above, what questions or recommendations should the Fishermen's Organizations pose to the Nova Scotia Environment?

2 Review & Key Findings

2.1 Format and Focus

In undertaking this review NEXUS was cognizant of the fact that during the development of the EARD and the subsequent Focus Report changes were being introduced in the nature and approach to impact assessments in Canada. Accordingly, the review of the Focus Report took a broader approach in keeping with the principles of impact assessment that were introduced in Bill C68 (An Act to amend the *Fisheries Act* and other Acts in consequence) and Bill C69 (An Act to enact the *Impact Assessment Act* and the *Canadian Energy Regulator Act,* to amend the *Navigation Protection Act* and to make consequential amendments to other Acts). All of these associated Acts with Bill C68 and Bill C69 have received Royal Ascent. It is clearly understood that the Province of Nova Scotia's Environment Act *(Nova Scotia Environment Act)* is the governing legislation for the Northern Pulp Nova Scotia's EARD and subsequent Focus Report, changes made at the federal level are likely to be reflected in provincial legislation due to the increased awareness of the need to consider social, economic and cultural impacts of projects. In the past, the need to consider project effects on Indigenous communities was similarly adopted by provincial environmental assessment processes after becoming a requirement in federal EAs. The results of NEXUS' review is presented in table format in Section 3.5. Some of the observations made during the review that are pertinent and may be of concern to Fishermen's Associations are also included as reviewers' comments in Table 2 below.

2.2 Bio-physical Impacts

Many of the concerns that precipitated the need for the Focus Report were both scientific and non-scientific regarding the potential and perceived impacts of the introduction of effluent into the marine environment through a dispersion pipe in Caribou Harbour. Northern Pulp Nova Scotia (NPNS) engaged several environmental engineering consultants and scientists to conduct studies to address the questions raised and set out in the Terms of Reference for the Focus Report (including Addenda).

For the most part, NPNS has provided sufficient information to technically and scientifically address the questions raised, albeit, many of these responses may not satisfy public perception concerns which were based on emotion or lack of trust. NEXUS' review of the Focus Report and Appendices did, however, identify some areas where the level of content and scope of the information provided are not fully satisfactory, in that they either did not fully answer the question or the level of content was inadequate.

In general, the approach to disposal of Compounds of Public Concern (COPC) and Total Suspended Solids (TSS) by discharge into the marine environment has been a contentious issue, internationally, for decades. Consensus within the scientific and technical community is that COPC disposal in marine environments is unacceptable. Considering mounting concerns over the need for more stringent attention to cumulative effects and consideration of increasing stress indicators of ocean health (Bernier et al, 2018) greater study is required. For this reason, better design options should be considered that make use of best available technologies for minimizing absolute volumes of effluent discharged, or that maximize removal of effluent content of potential concern (Suhr et al, 2015; Kamali et al, 2019).

The results of this Focus Report confirm that the major difference between the proposed ETF and current ETF is simply that comparable effluent (in terms of volumes and content) will be discharged further out to sea, with more rapid dilution performance. This assumption appears to be based on the fact that settlement ponds are ineffective in removing dissolved heavy metals from effluent without the use of additional direct use of physical-chemical processing of effluent water (adsorption on new adsorbents, ion exchange, membrane filtration, electrodialysis, reverse osmosis, ultrafiltration and photocatalysis) or bio-absorption (Gunatilake, 2015 Ayres et al, 1994). Each of these processes involve additional investment and create their own problems, such as the creation of concentrated sludge, with significant potential but unspecified risk to the local environment.

Detailed observations and responses are provided in the Compliance Table (Table 1) and Reviewers Additional Comments and Considerations Table (Table 2) below.

2.3 ECONOMIC IMPACTS

A motivation for those advancing and opposing any new development relates to the economic impact that the project will have on their livelihood and economic wellbeing (economic competition, economic displacement, changes in property values, changes in cost of living etc.). This is true for the NPNS project as well. As noted in Section 3.1, While Impact Assessments, under the new federal *Impact Assessment Act* now include economic considerations as part of the assessment process, it is likely that these considerations should be included in NSE-led assessments to avoid conflict and economic uncertainty in other resource sectors. However, there is little detail in the Focus Report regarding the longer-term economic impacts of the project on other resource users in the area. This should include the impacts of the project on the changing perceptions of the fishery due to the presence of the ETF outflow, changes such as confidence in the fishery as a viable source of income that can impact intergeneration transfer of licenses, value of licenses, public perception of the health safety of the harvest from the area which can change market price, etc.

General comments and recommendations to mitigate potential impacts are provided in the in the Compliance Table (Table 1) and Reviewers Additional Comments and Considerations Table (Table 2) below.

2.4 SOCIAL IMPACTS

Similar to the lack of a robust economic impact assessment, social impacts and concerns were not specifically part of the Focus Report Terms of Reference; however, considering the nature and content of several public responses in the Concordance Table, NPNS should have taken social impact concerns into consideration when preparing responses in the Focus Report. This is also in keeping with the principles set out in the new *Impact Assessment Act,* and which should be considered under a robust and complete assessment under the provincial EA process.

Social considerations and impacts are of particular importance for coastal fishing communities, First Nations and fishing industry participants who are the groups most likely to be impacted by the project with little or no direct benefit from the project.

Specific comments regarding the participation of these most vulnerable groups are provided in the Compliance Table (Table 1) and Reviewers Additional Comments and Considerations Table (Table 2) below.

2.5 COMPLIANCE TABLE

The following table summarizes NEXUS' key findings, comments and considerations during the review of the NPNS Focus Report.

Table 1: Compliance Table

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
1. Public, Mi'kmaq and Government Engagement			
1.1 Provide a response (via a concordance table) to questions and comments raised by the public, Mi'kmaq and government departments, and incorporate these comments into the Focus Report where applicable. Comments may be summarized prior to providing the response.	Concordance Table is complete, however, the nature and level of detail of responses is lacking in several cases (addressed below)	1) Although the Concordance Table seems to address all questions and comments provided by public, Mi'kmaq and government departments in some cases responses are inadequate or incomplete. In particular, with respect to the Marine Refuge Buffer Zone within Scallop Fishing Area 24 (Appendix 1.1 p. 27 of 40), the answers provided do not address the concerns raised.	R1: The responses to the Focus Report by the initial reviewers of the EARD (as recorded in the Concordance Table in Appendix 1.1) should be publicly available. This is advisable, especially given the serious levels of concern expressed by both federal departments (Health Canada, ECCC, DFO) and local communities.
1.2 Provide a plan to share future reports and/or studies relevant to this project with the public and the Mi'kmaq such as the Pictou Landing First Nation, including but not limited to the future Environmental Effects Monitoring results for the new effluent treatment facility.	Incomplete	1) There is not enough specificity as to how and the frequency in which engagement will occur with each stakeholder group within the Stakeholder Engagement Plan. 2) It is important for all stakeholders to understand fully how project information and reports will be communicated so they can be properly prepared.	R1: NPNS should provide reports in a format that are understandable as well as sufficient information to meet the needs of fishermen on a timely basis. R2: Reports should be provided on a routine and regular basis. A timetable should be provided to all stakeholder groups.

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
2. Project Description			
2.1 Provide the following information regarding the on-land portion of the effluent pipeline: o A re-alignment route for the effluent pipeline, given Department of Transportation and Infrastructure Renewal does not permit the pipeline to be placed in the shoulder of Highway 106; o Maps and/or drawings of the new pipeline location; o A list of properties (i.e.., Premises Identification number or PID) that will intersect with the new pipeline alignment.		N/A	
2.2 Conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must determine the potential impacts of ice scour on the pipeline.	Incomplete	1) The Report does not provide information on the specific sediment types other than size. 2) With respect to ice scouring the survey only used a single year study. There is no mention as to whether this was an average for ice conditions and there was no determination of extreme weather events during ice breakup. These factors could have a significant implication to ice scouring.	R1: Information on the mineral composition of the sediment will be useful in understanding the dynamics between effluent and the sediment, such as chelation and adsorption, which is useful in regard to contaminant dispersion. R2: A multi-year ice scouring survey should be conducted, including an analysis of the effects of changing ice conditions due to climate change.
2.3 Submit data regarding the complete physical and chemical characterization of NPNS' raw wastewater (i.e.., influent at Point A for the Project), to support the assessment of the appropriateness of the proposed treatment technology. The influent characterization results must be	Complete	No comment	

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
compared against the proposed treatment technology specifications.			
2.4 Submit a complete physical and chemical characterisation of NPNS's expected effluent following treatment by the proposed technology. To assess the efficacy of the proposed treatment technology, the following must be included: ○ Data from laboratory trials on NPNS's raw wastewater that were conducted at Veolia/AnoxKaldnes in Lund, Sweden in May 2018; ○ Modelling results using the raw wastewater parameters and quality; ○ A comparison of the effluent characterization results from the laboratory trials and modelling work, against appropriate regulations and/or guidelines.	Complete (partially)	1) It is noted in the Report that "effluent is similar to published effluent composition data from other Canadian jurisdictions indicates that the mills effluent is similar to effluent from other bleached Kraft mills in Canada operating either an ASS or ASF system". There is no mention or discussion as to whether the receiving environments are similar to that of Northern Pulp. More information should be provided to determine specific local environmental efficacy of the system.	R1. While the information provided meets the requirement for the Focus Report, it does not provide sufficient detailed information to assist interested and affected stakeholders to confidently determine the efficacy of the system in the specific local environment.
2.5 Provide any proposed changes to the pipeline construction methodology and other associated pipeline construction work, related to the potential changes to the marine portion of the pipeline route (e.g., infilling, trenching, temporary access roads, excavation, blasting, disposal at sea, and others where applicable).		N/A	

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
3. Facility Design, Construction & Operation and Maintenance			
3.1 Submit treatment technology specifications (e.g., optimal performance range of the technology) and an assessment of the efficacy of the proposed treatment technology for use at the NPNS facility, to the satisfaction of NSE. For example, peak effluent temperature is proposed to be above the generally accepted range of temperatures to achieve optimal biological treatment. Explain how the proposed higher than optimal treatment temperature would affect the treatment performance.		N/A	
3.2 Provide effluent flow data to support the proposed peak treatment capacity of 85,000 m3 maximum flow of effluent per day. At a minimum, data from 2017 and 2018 is required. Provide flow data for Point A, clarify source of the effluent flow volumes given in the EARD, and provide other relevant data and information to support the proposed treatment system design. If the 85,000 m3 cannot be justified based on historical data, identify water reduction projects, or re-evaluate the treatment system design and update the receiving water study accordingly.		N/A	
3.3 Effluent discharge parameters must be updated (where necessary) based upon the results of the effluent characterization in Section 2.4 and relevant additional studies. Refer also to Addendum item 2.0	Complete	1) While characterization of the effluent discharge parameters has been updated, there remains the issue related to the impact on the receiving environment.	R1: See "R1 in Section 2.4"

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
3.4 Provide the following information regarding the spill basin: ○ Submit information to assess the sizing and appropriateness of the design of the spill basin. The EARD indicates a retention time of 10-13 hours at a design capacity of 35,000 m3. The basis of this design has not been provided. If flows exceed 85,000m3 per day on a consistent basis (e.g., during summer months), confirm that there will be sufficient recovery time in the treatment system to empty the basin before the additional volume is required; ○ Explain where the overflow will be directed in the event of unforeseen scenarios (e.g., power outage).		N/A	
3.5 Provide the following information regarding the effluent pipeline: ○ Provide viable options including the selected option for leak detection technologies and inspection methodologies, with specific consideration to any portion of the pipeline located in the Town of Pictou's water supply protection area; ○ Provide viable options including the selected option for the enhanced pipeline protection, such as trench lining and justify how the chosen option is an adequate option for secondary containment. Be sure to address any potential changes in flow regimes, especially within the Town of Pictou's water supply protection area, due to the installation of the pipeline and secondary containment. If different options are provided for different areas of the proposed re-aligned pipeline route, the locations for each option must be identified.	Incomplete	1) The proposed pipeline will have <u>NO</u> leak detection capacity in its marine phases (Focus Report, p. 62). Effluent in final 4km of pipe to diffuser will flow under gravity (from max height of 1300m; Focus Report. p. 60). Assumption is that subsurface burying of the pipeline (3m) will protect against vessel traffic and ice scour to the marine portion of the pipe (Focus Report p. 39 and Appendix 3.5). Precise location of the diffuser and its integrity are a significant part of the proponent's plan to mitigate environmental impacts. Thus, compromises to this marine portion of the pipe or the diffuser could impact this plan. 2) Relatedly, the integrity of the diffuser ports (Focus Report 4.2.2, p. 86) depend on	R1: It is suggested that an installation of a detection system or regular monitoring of the marine portion of the pipeline be conducted to determine whether leaks, of any scale, result in local non-dispersed effluent accumulate in the local marine environment. R2: Request that information regarding the selected inspection regime be available to all stakeholders in order to properly assess and monitor the diffuser port integrity.

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
		the flexibility of the one-way rubber valves being maintained. The diffusion capacity of these ports is a significant part of NPNS's argument that the new system constitutes an improvement, and that rapid dilution will take place as per modelling in RWS.	
3.6 Clarify where the potential releases of waste dangerous goods at the Project site will be directed for treatment and/or disposal. It is important to note that the new treatment facility is not proposed to treat waste dangerous goods based on the information provided in the EARD and requirements of NSE.		N/A	
4. Marine Water and Marine Sediment			
4.1 Conduct baseline studies for the marine environment (such as marine water quality and marine sediment) in the vicinity of proposed marine outfall location.	Complete	1) The baseline studies do not examine mineral composition of sediments (other than grain size). Information on sediment composition would be useful in understanding the nature of the interaction between the receiving environment and the effluent.	
4.2 Update the receiving water study to model for all potential contaminants of concern in the receiving environment (based on the results of the effluent characterization and/or other relevant studies such as Human Health Risk Assessment). Baseline water quality data for Caribou harbour must be applied to this study. Refer also to Addendum 3.0.	Complete	No comment	

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
4.3 Provide results of sediment transport modelling work to understand the impacts of potential accumulation of sediment within near field and far field model areas. This should include chemical and physical characterization of the solids proposed to be discharged by NPNS as well as a discussion of how these solids will interact with the marine sediments and what the potential impact will be on the marine environment as a result.	Incomplete	1) According to Focus Report, App. 4.3, 90% of the Total Suspended Solids (TSS) will, depending on diffuser height (from seabed), and depending on which mean current speeds are used, be deposited within 1 to 4.8 kms or 4.2 to 21.1 kms of the diffuser. Given the wide range of these figures, and given that a high proportion of TSS will be non-easily biodegradable (refractory) cellulose fibres (Focus Report p. 25), there is a reasonable concern of impacts to fish habitat (benthic smothering) by sediment of such fibrous material within fishing grounds (see Focus Report figures 7.3-4 - 7.3-7). 2) The potential effect of TSS is dependent on the type of raw material introduced to the natural environment and the nature of the receiving environment. Therefore, comparison of models using effluent from mills in other regions is irrelevant and can lead to inaccurate conclusions.	R1: NPNS should give consideration to alternative and newer treatment technologies (e.g. centrifugal systems widely used in other mills) to reduce TSS, including cellulose fibres, not currently planned to be captured by the proposed new ETF system. R2: NPNS should review the statement regarding confidence levels of the conclusion of Appendix 4. 3 that "it is unlikely that sediment will build up in either the near- or far-field." (p. 6). The data presented in Appendix 4.3 undermines this confidence.
5. Fresh Water Resources			
5.1 Complete a wetland baseline survey along the proposed re-aligned effluent pipeline route (if wetlands are expected to be altered).		N/A	

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
5.2 Provide monitoring methodologies for areas with significant risk of pipeline leaks or spills (e.g., two areas where the pipeline crosses the Source Water Protection Delineated Boundary for the Town of Pictou wellfields; below water table; important wetlands; watercourse crossings; etc.).		N/A	
6. Air Quality			
6.1 Provide a revised inventory of all potential air contaminants to be emitted from the proposed project, including but not limited to, speciated volatile organic compounds, semi-volatile organic compounds, reduced sulphur compounds, polyaromatic hydrocarbons and metals.		N/A	
6.2 Update the air dispersion modelling for the pulp mill facility for all potential air contaminants of concern related to the Project.		N/A	
6.3 Complete an updated ambient air monitoring plan for the Project site based on the air dispersion modelling results. This plan must include the potential air contaminants to be monitored and proposed air monitoring location(s).		N/A	

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
7. Fish and Fish Habitat			
7.1 Conduct fish and fish habitat baseline surveys for the freshwater environment, to the satisfaction of Fisheries and Oceans Canada.		N/A	
7.2 Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada.	Incomplete	1) As noted in the Focus Report, baseline surveys have not been completed.	R1: Baseline surveys should be completed for all commercially important species before a final decision is reached.
7.3 Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodology must first be agreed upon by NSE in consultation with relevant federal departments.	Incomplete	1) The Focus Report deals with Valued Ecological Components (VECs) related to fisheries. In the EARD the social and economic ('socio-economic') environment was identified as a VEC in consideration of the potential interactions with local communities, how land and water is used in the vicinity of the project, and the potential interaction between the project and the economic well-being of these communities. These potential interactions are of concern to regulatory agencies, non-governmental organizations, and the general public because they can have a direct influence on the everyday lives of those living and working in the vicinity of a project. The socio-economic environment VEC includes land and water uses such as community resources and recreation, and economic industries, infrastructure. Furthermore, Appendix 7.3 references the socio-economic	R1: NPNS should commit to undertaking a socio-economic effects monitoring program related to the implementation of the NPNS ETF on local commercial fishing activities.

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
		importance of American lobster, rock crab and Atlantic mackerel that may have a higher potential for interaction with the project than some other indicators that were assessed specific to the Marine Fish and Fish Habitat VEC, it is recommended that EA Follow-up Monitoring be undertaken. There is, however, no indication of the intention to monitor socio and economic effects on this important resource sector.	

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
7.3 Continued.	Incomplete	1) Spatial boundaries for the assessment of environmental effects on the socio-economic environment include the following: a) the project footprint area (PFA) is defined as the physical footprint of the project including the location of the new replacement ETF on the NPNS mill property, the overland portion of the effluent pipeline, and the marine portion of the effluent pipeline and the marine outfall. The PFA is defined in Section 5.1.1. b) the local assessment area (LAA) is the maximum area within which environmental effects from the project activities and components can be predicted or measured with a reasonable degree of accuracy and confidence. The LAA can be thought of as the "zone of influence" of the project. For the socio-economic environment, the LAA is represented by the communities whose regular activities intersect with the PFA: Pictou Landing First Nation, local residents, and local industries located in the Municipality of Pictou County or the towns of New Glasgow, Stellarton, Pictou, Westville, and Trenton. Since the PFA is deemed to terminate at the marine outfall downstream impacts were not considered.	R1: Downstream impacts, such as drift of the effluent and its impact on adjacent fisheries, should be considered. Accordingly, a socio-economic baseline study should be conducted, which will include all the communities in the LAA to determine future socio-economic effects. This survey should include demographic profile of the towns and regions, industrial profile, including business counts, and labour force profile.

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
7.3 Continued.	Incomplete	1) The Impact Assessment only addressed biophysical environmental impacts. There was no consideration of social and economic impacts, particularly in relation to other key economic sectors in the region. See comments in "Reviewers Comments and Considerations" Section. 2) Monitoring is only for the bio-physical and chemical effects in the physical environment. There is no monitoring of bioaccumulation of effluent born compounds (for example, PAHs, mercury, dioxins and furans, etc.) in commercially important species. 3) Section 5.4 of Appendix 7.3 states "...will continue to investigate the feasibility of performing toxicity testing...". There is documented evidence that pulp and paper mill effluent cause physiological changes in fish as well as changes in physical and reproductive behaviour (Lehtinen et al 1990 Munkittrick et al, 1998). Thus, NPNS should agree to conducting toxicity testing on local fishery species of importance. 4) Section 5.3 of Appendix 7.3 states "Following completion of the HHRA, the potential utility of a continued fish tissue monitoring program following commissioning of the effluent treatment system and subsequent discharge will need	R1: Consideration should be given to the social and economic impacts that the treated effluent may have on key marine fish species (key economic sector). R2: Fishermen should be involved in all aspects of the EEM program, including selecting the EEM parameters and in monitoring activities. R3: It is requested that more information be provided on the predicted effects of effluent on resident species of fish, shellfish and crustaceans, including foraging species, through regular toxicity testing. R4: These discussions should commence **prior** to the initiation of construction to ensure certainty that tissue sampling and analysis studies be conducted by NPNS. R5: The Fishermen strongly urge the NSE to require **ALL** baseline studies to be completed prior to the approval of the NPNS ETF EARD.

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
		to be discussed with First Nations, stakeholders and government agencies. 5) The Focus Report further states in Appendix 7.3 that "The potential studies are still likely to target: lobster, rock crab, scallop, blue mussel, softshell clam, oyster, and locally relevant finfish (e.g., Eel, Smelt, Gaspereau, Striped Bass, Mackerel, Atlantic Herring). Given the likely timing for EA approval and the subsequent construction and commissioning of the proposed ETF, it will be possible to target collections of any of the species identified above that have not already been collected for baseline purposes (i.e., predevelopment) should engagement indicate the need."	R6: The Fishermen further request that NPNS consult closely with the Fishers Associations to ensure baseline studies include a broader range of species, to include commercially important species, and the foraging species upon which these economically important resources depend.
7.4 Submit an updated Environmental Effects Monitoring (EEM) program based on the results of various relevant baseline studies and an updated receiving water study. Refer also to Addendum item 4.0	Incomplete	1) Beyond the existing design of the effluent diffuser, no indication is made in the Focus Report about what mitigation steps could be taken if a post-construction EEM program discovers an unacceptable toxicological effect on fisheries resources. 2) The Environmental Effects Monitoring (EEM) program does not include studies on the bioaccumulation of effluent within key economically important species. This has significant social and economic implications as well as biological implications to the viability of the local resource. 3) There is insufficient information regarding the specificity and processes	R1: Fishermen should be involved in all aspects of the EEM program, including selecting the EEM parameters and in monitoring activities. R2: Fishermen should be involved in discussion and decisions regarding appropriate mitigation measures.

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
		involved in the EEM program. As a result, the opportunity for stakeholder groups to provide input and recommendations on how to enhance the EEM program so that monitoring measures are acceptable is not apparent or available.	
7.5 Clarify what contingency measures will be in place to mitigate potential impacts (e.g., thermal shock to fish) due to potential large and rapid fluctuations in water temperature in the winter at the diffuser location during low production or maintenance shut down periods.	Complete	1) There remains a question that while the Focus Report addresses routine contingencies there is no discussion on what measures are in place for catastrophic events that could result in rapid or unmanaged discharge of effluent into coastal waters.	R1: NPNS should consider an emergency response plan as a part of their contingency measures.
8. Flora and Fauna			
8.1 Complete a plant baseline survey along the proposed re-aligned effluent pipeline route.		N/A	
8.2 Complete a migratory bird survey along the re-aligned pipeline route.		N/A	
8.3 Complete a bird baseline survey for common nighthawk (Chordeiles minor), double crested cormorants (Phalacrocorax auratus), owls, and raptors and raptor nests, for the entire project area which includes the re-aligned pipeline route.		N/A	

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
8.4 Complete a herptile survey for the Project area which includes the re-aligned pipeline route.		N/A	
9. Human Health			
9.1 Complete baseline studies for fish and shellfish tissue (via chemical analysis) of representative key marine species important for commercial, recreational and Aboriginal fisheries in the vicinity of the proposed effluent pipeline and diffuser location.	Incomplete	1) The baseline surveys did not include several commercially important species, such as scallops and other benthic invertebrates. 2) While the baseline survey includes tissue analysis of commercially important species and food resources for First Nations, the EEM does not indicate that this will be continued to determine the level of bioaccumulation of effluent in these species.	R1: A complete baseline survey is necessary to ensure compliance with the requested information in the Focus Report Terms of Reference and useful for the development of an effective EEM program. R2: The EEM should include tissue analysis to determine health risks resulting from potential bioaccumulation and to determine potential economic impacts on the fishery.
9.2 Commence a Human Health Risk Assessment (HHRA) to assess potential project-related impacts on human health. The risk assessment must consider human consumption of fish and other seafood, consumption of potentially contaminated drinking water, exposure to recreational water and sediment, outdoor air inhalation, and any other potential exposure pathways. The analysis must inform the identification of contaminants of concern and updating of the receiving water study.	Incomplete	1) The Seafood Intake Survey did not include an analysis of the food ingested to determine the presence or absence of compounds that may be present in effluent (useful and essential background information for future studies). 2) Impact from consuming commercially important species from the area can have wider impact on the economic viability of the fishery in the region as a whole (e.g. amnesic shellfish poisoning in PEI affected the Atlantic fishery).	R1: The Food Intake Survey should include analysis of presence of heavy metals, PAHs, dioxins and furans in the foods after preparation for consumption. R2: See "R2 in Section 9.1"

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
10. Archaeology			
10.1 Complete an Archaeological Resource Impact Assessment for the marine environment related to the Project.		N/A	
10.2 Complete shovel testing for areas in the terrestrial environment that are identified to have elevated or medium potential of archaeological resources, to confirm the presence or absence of these resources.		N/A	
11. Indigenous People's Use of Land and Resources			
11.1 Complete a Mi'kmaq Ecological Knowledge Study (MEKS) for the Project.		N/A	
ADDENDUM: Items Raised by Reviewers Requiring Clarification			
1.0 Provide information regarding whether and when new technology and equipment will be installed at the NPNS pulp mill to improve the effluent quality, including but not limited to the following: o Will O_2 delignification be installed at the NPNS pulp mill? o What other technology and equipment will be installed at the NPNS pulp mill? o How will each proposed new technology and/or equipment improve the effluent quality?	Complete	No comment	

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
2.0 With respect to the effluent discharge parameters: o Explain why the total nitrogen parameter has changed to 6 mg/L (daily maximum) from the 3 mg/L (proposed in the August 11, 2017 receiving water study); o Provide data to support assertions that chemical oxygen demand (COD) can be reduced to the proposed limit.		See Section 3.3 above.	
3.0 With respect to the updating of the Receiving Water Study: o Provide a response to questions and comments on the receiving water study (not already outlined in this document) from Environment and Climate Change Canada's EARD review submission dated March 18, 2019, and update the receiving water study as applicable; o Explain how the initial mixing and dispersal of the plume was taken into account when simulating far-field extent and concentrations of effluent in Section 3 of Appendix E1 of EARD. It appears that the far-field model simulations were run before the near-field model. One could expect that the behaviour of the plume further afield depends a large extent on how it behaved at the diffuser, i.e. how quickly it mixed and spread and rose to the surface; o Confirm dilution ratios and distances required to achieve background level for water quality parameters in Appendix E1 of the EARD, as the dilution ratios and distances may be overestimated; o Explain if the salinity and temperature differential between the effluent and the receiving waters has been accounted for in the model. When the buoyancy differential between the effluent and receiving waters are	Complete	No comment	

Requirements from Terms of Reference	Completeness	Review Comments & Considerations	Additional Issues/Suggestions for Consideration
greater in winter, it results in a faster rising plume. This can potentially affect the visibility of the effluent in the receiving environment. Has this been accounted for in the model? Also provide results for winter conditions; o Explain if re-entrainment of effluent and sediment at the diffuser location was accounted for in the one-hour period surrounding slack tide. Support this explanation with model results using a smaller time step (30 minutes) if necessary.			
4.0 It is important to note that the following field study and monitoring are likely to be required as part of an EEM program regulated under the Pulp and Paper Effluent Regulations for the Project if it is approved: o Field delineation of treated effluent plume to confirm the prediction from the receiving water study; o Monitoring of marine water quality and marine sediment quality; o Sublethal toxicity testing and chemistry testing of the treated effluent; and o Biological monitoring studies including benthic invertebrate community study, fish population study, and dioxin and furan levels in fish as applicable.	Complete	See Section 4 above	

Table 2: Additional Reviewer General Comments & Considerations

Additional Reviewers Issues	Review Comments and Considerations	Comments for Consideration
Issue: Major Findings and Conclusion from the Report	1) In the Focus Report it is summarized that "through appropriate mitigation, no significant adverse residual environmental impacts have been predicted" (vi) which is a reflection of the overall content and conclusions of the Focus Report and its appendices. However, despite the Focus Report's presentation of this overall finding as "scientific" and "science-based" (i, ii), there are significant questions and uncertainties that remain. 2) Predictions based on modelling in the Focus Report suggest that the proposed ETF will meet current federal and provincial regulatory requirements. However, new federal guidelines (e.g. PPER in accordance with the *Fisheries Act*) have not yet been published; assumptions about the content of the new PPER are acknowledged within the Focus Report as being "speculative" (n. 1, Table 2.4-2). Thus, the Focus Report's overall conclusion that "proposed future" (Focus Report, p. xxxi) regulations will also be met by the new ETF is premature and introduces additional uncertainty. 3) The Focus Report does not conform to best practice of impact assessments that clearly requires full disclosure of uncertainties so as to adhere to the precautionary principle, for many years now a guiding principle in impact assessment in Canada. Such disclosure is necessary to allow for full participation of potentially impacted communities to contribute to determination of acceptable levels of risk.	R1,2,3: The responses to this Focus Report should be included in a continued engagement process that allows for a collaborative review of public responses, and collaborative decision-making involving impacted stakeholder groups, proponents and regulators as an extension of this review process prior to regulatory approval. This will enable stakeholder groups to be fully aware of uncertainties that are unstated in the Focus Report. This will be consistent with the principles of Free, Prior and Informed Consent (FPIC) that should guide this process.
Issue: Assumptions in the Focus Report	1) The assumption made within the Focus Report is that dilution of the effluent in receiving water is sufficient to avoid significant, adverse and residual impacts on the environment. However, there is growing evidence that this assumption is being questioned in other jurisdictions whereby environmental monitoring programs are requiring more stringent	R1,2,3: Greater effort must be made to fully characterize the receiving ecosystem, particularly completing all baseline studies and economic analysis of the receiving environment (bio-physical and socio-economic). These

Additional Reviewers Issues	Review Comments and Considerations	Comments for Consideration
	regulations for Environmental Effects Monitoring (EEM), including cumulative effects, lower toxicity thresholds (sub-lethal effects), and introduction of more advanced technologies for effluent treatment and disposal. 2) The assumption in the Focus Report that meeting current Pulp and Paper Effluent Regulations (PPER) is enough to ensure that the new Effluent Treatment Facility (ETF) will not cause an acceptable significant adverse residual negative impact is questionable considering changes being proposed to create new and enhanced PPER (Bill C-68). 3) The impact assessment methodologies employed by NPNS and documented in the Focus Report (and EARD) rely on the comparability of effluent parameters to other kraft mills operating in Canada and internationally (e.g. Focus Report pp. xxvi-xxviii; App. 2.4). Best practices of impact assessments now follow ecosystem (social, economic, and biophysical) assessment approaches. Conclusions drawn in this Focus Report on the basis of such comparisons, particularly those with respect to "significant adverse residual impacts", ought to be treated with caution. The proposed NPNS ETF is the first in Atlantic Canada, and certainly for this distinctive ecosystem of the Northumberland Strait, which is different and unique even to other areas within Atlantic Canada. The closest relevant ecosystem comparison is to the existing BHETF, which clearly has left a "negative legacy" (Focus Report, p. xxxix). 4) iv. The approach to disposal of COPC and TSS by discharge into the marine environment has been a contentious issue, internationally, for decades. Consensus within the scientific and technical community is that COPC disposal, particularly those identified as endocrine disruptors and persistent (not or not easily and safely biodegradable) pollutants in marine environments is of mounting concern (Singh and Chandra, 2019; Chandra et al, 2018) and that conventional treatment options (including activated sludge processes as proposed in this ETF) are considered to be insufficient	studies will help determine cumulative effects and appropriate mitigation strategies. R4: The corporate social responsibility and public interest should be married through greater collaboration between affected stakeholders, regulators, and NPNS in decision-making, such that conditions of approval include strategies to continually strive to reduce and eliminate at-sea effluent disposal.

Additional Reviewers Issues	Review Comments and Considerations	Comments for Consideration
	to address concerns regarding commercial fisheries (Hubbe et al, 2016). This is particularly in light of mounting concerns over the need for more stringent attention to cumulative effects and consideration of increasing stress indicators of ocean health (DFO state of the ocean report 2019). For this reason, better design options should be considered that make use of best available technologies for minimizing absolute volumes of effluent discharged, or that maximize removal of effluent content of potential concern (COPC, TSS). The results of this Focus Report confirm that the major difference between the proposed ETF and current ETF is simply that a comparable effluent (in terms of volumes and content) will be discharged further out to sea, with more rapid dilution performance. (It has been noted in the review of the Focus Report that heavy metals require the use of additional direct use of physical-chemical processing of effluent water (adsorption on new adsorbents, ion exchange, membrane filtration, electrodialysis, reverse osmosis, ultrafiltration and photocatalysis) or bio-absorption (Gunatilake, 2015 Ayres et al, 1994)	
Issue: General comments regarding Socio-economic Assessment	1) The Focus Report makes reference to and draws conclusions about socio-economic impacts but provides no analysis, quantification, or justification to support these conclusions. a) Identified socio-economic impacts are not quantified, including the economic impact of construction spending. b) The EARD contains no apparent socio-economic analysis. c) Reference to disruption of economic activity during construction is too narrowly defined as disruptions to use of land and water resources. Potential changes to market and consumer perception / behaviour resulting from the project are not addressed (e.g. changes in demand for seafood harvested in the PFA).	R1: Socio-economic impact assessment should consider: what is the nature of the impact (e.g. employment, production, revenue, cost, etc.)? What could drive it (i.e. changes in labour demand, consumer perception)? What is the potential scale and direction of the interaction (i.e. size of the impact, positive or negative)? There appears to have been no effort made to estimate the extent (qualitatively or quantitatively) of these potential interactions between the NPNS ETF and other economic sectors during and after construction. Therefore, NPNS should undertake an assessment of potential interactions to

Additional Reviewers Issues	Review Comments and Considerations	Comments for Consideration
	d) EARD does not include an analysis of potential economic opportunities related to the project (e.g. supply chain, employment, training, local industry capacity-building, local construction / employment income spending). e) Impacts to property values in the PFA have not been considered. f) Potential interactions and impacts to fisheries, tourism, transportation, and other sectors have not been estimated or quantified. It should be noted that some impacts to sectors such as tourism can be "sticky", meaning temporary changes in access to or perceptions of tourism destinations and activities can result in longer-term consumer behaviors that are difficult to alter. Similarly, temporary changes in seafood markets because of public perceptions from the environment in which they are harvested can have long-term implications to the local as well as regional marketability of seafood products.	determine and describe the nature and extent of the impact on the local and wider Nova Scotia economy.
Issue: Significance Criteria	1) The significance criteria defined for NPNS ETF project does not fully consider the social and economic environment. A significant adverse residual environmental effect on the socio-economic environment is one where project-related activities directly interfere with the use of the land or water such that their intended use is no longer possible. This would include interference with land uses, recreational uses, employment and economic impacts in the community, region, or province. A significant positive residual environmental effect of the project on the socio-economic environment is one that results in project-related sustained increased level of employment and economic activity in the community, region, or province, or enhances land and water uses.	R1: Criteria could be expanded beyond "the use of land or water such that their intended use is no longer possible." Could include: Impacts to land or water such that their intended or desired use is affected in any way (negatively or positively). Impacts to fisheries – increase or decrease in fish stocks, changes in consumer perception of or demand for seafood originating from the PFA. Impacts to tourism / recreation based on actual or perceived impacts of the project. Negative residual environmental effects of the project on the socio-economic environment resulting in decreased levels of (or negative shifts in) employment and economic activity in the

Additional Reviewers Issues	Review Comments and Considerations	Comments for Consideration
		community, region, or province. For example: demand for local project-related labour causing shifts away from existing local industry.
Issue: Compensation	1) The Focus Report discusses compensation only in terms of habitat compensation as it relates to HADD, however, the EARD does address compensation in the commercial fishery in only general terms. As stated in the EARD: a) "In advance of and during construction, communication with the fishing industry will allow for strategic planning and limit risk of impacting movement through Caribou Harbour into the Northumberland Strait." b) "The area of disturbance will be small, particularly in comparison to the licensed fishing areas. Impact, if it occurs, would be limited to a small number of individual fishers who may be able to compensate for that loss by adjusting their fishing patterns. The impact to income is not expected to be significant."	R1a: Since communication and strategic planning requires cooperation measures should be taken to ensure that effective communication and cooperation and NPNS and fishermen takes place. This important to ensure mitigation will include opportunities to avoid detrimental effect on the commercial fishery and that suitable compensation can be negotiated. R1b: The area of disturbance may be physically small; however, the impact can be global because of the fact that the Atlantic lobster fishery is perceived as a common resource in the marketplace. Consumer perception and demand for seafood is important and consumers are becoming increasingly sensitive to the environment from which seafood products are harvested. Therefore, NPNS is well advised to effectively engage the commercial fishery on an ongoing basis.

APPENDIX A: REFERENCES

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APPENDIX B: CVS

NEXUS COASTAL

NEXUS COASTAL

NEXUS COASTAL

From: @juniperlaw.ca
To: Environment Assessment Web Account
Subject: Proposed Project Comments
Date: November 8, 2019 5:48:03 PM

** EXTERNAL EMAIL / COURRIEL EXTERNE **
Exercise caution when opening attachments or clicking on links / Faites preuve de prudence si vous ouvrez une pièce jointe ou cliquez sur un lien

Project: replacement_effluent_treatment_facility_project Comments: Comments on behalf of three fishing industry associations have been just submitted via email to EA@novascotia.ca. Name: @juniperlaw.ca Address: Municipality: Halifax Postal-Code: Fax: ### ### - #### email_message: Privacy-Statement: agree x: 80 y: 17

From:	
To:	Environment Assessment Web Account
Subject:	[PROBABLE-SPAM] No Pipe
Date:	November 8, 2019 5:48:24 PM
Attachments:	Replacement Effluent Treatment Facility Project.pdf

CANOEKAYAK
NOVA SCOTIA

5516 Spring Garden Road, Halifax
Nova Scotia, Canada. B3J 1G6
(902)425-5450, ext.

Government of Nova Scotia
EA@novascotia.ca

Replacement Effluent Treatment Facility Project — Environmental Assessment
November 7, 2019

To Whom It May Concern:

I am writing to you on behalf of Canoe Kayak Nova Scotia; an association of recreational canoeists, kayakers, and standup paddleboarders throughout the province. We are concerned with Northern Pulp's proposal to pump only partially treated effluent from its Abercrombie Point, Pictou County, pulp mill some 15 km and then release it into the Northumberland Strait.

We have reviewed the proponent's voluminous Focus Report and find that it doesn't answer the important questions asked of the Proponent in the Terms of Reference. From the information supplied we are not convinced that the pulp mill's effluent is essentially harmless, and that it will not adversely effect the local marine environment, locally harvested seafood, and human health.

Moreover, based on the information supplied, we are concerned that diffusing the effluent, rather than concentrating it in Boat Harbour as is done now, will reduce the water quality of a much larger area and thus further harm local tourism and outdoor recreational opportunities. This Proposal should be rejected for the above reasons.

From:	
To:	Environment Assessment Web Account
Cc:	
Subject:	Submissions of the Friends of the Northumberland Strait in Response to the call for Public Comments on the Focus Report
Date:	November 8, 2019 6:06:32 PM

Good evening,

Please see the attached link enclosing comments in regard to the Focus Report for the Replacement Effluent Treatment
Facility Project proposed by Northern Pulp Nova Scotia Corporation.

https://ln2.sync.com/dl/858181470/2htdvp2c-9ghkj6qt-hsrjaesy-dfyi6anz

Please confirm that this link has been accepted by the Environmental Assessment Branch at your earliest convenience. If there should be a technical difficulty, we shall arrange for alternate submission.

Best regards,

| Ecojustice
520-1801 Hollis Street, Halifax, NS B3J 3N4
T: 902-417-1700 | 1-800-926-7744 ext.
F: 902-417-1701

Ecojustice is Canada’s largest environmental law charity. Help us build the case for a better earth.

Submissions of the Friends of the Northumberland Strait in Response to the call for Public Comments on the Focus Report for the Replacement Effluent Treatment Facility Project

Ecojustice
1801 Hollis Street, Suite 520
Halifax, NS B3J 3N4

November 8, 2019

Table of Contents

1. Overview

1. This submission is filed on behalf of the Friends of the Northumberland Strait (FONS). FONS is a society registered under Nova Scotia's *Societies Act* and its members are residents of Pictou and the surrounding area. These materials are filed in response to the call for public comments regarding the Focus Report submitted by Northern Pulp Nova Scotia (NPNS) in respect of the proposed project to build a new Effluent Treatment Facility (ETF or the "project").

2. These submissions are made within the Environmental Assessment (EA) process for the ETF under Nova Scotia's *Environment Act*[1] (the *Act*) and *Environmental Assessment Regulations*[2] (the *EA Regs*). FONS filed its original submissions with Nova Scotia Environment (NSE) and the Minister on February 12, 2019 and March 8, 2019[3], in response to NPNS' original Environmental Assessment Registration Document (EARD) of January 31, 2019.[4] FONS relies on all of these materials in respect of this EA process and asks that all of its submissions and those of other members of the public be properly and thoroughly considered by the Minister prior to making any decisions.

3. FONS' concerns as expressed in its February 12 and March 8 submissions, and the concerns of many other Pictou and area residents, have not been addressed by the Focus Report, and NPNS and its consultants have not cured the fundamental defects in the NPNS EARD materials. The project presents significant environmental effects and adverse effects, and must

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[1] *Environment Act*, S.N.S. 1994-1995, c. 1, Part IV.
[2] *Environmental Assessment Regulations,* NS Reg 26/95 ["*EA Regs*"].
[3] Ecojustice's submissions on behalf of FONS are posted to the Environmental Assessment website of Nova Scotia Environment in four parts:

1. Part A - February 12, 2019 submission, at https://www.novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facility_Project/comments/4-Ecojustic-comment-A-part-1.pdf and https://www.novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facility_Project/comments/5-Ecojustic-comment-A-part-2.pdf
2. Part B, March 8, 2019 submission, at https://www.novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facility_Project/comments/6-Ecojustic-comment-B-part-1.pdf and https://www.novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facility_Project/comments/7-Ecojustic-comment-B-part-2.pdf

[4] NPNS EARD, as posted to the Environmental Assessment website of Nova Scotia Environment, at https://www.novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facility_Project/.

be rejected. NPNS' proposed mitigations will not prevent harm to the terrestrial and marine environment and to local communities, and will not perform as predicted in the EARD and Focus Report.

4. The process followed by the Minister is flawed and unfair. The Minister and his cabinet have demonstrated a conflict of interest and are biased toward approving this project. The Minister and his predecessor have repeatedly and unfairly limited the public's ability to participate in the process, despite the high level of concern and anxiety regarding this project in the Pictou area, in Nova Scotia, and within the Atlantic Region. The Minister's procedural choices within this EA process have undermined public confidence in the EA process and are contrary to the letter and spirit of the *Act*.

5. The Focus Report package made available to the public was incomplete and the public may never have the chance to comment on some contemplated reports and submissions before the Minister makes his decision. The various processes chosen appear to have been deliberately designed to prevent the public from reviewing and understanding the thousands of pages of technical materials, obtaining advice from experts, and making considered and focused submissions, all of which would have been of benefit to the process and to the Minister in making an appropriate decision. FONS and other interested groups and individuals requested more time for review, but all such requests were rejected by the Minister.

6. As in NPNS's original EARD, the Focus Report once again attempts to characterize the risks of this project as minimal. Some key concerns identified by FONS and others are not discussed at all, despite the clear obligation to address and respond to public concerns under the *Act* and the *EA Regs*.

7. The updated and original receiving water studies put forward by NPNS and its consultants, and the impact assessments based on those studies, are poorly done, fundamentally flawed and unreliable. Dr. Oliver Fringer, an oceanographer and expert in modelling coastal systems, is of the opinion that the Stantec modelling does "not provide science-based evidence that can be used to assess the potential environmental impacts of the near- and far-field dilution from the

proposed outfall site."[5] The Stantec reports overpredict effluent dilution rates and under predict the likelihood of sediment deposition and accumulation, both by significant margins.

8. Inaccurate information and inappropriately selective information is provided about the marine ecosystem, including fish habitat and the fisheries that are conducted there.

9. NPNS' Focus Report was filed before all requirements of its Terms of Reference were completed, although NPNS has known since 2015 that a new ETF would be required and an EA would be triggered. The Focus Report contains omissions, errors and inaccuracies. It neither complies with its Terms of Reference nor satisfactorily addresses the many omissions, information gaps and inadequate assessment in the original EARD. Important baseline studies have still not been done, planning and detailed designs are incomplete, and a number of studies are withheld from public comment. The Minister is once again asked to consider an incomplete set of materials.

10. NPNS' consultants make optimistic predictions that there will be no significant effects from this proposed ETF. As a reality check, the Boat Harbour Basin has been receiving effluent from this pulp and paper mill for over 50 years. The effects of continuous flow of the mill's treated effluent into that ecosystem are devastating and lasting and have negatively impacted generations of members of the nearby Pictou Landing First Nation. The planned cleanup of Boat Harbour will require a massive effort and is estimated to cost over $200 million dollars, all at public expense. It strains credibility to assert that the same effluent, when discharged at a similar rate into a pristine nearby ecosystem within the Caribou Channel, will somehow have no significant impact.

11. The risks associated with this project are significant. Despite two opportunities to do so, NPNS has failed to discharge its burden to show that the project will not cause significant environmental effects or adverse effects, or that any such effects can be mitigated. As discussed in detail below, ample evidence is before the Minister requiring rejection of the

[5] Fringer, O.B., *Review of updated modeling studies by Stantec Consulting for the Northern Pulp effluent treatment facility replacement project*, 5 November 2019 at p. 16, **Appendix A-1** (Fringer update report).

project pursuant to ss 35(3)(d) and 40(c) of the *Act*, as the project is likely to cause adverse effects or significant environmental effects that cannot be mitigated and are unacceptable.

2. Introduction

12. In its original submissions to the Minister in February and March 2019, FONS set out its concerns which had not been addressed by the EARD. Most of these concerns remain unaddressed, as set out in the following list:

(i) The registration materials filed by NPNS are incomplete and do not comply with the requirements of section 9(1A) of the *Environmental Assessment Regulations*. The Project is therefore improperly registered and the current EA process is a nullity.

(ii) The Focus Report, as submitted, does not comply with the Terms of Reference as discussed within this submission;

(iii) All studies identified in the Terms of Reference should have been finalized and included in the Focus Report, in order that the entire Focus Report would be available to enable meaningful public comment and additional time must be granted to allow public comment on the entire Focus Report, once it is finalized;

(iv) The ongoing EA process is inadequate and unfair, as it does not allow the public to assess the large amount of scientific documentation and conduct a comprehensive review of the information contained in NPNS's EA submission and Focus Report, and all comments on each. NPNS failed to hold promised public information sessions, and held back from the public the majority of the scientific studies until registration; requests for more time to review the materials were rejected by the Minister;

(v) The Minister's connection to this project, as a member of cabinet, gives rise to a reasonable apprehension of bias, and renders the process as a nullity;

(vi) The EARD and Focus Report submissions, although lengthy, lack critical information, or sufficient detail, in crucial areas such as:

(a) Studies showing the nature and frequency of process interruptions and disruptions, leaks and spills at the NPNS facility and the impacts of same on effluent composition and effective operation of the proposed ETF;

(b) Studies showing that the proposed ETF, which is not yet constructed, can and will in fact reliably and consistently discharge effluent which will meet any particular parameter, or whether it will meet the parameters which form the basis of the discussion in the NPNS submission; and that NPNS actually will operate its facility in a manner that achieves the required parameters and in an optimally environmentally sustainable manner;

(c) Studies and analyses regarding mercury issues associated with the project, including methylmercury, mercury and other metals in effluent, and mercury contamination of the NPNS/Canso site;

(d) Full sets of baseline data obtained over full annual cycles and over the entire affected areas for all aspects of the ecosystems that will be affected;

(e) Complete ecosystem studies in relation to the marine and terrestrial environments;

(f) Thorough and accurate modelling to determine mixing capabilities in Caribou Channel and how the effluent will fare as it circulates in the Strait;

(g) Drawings or mapping/chart coordinates and detailed plans showing the precise pipeline route proposed on land, in Caribou Harbour, and in Caribou Channel;

(h) Reliable leak detection for all portions of the pipeline,

(i) Modelling in regard to spills or other accidental events;

(j) Air emissions data from current operations from all stacks and vents; and

(k) Clear, effective and comprehensive mitigation plans, with substance and that take into account actual conditions in the local environment.

The above defects, individually and collectively, show that the NPNS EA and Focus Report materials remain incomplete, are based on inaccurate information and unproven assumptions, and are not supported by credible scientific studies in relevant disciplines.

3. Procedural Issues

13. As stated in FONS March 8, 2019 submission, there is "[…] a duty of procedural fairness lying on every public authority making an administrative decision which is not of a legislative nature and which affects the rights, privileges or interests of an individual."[6]

[6] *Cardinal v Kent Institution*, [1985] 2 SCR 643 at 653.

14. A number of procedural issues have fundamentally compromised the fairness of the environmental assessment process for NPNS' proposed new ETF. Those procedural issues, each of which has been raised with the Minister on previous occasions, are as follows:

    (a) the Minister's reasonable apprehension of bias;

    (b) the insufficient public comment period on NPNS' Focus Report; and

    (c) the Province's failure to make certain portions of NPNS' Focus Report available for public comment.

15. In FONS' submission, each of these issues constitutes a violation of the Province's and/or the Minister's duty of procedural fairness in the context of the ongoing environmental assessment. FONS therefore calls on the appropriate authority to remedy these failings in order to restore the fairness and integrity of the environmental assessment process.

16. The following sections examine each of the three procedural issues identified by FONS in turn.

a) **Reasonable Apprehension of Bias**

17. On February 12, 2019, we submitted a package to both the Minister and the Environmental Assessment Branch on behalf of FONS. In our submission, we asked the former Minister of the Environment, Margaret Miller, to recuse herself from the EA process for NPNS' proposed ETF due to a significant conflict of interest.[7] On March 6, 2019, we received a letter dated March 5, 2019 from the former Minister Miller advising that she would not be recusing herself from the EA process.

18. On March 8, 2019, on behalf of FONS we submitted a package of substantive comments on NPNS' Registration Document for its proposed ETF. In those submissions, FONS maintained its position that the former Minister Miller's involvement in the EA process gave rise to a

[7] FONS' February 12, 2019 submission to the Minister is available on NSE's Replacement Effluent Treatment Facility Project webpage at the following addresses: https://novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facility_Project/comments/4-Ecojustic-comment-A-part-1.pdf and https://novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facility_Project/comments/5-Ecojustic-comment-A-part-2.pdf.

reasonable apprehension of bias.[8] FONS therefore continued to call on the Minister to recuse herself in order to maintain public confidence and ensure the integrity of the EA process.

19. Following the conclusion of the first stage of the EA process, additional evidence has come to light about the extensive financial ties between NPNS and the Province, and in particular about the strong financial incentives for the current Minister to approve the proposed ETF.

20. In the recently decided *Pictou Landing First Nation* case, the Nova Scotia Court of Appeal (NSCA) identified an Agreement and an Amendment between NPNS and the Province that provide for reimbursement by the Province to NPNS for engineering, design, and environmental assessment expenses for the new ETF. The Agreement is dated December 28, 2016, and the Amendment is dated September 27, 2017. In conjunction, the Agreement and the Amendment provide that the Province will reimburse NPNS for "Eligible Expenses," including reasonable costs for the design and engineering of the new ETF (up to $300,000) and the EA (up to $250,000) and "other costs approved by the Province in writing."[9]

21. The NSCA also noted that the Province and NPNS signed a second agreement on December 13, 2017. That agreement provided that the Province would reimburse NPNS' detailed design and engineering costs for the new ETF, up to a maximum of $8 million. Under the December 13, 2017 agreement, the Province can choose to use any contribution it makes to NPNS under the terms of the agreement to offset any future award NPNS may be granted for damages against the Province.[10] It appears that the Province is particularly concerned about potential compensation owed to NPNS as a result of the statutorily mandated closure of the Boat Harbour ETF.[11]

22. The December 28, 2016 and December 13, 2017 agreements, and the September 27, 2017 amendment will be referred to herein as the "**Funding Agreements**."

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[8] FONS's March 8, 2019 comments on the Registration Document are available on NSE's Replacement Effluent Treatment Facility Project webpage at the following addresses: https://novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facility_Project/comments/6-Ecojustic-comment-B-part-1.pdf and https://novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facility_Project/comments/7-Ecojustic-comment-B-part-2.pdf.
[9] *Nova Scotia (Aboriginal Affairs) v Pictou Landing First Nation*, 2019 NSCA 75 at para 44 ["***PLFN***"].
[10] *Ibid.*
[11] *Ibid.*

23. The NSCA commented on the impacts of these Funding Agreements on the Minister's decisions to issue approvals for the new ETF under Parts IV and V of the *Environment Act* (which include the Minister's decision to approve or reject the new ETF following the current environmental assessment). The Court wrote as follows:

> 136 […] the Funding Agreements inject their own incentives into the process of ministerial approval.
>
> 137 Those incentives include the following:
>
> • Provincial funds have already been paid, with more to come, toward the design, engineering, environmental assessment or capital cost of the New ETF. Without the ministerial approvals, the Province's payments would be wasted, The New ETF would not operate. Ministerial approvals are needed for the Province's investment to be productive.
> • The Funding Agreements say the Province "approves" the items of design, engineering and environmental assessment before paying Northern Pulp. Once the Province approves under the Funding Agreement, would there be an about-face that denies approval under the *Environment Act*? Likely, the contractual approval would facilitate the statutory approvals. In the past, the Province has contracted to give approvals for a new ETF. The 1995 [Memorandum of Understanding], articles 4.01(k) and (l), said the Province would "obtain all required…approvals…for the continued operation of the Reconfigured Facility." In 2008, the Province signed an acknowledgement that this provision would continue to benefit Northern Pulp. […]
> • The Funding Agreements embody partial terms of settlement of a threatened lawsuit by Northern Pulp against the Province for early termination of the Lease. A settlement is meaningful only with ministerial approvals under the *Environment Act.* The approvals would allow the Mill to operate toward the expiry date of the terminated Lease, reducing Northern Pulp's claimed damages. Denial of approval could leave Northern Pulp's alleged losses mostly intact, subject to issues of mitigation, for pursuit in litigation against the Province. The Minister might consider an avoided lawsuit to be beneficial for the Province. [12]

24. In light of the NSCA's findings, and in alignment with its previous submissions on this issue, FONS maintains its position that the Minister's role in the EA process for NPNS' proposed ETF gives rise to a reasonable apprehension of bias. As a result, FONS repeats its call for the Minister to recuse himself from the EA in order to restore public confidence in the process.

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[12] *Ibid*, at paras 136-137.

b) Insufficient time for public comment on the Focus Report

25. On October 10, 2019, we wrote to Minister Wilson on behalf of FONS to request that he grant additional time for both the public and the Administrator to review NPNS' Focus Report.[13] Specifically, FONS requested that the Minister:

   (a) Grant additional time for the submission of public comments on the Focus Report, with a new deadline of Monday, December 9, 2019; and

   (b) Add 30 more days to the 25-day period within which the Administrator must submit all comments and a recommendation to the Minister, following the deadline for public comments.

26. The current public comment period is exactly 30 days, running from October 9, 2019, the date on which NSE announced receipt of the Focus Report in the Nova Scotia Gazette.[14] This is the minimum public comment period required by the *Regulations.* The Minister has the authority to grant both extensions requested by FONS, pursuant to ss 16(2) and 17(2) of the *Regulations,* respectively, if the default timelines are insufficient for public comment or the Administrator's review.

27. Following the Minister's receipt of FONS' letter, the Minister made comments in the media indicating that he would not grant the requested extensions.[15] However, he did not respond directly to FONS.

28. On October 23, 2019, we wrote to the Minister on FONS' behalf once again to request a response to our letter of October 10.[16] We received a reply from the Minister denying our requested extensions that same day.[17]

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[13] Letter from James Gunvaldsen Klaassen and Sarah McDonald to the Honourable Minister Gordon Wilson, dated October 10, 2019, **Appendix E-1**.
[14] Release of Focus Report Pursuant to the Nova Scotia *Environment Act,* (2019) NS Gaz I, 1529, **Appendix E-2.**
[15] Michael Gorman, "Minister not considering extension to comment period on Northern Pulp report," CBC News, October 10, 2019, **Appendix E-3**; Taryn Grant, "More time needed for review of Northern Pulp pipeline proposal: community group," The Star, October 10, 2019, **Appendix E-4**.
[16] Letter from James Gunvaldsen Klaassen and Sarah McDonald to the Honourable Minister Gordon Wilson, dated October 23, 2019, **Appendix E-5.**
[17] Letter from the Honourable Minister Gordon Wilson to James Gunvaldsen Klaassen, dated October 23, 2019, **Appendix E-6**.

29. Without prejudice to its submissions on the Minister's bias, FONS maintains its position that the Minister should extend the timelines for both public review and comment on the Focus Report, and for the Administrator to review the various submissions and provide a recommendation to the Minister. FONS reiterates the concerns expressed in its October 10, 2019 letter about the volume, complexity, and highly technical nature of the materials that the general public is now tasked with reviewing within a very short timeframe. A 30 day comment period is entirely insufficient to allow the general public to review, understand, and provide thoughtful comments on thousands of pages of complex, technical scientific materials. Indeed, the former Minister Miller herself echoed that concern when NPNS filed its original registration document.[18]

30. In addition, as reviewed in detail in FONS' February 12, 2019 submission to Minister Miller, the proposed ETF is highly controversial and has generated high levels of public interest and concern within the Pictou area and across Nova Scotia. As a result, it is all the more important to ensure that the public has ample time to review the Focus Report, the EARD, the many comments offered on the EARD, including government responses and determine how to respond, and what to say. Without adequate time, there is no meaningful opportunity for either the public or the Minister to understand the potential impacts of the proposed ETF on their communities and on Nova Scotia's environment and economy.

31. The Terms of Reference for the Focus Report recommended that NPNS engage with relevant stakeholders and share relevant studies and reports in the process of preparing its Focus Report. However, our understanding is that NPNS shared <u>nothing</u> with FONS or with numerous other affected groups who have consistently expressed strong concerns about the proposed ETF before submitting the various studies comprising its Focus Report *en masse* to the Province. This approach created additional and entirely unnecessary barriers to meaningful public participation in the EA process.

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[18] Jean Laroche, "Northern Pulp's plans for pipeline, effluent treatment plant now public," CBC News, February 7, 2019, **Appendix E-7**.

32. FONS therefore renews its call on the Minister to extend the timelines as requested in its October 10, 2019 and October 23, 2019 letters, in order to restore fairness and integrity to the current EA process.

c) Failure to provide documents for public comment

33. In the October 10, 2019 and October 23, 2019 letters to the Minister, FONS identified the following documents as missing from the Focus Report posted on the NSE website:

    (a) Appendix 7.2 – states it includes as Appendix A an "Underwater Benthic Habitat Survey Video." However, no such video or link to any such video appears in this Appendix or elsewhere in the Focus Report.

    (b) Appendices 10.1 and 10.2 both refer to reports which are not provided.

    (c) Appendix 11.1 refers to a Mi'kmaq Ecological Knowledge Study but no such study is included in this Appendix or elsewhere in the Focus Report.

34. FONS letter went on to say: "[…] it is unclear as to whether reports are intended to be included, or submitted late, under Appendices 3.3, 3.5, 5.2, 6.1 and 7.5 of the Focus Report. If any such report will be submitted for your consideration, it must also be made available for public comment prior to any decisions being made […]".

35. The Minister did not address FONS' submission about these missing documents in any way in his comments to the media following the October 10, 2019 letter, or in his written response to the October 23, 2019 letter.

36. Jill Graham-Scanlan, president of FONS, has also corresponded with NSE's environmental assessment department via email about additional information missing from the Focus Report. On October 16, 2019, Ms. Graham-Scanlan sent two emails to EA@novascotia.ca noting the following errors and omissions:[19]

[19] Email chain between Jill Graham-Scanlan and the Environmental Assessment Web Account, dated October 23, 2019, **Appendix E-8**; Email chain between Jill Graham-Scanlan and the Environmental Assessment Web Account, dated October 24, 2019, **Appendix E-9**

(a) The Focus Report does not include information that would allow the public to determine whether the "fish and fish habitat baseline surveys for the freshwater environment" and "fish habitat baseline surveys for the marine environment" were completed to the satisfaction of Fisheries and Oceans Canada, as required by the Terms of Reference;

(b) The Focus Report does not include details of the assessment methodology for additional impact assessment of treated effluent on representative key marine fish species agreed upon by NSE in consultation with relevant federal departments, as required by the Terms of Reference; and

(c) A number of Figures in the Focus Report are blurry, and therefore partially illegible, both in the online version and in the hardcopy at the Pictou Library.

37. NSE did not address these errors and omissions in response to Ms. Graham-Scanlan's concerns. Shockingly, in one response NSE stated that "[t]he NS EA process does not include a conformity review or other check that the Focus Report contains all of the items listed in the Terms of Reference." This is in clear contrast to the press release NSE posted online upon receipt of the Focus Report, which stated that "[t]he report will be available online within 14 days <u>once department staff have done a preliminary check to confirm it is complete.</u>"[20]

38. NSE's failure to ensure that the complete Focus Report was made available for public comment clearly undermines the public's ability to participate meaningfully in the EA process. NSE requested this information from NPNS because it is necessary in order to fully understand the potential impacts of the proposed ETF. If the public cannot understand the potential impacts on their communities and environment, then they cannot provide fulsome comments and the integrity and fairness of the EA process is compromised.

39. As a result, and without prejudice to its position on the Minister's bias, FONS calls upon the Minister to make the missing documents available to the public and to provide additional time for the public to review and comment on those documents. FONS notes that the Province's failure to make the complete Focus Report available for public comment at the outset further

[20] NSE news release, "Northern Pulp Focus Report Submitted," October 2, 2019, **Appendix E-10**.

supports FONS' request for the Minister to extend the timelines for review under the *Regulations,* as outlined in the previous section.

4. Effluent and Sediment Transport Modelling

40. The modelling exercise conducted by Stantec, NPNS' consultants, is summarized in the set of receiving water studies contained in the original EARD. For the Focus Report, Stantec conducted a further modelling exercise and summarized those conclusions in an "Updated Receiving Water Study", dated September 27, 2019.[21] The findings of the full set of receiving water studies, including the Updated RWS, are fundamental to the overall and entirely questionable conclusion that none of the impacts of any aspect of this project will be significant. The accuracy and reliability of the modelling exercise is essential for a fulsome and in-depth evaluation of the project. If the modelling is not reliable, many of the conclusions asserted by NPNS' other consultants in relation to marine impacts and water quality will likewise be unreliable.

41. Stantec's central premise is that all contaminants will be quickly diluted. Stantec relies heavily on the questionable mixing zone concept as discussed below.

42. The Stantec Receiving Water Studies, on which much of the NPNS EA is founded, are unreliable and fundamentally inaccurate. The modelling exercise undertaken was not appropriate for the receiving environment and is not an accurate representation of effluent and sediment interaction with that environment. FONS submits that the Receiving Water Studies, and other materials based on the conclusions of those studies, must be disregarded and no assessment of environmental effects can be undertaken based on those studies.

43. FONS relies on the critique of the Receiving Water Studies prepared by Dr. Oliver Fringer. Dr. Fringer is an Associate Professor (with tenure), Department of Civil and Environmental Engineering, Stanford University. He is an oceanographer with expertise in numerical modelling of coastal dynamics.[22]

[21] Appendix 4.2, Focus Report.
[22] Oliver Fringer, CV, **Appendix A-3**

44. Dr. Fringer's original report regarding the Stantec Receiving Water Studies was submitted within the FONS submission of March 8, 2019.[23] We have again appended it to this submission. Dr. Fringer has also prepared a new report, which critiques Stantec's updated Receiving Water Study.[24] Dr. Fringer's reports speak for themselves and should be read together. We hereby submit them to the Minister for a detailed and thorough review. FONS submits that Dr. Fringer's two reports in combination make clear that all effluent modelling work done for NPNS in relation to this project is defective and unreliable, and all conclusions based on that modelling must be discounted and disregarded.

45. Dr. Fringer notes that his concerns regarding Stantec's original modelling work were not addressed within the updated receiving water study and the same flaws inherent in the original Stantec studies were carried forward into the updated study.

46. Dr. Fringer concludes that the updated studies prepared by Stantec based on the MIKE 21 and CORMIX system models are both inaccurate and misleading. They do not provide science-based evidence that can be used to assess the potential environmental impacts of the near- and far-field effluent dilution from the proposed outfall site.

47. The problems with these models arise from deficient modelling practices that Dr. Fringer criticized in his original report but were not addressed in the new studies. Dr. Fringer concludes that the Stantec studies suffer from fundamental problems associated with model setup, validation and analysis. Despite some additional measurements obtained in early summer 2019, the validation of the currents near site CH-B indicates that the Stantec model performs poorly and cannot be trusted to accurately predict the far-field transport of the effluent.

48. The models fail to take into account the stratification within the water column, which prevents the total mixing assumed by both the near-field and far-field modelling exercise. Stantec's near and far field models therefore over-predict mixing and dilution of effluent.

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[23] Fringer, O.B., *Review of near- and far-field modeling studies by Stantec Consulting for the Northern Pulp effluent treatment facility replacement project*, 7 March 2019 **Appendix A-4**

[24] Fringer, O.B., *Review of updated modeling studies by Stantec Consulting for the Northern Pulp effluent treatment facility replacement project*, 5 November 2019 **Appendix A-1** (Fringer update report)

49. Dr. Fringer finds that Stantec significantly overestimates the dilution by at least a factor of 3.5 based solely on its selection of parameters regarding effluent and receiving water density.[25] If different parameters are used, the dilution factor at 100 m from the diffuser is only 42, and not the much higher figures used by Stantec.[26] Dr. Fringer further concludes:

> This dilution factor is expected to be even lower when taking into account the effects of vertical density stratification, weaker slack currents during neap tides, and receiving water densities that should be at their lowest during late summer/early fall.[27]

50. Dr. Fringer's report also critiques the sediment transport report prepared by Stantec at Appendix 4.3. Dr. Fringer concludes that the sediment transport study is fundamentally flawed because it ignores the effect of flocculation and fails to use MIKE software designed for sediment transport modelling. Had Stantec accounted for flocculation, it would have concluded that solids within the effluent would deposit and accumulate much more rapidly and much closer to the outfall. Dr. Fringer finds:

> …owing to the use of floc diameters that are too small, and because the settling velocity is proportional to the square of this diameter, the settling velocities are vastly underpredicted and the resulting transport distances are substantially overpredicted. Substantially more flocculated effluent particulate matter will accumulate around the outfall….[28]

> The second flaw of the sediment transport study is that it is overly simplistic. The tidal currents are highly variable in the region in both space and time, and it is naïve to imply that the suspended particulate matter in the effluent will not pose an environmental or ecological problem based simply on an approximate distance it is expected to propagate away from the outfall. Not only do we expect flocculation to promote particle settling in the vicinity of the outfall, but the particles that settle far from the outfall may accumulate in sensitive fisheries habitats in deeper water or in Caribou Harbour.[29]

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[25] The parameters selected by Stantec do not match the trends shown by sampling results within Appendix 2.3. And where there is a range of results in 4.3, density and salinity factors most favourable to a higher level of dilution is selected, without explanation or justification.
[26] Fringer update report, at pp .14 and 18.
[27] Fringer update report at p 1. See also pp 10-13.
[28] Fringer update report pp 15-16.
[29] Fringer update report p. 16.

51. Stantec fails to assess the potential for fine particulate matter to accumulate within Caribou Harbour or other ecologically sensitive sites in the region.[30] Likewise, Stantec's statements that no effluent buildup will occur within Caribou Harbour are in doubt. Dr. Fringer writes:

> It is noted that "no effluent concentration buildup was found in the harbour basins, along the shorelines and in the entire model domain."[31] There is no scientific justification for this statement. Not only do the figures show buildup of effluent along the shorelines and signatures of effluent entering Caribou Harbour, but it is straightforward to compute the exact amount of effluent entering the harbour with the MIKE 21 model.[32]

52. In respect of winter scenario modelling, the report says:

> The winter scenario models ice cover simply by removing winds and waves, yet ice cover should be modeled with reduced tidal currents at the model boundaries and higher friction at the free surface. Improper ice modeling leads to an overprediction of the near- and far-field dilution.[33]

53. Dr. Fringer also finds that the modelling done by Stantec in relation to the existing Boat Harbour Facility is unreliable and incapable of being simulated accurately within the two-dimensional model used by Stantec.[34]

54. Based on the above and Dr. Fringer's detailed findings and analysis, the Stantec reports must be viewed as fundamentally unreliable, and an inappropriate tool to assess the effectiveness of the dilution of effluent, proposed as the main mitigation measure in relation to impacts on the marine environment.

55. Contrary to Stantec's assertions, it is therefore likely that there will be effluent buildup within Caribou Harbour and sediment deposition near the outfall. The effluent will not dilute to the degree asserted by Stantec, making the proposed mitigation ineffective. The proposed effluent discharge at the outfall will therefore present significant environmental effects and adverse effects for which no effective mitigation is proposed.

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[30] Fringer update report, pp 17-18.
[31] Dr. Fringer is quoting from p ii of the executive summary of the Stantec Updated Receiving Water study, Focus Report, Appendix 4.2.
[32] Fringer update report, at p. 9.
[33] Fringer update report, at p. 2 – see also p. 9.
[34] Fringer update report at p. 17.

5. Modelling and Marine Impact assessment

56. NPNS's consultant, Ecometrix, provided a report on its conclusions as to impacts on the marine environment and marine species.[35] The Ecometrix report relies heavily on the findings of the Stantec receiving water studies, including the last study which is dated September 27, 2019. Consequently, to the extent Ecometrix based portions of its report on unreliable or incorrect findings made by Stantec, then those Ecometrix findings must also be considered unreliable or wrong.

57. Ecometrix did not record any independent assessment or evaluation of Stantec's conclusions, but nonetheless carries them forward into the Ecometrix report. The timing of the two reports shows that, within 3 days of receiving the Stantec report, Ecometrix produced its own report which repeats Stantec's conclusions. Like Stantec, Ecometrix makes no allowance for error in respect of the modelling conclusions. Neither mentions Dr. Fringer's report and critique dated March 7, 2019, which seriously questions the reliability of the fundamentals of Stantec's work on the initial Receiving Water Studies and the accuracy of Stantec's predictions.

58. Stantec's fundamental conclusion is that all contaminants and other effluent substances will quickly dilute, within a few metres of the diffuser. Ecometrix's Marine Environment Impact Assessment (Table 4-6) characterizes the dilution effect as a "proposed mitigation", described as: "[t]he diffuser configuration promotes rapid mixing of effluent to minimize the spatial extent over which constituent concentrations are expected to be distinguishable from "background" or ambient conditions."[36] Once diluted, neither Stantec nor Ecometrix considers any effluent component to present any significant concern or risk, including by way of bioaccumulation and concentration within food chains. Underlying Ecometrix's report is the notion that dilution renders all contaminants as essentially benign despite their continuous flow into Caribou Channel, the Strait and beyond. Determining impacts to marine ecosystems and organisms is therefore mostly a mathematical exercise, dependent on dilution rates.

[35] Focus Report, Appendix 7.3.
[36] Ecometrix Report, at, for example p. 4.31 (see column under the heading "proposed mitigation").

59. As discussed above, Dr. Fringer's expert opinion is that the Stantec models are fundamental defective and unreliable. If Stantec is incorrect, Ecometrix's conclusions and predictions must also be in doubt. Some of Ecometrix's conclusions that rely on Stantec modelling are:

(i) Definition of study areas - the Marine Local Assessment Area (LAA) and the Regional Assessment Area (RAA) - in terms of Stantec's predicted dilution factors i.e areas which are predicted to be exposed to relative effluent concentrations exceeding 1% and those predicted to be lower than 1%;[37]

(ii) Assumption that effluent dispersion in winter is very similar to summer;[38]

(iii) Dilution ratios set out in table 4-4;[39]

(iv) Calculation of distances from the diffuser at which each substance reaches "ambient condition" per Table 4-3; [40]

(v) There will not be a requirement to conduct a fish community or benthic community study as part of an Environmental Effects Monitoring study[41] under the *Pulp and Paper Effluent Regulations*;[42] and,Purported impacts (or no impacts) on marine species, including Atlantic herring,[43] Rock crab,[44] American lobster,[45] Marine shellfish,[46] plankton,[47] and benthic invertebrates.[48]

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[37] Ecometrix Report, page 2.4, Appendix 7.3.
[38] Ecometrix Report, page 4.12, Appendix 7.3. "As shown by MIKE 21 2D modelling presented in Stantec (2019c), effluent dispersion in winter is very similar to summer."
[39] Ecometrix Report, "Table 4-4: Dilution Ratios at Distance"; page 4.15, Appendix 7.3.
[40] Ecometrix Report, "Table 4-3: Marine Water Quality COPCs and Estimated Dilution"; page 4.13, Appendix 7.3.
[41] Ecometrix Report, p. 5.3, Appendix 7.3.
[42] *Pulp and Paper Effluent Regulations*, SOR/92-269, Schedule IV.1, s. 3.
[43] Ecometrix Report, p. 420 and p. 4.25, Table 4-6, "Significance Determinations of Residual Effects after Mitigation on the Marine Environment VEC", Atlantic herring, Appendix 7.3.
[44] Ecometrix Report, Table 4-6, "Significance Determinations of Residual Effects after Mitigation on the Marine Environment VEC", Rock crab, page 4.27, Appendix 7.3.
[45] Ecometrix Report, Table 4-6, "Significance Determinations of Residual Effects after Mitigation on the Marine Environment VEC", American lobster, page 4.29, Appendix 7.3. "Effects are considered to be minor and encompass a small area within 5 m of the diffuser area."
[46] Ecometrix Report, Table 4-6, "Significance Determinations of Residual Effects after Mitigation on the Marine Environment VEC", shellfish, page 4.31, Appendix 7.3.
[47] Ecometrix Report, Table 4-6, "Significance Determinations of Residual Effects after Mitigation on the Marine Environment VEC", plankton, page 4.32, Appendix 7.3.
[48] Ecometrix Report, Table 4-6, "Significance Determinations of Residual Effects after Mitigation on the Marine Environment VEC", benthic invertebrates, page 4.34, Appendix 7.3.

60. The Ecometrix report provides little assessment as to what will happen to individuals of marine species that come into contact with effluent discharging from the diffuser. Based on Stantec's modelling, Ecometrix treats the "mixing zone" as a small area, and mostly concludes that the effluent will dilute quickly and any contact with marine organisms will be fleeting.[49]

61. This conclusion is reached despite the reality that an average of 65 million litres of effluent will be discharged at the site each day, amounting to 23.7 billion litres a year. At that rate, over 30 years of operation, the total effluent discharge will be 711 billion litres. As stated above, there is no indication that any testing was conducted to assess impacts of such discharges over time on marine species at all life stages, despite the nature of the ecosystem being examined and the concerns raised by the public as to potential toxicological effects of the effluent on the ecosystem. In this regard, Ecometrix simply states:

> To address these concerns, NPNS will continue to investigate the feasibility of performing toxicity testing to determine both potential acute and sublethal effects on immature stages of lobster and herring.

62. "Investigating the possibility" of doing such a test does not satisfy the requirement to consider and assess the potential risks to lobster and herring from this project. NPNS has chosen to leave this requirement unsatisfied.

<u>Further potential errors in with application of the dilution rates</u>

63. The information provided by NPNS' consultants in Table 7.3-1[50] of the NPNS Focus Report, appears to contain significant internal errors, in addition to being based on the erroneous predictions from the Stantec modelling exercise. The table purports to set out the distances by which each parameter in the effluent will reach "ambient conditions".

64. The right hand column of the table is clearly erroneous. That column, entitled "distance from diffuser ambient conditions are reached", says, for the most part, that concentrations of various effluent components will reach ambient conditions <u>within less than 2 m</u> of the diffuser. A quick look at the table shows that this is obviously not true. As the most glaring example,

[49] Ecometrix Report, page 4.20, Appendix 7.3.
[50] Table 7.3-1: Marine Water Quality COPCs and Estimated Dilution, Focus Report p. 138.

Mercury is shown not to be present in seawater in either 2018 or 2019. As it is contained in the effluent entering the seawater at the diffuser, those concentrations will be at 0.028 µg/L[51] 5m from the diffuser and the same at 100m. Yet the right hand column concludes that it will reach ambient conditions (of 0 µg/L) within 2m of the diffuser. It cannot reach 0 µg/L at 2m if it is still at 0.028 µg/L at both 5 m and 100 m. Moreover, it shows that it still exceeds the CWQG guideline of 0.016 even at 100m.

65. As another example, ambient concentrations for cadmium were measured at n/a in 2018, and 0.084 µg/L in 2019. The table says that the effluent discharge of 1.03 µg/L will reach ambient conditions by "<2m", but shows that by 5 m it has only reached 0.1 µg/L, and only reaches 0.084 µg/L by 100m. Obviously, if the ambient concentration for cadmium is n/a, then it has not reached ambient conditions even by 100m and certainly not <2m The <2m prediction is therefore not even borne out by the modelling result presented, yet it is the conclusion given in the Dillon table.

66. The table lists measurements of Caribou seawater from 2018 and 2019 and the concentrations vary from one year's measurement to the other. It is important to note that there are only a couple of measurements for each year, and no attempt was made to conduct an intensive sampling program to obtain a full set of measurements over one or more annual cycles.

67. But despite this very limited data set, Dillon consistently selects the higher level of concentrations as ambient conditions. There is no discussion as to why one is chosen over the other. Rather than attempting a balanced and neutral analysis, the table consistently uses the highest level of a particular parameter, even though a lower level was measured in another year. Again, repeating the cadmium example, measured ambient concentrations for cadmium were measured at n/a in 2018, and 0.084 µg/L in 2019. Yet 0.084 is used as the ambient condition, even though it was not measured at all in 2018. No explanation is provided as to why 0.084 was selected.

[51] Micrograms per litre

6. Canso chemical site and mercury contamination

68. In its March 8, 2019 submission FONS identified mercury contamination present on the NPNS property in close proximity to the proposed site for the ETF and its potential to be disturbed via construction activities.[52] FONS provided a report by Dr. Margaret Sears describing the basis for the concerns and the adverse environmental effects that can be caused by mercury contamination.[53] As shown by Appendix 1.1, many members of the public expressed similar concerns.[54]

69. FONS also provided supporting technical materials documenting the risks and known problems with mercury contamination on the NPNS/Canso Chemicals site.[55] In a Canso site decommissioning report dated January 26, 2000, Dillon consulting concluded that mercury was present in the bedrock at the site[56] and there was "potential for mercury to migrate and discharge to Pictou Harbour in the future."[57]

70. Neither the Focus Report nor the original EARD contains any discussion or assessment of this risk in connection with the proposed ETF project, or provides any mitigation measures. In response to the numerous concerns raised regarding site mercury contamination, NPNS' report only says: "Monitoring will be conducted as part of construction. Contingency plans will be in place to address contaminant if identified."[58]

71. This approach is not acceptable as the Minister must consider, *inter alia*, the "potential and known adverse effects or environmental effects of the proposed undertaking...[.]" [59] This must be done before the work commences, not after it has proceeded and a foreseeable problem has been encountered. One would expect to see an identification of the risks, delineation of the contamination, and the steps that are proposed to avoid and mitigate the risk.

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[52] FONS submission, March 8, 2019, at p. 29 and Appendices F-1 and H-2; Dr. Margaret Sears, *Comments regarding the Northern Pulp Nova Scotia Environmental Assessment Registration Document, Replacement Treatment Facility*, March 8, 2019 (Appendix F-1). Partial decommissioning report for Canso site (Appendix H-2).
[53] Dr. Sears' report, at p. 4 (Appendix F-1).
[54] Focus Report, Appendix 1.1, Public Comments, for example at pp. 20 and 122 of 125.
[55] Canso Chemicals Site materials, FONS submission, March 8, 2019, Appendix H-2.
[56] Canso Chemicals Site report, p. 35, FONS submission, March 8, 2019, Appendix H-2.
[57] Canso Chemicals Site report, p. 37, FONS submission, March 8, 2019, Appendix H-2.
[58] Focus Report, Appendix 1.1, Public Comments, for example at pp. 20 and 122 of 125.
[59] *EA Regulations*, ss 9(1A)(b)(vi) and 12(e).

72. As Dr. Sears says, gathering information and conducting analysis relating to the Canso site mercury issue should be an essential component of the EA process.[60] However, its potential impacts have not been assessed and no information has been provided regarding mercury contamination at the site. Despite advance knowledge of mercury contamination, NPNS proposes only to wait and see if any mercury is encountered while the project is underway, without assessing any associated risk within this EA process prior to beginning the work. Without any information and evaluation regarding mercury contamination, an EA cannot be conducted and the obligation to consult Indigenous peoples and the public has not been discharged.

73. Consequently, the project description and assessment cannot be considered complete and NPNS's proposed ETF must be rejected.

7. Failure to conduct primary studies and obtain baseline data

74. As discussed above in the context of site mercury contamination, the *EA Regs* require that NPNS provide environmental baseline information in respect of its proposed project.[61] Despite this requirement, as discussed in FONS' March 8, 2019 submission, in many cases NPNS did not provide such information when it submitted its original EARD. The subsequent Terms of Reference for the Focus Report provided NPNS with another opportunity to submit baseline information. As one example, paragraph 7.2 of the Terms of Reference requires NPNS to:

> 7.2 Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada.

75. However, in its Focus Report, while NPNS asserts that its current evaluation regarding the benthic community is comprehensive, it then suggests that more information will be gathered in the area of the effluent diffuser in fall 2019 to supplement the existing database.[62] It also appears to concede that it has not achieved a baseline for phytoplankton and zooplankton presence, diversity and relative abundance.[63] No information has been provided to the public

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[60] Dr. Sears' report, at p. 4 (Appendix F-1).
[61] *EA Regulations*, ss 9(1A)(b)(x) and 12(da).
[62] Focus Report, p. 126.
[63] Focus Report, p. 126.

as to whether any surveys were conducted to DFO's satisfaction. Consequently, it appears that the requirement to provide comprehensive baseline information has not been met.

76. As well, paragraphs 7.3 and 9.1 of the Terms of Reference require:

> 7.3 Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries.
>
> 9.1 Complete baseline studies for fish and shellfish tissue (via chemical analysis) of representative key marine species important for commercial, recreational and Aboriginal fisheries in the vicinity of the proposed effluent pipeline and diffuser location.

77. While Appendix 9.1 shows some limited testing was done in September 2019, many more species have yet to be tested.[64] No testing of juvenile or larval stages was apparently conducted, even though, in its original EARD at Appendix H, Ecometrix stated that the environmental effects monitoring program would include toxicity testing to determine both potential acute and sublethal effects of effluent on immature stages of lobster and herring.[65] Despite the requirements of paragraph 7.3 of the Terms of Reference, Ecometrix's most recent report appears to indicate that no toxicity testing was done, and that NPNS is now only "considering" doing such testing.[66] It is submitted that a complete set of such tests is necessary baseline information and without a full set of tests, the Focus report is incomplete and does not satisfy the Terms of Reference.

78. Moreover, the limited testing conducted thus far provides no assurance that effluent exposure at any concentration and duration is benign for lobster, herring, rock crab or other species, at all life stages. Until comprehensive test results are available, such effects cannot be reliably assessed and the Minister will not be in a position to evaluate the risks of effluent exposure during the full life cycle of marine organisms.

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[64] Focus Report, Appendix 9.1, p. 2.
[65] NPNS EARD, January 2019, Appendix H, at p. 2.1.
[66] Ecometrix Report, p. 5.4,

79. FONS further states that the area within which the surveys were conducted appears to be relatively small, and was confined to the immediate area of the proposed pipeline corridor and diffuser location. It also appears that the Terms of Reference unduly narrowed the area in which baseline information was to be gathered. Even according to the Stantec predictions, diluted effluent will still be present in the wider area surrounding the immediate location of the diffuser. Consequently, appropriate baseline data should have been gathered beyond the pipeline corridor and diffuser location.

80. As well, the baseline data gathered represents only one point in time, and is not being conducted over a full year cycle. As effluent will be discharging year round, the full impacts of same cannot be measured against baseline data taken only in one small window of time.

81. Included with FONS March 8, 2019 was a commentary by Arthur MacKay.[67] Mr. MacKay is an experienced fisheries biologist and consultant.[68] He recommended that at least 12 monthly surveys should be conducted in order to establish a clear baseline.[69] While the Minister provided NPNS with ample time to gather significantly more baseline information, it is clear that no such comprehensive baseline has been established. No explanation is provided to explain the failure to use the allotted time to gather this crucial information.

82. FONS therefore submits that the requirement to gather baseline data in relation to the marine environment, fish and fish habitat has not been satisfied.

8. Herring Spawning, Fisheries and Mixing Zones

83. When responding to the original EARD, FONS[70] and many other groups and individuals raised a major concern regarding the impacts of NPNS's effluent discharge on herring spawning.[71] More specifically, the proposed outfall will discharge an average of 65,000,000 litres of treated effluent each day into one of the last remaining herring spawning grounds in the Southern Gulf

[67] MacKay, A.A., *Northern Pulp's Effluent Disposal Plans – Issues and Answers*, February 2019 (MacKay report)(Appendix C-1)
[68] Art MacKay cv (Appendix C-1).
[69] MacKay report, p. 3 (Appendix C-1).
[70] FONS March 8, 2019 submission, at pp.
[71] Focus Report, Appendix 1.1 – Concordence [sic] Table [get references to comments]

of St. Lawrence.[72] The discharged effluent will contain Persistent Organic Pollutants, as discussed further below in relation to Dr. Cameron's report.

84. The Minister directed NPNS to respond to all comments raised by the public. The Concordence [sic] Table at Appendix 1.1 of the Focus Report package records many concerns being expressed about impacts to herring spawning. In virtually every case, NPNS's response to this concern is "[r]efer to section 7.3 for comments concerning the impact assessment of treated effluent on representative key marine fish species."

85. However, section 7.3 of the Focus Report makes no mention of herring spawning. Appendix 7.3, on which section 7.3 is based, refers only twice to herring spawning, and makes no attempt to assess impacts on spawning.[73] The reference to herring spawning appears in table 3-10 of Appendix 7.3.[74] The entry from table 3-10 relating to Atlantic Herring is set out below:

Occur-rence	**Group**	**Com-mon Name**	**SARA**	**COSEWIC**	**Likely Occur-rence in LAA***	**Notes**	**CRA Fishery?**
Pelagic	Migra-tory	Atlantic Herring	No Status	No Status	High	Migratory and passing through the LAA to spawning areas, limited spawning habitat within the LAA	Yes

86. Beyond this entry, and a virtually identical entry in Appendix D,[75] nothing in Appendix 7.3 or the Focus Report establishes where herring spawning takes place and how that relates to the outfall. The sparse information included in the table simply confirms the clear evidence from the fishers that NPNS proposes to place the outfall and the LAA inside a herring spawning area.

[72] FONS March 8, 2019 submission at Appendix B-1- Egilsson, G., and MacCarthy, A., Caribou Harbour and Caribou Channel - dynamics, tides, ice, marine species and fisheries, February 21, 2019 (Appendix B-1).
[73] Focus Report Appendix 7.3.
[74] Table 3-10: Potential Fin Fish Species in the RAA, Focus Report Appendix 7.3, p. 3.31. See also p. 3.33.
[75] "Appendix D: Marine Fin-Fish Species Status, Occurrence, Habitat and Resource Use", Appendix 7.3, last page of table (pages not numbered).

87. An excerpt from a May 2018 DFO report states:

> Fall spawning occurs from mid-August to mid-October at depths of 5 to 20 m. Herring also show high spawning site fidelity. In recent years, the largest spring spawning areas are in the Northumberland Strait and Chaleur Bay and the largest fall spawning areas are in coastal waters off Miscou and Escuminac N.B., North Cape and Cape Bear P.E.I., **and Pictou, N.S**. When spawned, the eggs are attached to the sea floor.[76] [emphasis added]

88. The report also concludes that the estimated likelihood that the herring fall fishery will be in the "cautious zone in 2020" is 94%.[77] This is an indicator that the fishery is in decline and becoming vulnerable, consistent with the information provided by Greg Egilsson and Alan MacCarthy, both experienced herring fishers.[78]

89. As per FONS' submission dated March 8, 2019, NSE has stated that "mixing zones should not impinge upon…important fish spawning and/or fishing areas".[79] FONS's concern is noted at p 12 of 125 in the Concordence [sic] table at Appendix 1.1. NPNS' and its consultants respond by saying "refer to section 3.3 for comments concerning effluent discharge parameters". Section 3.3 says nothing about spawning and makes no attempt to explain how mixing zones can be situated within spawning areas or areas of active fisheries, despite the clear direction from NSE. In the same letter, NSE also states that persistent substances cannot be discharged in mixing zones, although we see that NPNs proposes to discharge a number of AOX substances.

90. A DFO report from 2016 makes clear that the Northumberland Strait supports many species which are fished commercially in the area. Ecometrix cites this report as "Rondeau et al. 2016".[80] The Rondeau 2016 report confirms evidence from fishers that intensive fishing for

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[76] DFO, Assessment of the Southern Gulf of St. Lawrence (NAFO Div 4T) Spring and Fall Spawner Components of Atlantic Herring (*clupea harengus)* with Advice for the 2018 and 2019 Fisheries, May 2018, Canadian Science Advisory Secretariat, Science Advisory Report 2018/029, at page 3 (DFO Herring Assessment May 2018).
[77] DFO Herring Assessment May 2018, at p. 28.
[78] FONS March 8, 2019 submission at Appendix B-1- Egilsson, G., and MacCarthy, A., Caribou Harbour and Caribou Channel - dynamics, tides, ice, marine species and fisheries, February 21, 2019 (Appendix B-1), at p. 3.
[79] FONS submission March 8, 2019, paras. 106-110 and Appendix H-6, Letter to the NPNS General Manager, from Nova Scotia Environment, Engineering Specialist, dated 14 June 2017, p. 1.
[80] The Report cited by Ecometrix is: Rondeau, A, et al. 2016 *Identification and Characterization of Important Areas based on Fish and Invertebrate Species in the Coastal Waters of the Southern Gulf of St. Lawrence,* Canadian Science Advisory Secretariat, 2016/044. It is attached to this submission at **Appendix D-4.**

lobster and herring, and other species, takes place in the area where NPNS wishes to discharge its pulp and paper effluent.

91. Via the Terms of Reference, the Minister directed NPNS to respond to public concerns about this project and to incorporate the comments in the Focus Report, where applicable.[81] The concern about the proposed position of the outfall is real and based in clear evidence from fishers.

92. NPNS and its consultants do not discuss or justify placement of a mixing zone in the middle of a spawning ground and active fishery. As stated in FONS' March 8, 2019 submission, NPNS and its consultants purport to rely on CCME and other guidance regarding mixing zones, but make no attempt to explain how the proposed ETF meets the preconditions for use of such a mixing zone.

93. The information provided in the Focus Report discussing active fisheries at or near the proposed outfall is biased, selective and unsupported. A map included in the Focus Report purports to depict lobster fishing in the vicinity of the outfall by counting density of "lobster buoy clusters". This is apparently based on 3 days of data, instead of one or more full seasons. No explanation is given as to what constitutes a "lobster buoy cluster", why data from only those dates was chosen for the map, or whether surveys were also conducted on other days. It appears designed to show that no lobster fishing takes place near the outfall, despite the direct evidence from fishers to the contrary. Likewise, the maps included in the Ecometrix report (Appendix 7.3),[82] and reproduced in the Focus Report, state that they show fishing areas of various commercial species. No source or raw data is provided to support the lines which purport to demark areas where fishing activity does or does not take place. There is no indication that the information comes from those who actually fish in those areas. Without seeing Ecometrix's sources and raw data the maps' accuracy cannot be assessed and must be viewed as unreliable. Further, the maps depict only a tiny area immediately around the outfall, despite the Stantec predictions of a much wider distribution of effluent at diluted

[81] Terms of Reference, paragraph 1.1.
[82] Focus Report, Appendix 7.3, pp 3.35-3.39.

concentrations along with sediment deposition as far away as 4.8 km from the outfall. No explanation is provided as to why the maps show only this very small area.

94. The Focus Report provides no assessment or discussion about herring spawning, and minimizes the active fisheries in the LAA and RAA. As stated in FONS' original submission, the mixing zone concept is not appropriate for the proposed outfall and ETF. It is being used to mask the fact that NPNS wishes to discharge 65,000,000 litres of treated effluent each day, which is likely to contain persistent and bioaccumulative substances such as dioxins, furans, cadmium and other harmful substances, into a vibrant ecosystem containing essential fish habitat, and an active fishery.

9. Toxic Substances - Dioxins and Furans

95. Test results produced as part of the Focus report show that the NPNS mill currently discharges effluent containing detectable amounts of certain dioxins and furans at Point C (into Boat Harbour Basin).[83] At table 1-12 of Appendix 2.3,[84] KSH summarizes those test results demonstrating that several dioxins, including TCDD (2,3,7,8-Tetra CDD)[85] and TCDF (2,3,7,8-Tetra CDF) are present in the effluent at Point C. These substances are toxic and bioaccumulative.

96. The KSH summary (in which the tables are included) concludes that Point C effluent "is an accurate representation of what the effluent from the new ETF will resemble."[86] If that is in fact accurate, then dioxins and furans will also be discharged at the proposed outfall in Caribou Channel.

97. Throughout the Focus report and Receiving Water Studies, NPNS and its consultants suggest that they must achieve compliance with discharges of dioxins and furans, and other problematic substances, within the mixing zone. This assumes that they are permitted to

[83] Focus Report, Appendix 2.3, Table 1-12, page 32.
[84] Focus Report, Appendix 2.3, p. 32.
[85] TCDD is considered to be the most toxic of all dioxins and furans. See Health Canada handout
[86] Focus Report, p. 33; and Focus Report Appendix 2.3, p. 33.

discharge at exceedance levels at the diffuser, provided it dilutes to "background" within a certain distance. They purport to apply CCME guidance in this regard.

98. There is no CCME guidance as to permissible discharge of dioxins and furans. Discharge of such substances by pulp mills is governed by the *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations*,[87] made under the *Canadian Environmental Protection Act, 1999.*

Section 4 of those *Regulations* prohibits a pulp mill operator from releasing "measurable amounts" of TCDD and TCDF. It does not matter whether concentrations of these substances could be diluted after discharge into a "mixing zone" or whether the background conditions already show some concentration of such substances. If measurable amounts as defined by the *Regulations* are discharged at the diffuser, it would constitute a breach of section 4.

Report of Dr. Lynn Cameron

99. Dr. Lynn Cameron has provided commentary on the Focus Report detailing several significant risks associated with the proposed ETF project.[88] Dr. Cameron has a PhD in organic chemistry[89]. We submit Dr. Cameron's entire commentary to the Minister for consideration. The following summarizes only some highlights from that report.

100. Dr. Cameron states that the proposed treatment facility is unacceptable as it will not sufficiently remove substances within a grouping referred to as AOX (Adsorbable Organic Halides). Most AOX are toxic to marine and human health, and some are considered Persistent Organic Pollutants. AOX substances include dioxins, furans and PCBs.[90]

101. Dr. Cameron advises that the concentrations of AOX are likely to be higher than predicted by KSH (as depicted in the Focus Report at Figure 2.3-1). This is because Point C effluent has had about 8.5 days in the Boat Harbour Effluent Treatment Facility process to permit the

[87] *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations*, SOR/92-267.
[88] Dr. Lynn Cameron, *Comments on the Focus Report*, Nov. 8, 2019 **Appendix C-1 (**Cameron Commentary).
[89] Dr. Cameron's Resumé, **Appendix C-2**
[90] Cameron Commentary, 2d page.

heavier molecular weight AOX compounds to settle out. In contrast, the new ETF would allow for less than 13 hours settling time for such compounds.[91]

102. As well, the sampling referred to in the Focus Report, conducted to determine concentrations of AOX and other effluent constituents, was done using HDPE sampling bottles. As AOX adheres to HDPE (as well as to organic tissue and sediment), the actual amount of AOX in effluent would be expected to be higher had the appropriate glass bottles been used for sampling.

103. Dr. Cameron also identifies problems associated with effluent constituents nitrogen and phosphorous. Once again, she is concerned that these concentrations will be higher in the effluent coming from the new facility than those drawn from Point C effluent, as the 8.5 day settling time is a factor in reducing the concentrations at Point C. Nitrogen and phosphorous can cause areas of depleted oxygen or "dead zones" in marine environments. The algal blooms associated with these compounds produce toxins which cause health issues for marine life and human consumption of seafood.[92]

104. Consequently, based on Dr. Cameron's assessment, it can be concluded that the adverse effects and significant environmental effects of AOX, nitrogen and phosphorous concentrations in NPNS effluent have been underestimated by NPNS' consultants.

10. Outstanding pipeline issues

105. No automated leak detection system is proposed for the marine portions of the proposed pipeline.[93] There has been no explanation offered for this, nor any substantive response to any of the concerns expressed regarding serious impacts of spills due to leakage or pipe rupture within Caribou Harbour, or pipe ruptures or diffuser damage in Caribou Channel. No information is provided as to how pipe leaks, ruptures or malfunctions will be detected and addressed during storms, rough seas or in winter when ice covers the Strait and the pipeline route. The only response to any concerns expressed regarding leakage or rupture is that a

[91] Cameron Commentary, 2d page.
[92] Cameron Commentary, 3rd page.
[93] Focus Report, p. 62.

properly installed and maintained pipeline will be leak-free. Given the documented leaks over the years due to NPNS' failure to inspect and maintain its existing pipelines, this cannot be a satisfactory answer.

106. None of the precise routes to be followed by any segment of the pipeline have been determined. Regarding the land-based section of the pipeline from Pictou to Caribou, Nova Scotia Transportation and Infrastructure Renewal (TIR) says that it is "continuing to hold talks with Northern Pulp regarding a possible pipeline route."[94] Until certainty is achieved as to whether the TIR will allow the proposed pipeline, the project description cannot be viewed as complete since major changes to it would be required if a new route had to be proposed.

107. The precise route through the marine areas is also still unclear. Without a complete route which has been precisely defined via a detailed design, the impacts of this project cannot be described and assessed.

11. Receiving environment – air quality

108. The ETF proposal includes the burning of sludge generated from the effluent treatment. Via Terms of Reference paragraph 6.2, the Minister required NPNS to undertake Air Dispersion modelling for all potential contaminants of concern related to the project.

109. Dr. Elaine MacDonald, Senior Staff Scientist with Ecojustice has reviewed the Air Dispersion modelling report. Dr. MacDonald's written comments[95] and CV[96] are appended to this submission and are submitted in their entirety for the Minister's review within this EA and Focus Report process.

110. Dr. MacDonald concludes that the air quality analysis included with the Focus Report should be considered unreliable and incomplete. The input data is not site-specific and the chosen model is not appropriate for a coastal location with complex terrain. Transitional operating conditions such as unit start-ups and shutdowns when air emissions peak were not considered.

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[94] Focus Report, Appendix 2.1, letter of September 21, 2019 from TIR to General Manager, NPNS.
[95] Dr. Elaine MacDonald, Review of the Northern Pulp Nova Scotia Focus Report Section 6.0 and Appendix 6.2 Expanded Air Dispersion Modelling Study, FONS submission **Appendix B-1**
[96] CV of Dr. Elaine MacDonald, Ecojustice Senior Staff Scientist, **Appendix B-2**

Even if these limitations in modelling quality and methodology are ignored, the air dispersion modelling predicted exceedances of several air pollutant standards, including exceedances of cancer-causing substances benzo(a)pyrene and hexavalent chromium. The analysis also estimated that several residents would experience frequent and elevated concentrations of highly odorous reduced sulphur compounds, resulting in an unacceptable adverse impact on the community.[97]

111. As well, paragraph 6.3 required an updated air monitoring plan for the Project site based on the air dispersion modelling results. The plan must include the potential air contaminants to be monitored and proposed air monitoring location(s). However, as the air dispersion modelling exercise cannot be relied upon, and as the updated air monitoring plan provided by NPNS (section 6.3) does not include all of the contaminants for which exceedances are predicted (pp 113-114), paragraphs 6.2 and 6.3 of the Terms of Reference have not been satisfied and the environmental impacts cannot be evaluated.

12. Conclusion

112. In the Executive Summary of NPNS' Focus Report, the consultants advise of their prediction that, on all aspects of the project, there will be no "significant adverse residual environmental impacts".[98] This conclusion is not supportable and must be rejected, due to the evidence and material submitted within this EA and Focus Report process and referenced herein, as well as per the submissions of Pictou Landing First Nation, the fishing community and their associated organizations, the Town of Pictou, the Caribou Harbour Authority, the expert reports from qualified experts, and the vast amount of information provided others, including concerned residents and organizations within Pictou County and in other areas of Nova Scotia. FONS submits that the information and analysis provided to the Minister shows that adverse effects and non-mitigable unacceptable significant environmental effects <u>will</u> occur in respect of the ETF project.

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[97] Dr. MacDonald Commentary, at p. 3 **Appendix B1.**
[98] Focus Report, Executive Summary, p. vi.

13. Decision Requested –ss 35(3)(d) and 40(c) of the *Environmental Assessment Act* and ss. 18(c) of the *Environmental Assessment Regulations*

113. This submission and the accompanying Appendices, as well as the information and evidence provided in FONS' previous submissions,[99] and the evidence, comments and concerns of Pictou Landing First Nation and many other participants in this EA and Focus Report process, have established that it is likely that the ETF project will cause adverse effects and/or significant environmental effects that are unacceptable and cannot be mitigated. FONS therefore requests that the Minister reject the proposed undertaking pursuant to subsection 35(3)(d) of the *Environment Act* and subsection 18(c) of the *Environmental Assessment Regulations.*

114. The Decision requested above is without prejudice to the following relief which is requested in the alternative:

(a) that the Minister recuse himself from any and all decisions in relation to the ETF project as his involvement creates a reasonable apprehension of bias that invalidates the EA process;

and,

(b) that the Minister, or alternatively the decision-maker appointed following the Minister's recusal, take all necessary steps to remedy the procedural defects that have fundamentally compromised the fairness and integrity of the process before any final decisions are made regarding the ETF project. This includes making all of the missing documents from the Focus Report available for public review, and providing an appropriate period of time for both the public and the Administrator to comment on the additional documents pursuant to ss 16(2) and 17(2) of the *EA Regs.*

115. Further and in any event of the above, FONS requests that it be provided with a written statement of the decision rendered after review of the Focus Report in respect of the EA of the

[99] See footnote 3 above.

ETF project, setting out the findings of fact upon which it is based and the reasons for the decision, pursuant to subsection 10(4) of the *Environment Act*.

Dated November 8, 2019, at Halifax Nova Scotia.

Barrister and Solicitor

Barrister and Solicitor

APPENDICES

Scientific Reports

Supporting Documents

APPENDIX A-1

Review of updated modeling studies by Stantec Consulting for the Northern Pulp effluent treatment facility replacement project

Prepared by:

San Francisco, CA, USA

November 5, 2019

1. Executive summary

Stantec, Ltd., conducted an updated receiving water study to assess the near- and far-field mixing and dilution of effluent discharged from the proposed outfall at site CH-B. They also conducted a study to assess the transport of suspended particulate matter from the outfall. For the reasons enumerated below, these studies are flawed and provide no evidence that the environmental impact of the outfall will be minimal:

1) Although additional measurements were made in the vicinity of site CH-B to justify the use of a two-dimensional model, the measurements indicate exactly the opposite because they show strong density effects that can only be simulated with a three-dimensional model. Three-dimensional currents can transport effluent in a direction that is opposite to that of the two-dimensional currents, and thus the two-dimensional far-field results are meaningless.

2) The two-dimensional MIKE 21 model does not accurately predict the observed currents, and hence we can have no confidence in its ability to simulate the far-field effluent dilution, even if the flow were two-dimensional. Although the simulated temperature matches observations, this is misleading because the temperature has no bearing on the computed currents. Similarly, a wave model accurately predicts the surface, wind-generated waves when compared to the measurements, yet no assessment as to their impact on the effluent dilution

is discussed.

3) The winter scenario models ice cover simply by removing winds and waves, yet ice cover should be modeled with reduced tidal currents at the model boundaries and higher friction at the free surface. Improper ice modeling leads to an overprediction of the near- and far-field dilution.

4) Plots of far-field effluent concentrations around site CH-B are misleading: the two-dimensional MIKE 21 model overestimates the dilution by assuming complete mixing over the water column. These plots are used to show that there is no buildup in Caribou Harbour[1], although there is clear buildup that could easily be quantified with the model.

5) The updated near-field modeling using CORMIX overpredicts the near-field dilution by a factor of 3.5 because it assumes the receiving waters are too dense. Factoring in the correct receiving water density gives a dilution factor of just 42 at the edge of the 100-m mixing zone. This dilution factor is expected to be even lower when taking into account the effects of vertical density stratification, weaker slack currents during neap tides, and receiving water densities that should be at their lowest during late summer/early fall.

6) The sediment transport study is fundamentally flawed because it ignores the effect of flocculation which will cause the fine suspended particulate matter to settle much faster and deposit in the vicinity of the outfall. The sediment transport study is also overly simplistic and does not assess the potential for fine particulate matter to accumulate in Caribou Harbour or in other ecologically sensitive sites in the region.

Stantec also conducted a study to simulate the far-field dilution of effluent discharged from the Boat Harbour weir. The results are inaccurate and cannot be trusted because (1) the hydrodynamic model is based on the poorly validated model used in the original study and (2) the buoyant surface plume emanating from Boat Harbour is highly three-dimensional and cannot be simulated with a two-dimensional model like MIKE 21.

2. Introduction

In this report I evaluate modeling studies conducted by Stantec Consulting, Ltd., as part of the Focus Report for the Replacement Effluent Treatment Facility Project for environmental assessment, that was submitted by Northern Pulp Nova Scotia on October 2, 2019. I review the following three components of the report:

1) Appendix 4.2: Far-field Dispersion Modelling of Treated Effluent Discharge at the Existing Weir in Boat Harbour, Pictou, Nova Scotia.
2) Appendix 4.2: Northern Pulp Effluent Treatment Facility Replacement Project: Updated Receiving Water Study, Caribou, Nova Scotia.
3) Appendix 4.3: Estimate of Sediment Transport of the NPNS treated effluent.

These three reports will be referred to as (1) The Boat Harbour study, (2) the updated receiving water study or just the updated study, and (3) the sediment transport study.

[1] In this report, Caribou Harbour refers to the semi-enclosed shallow water body with a mouth defined by the opening between Caribou Point to the north and Munroes Island to the south.

This review references my review of the original receiving water study (the Original Study) conducted by Stantec Consulting, Ltd. In the Original Study, the MIKE 21 hydrodynamic model was used to simulate the far-field transport and dilution of effluent discharged from the proposed CH-B location. The CORMIX near-field model was used to compute the dilution within 100 m of the outfall due to turbulence and mixing of the buoyant effluent. The Boat Harbour and updated studies I review in this report use the same models and setup as the Original Study.

→ *The updated study includes a wave model to compute the wind-generated waves around site CH-B. This model computes both wind-generated waves and remote swell waves, although swell is not included in the updated study.*

The primary differences between the Original Study and the updated study are the additional validation of temperature, currents, and surface wave heights at site CH-B. To compute the waves, the updated study includes a wave module that computes the distribution of surface waves driven by winds in the region. This wave module is needed to compute the surface waves because wind-generated surface waves have wavelengths less than 50 m and periods less than 5 s. These spatial scales are not resolved by the computational grid and must be modeled with what is referred to as a spectral wave model. Instead of modeling individual waves as they are generated and propagate on the free surface, which would require a three-dimensional grid with thousands to millions more grid cells, spectral wave models compute the energy of waves at different frequencies and directions in each computational cell. This gives a measure of the average wave height (the significant wave height, or the average height of the largest 1/3 of the waves) in each grid cell in response to winds, breaking, refraction and diffraction by bathymetry, and currents computed by the hydrodynamic model. The effect of waves is also fed back into the hydrodynamic model to drive currents. Such currents are strongest on beaches where waves break and drive alongshore flows. Although the spectral wave model can compute the evolution of both locally wind-generated and remotely-generated swell waves, swell waves are not considered in the updated study.

→ *New measurements of currents were obtained with an ADCP, an instrument that measures currents using sound waves in the water. New measurements of salinity and temperature were also obtained.*

Stantec conducted additional field surveys to measure currents, salinity, and temperature in the vicinity of site CH-B. Profiles, or measurements at different depths below the surface, of temperature and salinity were measured to assess their vertical variability. Currents were measured with an ADCP, or acoustic Doppler current profiler, which uses sound waves to measure the current magnitude and direction at different depths, and is a very common instrument used in oceanography. The ADCP was mounted to a boat that was driven back and forth to measure transects of currents as a function of depth and horizontal position around site CH-B. Such measurements are useful for assessing the vertical and horizontal variability of currents at different snapshots in time, for example during flood and ebb tides. The ADCP was also mounted to a bottom mooring to measure currents as a function of depth and time near CH-B. These moored measurements are useful to understand the variability of currents over a tidal cycle at a fixed location in space. The ADCP also measures water levels which can be used to validate the tidal water levels computed by the hydrodynamic model and the wave heights computed by the spectral wave model.

3. Review of the far-field modeling of the discharge from the Boat Harbour weir

The far-field modeling of discharge from the Boat Harbour weir is inaccurate and cannot be trusted because (1) the hydrodynamic model is based on the poorly validated model used in the Original Study and (2) the buoyant surface plume emanating from Boat Harbour is highly three-dimensional and cannot be simulated with a two-dimensional model like MIKE 21.

Stantec used the MIKE 21 model setup from the Original Study to simulate far-field transport of effluent from the Boat Harbour weir during the month of July 2016. The MIKE 21 model setup was identical to that in the Original Study except for the location of the outfall source: instead of being located at one of the proposed outfall sites, it was located at the location of the Boat Harbour weir. The advantage of models like MIKE 21 is that they do not distinguish between an effluent source on the bed and one at a shoreline model boundary. Both are identical in that they are simply a source of effluent into one of the model grid cells.

→ *The plume emanating from the Boat Harbour weir is confined to the surface and cannot be simulated with a three-dimensional model.*

Since this model setup is identical to that in the Original Study, all of the criticisms I made in my review of that study are applicable to the Boat Harbour study. ***The Boat Harbour study is perhaps the best possible example of a problem that should NOT be studied with a two-dimensional model like MIKE 21.*** Based on the parameters indicated in the study, the effluent is roughly 20 kg/m^3 less dense than the receiving waters. Therefore, the effluent discharged from Boat Harbour remains confined to a thin, near-surface layer as it flows into Pictou Harbour. Owing to the rotation of the earth, the plume turns to the right of Boat Harbour and propagates along the shoreline to the east and south. Because the plume is confined to the surface and arises as a direct result of three-dimensional, density-driven processes, it cannot be simulated with the MIKE 21 model. Nevertheless, owing to the inclusion of the earth's rotation in the MIKE 21 model, the results still indicate transport to the right of Boat Harbour (e.g. Figure 13 in the Boat Harbour study), albeit in a vertically well-mixed plume. I note that none of the results in the Boat Harbour study are validated beyond the substandard validation performed in the Original Study.

→ *Weak currents at the Boat Harbour weir lead to weak mixing and high effluent concentrations. These are underpredicted by the MIKE 21 model because it assumes complete mixing over the water column.*

It is no surprise that the far-field effluent transport simulated with the MIKE 21 model does not disperse very efficiently as it emanates from Boat Harbour, leading to effluent concentrations that are much higher than those in the original and updated studies of effluent discharged from site CH-B. Because the two-dimensional MIKE 21 model assumes complete and instantaneous mixing over the water column, these results emphasize the point I made in my original review about how the concentrations and dilution factors are a strong function of the depth. In a two-dimensional model, we expect at least a factor of 8 or greater dilution at site CH-B than we do at the Boat Harbour weir simply because the weir has a depth of 2.5 m (based on Figure 2 in the Boat Harbour study) while site CH-B has a depth of 20 m. Further lack of dilution occurs at the Boat Harbour weir because of the weak currents in the shallow waters near the weir. The two-dimensional nature of the MIKE 21 model actually overpredicts the dilution, since the effluent should remain trapped in a high-concentration buoyant surface layer with limited vertical mixing owing to the strong effects of stratification (Discussed in Section 4.1 below).

4. Review of the updated receiving water study offshore of Caribou Harbour

4.1. Two- vs. three-dimensional modeling

In the updated study, Stantec collected field data in the vicinity of the proposed outfall location which they use to further justify the use of a two-dimensional model. This field data demonstrates exactly the opposite, in that there are strong three-dimensional currents that can transport effluent in a direction that is opposite to that in a two-dimensional model. Such transport can lead to more buildup of effluent in, for example, Caribou Harbour.

In the updated study, Stantec used the ADCP to measure currents in two ways:

1) The ADCP was mounted to a boat and the boat was driven back and forth across a transect line stretching from the mouth of Caribou Harbour through site CH-B. The measurements extended 1.2 km on either side of site CH-B and were taken during the flood tide on May 24, 2019, and ebb tide during May 25, 2019. These data are shown in Figures 7-10 in the updated study.
2) The ADCP was attached to a fixed mooring on the bed 490 m northwest of site CH-B and measured currents as a function of depth and time during June 17-19, 2019. These data are shown in Figure 11 in the updated study. The ADCP also has a pressure sensor that measures water level as a function of time to calculate tidal water levels and wave heights. The wave-height data are shown in Figure 19.

In addition to the ADCP data, measurements of temperature and salinity over the depth were obtained near CH-B during flood and ebb tides on May 24 and 25, 2019. These data are shown in Figures 13 and 14 of the update study.

→ *The ADCP boat transect data are too noisy to justify that the currents do not vary with depth.*

In the updated study, Stantec justifies use of a two-dimensional model by noting that the velocity profiles from the ADCP data indicate “weak stratification from near the water surface to the seabed” and that “temperature and salinity were relatively homogeneous throughout the water column, ranging from 12.6°C to 12.9°C and 28.8 to 29.0 ppt, respectively”. Indeed, the ADCP transect data show weak vertical variability, although these data are very noisy and cannot be trusted to infer vertical variability of currents. Furthermore, the transects reflect the velocity field at an instant in time, and thus do not reveal the potential for three-dimensionality over the entire tidal cycle. This is precisely the purpose of the moored ADCP data which very clearly indicate vertical variability in the currents that is consistent with strong density effects, as discussed below.

→ *The ADCP mooring data very clearly show the presence of three-dimensional, density driven currents that cannot be simulated with the two-dimensional MIKE 21 model.*

Figure 1 below shows how the moored ADCP data nicely captures the variability of the currents with depth and time over several tidal cycles. In the absence of density effects, the tides drive currents that are strongest near the surface and weakest near the bed where they are impeded by friction. This gives the "expected" velocity profiles that occur during flood tides indicated by the sketch in Figure 1. During the ebb tides, however, there is a peak in the velocity profile at a depth of 15 m instead of the surface. ***The only mechanism that can drive currents at this depth arises from horizontal differences in density between water masses in the region.*** Unfortunately, the ADCP boat transects were taken at times that did not coincide with the ADCP mooring observations nor were the transects taken at different phases of the tidal cycle to reveal the source of the vertical variability in currents during ebb tides. Furthermore, salinity and temperature were not measured at sufficient points in time and space needed to obtain a complete picture of the density effects over a tidal cycle or over the course of the year (i.e. during winter ice cover or during late summer/early fall when runoff is highest). Therefore, while the measurements clearly indicate the presence of density-driven currents, there is insufficient data to ascertain the source of the density-driven circulation. Regardless, these data strongly indicate that MIKE 21 is not an appropriate tool to model the three-dimensional circulation in this region. Three-dimensional currents can transport effluent in a direction that is opposite to that in a two-dimensional model and lead to more buildup in, for example, Caribou Harbour.

4.2.Model validation

The validation of the far-field model with additional data indicates that the model performs poorly and cannot be trusted to assess far-field dilution of the effluent. The validation of temperature is misleading because it implies inclusion of density effects, yet these have no bearing on the two-dimensional MIKE 21 model.

→ *There is no quantitative validation of the MIKE 21 model to indicate that it performs well.*

Like the Original Study, in the updated study Stantec included validation of currents and water level, but with new data from the moored ADCP near site CH-B. Stantec added validation of wind-generated waves and water temperature that were also measured with the moored ADCP. The validation is conducted for a simulation during May 26-June 26, 2019. As I noted in my review of the Original Study, no quantitative metrics that are well established in the coastal modeling community are computed, and only qualitative comparisons are made. Despite the addition of new data for validation, the validation is poor and provides no confidence that the model is accurately reproducing the far-field dynamics in the region.

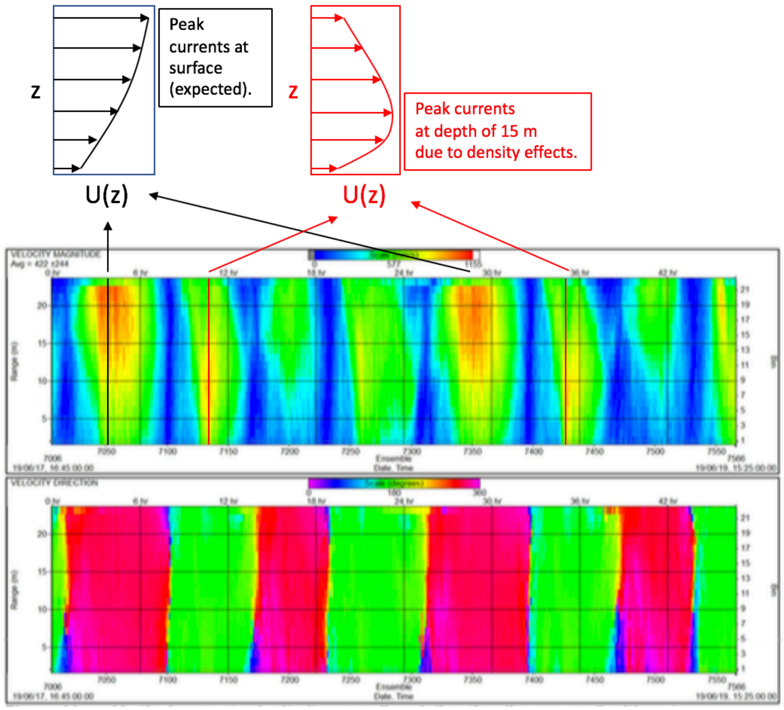


Figure 1: ADCP mooring data from Figure 11 in the updated study. The top panel shows current magnitude while the bottom panel shows current direction. The sketches illustrate velocity profiles that produce the observed ADCP data.

→ *The MIKE 21 model does not accurately predict the tidal water levels or currents. The three-dimensional nature of the density-driven currents explains in part the failure of the two-dimensional model to predict them.*

The simulated water levels in Figure 20 of the updated study appear to match the observations, but closer inspection reveals that the model fails to predict the full tidal range for most of the tides, particularly after June 9. Similarly, the simulated currents appear to match the observations, but closer inspection reveals that the strength of the currents only qualitatively matches the growth and decay over the spring-neap cycle. The peak magnitudes of the simulated currents only match a small fraction of the observed peaks, while the model over- or under-predicts a majority of the peaks by 25-100%. Stantec explains these errors by noting that the ADCP-derived observations are depth-averaged, while the model is two-dimensional. This is not correct, because a two-dimensional model should reproduce the depth-averaged currents if they arise from two-dimensional processes. However, as explained in Section 4.1 of this report, the processes in the region are highly three-dimensional, making it impossible for the two-dimensional MIKE 21 model to reproduce them. The substantial errors between the simulated and observed currents are not reflected by the metrics in Table 10 of the updated report because these metrics tend to obscure errors incurred during individual tidal cycles. As I discussed in my review of the Original Study, a better representation of the error is obtained with metrics like the root-mean-square error or skill score, which would show that the model performs poorly.

→ *Surface wind-generated waves are validated, yet there is no discussion of how they affect the currents. Temperature is also validated, but temperature has no bearing on the results because the model is two-dimensional.*

The addition of a wave model to simulate wind-generated waves in the updated study was validated with observations at the moored ADCP in Figure 19 of the updated report. While the simulated waves appear to match the observed waves, they have no bearing on the observed currents and no discussion is made as to the relevance of the waves to the characteristics of the far-field dispersion. Similarly, the temperature is validated via comparison of simulated to observed temperature at the moored ADCP in Figure 22 of the updated report. As discussed in Section 4.3, because the temperature field has no effect on the two-dimensional currents, validation of the temperature field as predicted by the two-dimensional MIKE 21 model is irrelevant. Furthermore, it is odd that the salinity field is not validated given that the salinity has a much stronger effect on the density than the temperature.

4.3.Model setup and scenarios

The updated report is misleading because there is extensive discussion of temperature and salinity modeling, yet these play no role in the circulation of the two-dimensional MIKE 21 model. Furthermore, simply removing winds and waves to account for ice cover does not correctly account for the more significant reduction in currents that is expected during winter.

→ *The two-dimensional MIKE 21 model in the updated study only has the ability to predict two-dimensional tidally-driven currents. It cannot predict the effects of temperature or salinity since these only affect the three-dimensional dynamics.*

On p 2.19 of the updated study, it is noted that "A coupled hydrodynamic model was developed to simulate the physical oceanographic conditions under the complex forcings of tide, current, wind, wave, air heat, and water temperature and salinity." As discussed in my review of the Original Study, the updated study only demonstrates the ability to simulate the effects of tidal currents in the region. Winds and waves can impact the circulation, and while wave heights are validated in the updated study, their effects on the currents are not validated or discussed. Although there is extensive discussion of details related to modeling the effects of air, heat and water temperature and salinity, this is misleading because the temperature and salinity fields have little to no effect on the currents predicted by the MIKE 21 model because it is two dimensional. Density dynamics can only be computed with a three-dimensional model like MIKE 3. Furthermore, it is very difficult if not impossible to correctly predict temperature and salinity dynamics in a two-dimensional model because these quantities vary strongly in the vertical, as clearly indicated by the temperature and salinity profiles in Figures 13 and 14 of the updated study (also Figure 3 below). It is also difficult to model temperature and salinity because these quantities require a lot more data than indicated in the updated report, which only mentions use of air temperature and humidity but does not say anything about other important quantities like incoming solar radiation, cloud cover, optical clarity, and evapotranspiration. Given that these details were not mentioned, it is likely that the parameters needed to compute the temperature field in the model were simply tuned to obtain a match to the observations. Predictions of salinity are also very sensitive to freshwater inflows, yet these are not mentioned in the updated study, nor is the model-predicted salinity validated.

→ *The winter scenario does not correctly account for the effects of ice cover which should act to reduce the effects of the tidal currents and the associated mixing and dilution.*

To assess the effects of winter ice cover, a scenario is devised to simulate far-field dispersion during February 2019. The effects of ice cover are modeled by eliminating waves, winds, and air heat exchange. A constant ice sheet thickness of 0.7 m was assumed based on observations, yet it is unclear how this was exactly implemented in the MIKE 21 model. Was the mean water level lowered by 0.7 m, or was the depth data raised by 0.7 m? Nevertheless, as discussed in my review of the Original Study, the scenario simulates absolutely no physical mechanisms that one would expect to occur in the presence of ice. There is no added friction by the ice cover which would reduce the magnitude of the tidal currents, and the strength of the tides at the boundaries is not reduced as it should be when there is large-scale ice cover in the Northumberland Strait during winter. The result is a "winter" scenario that simply evaluates the effect of the tides in February. Given the inaccuracy of the results as indicated by the validation, elimination of winds and wave effects in this scenario is meaningless because their effects are smaller than the overall errors in the modeled currents.

4.4.Analysis of model results

The plots of effluent concentrations are misleading because the two-dimensional MIKE 21 model overestimates the dilution by assuming complete mixing over the water column. These plots are used to show that there is no buildup in Caribou Harbour, although there is clear buildup that could easily be quantified with the model.

→ *Far-field dilution results cannot be trusted because they are overpredicted by the two-dimensional model.*

As in the Original Study, the far-field dilution results in the updated study are misleading because they assume complete mixing over the water column. This gives an instantaneous dilution of roughly 100 at the location of the outfall that is a strong function of its depth. This instantaneous dilution would be significantly reduced in a three-dimensional model that included the effects of stratification in the region, as discussed in Section 4.5.

→ *It would be straightforward to show that there is effluent buildup in Caribou Harbour.*

It is noted that "no effluent concentration buildup was found in the harbour basins, along the shorelines and in the entire model domain." There is no scientific justification for this statement. Not only do the figures show buildup of effluent along the shorelines and signatures of effluent entering Caribou Harbour, but it is straightforward to compute the exact amount of effluent entering the harbour with the MIKE 21 model. Such a calculation would quantitatively assess the rate at which effluent enters the harbour under different conditions, yet this is ignored in favor of misleading plots of effluent concentrations at the end of the one-month simulations.

4.5.Near-field modeling

The updated near-field modeling using CORMIX overpredicts the near-field dilution factor by at least 3.5 because it assumes the receiving water is too dense, implying that the dilution factor 100 m from the outfall should be at most 42 instead of the worst-case value of 145.7 in the updated study. The true worst-case dilution scenario is expected to be even lower when accounting for the effects of vertical density stratification, weaker neap tidal currents, and a receiving water density that is at its lowest in late summer/early fall.

→ *The currents used in the updated study are stronger than they should be and hence they overpredict the mixing. The salinity in the updated study is too high and also overpredicts the effluent buoyancy and associated mixing.*

As in the Original Study, the near-field modeling with CORMIX gives near-field dilution results using parameters that do not reflect the possible worst-case scenarios. Table 1 compares values used in Scenario 2 of the Original Study and Scenarios A, B, and C of the updated study. The main parameters that differ between the original and updated studies are:

1) The updated study employs cases with weaker slack tidal currents (Scenarios B, C)
2) The updated study employs a denser receiving water for all cases
3) The updated study employs a less dense effluent for all cases
4) The updated study includes a case with a lower effluent flow rate (Scenario C)

The CORMIX results in the updated study show that, when compared to dilution with average currents, weaker slack currents reduce the near-field dilution factor from 113.5 to 33.0 at a distance of 2.0 m from the diffuser (Scenario A vs. Scenario B in Table 2 below). In this regard, the use of slack tidal currents represents a more realistic scenario in which dilution is significantly weaker in the presence of slack tides. However, these slack tidal currents still do not represent the worst-case scenario in which the slack tidal currents are even weaker during a neap tide. Furthermore, the updated study uses an ambient receiving water salinity of 30 ppt as opposed to 28 ppt as in the Original Study. It also assumes an effluent salinity of 2 ppt, 50% lower than the value of 4 ppt used in the Original Study (No justification for the lower effluent salinity is provided). This leads to an effluent that is 28.2 kg/m^3 less dense than the receiving waters in the updated study, significantly more than the value of 23.7 kg/m^3 used in the Original Study. As a result, the mixing induced by the effluent buoyancy in the Original Study is weaker, leading to a dilution of 32.4 at a distance of 2.0 m from the diffuser, roughly the same as Scenario B in the updated study which has a lower dilution factor than Scenario A due to the slack tidal currents (See Table 2 below).

→ *The receiving water density is expected to be at its minimum, giving the worst-case scenario for buoyancy-driven effluent mixing, in late summer/early fall when waters are warmest and salinity is lowest.*

Unlike temperature, Stantec did not conduct a historical analysis of salinity in the updated study that can be used to estimate the minimum receiving water salinity at the outfall. However, the salinity profiles in Figure 14 of the updated study (and Figure 3 below) indicate a minimum salinity closer to 29.25 ppt (0.75 ppt lower than the assumed value of 30 ppt), a value that is expected to decrease as precipitation and the associated runoff in the region increase to their maximum in September, as shown in Figure 2 below. As indicated by the temperature data in Figure 16 of the updated study, the decreased salinity of the receiving waters is accompanied by an increase in temperature that peaks at a maximum of 20°C in August, further decreasing the density of the receiving waters beyond the scenarios in the updated study, which assume a receiving water temperature of 16.8°C. Therefore, the worst-case scenario should employ slack neap tides and receiving water density values that are at their lowest in the late summer/early fall.

→ *The vertical variations in density are strong enough to decrease or eliminate vertical mixing, yet this effect is not accounted for in the CORMIX modeling.*

In addition to using parameters that do not reflect worst-case scenarios for the near-field effluent mixing, the updated near-field CORMIX studies also do not include the effects of vertical density stratification, even though the ADCP, salinity, and temperature data discussed in Section 4.1 clearly show that vertical stratification effects are important. In Figure 3 below I show salinity and temperature profiles taken from Figures 13 and 14 in the updated study. These data show that the top-bottom temperature and salinity differences are roughly 0.3°C and 0.4 ppt, respectively, which translates to a top-bottom density difference of 0.4 kg/m^3. While these may seem small, an assertion employed by Stantec to justify ignoring vertical stratification effects, the CORMIX manual suggests including stratification effects when the vertical variation in density exceeds 0.1 kg/m^3 (Page 33 of Jirka et al. 1996).

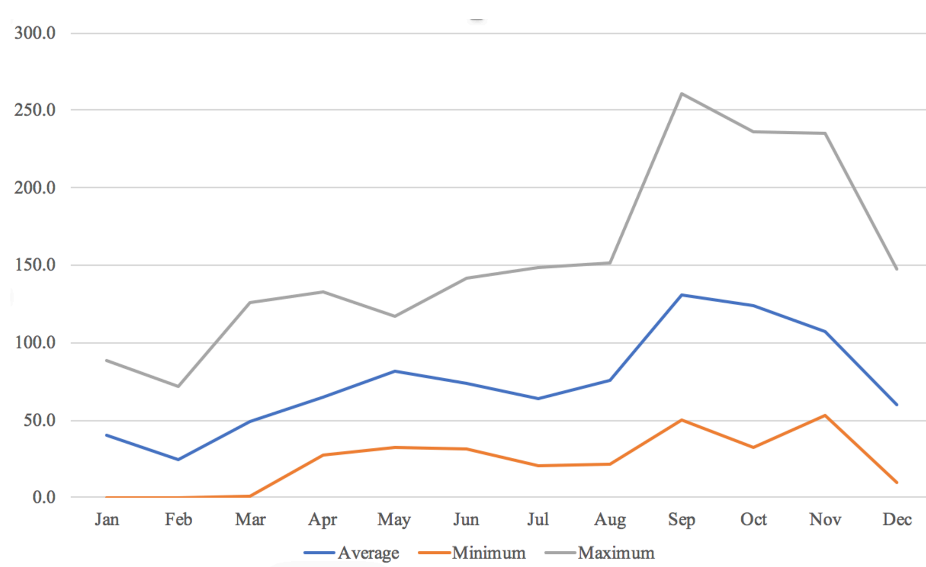


Figure 2: Monthly-averaged precipitation in mm during 1994-2005 in Tatamagouche[3], Nova Scotia (data from climate.weather.gc.ca).

[3] There is insufficient monthly precipitation data at the nearby Caribou Point station, so Tatamagouche was used as a representative station which reflects the precipitation patterns at Caribou Point.

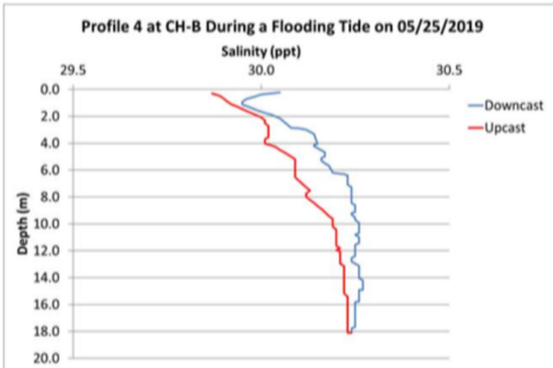
	Original Study	Updated study
Avg depth in mixing zone (m)	18.0	18.9
Depth at outfall (m)	20	20.3
Avg slack currents (m/s)	-	0.10
Max currents (m/s)	0.27	0.85
Mean currents (m/s)	0.10	0.41
Avg winds (m/s)	3.75	3.79
Ambient temperature (^{o}C)	17.6	16.8
Ambient salinity (ppt)	28.0	30.0
Ambient density (m^3/s)	1020.06	1021.76
Effluent temperature (^{o}C)	37.0	37 (Scenario A) 35 (Scenarios B+C)
Effluent salinity (ppt)	4.0	2.0
Effluent density (kg/m^3)	996.32	993.36 (Scenario A) 993.55 (Scenarios B+C)[4]
Difference between receiving water and effluent density (kg/m^3)	23.74	28.4 (Scenario A) 28.2 (Scenarios B+C)
Wastewater flow rate (m^3/s)	0.980	0.984 (Scenarios A+B) 0.579 (Scenario C)

Table 1: Comparison of CORMIX values used in Scenario 2 of the Original Study and Scenarios A, B, and C of the updated study.

Scenario	Distance from Diffuser (in m) and Dilution Factor						
	2	5	10	20	50	100	200
Updated Scenario A	113.5	178.6	251.6	353.8	407.5	427.2	454.3
Updated Scenario B	33.0	51.4	71.8	100.1	129.9	145.7	164.1
Updated Scenario C	50.1	78.3	109.6	152.8	195.6	219.0	247.9
Original Scenario 2	32.4	50.5	70.8	99.1	128.3	144.1	159.8

Table 2: Comparison of dilution results from Scenarios A, B, and C in the updated study to those from Scenario 2 in the Original Study.

[4] The density of 955.55 kg/m^3 is unreasonably small in the updated report, likely a typo. Here I assume it to be 993.55 kg/m^3, slightly more dense than Scenario A due to the colder temperature by $2^{o}C$.



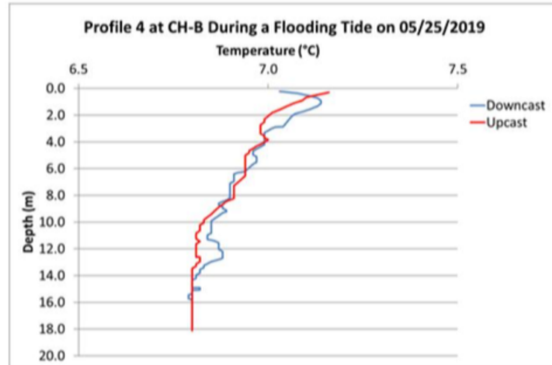


Figure 3: Vertical profiles of salinity (left) and temperature (right) taken from Figures 13 and 14 in the updated study. "Downcast" implies measurements taken with the instrument as it sinks downward, while "upcast" implies measurements taken as the instrument is raised to the surface.

→ *Theory can be used to show that the vertical density stratification in the region reduces effluent mixing and dilution.*

The potential effects of stratification on the near-field mixing can be assessed by noting that mixing occurs because of turbulence driven by differences in the horizontal velocity with depth: a large change in the velocity in the vertical is likely to produce strong turbulence and mixing. This explains why turbulence and mixing are strongest near the free-surface and bed, since these are locations where the vertical changes in velocity strong. At the same time, however, vertical density stratification damps the turbulence and mixing by creating layers of different densities that stabilize the water column, making it harder for layers to mix. The strength of the damping effect of the stratification relative to the potential to generate turbulence by the currents is given by the gradient Richardson number, which is defined by

$$Ri_g = \frac{g\Delta\rho D}{\rho_0(\Delta \mathrm{U})^2}\,.$$

The different terms in this equation and the source of data from which values were approximated are shown in Table 3. Using these values, the gradient Richardson number around location CH-B is roughly $Ri_g = 0.31$, which is a lower bound given that this value is estimated during a period in which the bottom-top difference in currents (ΔU) is large. It is well known that, when the gradient Richardson number is larger than 0.25, the damping effect of stratification is so strong that it all but eliminates mixing. This suggests that the mixing and dilution will be substantially reduced by the vertical stratification, an effect that is ignored in the near-field CORMIX modeling. It also suggests that the far-field effluent transport is likely to be confined to shallow vertical layers and not mix over the water column, further justifying the use of a three-dimensional far-field model. The resulting dilution factors are thus significantly overpredicted in both the near- and far-field modeling in the updated study.

→ *When accounting for the correct lower receiving water density in addition to slack tidal currents, the dilution factor 100 m from the outfall should be at most 42, which is 3.5 times lower than the value of 145.7 in the updated study. This dilution factor will be further reduced when accounting for vertical density stratification, slack water during neap tides, and the lowest receiving water densities during late summer/early fall.*

The data from the original and updated near-field studies in Table 2 show that the effect of using slack tides reduces the dilution by a factor of 3.4 (Updated Scenario A dilution of 113.5 compared to Updated Scenario B dilution of 33.0, both 2 m from the outfall). However, the Original Study essentially shows that the effect of less buoyancy-driven mixing when the receiving water is less dense is also to reduce the dilution by a factor of 3.5 (Updated Scenario A dilution of 113.5 compared to Original Scenario 2 dilution of 32.4). This suggests that the combined effects of both slack tides and reduced buoyancy of the effluent can reduce the dilution factor from that in Scenario A of 113.5 by a factor of 11.9 (3.5×3.4) to just 9.5. The dilution factor 100 m from the outfall will thus be closer to 42 instead of 145.7 (based on the dilution in Scenario B at 100 m of 145.7, reduced by 3.5 due to decreased buoyancy). This dilution of 42 is likely an upper bound, since neap slack tides are weaker and the receiving water density is expected to be even lower during late summer/early fall. The reduction of vertical mixing due to density stratification will reduce the dilution factor even further. The result is that the near-field effluent concentrations will be in excess of the estimates in the updated study by at least a factor of 3.5, thus making it unlikely that many of the CCME water quality guidelines will be met in the mixing zone for the true, worst-case scenario.

Variable	Name/description	value	Source
D	Approximate water depth at ADCP mooring.	20 m	ADCP mooring; Figure 1.
g	Gravitational acceleration.	9.81 m/s^2	Known constant.
$\Delta\rho$	Bottom-top density difference.	0.4 kg/m^3	Salinity and temperature profiles; Figure 3.
ΔU	Bottom-top difference in currents.	0.5 m/s	ADCP mooring; Figure 1.
ρ_0	Reference density (average density of profile).	1023.6 kg/m^3	Salinity and temperature profiles; Figure 3.

Table 3: Variables used to estimate the gradient Richardson number, Ri_g.

5. Review of the sediment transport modeling

The sediment transport study is fundamentally flawed because it ignores the effect of flocculation which will cause the fine suspended particulate matter to settle much faster and deposit in the vicinity of the outfall. Furthermore, it is much too simplistic and does not accurately reflect where we expect the fine particulate matter to accrete in the region – such an assessment should be made with the sediment transport modules that are part of the MIKE modeling software.

→ *The distance from the outfall at which fine particulate matter settles can be estimated based on the distance it travels due to the tidal currents over the time it takes to settle onto the bed.*

Stantec, Ltd., analyzed samples of suspended particulate matter, or "sediment", from treated effluent similar to what is expected at the proposed outfall. To estimate the distance at which the sediment is expected to settle onto the bed after ejected from the outfall, Stantec assumed that the particles will settle from some height above the outfall while transported horizontally by the ambient currents. The distance they will travel is proportional to the time it takes for them to settle onto the bed while they are transported horizontally. Since a sediment sample consists of a distribution of particle sizes, it is common to refer to the 50th or 90th percentile particle diameters D_{50} or D_{90}, corresponding to the particle diameter that is larger than 50 or 90 percent of the particles in the sample. The distance at which a particle with size D_{50} or D_{90} is then the minimum distance we expect 50% or 90% of the total volume of particles to be transported.

→ *A simple analysis shows that fine particulate matter will settle at least 1 km from the outfall, which is an overestimate.*

Average slack tidal currents of 0.08 m/s and average total tidal currents of 0.35 m/s are obtained from the updated receiving water study. Owing to the small particle sizes of the samples, particles originating 1 m above the bed settle slowly enough to allow 90% of the sediment to be transported at least 1 km from the outfall for the average slack tidal currents and 4.2 km for the average total tidal currents. The same analysis shows that 50% of the sediment (based on the settling velocity of D_{50}) is expected to be transported at least 33.4 km and 148.2 km from the outfall for the slack and average currents, respectively. This is confirmed by analysis of sediment samples at location CH-B which indicate the presence of medium- to coarse-grained sand. The lack of fine-grained particles on the bed is proof that the local currents are too strong to enable settling of fine suspended particulate matter in the effluent.

→ *The analysis is flawed because fine particulate matter aggregates into larger particles, or flocs, which will deposit in the vicinity of the outfall because they settle faster.*

This sediment transport analysis is suitable to estimate the approximate distance at which particles are expected to travel under the influence of tidal currents. However, the analysis is flawed in two ways. First, the effluent is composed of organic material which has the tendency to make the fine-grained particles flocculate, or stick together to form "flocs". Therefore, the particle size distribution based on the laboratory sampling is not representative of the actual distribution of floc sizes at the outfall which can be much larger. Because flocs are composed of loosely packed suspended particulate matter, they are composed mostly of water, and hence their densities are much smaller than the density of individual mineral particles. This is why the density of 1060 kg/m^3 was used in the study rather than the value of ambient marine sediment density of 2650 kg/m^3. While this is a fair estimate, one cannot use such a low floc density to estimate the settling velocity without also assuming a floc diameter that can be much larger than the individual sizes based on the laboratory sampling. Therefore, owing to the use of floc diameters that are too small, and because the settling velocity is proportional to the square of this diameter, the settling velocities are vastly underpredicted and the resulting transport distances are substantially overpredicted. Substantially more flocculated effluent particulate matter will accumulate around the outfall.

→ *A sediment transport model should be employed with the MIKE modeling software to predict with more confidence whether the fine particulate matter is expected to settle in sensitive fisheries habitats in the region.*

The second flaw of the sediment transport study is that it is overly simplistic. The tidal currents are highly variable in the region in both space and time, and it is naïve to imply that the suspended particulate matter in the effluent will not pose an environmental or ecological problem based simply on an approximate distance it is expected to propagate away from the outfall. Not only do we expect flocculation to promote particle settling in the vicinity of the outfall, but the particles that settle far from the outfall may accumulate in sensitive fisheries habitats in deeper water or in Caribou Harbour. A more science-based and quantitative study of the fate of the suspended particulate matter should be done with the sediment transport modules that are part of the MIKE modeling software. A well calibrated hydrodynamic model that accurately computes the three-dimensional currents in the region would enable use of the sediment transport modules that could provide an accurate assessment of the potential environmental impacts of fine effluent particulate matter throughout the region.

6. Conclusions

The updated studies using the MIKE 21 and CORMIX models are both inaccurate and misleading. They overpredict the mixing and dilution of the effluent and do not provide science-based evidence that can be used to assess the potential environmental impacts of the near- and far-field effluent dilution from the proposed outfall site. This is based on sloppy modeling practices that I criticized in my original report but were not addressed in the new studies.

→ *New data show that density effects are very important in the region. Therefore, not only does the two-dimensional model give meaningless effluent concentration fields, but both the near- and far-field models overpredict the mixing and dilution.*

The most important aspect of the dynamics in the region that continues to be ignored by Stantec is the effect of density stratification. In the updated study, while Stantec set out to discount the importance of density effects with a series of oceanographic measurements, these measurements only serve to strengthen a case for their importance in the region. The ADCP data reveal peaks in the horizontal currents 15 m below the surface that arise from three-dimensional, density-driven flows that cannot be simulated with the two-dimensional MIKE 21 model used in the studies. The vertical profiles of salinity and temperature show that the density varies by 0.4 kg/m^3 over the water column. Nevertheless, Stantec argues that this density variability is small and ignores its effects even though the CORMIX manual suggests a threshold of just 0.1 kg/m^3. Because the vertical density variability is large enough to damp vertical turbulent mixing, ignoring its effects has important ramifications for both the near- and far-field modeling. The near-field dilution with CORMIX is overpredicted because the turbulence and mixing at the outfall are not damped as they should be. The far-field dilution is also overpredicted because the two-dimensional MIKE 21 model assumes complete mixing over the water column even though the stratification promotes effluent transport in shallower layers with higher concentration.

→ *The simulations of the far-field dilution of effluent discharged from the Boat Harbour weir are meaningless because the buoyant effluent can only be simulated with a three-dimensional model.*

Three-dimensional, density-driven effects are particularly important for simulating the effluent discharged from the Boat Harbour weir, where the effluent plume is confined to a near-surface, buoyant layer that cannot be represented with the two-dimensional MIKE 21 model. The effluent concentrations are expected to be higher at the Boat Harbour weir than at site CH-B because of the shallow water, weaker tidal currents and a lack of an outfall diffuser to promote near-field mixing. The shallowness and the effect of the weak tidal currents can be simulated with the MIKE 21 model to produce far-field effluent concentrations at the Boat Harbour weir that are significantly higher than those simulated at site CH-B. However, the dynamics of the buoyant plume are not accurately simulated with a two-dimensional model, and so the results do not accurately reflect the far-field dilution of the effluent discharged from Boat Harbour.

→ *Based on the validation results, the far-field model performs poorly and the resulting effluent fields cannot be trusted. Waves and temperature are validated yet they have no bearing on the results, and sea ice is not correctly represented in the model.*

Regardless of the lack of density effects, the studies suffer from fundamental problems associated with model setup, validation and analysis that I pointed out in my review of the Original Study. Despite the additional measurements, the validation of the currents near site CH-B indicates that the model performs poorly and cannot be trusted to accurately predict the far-field effluent transport. Although validation shows reasonably accurate predictions of wind-generated waves, their impacts are not quantified, and the relatively minor impact they may have is overwhelmed by errors in simulation of the tidal currents. The simulated temperature is shown to match observations to a reasonable degree, and there is extensive discussion of temperature and salinity modeling in the updated study. However, this discussion is misleading because the associated density effects related to temperature and salinity have no effect on the circulation in the two-dimensional MIKE 21 model. Also misleading is the implementation of the winter scenario, which accounts for sea ice simply by eliminating wind and waves from the study without accounting for reduced tidal currents due to the ice.

→ *Stantec states that there is no effluent buildup in Caribou Harbour, although this is clearly not the case and could easily be quantified with the MIKE 21 model.*

In the end, the MIKE 21 model setup as it is implemented can only assess the effects of tidal currents on the far-field effluent transport during different months of the year – in this case February and July 2019. Not only are the results inaccurate, but the resulting plots of the effluent at the end of each month are misleading because the two-dimensional MIKE 21 model overpredicts the dilution factors. Nevertheless, Stantec uses these plots to falsely claim that there is no effluent buildup in Caribou Harbour even though this is clearly not the case. It would be straightforward to compute the effluent accumulation in the Harbour with the model and assess the relative impact of realistic scenarios on this buildup. However, such science-based analysis is clearly beyond the scope of the Stantec studies.

→ *Including the correct receiving water density in the near-field CORMIX model, the dilution factor 100 m from the outfall is 42, 3.5 times lower than the value of 145.7 in the updated study. A more realistic worst-case scenario would give an even lower dilution factor when accounting for vertical density stratification effects, weaker slack tidal currents during neap tides, and less buoyant effluent during late summer/early fall.*

While the updated near-field modeling with CORMIX correctly accounts for the potential for reduced mixing during slack tidal currents, the scenario employs a receiving water density that is too high. Use of a more realistic, less dense receiving water gives less vigorous buoyancy-driven mixing and an effluent dilution factor of 42 at the edge of the mixing zone 100 m from the outfall, 3.5 times lower than the value of 145.7 with the denser receiving water. Although this scenario includes less dense receiving waters and slack tides, a more realistic worst-case scenario should include slack tidal currents during neap tides, which can be significantly weaker. The worst-case scenario should also use a receiving water density in late summer/early fall when waters are expected to be at their warmest and freshest, or least dense. Finally, the potential for reduced vertical mixing due to strong vertical density stratification should be accounted for in the CORMIX model. The full nature of the temperature and salinity dynamics and the vertical stratification in the region would need to be assessed with more observations of salinity along with three-dimensional modeling.

→ *Fine particulate matter will settle in the vicinity of the outfall due to particle aggregation and setting rates that are much faster than those predicted by Stantec. Accurate sediment transport modeling should be conducted with the MIKE sediment transport modules.*

The sediment transport modeling conducted by Stantec is fundamentally flawed because it does not account for flocculation of fine particulate matter in the presence of organic material in the effluent. Flocculation produces large particles, or flocs, that settle much faster than the fine particulate matter, thus incurring settling and buildup in the vicinity of the outfall. The fate of the smaller particles that are transported further from the outfall cannot be assessed with the model employed by Stantec, since it makes too many overly simplistic assumptions about the currents. Instead, transport of fine particulate matter can be computed with the sediment transport modules in the MIKE modeling software. This would enable assessment of the ultimate fate of the particles and their potential to impact sensitive fisheries habitats in the region.

7. Reference

Jirka, G. H., Doneker, R. L., and S. W. Hinton, 1996, User's manual for CORMIX: A hydrodynamic mixing zone model and decision support system for pollutant discharges into surface waters, DeFrees Hydraulics Laboratory, School of Civil and Environmental Engineering Cornell University, (https://www.epa.gov/sites/production/files/2015-10/documents/cormix-users_0.pdf).

APPENDIX A-2

The **tidal period (PERIOD)** must be supplied; in most cases it is 12.4 hours, but in some locations it may vary slightly. The **maximum tidal velocity (UAmax)** for the location must be specified; this can usually be taken as the average of the absolute values of the two actual maxima, independent of their direction. A CORMIX design case consists then of an instantaneous ambient condition, before, at or after one of the two slack tides. Hence, the analyst must specify the **time** (in hours) **before, at, or after slack** that defines the design condition, followed by the actual **tidal ambient velocity (UA)** at that time. The ambient depth conditions are then those corresponding to that time.

In general, tidal simulations should be repeated for several time intervals (usually hourly or two-hourly intervals will suffice) before and after slack time to determine plume characteristics in unsteady ambient conditions.

Strongly unsteady conditions can also occur in other environments, such as in wind-induced current reversals in shallow lakes or coastal areas. In this case, any typical reversal period can be analyzed following an approach similar to the above.

4.3.4 Ambient Density Specification

Information about the density distribution in the ambient water body is very important for the correct prediction of effluent discharge plume behavior. CORMIX first inquires whether the ambient water is **fresh water** or **non-fresh** (i.e. brackish or saline). If the ambient water is fresh and above 4 °C, the system provides the option of entering ambient temperature data so that the ambient density values can be internally computed from an equation of state. This is the recommended option for specifying the density of fresh water, even though ambient temperature per se is not needed for the analysis of mixing conditions. In the case of salt water conditions, Figure 4.3 is included as a practical guide for specifying the density if "salinity values" in parts-per-thousand (ppt) are available for the water body. Typical open ocean salinities are in the range 33 - 35 ppt.

The user then specifies whether the ambient density (or temperature) can be considered as **uniform** or as **non-uniform** within the water body, and in particular within the expected plume regions. As a practical guide, vertical variation in density of less than 0.1 kg/m^3 or in temperature of less than 1 °C can be neglected. For uniform conditions, the **average ambient density** or **average temperature** must be specified.

When conditions are non-uniform, CORMIX requires that the actual measured vertical density distribution be approximated by one of three schematic stratification profile types illustrated in Figure 4.4. These are: Type A, linear density profile; Type B, two-layer system with constant densities and density jump; Type C, constant density surface layer with linear density profile in bottom layer separated by a density jump. Corresponding profile types exist for approximating a temperature distribution when it is used for specifying the density distribution.

Note: When in doubt about the specification of the ambient density values it is reasonable to first simplify as much as possible. The sensitivity of a given assumption can be explored in subsequent CORMIX simulations. Furthermore, if CORMIX indicates indeed a flow configuration (flow class) with near-field stability, additional studies with the post-processor option CORJET (see Section 6.1) can be performed to investigate *any arbitrary density distribution*.

After selecting the stratification approximation to be used, the user then enters all appropriate density (or temperature) values and **pycnocline heights (HINT)** to fully specify the profiles. The pycnocline is defined as zone or level of strong density change that separates the upper and lower layers of the water column. The program checks the density specification to insure that stable ambient stratification exists (i.e. the density at higher elevations must not exceed that at lower elevations).

Note that a dynamically correct approximation of the actua ldensity distribution should keep a balance between over-and under-estimationof the actual data similar to a best-fit in regression analysis. If simulation results indicate internal plume trapping, then it is

APPENDIX A-3

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APPENDIX A-4

Review of near- and far-field modeling studies by Stantec Consulting for the Northern Pulp effluent treatment facility replacement project

Prepared by:

San Francisco, CA, USA

March 7, 2019

Table of Contents

1. Executive Summary

This report provides a review of computer modeling of the fate and transport of effluent from proposed discharge locations in and around Pictou Harbour and offshore of Caribou Harbour near Pictou, Nova Scotia. The modeling work was carried out by Stantec Consulting for assessment of the Replacement Effluent Treatment Facility Project registered by Northern Pulp Nova Scotia Corporation. Simulations were conducted with accepted industry-standard models including the near-field CORMIX model and the far-field MIKE 21 model.

Owing to several problems related to the implementation of the CORMIX and MIKE 21 models, they overestimate the near- and far-field mixing and dilution of the effluent from the proposed outfalls, including the final outfall at site CH-B offshore of Caribou Harbour. This leads to the incorrect conclusion that the environmental impacts will be negligible because the effluent concentrations are predicted to be unphysically low. Instead, correct implementation of the models with more conservative and physically realistic scenarios would show that effluent concentrations in the region could be much larger and that effluent accumulation in Pictou and Caribou Harbours is likely.

The principle problems related to the far-field MIKE 21 modeling include:

1) Agreement between the model simulated currents and water levels and observed currents and water levels in Pictou Harbour is poor. Therefore, we can have no confidence that the model accurately predicts the far-field fate and transport of the effluent at any of the proposed outfall locations.

2) Use of the two-dimensional MIKE 21 model is inappropriate given the potentially strong vertical variability of currents driven by winds and river inflows in the region. These three-dimensional effects can significantly impact the far-field transport by exaggerating accumulation in Pictou and Caribou Harbours.

3) The far-field model scenarios using MIKE 21 omit or incorrectly simulate the impacts of winds, river inflows, offshore currents in the Northumberland Strait, ice, waves, and storm surge. These processes may significantly impact far-field mixing and dilution of effluent and lead to higher effluent concentrations throughout the region.

4) The figures showing maps of low effluent concentrations offshore of Caribou Harbour are misleading because the far-field model artificially dilutes the effluent. Nevertheless, the dilution factors are reported to be over 100 in most of the region surrounding the CH-B outfall, which is an overly optimistic result.

The principle problems related to the near-field CORMIX modeling include:

1) The ambient tidal current used to drive the CORMIX model offshore of Caribou Harbour is much stronger than the expected current during a neap tidal period. Tidal currents are even weaker during winter when there is ice cover which decreases the strength of the tides. Overestimation of the tidal currents gives an unrealistic overprediction of the near-field mixing and dilution of effluent, particularly during slack tides.

2) The ambient density employed in the CORMIX model is too saline because it does not take into account potential effects of river inflows. This makes the receiving waters too dense and leads to too much buoyancy-driven mixing of the effluent plume, thus leading to an overestimate of the near-field mixing and dilution. The CORMIX modeling also ignores the effect of vertical variability in salinity, which could be strong during periods of high river inflows and reduce the near-field mixing and dilution because fresh water layers near the surface may trap the effluent beneath them.

It should be noted that these problems are related to the implementation and choice of models, not to the models themselves. When implemented correctly, CORMIX and far-field models like MIKE 21 or its three-dimensional counterpart, MIKE 3, yield very reliable near- and far-field predictions of effluent transport.

2. Introduction

2.1. Overview

In this report I review the near- and far-field modeling studies conducted by Stantec Consulting to understand the fate of effluent from proposed outfalls located in and around Pictou and Caribou Harbours which are connected to the Northumberland Strait in Pictou County, Nova Scotia, Canada. These studies are part of the Environmental Assessment of the Replacement Effluent Treatment Facility Project registered by Northern Pulp Nova Scotia Corporation (Northern Pulp). Specifically, in this report I analyze the modeling studies contained in the following appendices included in the Environmental Assessment:

1) Appendix E1 – Stantec final Caribou discharge receiving water study (The final study)
2) Appendix E2 – Stantec response to questions
3) Appendix E3 – Stantec receiving water study effluent treatment plant replacement (The preliminary study)

In the preliminary study (Appendix E3), scenarios were conducted to study the effluent transport from two outfalls in (sites Alt-A and Alt-B) and offshore of (sites Alt-C and Alt-D) Pictou Harbour. It was deemed that the suggested outfall location Alt-D was not appropriate because of the potential for ice scour of the outfall in the relatively shallow water (11 m). The final study (Appendix E1) was then undertaken to assess the effluent transport from outfalls located offshore of Caribou Harbour in 20 m of water at sites CH-A and CH-B. Site CH-B was recommended as the location with the least environmental impact. In what follows, I will refer to these appendices as the "final study", the "response to questions", and the "preliminary study". Collectively, they will be referred to as "the studies" or "the Stantec studies".

Simulating the transport and fate of effluent from a coastal wastewater outfall requires two kinds of models. Roughly within 100 m of the outfall, effluent is diluted relatively rapidly by mixing with ambient ocean waters. This mixing is due to strong turbulence related to jet-like flow from the outfall ports and buoyancy arising from the difference in density between relatively warm and fresh effluent and colder and saltier receiving waters. In the studies reviewed here, this dilution process is simulated with CORMIX (Jirka et al. 1996), an industry standard near-field model that takes into account diffuser geometry and properties of the effluent and receiving waters. After the near-field turbulence and buoyant mechanisms have decayed, the fate and transport of the effluent is dictated by the larger-scale circulation in the coastal region surrounding the outfall. The far-field currents, salinity, and temperature are obtained with a hydrodynamic model that computes circulation in response to winds, tides, river inflows, and other relevant coastal processes. These currents are then used to compute the far-field transport and fate of the effluent. In the studies reviewed here, the MIKE 21 model (DHI 2017) was used to compute the far-field circulation and transport. This model is also an industry standard that has been applied extensively to study circulation and transport in coastal regions. While the CORMIX model is an appropriate choice for the near-field modeling, the MIKE 21 model is not appropriate for this study because it is a two-dimensional model, as discussed in Section 3.1 below.

It is common practice to use far-field models to supply ambient currents and environmental parameters like temperature and salinity to the near-field model. The near-field dilution results including the near-field concentration and vertical distribution of the effluent plume can be supplied to the far-field model. In the Stantec studies, the ambient currents needed for the CORMIX model are taken from the MIKE 21 model, while the ambient density field for CORMIX is taken from measurements of temperature and salinity. The far-field MIKE 21 model does not use results from CORMIX. This is common given that only relative concentrations are needed to assess the far-field dilution when using a two-dimensional model like MIKE 21. As will be discussed in this report, however, a three-dimensional far-field model is needed, and this model requires information about the vertical distribution of the effluent plume from the near-field model.

2.2. Currents and dispersion in the coastal ocean

In coastal areas like the regions in and around Pictou and Caribou Harbours, the currents arise from a multitude of processes, although a simple categorization is to distinguish between the tides and all other non-tidal processes, such as wind-driven, river-driven, and large-scale ocean currents in the Northumberland Strait. A prevailing and misleading theme in the Stantec studies is the suggestion that, although some non-tidal processes are included in the modeling (albeit incorrectly), these non-tidal processes are not important because the tidal currents dominate the near- and far-field effluent transport. However, as discussed throughout this review, the non-tidal processes are extremely important for predicting the fate of the effluent in both the near-field and far-field.

Because of their oscillatory motion in time, tides transport effluent back and forth over an outfall, and with each oscillation the effluent is dispersed, leading to horizontal spreading of the effluent plume. This so-called tidal dispersion is strongest in regions where the tidal currents are both large and vary strongly in space, such as at the mouths of Caribou and Pictou Harbours. Although an outfall plume will spread due to tidal dispersion, there will not be much dilution of the effluent after many tidal cycles unless there are non-tidal currents that can transport the effluent away from the outfall. Without non-tidal currents, effluent would simply accumulate around outfall location CH-B and in nearby Caribou Harbour.

Accumulation of effluent in the vicinity of an outfall is strongest during slack tides, periods of low or negligible currents that occur twice during every tidal period, which is approximately 12 hours (the tidal period due to the moon is 12.42 hours and that due to the sun is 12 hours). The effects of slack tides are most pronounced during neap tides when tidal currents are weakest. For example, the maximum neap tidal current is approximately 10 cm/s at outfall location CH-B (based on the discussion presented in Section 4.2 below). With this tide, the tidal currents will be weaker than 2.5 cm/s for the one-hour period surrounding slack, or for approximately two hours (17%) of the entire tidal cycle. During each one-hour slack tide period, 173 kg[1] of suspended solids would be discharged into the ocean from outfall CH-B. The solids that were discharged 30 minutes before slack tide would find themselves just 45 meters from the outfall, only to be transported back over the outfall again at the end of the next 30 minutes to be re-entrained into the outfall plume. This demonstrates the importance of slack tide in the accumulation of effluent over an outfall diffuser due to the prolonged periods of relatively weak currents, particularly during the neap period of the spring-neap tidal cycle. Furthermore, owing to the reduction in vertical turbulent mixing because of the weak currents during slack tides, there is a strong potential for the suspended solids in the effluent to settle out of the water

[1] Based on a concentration of 48 mg/L and effluent flow rate of 1 m^3/s, from Table 3.2 of the final study.

column and onto the bed in the vicinity of the outfall. The effects of slack tides and the potential for settling of suspended solids is not discussed in the Stantec studies.

Fortunately for the health of coastal ecosystems, non-tidal currents exist to varying degrees in all coastal regions. In fact, the tides themselves produce non-tidal currents, much like ocean swell waves produce rip currents that have no wave-like signature. Non-tidal currents that are produced by the tides are generally smaller than other non-tidal currents in the region, such as wind-driven, river-driven, and large-scale ocean currents. While river flows and winds are included in the far-field modeling, these effects are not accurately simulated, as discussed in Section 3.1 below. There are large-scale ocean currents that are predominantly from the west to east in the Northumberland Strait at speeds ranging from 6-9 cm/s (Lauzier 1965). Another non-tidal current in the region is the counterclockwise circulation around Pictou Island that has been observed by local fisherman (MacCarthy and Egilsson 2019). This non-tidal current is likely driven by a combination of winds and tides. Although they are important in dictating the far-field transport of effluent, these non-tidal currents are regarded as not important and not included in the Stantec studies.

3. Review of the far-field modeling

3.1. Two- vs. three-dimensional modeling

The MIKE 21 model employed in the far-field simulations is not appropriate because it is two-dimensional and does not represent important three-dimensional processes in the region, such as wind-driven circulation and density effects arising from freshwater flows from rivers. A more appropriate model like MIKE 3 would need to be used to account for these effects.

The MIKE 21 model employed by Stantec is a two-dimensional model in that it computes the depth-averaged currents at each grid cell in the computational domain. Therefore, it assumes that the currents are constant with height above the bed in each grid cell. The three-dimensional equivalent of MIKE 21 is the MIKE 3 model (also by DHI), which computes the variability in currents as a function of height above the bed. The principal advantage of two-dimensional, depth-averaged models is that they are computationally efficient because three-dimensional models require addition of grid cells in the vertical direction. In the case of the Stantec simulations, a three-dimensional model would require at least 20 layers in the vertical which would increase the model runtime by at least a factor of 20.

Despite its computational efficiency, a two-dimensional model is not appropriate to simulate the far-field effluent transport because of the importance of three-dimensional processes in the coastal region around Pictou and Caribou Harbours arising from variations in salinity and temperature, which affects the density stratification. Density stratification due to salinity arises along coastlines where river inflows bring fresh water into the ocean. Because the river water is fresh, it is less dense than the salty ocean, thus inducing vertical variations in the salinity field in which the denser, salty water lies beneath the lighter, fresher water above. Temperature stratification also exists throughout the oceans since the upper layers tend to be heated by the sun, leaving warmer and lighter waters above colder and denser waters. Temperature stratification is weakest in winter months when incoming heat is weakest.

Salinity stratification is more important than temperature stratification in coastal waters where river effects can be important. For example, the top and bottom salinities in the Pictou

Road region in July 1995 were 23.7 and 31.2 ppt (parts per thousand by mass), respectively, while the top and bottom temperatures were 13.5ºC and 14ºC, respectively (Preliminary study, p. 2.21). This translates to a top-bottom difference in density of 5.8 kg/m^3 due to the salinity and 0.1 kg/m^3 due to temperature, using the UNESCO equation of state calculator (UNESCO 1981). In December 1998, the salinity stratification at the same location was weaker (top-bottom salinity difference of 2 ppt) although the temperature stratification was slightly stronger (top-bottom temperature difference of 2ºC). The salinity stratification generally increases with increasing river flow and decreases with tidal flow strength, since tidal currents generate turbulence that tends to mix the salinity and temperature field and weaken the vertical density stratification. Measurements indicate that the surface salinity near the East River in the Pictou Harbour region varied from 20 ppt during low-flow periods to just 5 ppt during high-flow periods (Preliminary study, p. 2.21).

Ocean water is generally stratified in the vertical because density increases with depth, with lighter, less dense waters overlying heavier, denser waters. However, in the coastal ocean there is also horizontal variability in the salinity-induced density. At a river mouth, the water is fresh and there is no vertical salinity stratification, while in the ocean far from the river mouth the salinity is high, yet there is also weak vertical salinity stratification. The most important effect of this horizontal variability in density is to induce a three-dimensional circulation in which fresh, river waters flow seaward over denser ocean waters which flow landward. In addition to the implications for the near-field transport (See Section 4.2 below), the implication for far-field transport is that effluent may be transported into the harbours with the landward-flowing denser currents. This effect is accentuated in deeper waters, implying that it will be stronger in Pictou Harbour (which also has higher freshwater flows), although the shipping channel in Caribou Harbour can act as a conduit to transport effluent-rich ocean waters into the harbour.

A second three-dimensional effect that cannot be captured by a two-dimensional model is related to the winds. When aligned with the main axes of Pictou or Caribou Harbours, winds will drive currents downwind along the shallow edges while the flow in the central, deeper portions will be driven upwind. Since the dominant westerly winds (August-April[2]) in the region are generally aligned with the main axes of the harbours, they have the potential to drive surface effluent seaward and that at depth into the harbours. Wind-driven circulation is typically not as strong as that driven by the rivers or tides, although it can be important during periods with neap tides and low river inflows.

A two-dimensional model also cannot capture the variability of the effluent with depth. The assumption of two-dimensionality in the effluent field is reasonable when the three-dimensional effects in the flow field are relatively weak. In fact it is possible to approximate some three-dimensional processes quite well with a two-dimensional model, such as a process known as shear-flow dispersion. Because of bottom friction, currents are slower near the bed, and if there is wind-driven circulation, the currents may be stronger near the surface. Therefore, tracers[3] that are in regions of the water column with slower-moving currents will be transported more slowly in the horizontal than those in the faster-moving regions of the water column. This process can be thought of as horizontal dispersion of the tracer field because it is spreading horizontally, and can be approximated reasonably well in a two-dimensional model with a shear-

[2] https://weatherspark.com/y/28559/Average-Weather-in-Pictou-Canada-Year-Round

[3] A tracer is a substance that is transported passively with the flow without buoyancy effects.

flow dispersion coefficient. The MIKE 21 model includes many approximations like this to account for three-dimensional effects in the two-dimensional transport module, although these were not employed in the Stantec studies (Preliminary study Table 2-1; Final study Table 2-11: "No decay and no dispersion in the particle tracking module"). Indeed, these approximations are not suitable for estuarine environments given that they work best in riverine environments that are weakly stratified, weakly wind-driven, and lack tidal influence.

Regardless of the influence of dispersion on the two-dimensional transport, the lack of vertical variability in the modeled tracer prevents simulation of an effluent that in reality can vary quite strongly in the vertical. The proposed effluent will typically be less dense than the receiving waters (it is both fresher with a total dissolved solids concentration, or salinity, of 1-4 kg/m^3, and warmer, with a winter temperature of 25^{o}C and summer temperature of 37^{o}C; Preliminary report p. 3.54). Therefore, if the receiving waters are sufficiently salty and cold (See Section 4.2 below) the effluent is expected to rise to the surface and propagate as a surface plume that is just 1-2 m thick based on the CORMIX near-field results in the Stantec studies. Furthermore, the depth at which the plume propagates is not necessarily at the surface, particularly under high flow conditions in which the effluent may be more dense than the receiving waters (See Section 4.2 below). Therefore, it is possible that the effluent could be driven in a direction that is opposite to that in a two-dimensional model if a three-dimensional model were used.

In summary, while three-dimensional effects may not be important during some periods of the year, such as during periods of low river flows and weak winds, in general a three-dimensional model is needed to accurately simulate the far-field fate and transport of effluent from the proposed discharge locations. Indeed, the MIKE 21 manual (Page 2 of DHI 2017) states, "In water bodies with stratification, either by density or by species (ecology), a 3D model should be used. This is also the case for enclosed or semi-enclosed waters where wind-driven circulation occurs." One might argue that three-dimensional models take too much time to run because of the need to include many grid points in the vertical. However, the Stantec final study employed a computational mesh with 24,645 grid cells (15,872 were employed in the preliminary study). Three-dimensional effects would be resolved with reasonable confidence using 20 or more grid cells in the vertical, which would result in 492,900 grid cells in three dimensions. This problem size is well within the reaches of a model like MIKE 3 using modern desktop computers and is relatively low compared to the problem size in other modeling studies in which three-dimensionality is important, both for consulting and academic projects (see, e.g. MacWilliams et al. 2008). Therefore, Stantec should have used a three-dimensional model like MIKE 3 because the circulation in the region is highly three-dimensional and the computational overhead is not restrictive.

3.2. Model setup and forcing

Although rivers and winds are included in the MIKE 21 model, these have no bearing on the far-field results because the effects of winds and rivers are not correctly reproduced with a two-dimensional model. Other processes like waves, storm surges, and large-scale currents were also not included in the MIKE 21 model even though they are important. Finally, the MIKE 21 simulations were conducted over a one-month period which is not long enough to assess the potential for effluent to accumulate in the harbours over much longer periods.

Data from tidal, wind, and river inflow measurements were supplied to the MIKE 21 model using standard practices in coastal ocean modeling. However, owing to the two-dimensional nature of the model, the winds and river inflows have little to no bearing on the far-field results in the studies. Wind and river inflow data could be supplied to a three-dimensional model in a similar manner as it was supplied to the MIKE 21 model in the studies, although estimates for flows in all rivers and streams would need to be included (only the East River was included). As suggested in the Stantec studies, river inflows should be based on stream gauges when available, and based on approximations using the relative catchment area when unavailable (the East River inflow was inferred from measured flows in the Middle River at the Rocklin hydrometric station). With regard to tidal forcing, the standard practice was performed in which the observed tides at Wood Islands were reconstructed based on superposition of the most important components of the tides (using software such as T_TIDE; Pawlowicz 2002). However, the reduction in tidal amplitudes due to large-scale ice cover was not included in the tidal forcing (See Section 3.4 below).

The influence of wind-generated waves and swells were not included in the MIKE 21 model which is a reasonable assumption, although waves should be included during storms, as should the effect of storm surges (See Section 3.4 below). Finally, the west-to-east currents in the Northumberland Strait at speeds ranging from 6-9 cm/s (Lauzier 1965) should be included. These large-scale currents can have an important impact on transport by flushing a region that might otherwise accumulate with effluent without river flows or winds. While this will contribute to flushing of the proposed outfall at location CH-B near Caribou Harbour, it will drive the effluent southward with the potential to be entrained into Pictou and Boat Harbours. This effect is likely to be pronounced with three-dimensional modeling.

To evaluate the far-field dilution characteristics of effluent discharged from the proposed outfall locations, the MIKE 21 model was run over a total simulation time of one month during July 2016 for each outfall. This length of time is not sufficient to evaluate the effects of the effluent plumes given that the flow of effluent is not yet in equilibrium over such a short time period. The appropriate time period is dictated by the flushing time of the estuaries which can take days to months depending on the tides, river flows, winds, and large-scale circulation in Northumberland Strait. It is impossible to determine equilibrium from the spatial distributions of the effluent dilution factors (such as Figure 2.13 in the final study, showing the spatial distribution of the effluent dilution factor from the CH-B discharge location in the vicinity of Caribou Harbour after one month), since the effluent may still be accumulating in one of the harbours at the end of the month. A quantitative measure would need to be computed to demonstrate that the model is in equilibrium. For example, the total effluent mass in each harbour would need to be relatively constant in time, at least when averaged over a tidal cycle. Variations in forcing from processes that act over intervals that are longer than the tides (e.g. the spring-neap cycle, rainfall and associated river flow events, seasonal variations in winds), lead to associated slow variations in the effluent transport, and so these would need to be accounted for when assessing whether the total mass in the harbours is in equilibrium (see, e.g. Rayson et al. 2016).

In summary, the tides are the only component of the forcing in the far-field simulations that have any significant impact on the far-field dilution results. The other components of the forcing, including wind, river inflows, waves, storm surges, and large-scale currents are either not included or have little to no impact. Accurate representation of all of these effects would need a three-dimensional model that is run for much longer than one month to account for possible accumulation in the harbours.

3.3. Model validation

Model validation is an important step in coastal ocean modeling because it demonstrates that the far-field model accurately predicts realistic currents, water levels, and other parameters. Not only is there no quantitative model validation in the studies, but the comparisons of water levels and currents to observations in Pictou Harbour demonstrate that the MIKE 21 model performs poorly. Therefore, the MIKE 21 model cannot be used to assess, with any level of confidence, the far-field behavior of the effluent discharged from the proposed outfall locations.

Validation is the most important step in coastal ocean modeling because it proves that the model is a faithful representation of what is happening in the real world. This gives the user confidence to use the model to analyze results obtained during the validation period, but more importantly during periods when there is no data so that predictions under a wide variety of scenarios can be made. An important component of validation is the availability of appropriate observational datasets. For two-dimensional modeling, these datasets should include time series of observations of sea-surface height and the east and west components of depth-averaged currents. Depending on the instrument, depth-averaged currents can be computed if the instrument measures currents throughout the water column (such as an acoustic Doppler current profiler, or ADCP), since these measurements can be averaged to produce an accurate representation of the depth-averaged currents. However, it is more common to measure currents at a point above the bed. If three-dimensional effects are weak, then the depth-averaged model result can be validated with the point measurement. Strong three-dimensionality makes it difficult to compare a point measurement to the result from a two-dimensional model, which should not be expected to produce the correct currents when three-dimensional effects are important. Three-dimensional models should be validated with velocity data at different heights above the bed in the water column and with time series of salinity and temperature near the bed and free-surface (to assess model ability to reproduce the stratification). Since three-dimensional models compute the vertical distribution of turbulent mixing, then it is desirable to obtain measurements of turbulence to validate the turbulence models. Ideally, models could validate the results of effluent transport, although such observational datasets are rare and so this is not common.

A common step that is often performed in coastal ocean model validation is what is referred to as calibration, in which model parameters that cannot be measured are varied to improve the results. Despite the availability of accurate bathymetry datasets, the bed roughness is rarely measured although it plays an important role in dictating the resistance by the bed on the flow. For example, beds covered with sands or gravels are rougher than beds that are covered with silts or muds, and so the resistance over sands and gravels should be higher. Sometimes, the roughness may be very large if there are bedforms like sand ripples or dunes. Even the drag by vegetation, corals, and kelp is modeled with an effective roughness (Fringer et al. 2019). In some cases, the roughness is approximated with knowledge of the distribution of sediments (this was accounted for in the near-field CORMIX modeling). However, the bottom roughness is more commonly used as a calibration or tuning parameter and varied to give the best match between observations and simulations. In the MIKE 21 model, the roughness is represented specifically by the Manning's roughness parameter, which is used to compute the drag in flows with a free surface with given bed roughness properties.

After performing the appropriate calibration, it is standard practice to compare observations to simulations with quantitative metrics. There are many metrics available in the literature, although the most common are the mean error (also known as the bias), root-mean-square error, the coefficient of determination ("r-squared") and the lag, which is a measure of the time error between the observations and predictions. Another common metric is the skill score, which is a measure of the simulation error normalized by a measure of the spread in the observations. It is generally agreed upon in the coastal modeling community that a skill score greater than 0.65 characterizes excellent agreement between the model and observations (Allen et al. 2007). For simulations with tides, it is common to compare the amplitudes and phases of observed and modeled tidal constituents of both currents and water levels. These are particularly important to show that the model correctly captures the directions and magnitudes of the tidal currents. Examples of comprehensive validation of three-dimensional estuarine modeling studies can be found in MacWilliams et al. (2008) and Wang et al. (2011).

The MIKE 21 validation presented in the preliminary study by Stantec indicates that the model performs poorly because there is weak agreement between the simulations and observations. The validation is performed by running the model over a period in April 1990 when observations of water levels and currents in Pictou Harbour are available. Some statistics are computed, such as minimum, maximum, mean, and standard deviation, yet these statistics are computed separately for the observations and simulations and provide no objective measures for comparison like those found in the literature and discussed above. Despite a lack of quantitative comparisons, the qualitative comparisons represented by the figures in the preliminary study clearly indicate that the agreement between simulations and observations is poor. For example, Figure 1 below shows a comparison between simulated and measured water levels in Pictou Harbour (Figure 2-8 from the preliminary study). While the agreement in timing of the water level is good, most of the high- or low-water levels (indicated by the horizontal blue lines) are visibly incorrect. This lack of agreement could be due to wind and river forcing that was omitted from the model because of a "…lack of the simultaneous records of wind and river discharge during the period of model calibration in April 1990" (Preliminary study, p. 2.27). However, wind or flow events would produce disagreement in the tides over the duration of these events (over a few days each, such as during April 17-21), not throughout the entire record. Furthermore, attributing errors to incorrect forcing implies that the validation period is inappropriate because it does not allow for a demonstration of model fidelity through proper validation. Comparison of observed and simulated currents in Pictou Harbour in Figure 2-9 of the preliminary study shows that the model underpredicts the current speeds by roughly 20% at Location #1 and roughly 50% at Location #2, and in some cases by 80%. This level of disagreement is unjustifiable. Furthermore, there is no indication that the model correctly simulates the direction or timing of the currents since only current speeds are compared.

The differences between observations and simulations is attributed to "the nature of stratified currents through the water column from surface to the seabed, as well as the difference in bathymetry between the existing condition and that in 1990" (Preliminary study, p 2.28). If the difference is indeed due to stratification effects, then this justifies the need for a three-dimensional model. Differences in bathymetry would indicate that the choice of the validation period is not suitable because the circulation in the region was fundamentally different in 1990 than it was when the bathymetry datasets were collected over the past decade. Of course, it is always desirable to use more recent observations to ensure that the results are not contaminated by differences between the dates in which the bathymetry and flow measurements were made. However, a more careful validation procedure and use of an appropriate model should be able to indicate whether this is the case and if more recent data is needed. Regardless, the bottom line is that simply more observations are needed to prove that the model simulations are accurate. Even if the validation indicated that the simulations of currents and water levels in Pictou Harbour were excellent, it would be difficult to argue that the model also correctly reproduced currents in and around Caribou Harbour unless there were observations of water levels and currents from at least one station in that region.

In summary, the validation suggests that the model does not correctly predict the magnitude, direction, or timing of the currents. Therefore, in addition to a lack of validation in or near Caribou Harbour, the results provide no confidence that the model can accurately compute the currents and simulate the subsequent far-field fate and transport of the effluent from any of the proposed outfall locations. Furthermore, the validation provides no measure of confidence that can be ascribed to the predictions of ambient currents or directions at any of the six sites for use in the near-field modeling studies (See Section 4.2 below).

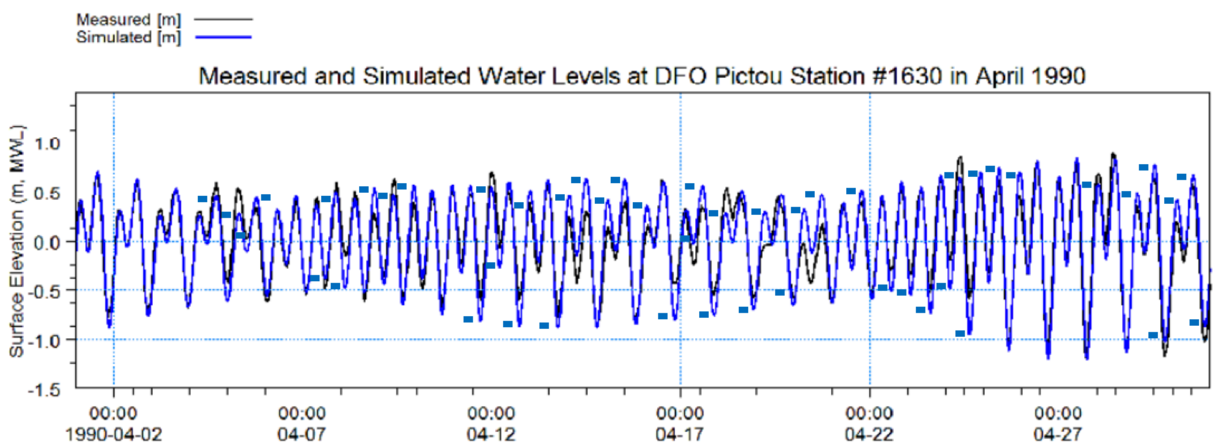

Figure 1: (Figure 2-8 from the preliminary study): Comparison of simulated to measured water levels in Pictou Harbour during April 1990. The blue horizontal lines were added to indicate incorrectly predicted low or high water levels.

3.4. Model scenarios

The scenarios that were conducted in the studies could only evaluate (unsuccessfully) the effect of the tides in a two-dimensional model. Many more scenarios are needed using a three-dimensional model to assess the potential impacts of winds, river inflows, large-scale currents in the Northumberland Strait, waves, storm surges, and ice during winter.

The far-field model scenarios in the studies were carried out with environmental conditions that are stated to minimize mixing of the effluent plume, thus producing conservative results. The conditions include use of "smaller tidal ranges, warmer ambient waters, less wind-driven surface currents, and lower freshwater flows from rivers" (Final report, p. 3). Warmer ambient waters during summer are conservative because, "in winter, mixing is effectively enhanced due to the larger difference in temperature and salinity (density) conditions" (Final report, p. 3). Wave and storm surge conditions are not included in the model given that "surge tides generate turbulence and ultimately provide better and faster mixing conditions" (Answer #2, Response to questions).

While some of these conditions are indeed conservative, not all are relevant or necessarily conservative, particularly in a two-dimensional model. Because the far-field model is two-dimensional and there is no vertical density stratification, the far-field plume dynamics are insensitive to the density of the effluent plume. Therefore, two-dimensional results should be the same for ambient summer or winter temperature conditions. A difference between two-dimensional effluent transport results in summer and winter could, in principle, be based on different initial effluent concentrations derived from the near-field model while taking into account the different ambient conditions from observations. However, the discharged effluent concentration in the far-field model is arbitrary because the dilution factor is a ratio of the far-field to discharged effluent concentration, and thus the actual concentration discharged from the outfall is irrelevant. A reduction in tidal and wind-driven currents reduces the vertical mixing of the plume, although again this has no bearing on the far-field results because the plume is vertically well-mixed in the two-dimensional model. However, different tidal conditions affect the tidal dispersion in the two-dimensional model and thus the tides have a significant impact on the far-field results. Wind-driven currents also affect the far-field results, but these effects are weak in a two-dimensional model since it does not account for wind-driven recirculating currents. Smaller river inflows may also be more conservative because they would be less likely to flush effluent out of the harbours. However, wind and river inflow effects can only be correctly simulated with a three-dimensional model, since both winds and river inflows can transport effluent into the harbours (See Section 3.1 above). Finally, while waves and storm surges indeed provide more mixing and dilution in the near-field, the surge has the potential to transport offshore effluent into the harbours, thus it may potentially be less conservative in terms of far-field transport.

Ice plays a significant role in the circulation and far-field effluent transport in coastal areas like Pictou and Caribou Harbours, yet its effects were not incorporated into the MIKE 21 model in the Stantec studies. While there are frameworks that can couple a model for ice formation and melting to a model like MIKE 21 (e.g. Kusahara and Hasumi 2013), it is possible to approximate the effects of ice sheets by imposing friction at the ice-water interface in the circulation model that impedes the flow of water due to the friction from the ice (Georgas 2012). In smaller domains like those in the Stantec studies, in addition to friction from the ice, the tidal boundary conditions must be altered to account for the significant reduction in tidal amplitude due to ice cover over the Gulf of St. Lawrence (Smith et al. 2006). Alternatively, these boundary conditions must be obtained from data measured during winter when there is large-scale ice cover. In shallow areas, the flow may be completely blocked when ice freezes over the entire water column, in what is referred to as "fast ice" by fishermen in the Pictou area (MacCarthy and Egilsson 2019). In the final Stantec study (p. 3), it is indicated that a winter scenario and the associated effects of ice are not considered because "the presence of ice cover would increase turbulence at the ice/water interface by providing resistance to the ambient water currents, resulting in higher mixing and dilution". Indeed, higher mixing and dilution may take place and can be modeled in the near field with CORMIX, but turbulent mixing at the ice/water interface is not accounted for in the far-field model because it is two-dimensional. Instead, the effect of ice in the far-field model is to reduce the magnitude of the currents and reduce the potential for far-field dilution. Therefore, a winter model run with extensive ice cover and appropriate boundary conditions is needed to represent a worst-case scenario for the far-field dispersion despite the substantial initial dilution of the strongly buoyant effluent during this period.

Overall, the scenarios in the Stantec reports do not reproduce the impact of different physical processes over the course of the year on the effluent transport in the region. In its current form, the far-field model can only be used to simulate the influence of tides on the far-field dispersion of the effluent plumes during low flow and low wind conditions in the absence of ice and large-scale currents. To obtain a good understanding of all of the possible scenarios that might impact the far-field transport, a three-dimensional model would need to be run under scenarios that demonstrated the effects of (1) strong/weak winds, (2) strong/weak river flows, (3) with/without ice cover (including the associated weaker tidal forcing and possibly fast ice), and (4) with/without large-scale currents through the Northumberland Strait. In each of these scenarios, the model would need to be run for at least as long as the flushing time to ensure that the far-field effluent field reaches equilibrium. If the flushing time is not much longer than a spring-neap tidal cycle, then additional scenarios would need to be run to understand the impact of strong (spring) vs. weak (neap) tides. The freshwater inflows would need to include all possible rivers and effluent from municipal wastewater treatment plants, given that the worst-case scenario may include freshening of the receiving waters to a point that significantly impacts the near-field dilution (See Section 4.2 below). Finally, storm surge scenarios would need to be studied given the possibility of strong waves and surges in the region, which could lead to significant accumulation in the harbours.

3.5. Results

The particle tracking module in MIKE 21 over-approximates the far-field mixing and dilution because of the assumption of uniformly distributed effluent mass throughout the volume of each grid cell. This gives the best-case scenario because it mixes the effluent from a point discharge completely over the water column, thus eliminating the possibility of higher concentrations confined to near-surface or mid-water layers of effluent. As a result, the assessment by Stantec that the far-field dilution factors for most of the region surrounding site CH-B are above 100 at the end of the one-month simulation period is overly optimistic. Accounting for vertical variability in the plume could lead to much smaller dilution factors but this would require a three-dimensional model. Dilution factors are also over-approximated in Caribou Harbour because the simulations are not run for long enough time to allow for accumulation of effluent in the harbour due to tidal dispersion.

As they are presented in the reports, the far-field modeling results provide only qualitative, and in some cases misleading, information about the far-field fate and transport of effluent from the proposed outfalls. The focus of this section is on Figures 2.5-2.13 in the final study, which depict extremely low concentrations of the effluent field around site CH-B. For example, in Figure 2.5 there is a small patch of effluent located over the outfall which appears to have a concentration of 2-3 mg/L. It is hard to imagine how the concentration of the effluent from the outfall could have diluted by nearly a factor of 50 (from 100 mg/L) even though this figure depicts the concentration field at slack tide during a neap tidal cycle. As discussed in Section 2.2 above, during slack tide we expect higher concentrations due to buildup of effluent because currents are too weak to induce any significant transport away from the outfall. Higher effluent concentrations are also expected because turbulent dispersion is ignored in the particle tracking module of MIKE 21 to promote conservative dilution factors. It is possible that a diluted concentration from the outfall is imposed in the far-field model based on the near-field modeling results, although an arbitrary concentration of 100 mg/L is assumed given that the relative concentration is of interest.

The low concentrations in the figures can be explained by the particle tracking module that is used to transport effluent in MIKE 21. In the particle tracking module, the outfall is modeled as a point source from which particles with a given amount of mass are released at specified time intervals. After being released, the particles are transported by currents computed with the MIKE 21 hydrodynamic module. In the Stantec final study, the mass flow rate from the outfall is given by 0.1 kg/s, based on the assigned concentration of 100 mg/L and flow rate of 1 m^3/s. Therefore, if we assume that one particle is released from the outfall every hydrodynamic time step of 60 s (the details of how often particles are released are not provided, although this is a safe assumption), then it must be assigned a mass of 6 kg. It is possible to release particles at shorter intervals or multiple particles at each time step, with mass divided equally among the particles to ensure the same prescribed mass flow rate of 0.1 kg/s. However, there would be no difference between transport of a single particle and a group of particles because particles in a group do not spread over time due to a lack of turbulent dispersion, which is ignored by Stantec in the particle tracking simulations. In addition to a lack of dispersion, there is no decay assigned to the particles in the Stantec studies, and hence the mass of each particle remains fixed during the simulations.

To convert the distribution of particles to a concentration field on the hydrodynamic grid, the total mass in each grid cell (which is the sum of the masses of all of the particles in each cell) is divided by the volume of the grid cell. Assuming the grid resolution around site CH-B is approximately 25 m (based on the mesh shown in Figure 2.3 in the final study), then the volume of the prismatic grid cell containing the point release at the location of outfall CH-B is approximately 6000 m^3, based on a depth of 20 m and cross-sectional area of approximately 300 m^2. The minimum concentration in this cell can be estimated by assuming it is empty and then filled with 6 kg of effluent after one 60-s time step. Since it is assumed that this mass is uniformly distributed over the cell volume, the resulting effluent concentration will be 1 mg/L, implying a dilution factor of 100 relative to the assumed inflow concentration of 100 mg/L. This shows that conversion of the particle mass to a concentration field results in artificial mixing of the effluent, giving rise to effective mixing and dilution that depend to great extent on the mesh resolution, depth, and details of the particle release at the outfall (i.e. particle release time interval, mass per particle, number of particles per interval). Although these details are not provided in the Stantec studies, it is clear that much of the far-field dilution is an artifact of the way in which the concentration fields are calculated.

The artificial dilution arising from two-dimensional particle tracking simulations like that in the MIKE 21 model is a common feature of coastal ocean modeling. It is possible to reduce the dilution by increasing the particle release rate or by decreasing the grid size. However, decreasing the grid size is often difficult given computational constraints associated with far-field studies on grids that are finer than those in the Stantec studies. Regardless of grid resolution or the details of the particle tracking module, conclusions about far-field mixing and dilution derived from particle tracking results in a two-dimensional model should take the inherent overestimation of mixing and dilution factors into account. In this regard, Figures 2.5-2.13 in the final study cannot be used to conclude that the environmental impacts of the effluent from outfall CH-B are negligible simply because the dilution factor is at least 100 in most of the domain at the end of the 1-month period. Instead, these dilution factors represent the best-case scenario in which the effluent is mixed over the water column instantaneously upon being released from the outfall. Owing to the buoyant nature of the near-field plume and other three-dimensional effects, the effluent could be confined to a layer much smaller than the depth (as discussed in Section 3.1). As indicated by the near-field modeling results in the final study, this layer can be as small as 1-2 m, which would lead to a reduction in the dilution factor in the region surrounding the CH-B outfall by a factor of 10 or more because the effluent is not completely mixed over the water column. A three-dimensional model would be able to account for the vertical variability of the effluent plume through use of the near-field model to inform the vertical variability in the vicinity of the outfall. This would reduce the artificial dilution associated with the assumption of complete mixing over the water column in a two-dimensional model.

An additional perplexing aspect of Figures 2.5-2.13 in the final study is that they appear to depict transport of patches created by pulses of effluent discharges rather than trails of effluent emanating from the continuous-in-time discharge at outfall CH-B. Examples of such an effluent field showing trails emanating from the outfall locations are depicted in Figures 2-20 and 2-21 from the preliminary study, which show the effluent concentration field surrounding sites Alt-C and Alt-D near Pictou Harbour. Effluent trails are not visible around site CH-B in Figures 2.5-2.13 from the final study because the overestimated dilution due to the particle tracking module produces concentrations in the trails that are too low to be visible with the given color scale. Instead, higher-concentration patches (that also have artificially low concentrations) oscillate with the tides while slowly propagating away from the outfall with the weak non-tidal flow produced by the tides (see Section 2.2 for a discussion of tidal vs. non-tidal flows). While these simulations indicate that there is some dilution of the effluent patches since their concentrations decay in time, the dilution is representative of the best-case scenario when compared to the effluent concentration at the outfall of 100 mg/L.

Another process that is likely reducing dilution factors but is not represented in the simulations is accumulation in Caribou Harbour. Figure 2.11 in the final study clearly shows a patch of effluent in the harbour at slack high tide, indicating that it was transported into the harbour during the previous flood tide. Although the patch appears to be leaving the harbour during the subsequent ebb tide (Figure 2.12 in the final study), tidal dispersion is expected to transport effluent into the harbour over many tidal cycles. Furthermore, although inclusion of turbulent dispersion in the particle tracking module would act to dilute the patches, it would accentuate the tidal dispersion and promote transport into the harbour, thereby reducing the dilution in the harbour after many tidal cycles. As discussed in Section 3.4, accumulation in Caribou Harbour would need to be quantified with simulations that were run for sufficient time to demonstrate that the effluent mass in the harbour was not changing in time.

In summary, when computing concentration fields from the particle tracking results, uniform and instantaneous mixing over the grid cell volumes leads to artificially low concentrations and high dilution factors associated with far-field effluent transport from site CH-B. While it is impossible to eliminate this effect, it can be thought of as the best-case scenario in which the outfall plume is uniformly mixed over the water column. As demonstrated by the near-field modeling results in the Stantec studies, this is clearly not the case. Instead, the plume is typically confined to a smaller region in the water column, which implies a much smaller dilution factor when compared to that arising from assuming a uniform effluent concentration over the depth. The artificially low concentrations and high dilution factors produce far-field effluent concentrations in the region surrounding the CH-B outfall after a month-long simulation that are greater than 100, which is an overly optimistic result. The artificial dilution eliminates most of the visible effluent in the figures except for a few small patches that oscillate with the tides. Some of these are transported into Caribou Harbour, indicating the potential for accumulation in the harbour due to tidal dispersion, an effect that should be assessed with simulations over much longer time periods than the 31-day simulations conducted in the final study.

4. Review of the near-field modeling

4.1. Overview of CORMIX

The CORMIX model was used to compute the three-dimensional effluent concentration field in the near-field mixing zone, which is generally defined as the region within 100 m of the outfall. Near-field mixing involves detailed flow and turbulence processes over length scales that are much smaller than the grid in the far-field model. Therefore, they cannot be simulated with MIKE 21 and must be modeled with a near-field model like CORMIX. According to the CORMIX model, the "near-field" is defined as the region between the outfall and the point at which the buoyant plume interacts with a boundary, which can be the bed, the free surface or some intermediate layer in the water column. In this near-field region, the plume dynamics are initially dictated by the high velocity flow and turbulence emanating from the outfall ports which rapidly mix the effluent with ambient waters. Once the high momentum fluid has decelerated (typically within 5-10 meters of the outfall ports), buoyancy-driven turbulence and mixing take over as the plume rises to the surface or at some point in the water column where the plume density matches the density in the water. This could be the thermocline (a point below the surface that separates the warmer, surface waters from the colder, bottom waters) or the halocline (a point at which fresher river waters are separated from the denser, saltier ocean waters below). After reaching the surface or intermediate layer, subsequent dynamics are referred to as the "far-field" zone in CORMIX. In this zone, the plume is transported by the ambient currents while spreading laterally due to weaker buoyancy effects. Once the density of the plume mixes with that of its surroundings, it propagates as a passive plume (i.e. no longer spreading due to buoyancy) with the ambient currents while spreading laterally and horizontally due to the ambient turbulence. This stage of plume development is modeled in CORMIX in a way that is similar to how it would be modeled under similar ambient conditions in a three-dimensional circulation model like MIKE 3.

The CORMIX model predicts the shape of the near-field plume in three dimensions based on the relatively complex geometry of an outfall diffuser, including the ability to specify different numbers of ports and the specific geometry of how they are attached to the diffuser pipe resting on the bed. Because CORMIX solves for the plume characteristics in a much smaller area and over much shorter time periods when compared to those in the far-field model, the characteristics of the flow needed to drive CORMIX are much simpler than the boundary conditions needed to drive the MIKE 21 model. As a result, parameters in CORMIX are generally not tuned, unlike the far-field modeling which requires tuning of, for example, the bottom roughness to improve agreement between observed and simulated currents (See Section 3.3 above). Furthermore, validation of CORMIX results is generally not required given that, at least under the scenarios that can be simulated with the CORMIX package, we expect the model to produce a good approximation of the near-field dynamics. The downside to this simplicity is that the results depend critically on choosing the effluent and ambient parameters that are representative of realistic worst-case conditions that would give the least amount of near-field dispersion and thus representative of the most conservative design scenario. As discussed in the next section, the receiving water conditions do not represent worst-case scenarios.

4.2. Near-field results at location CH-B

The receiving water current and ambient density field supplied to the CORMIX model to predict the near-field mixing and dilution at site CH-B are not representative of worst-case scenarios because the current is too strong and the ambient density is too high. This gives an over-prediction of the mixing and near-field dilution within the 100-m mixing zone surrounding site CH-B. The near-field effluent concentrations are expected to be higher, particularly during periods of high river inflows and when the tidal currents are weaker, such as during neap tides or when there is winter ice cover.

In the final study, two scenarios for the near-field mixing at site CH-B were conducted. The only difference between the two scenarios is the use of one port in the diffuser in the first scenario and three ports in the second. The dilution factor for the three-port design was roughly twice as large as that for the one-port design 100 m from the outfall (Table 3.4 in the final study). The three-port design at site CH-B had a dilution factor that was roughly 30% larger than the six-port design at site Alt-D (Table 4.1 in the final study shows results from site CH-B obtained in the final study and results from site Alt-D, which are repeated from the preliminary study). Despite the likely increase in the dilution factor at CH-B with six ports, it was concluded that the three-port design had a favorable seabed footprint with a lower potential to interact with the seabed than the six-port design, and hence the six-port design was not evaluated at site CH-B. Given the incorrect estimates of the worst-case currents and receiving water density discussed below, studies need to be conducted with three- and six-port designs to understand their characteristics under worst-case scenarios, particularly in the presence of vertical density stratification of the water column.

The inputs to the CORMIX model that have the most significant impact on the near-field mixing in the final study are the effluent flow rate and density and the ambient tidal currents and density. The effluent flow rate was fixed at the annual average rate of 0.98 m^3/s, while the effluent salinity was assumed to be 4 g/L = 4 kg/m^3, the densest value in the reported range of 1-4 g/L. The effluent temperature was reported to be 25^oC in winter and 37^oC in summer. The summer effluent temperature was chosen under the assumption that the plume would be least buoyant in summer when the receiving waters were at their warmest. The values chosen for the effluent salinity and temperature are stated to give an upper bound for its density, thus giving a conservative estimate for the dilution because more buoyancy-driven mixing is expected to take place if the effluent is less dense than the receiving waters. Using the UNESCO equation of state (UNESCO 1981), a salinity of 4 kg/m^3 and temperature of 37^oC give an effluent density of 996 kg/m^3, the value used in the final study.

A key assumption in the CORMIX model is that the ambient currents are steady. Therefore, approximations are needed when applying CORMIX to tidal flows that are unsteady in that the ambient currents flowing past the outfall vary in magnitude and direction over the tidal cycle. When currents are weak, the effluent accumulates above the outfall and dilution is poor. However, the worst-case scenario occurs roughly one hour before or after slack tide when currents are weak yet sufficient to re-entrain the effluent that was recently transported away from the discharge location in the opposite direction before slack tide. CORMIX requires information about the tidal period and peak currents and the magnitude of the ambient currents one hour before or after slack tide in order to provide an estimate of the worst-case scenario. The CORMIX manual (Page 33 of Jirka et al. 1996) also recommends that additional scenarios be conducted with tidal currents at intervals of one or two hours at different stages of the tidal cycle to ensure that all possible scenarios are analyzed.

Based on the information provided in the preliminary and final studies, the ambient current supplied to the CORMIX model does not represent the worst-case mixing scenario. The preliminary report mentions the use of tidal information in the CORMIX simulations, stating that, (p. 3.54) "The results are presented for a time step corresponding to 1 hour before slack tide conditions." However, in the final report only average (10 cm/s) and maximum (27 cm/s) tidal currents are supplied based on MIKE 21 simulations in July 2016 at site CH-B. There is no mention of the tidal current speed expected within one hour of slack tide, as needed for the worst-case calculation in CORMIX. Furthermore, simulations are not conducted during different phases of the tidal cycle as suggested in the CORMIX manual. These would demonstrate the impact of current speed and direction on the dilution factor. The direction, in particular, could impact the effect of the diffuser and port alignment relative to the oscillatory flow. An important implication of the worst-case slack tide is that suspended solids may settle onto the bed within 100 m of the outfall because of the weak currents, as discussed in Section 2.2 above. This possibility is not mentioned or modeled in the Stantec studies.

Regardless of whether the details of the tide are incorporated into CORMIX, the ambient currents applied to CORMIX in the final study are too large to represent a worst-case scenario. Based on Figure 2-14 in the preliminary report, which shows the Northumberland Strait water levels over the 31-day MIKE 21 simulation period, the weakest neap tide on July 14 has a tidal range of 0.6 m, which is more than three times smaller than the strongest spring tidal range of 2 m on July 5. Therefore, the average and maximum tidal currents used in the CORMIX scenarios are much larger than they would be in the worst-case scenario because they are impacted by the large spring tides. A more conservative, worst-case tide would be given by the weakest neap tide during the period, since the weaker currents would have significantly less near-field dilution than the average tide over the 31-day period. It is important to note that, given the insufficient far-field model validation presented in Section 3.3 above, the simulations of the currents at CH-B may not be representative of the actual currents. This implies that if the currents are underpredicted in Pictou Harbour, they will not necessarily be underpredicted at site CH-B, and therefore it is not valid to justify use of inaccurate far-field model results based on the notion that the errors would lead to a more conservative worst-case scenario.

The ambient density field supplied to the CORMIX model is equally as important as the ambient currents. Estimates of the ambient density of the receiving waters were based on observations because the far-field model is two-dimensional (See Section 3.1 above). However, because observations of temperature and salinity at site CH-B were not available, the ambient density was based on observations in the Pictou Road region in August 2014 and September 2006 (Appendix B, Preliminary study). In principle, this would provide a conservative receiving water density given the likelihood that the receiving water salinity, and hence its density, was lower in this region due to more inflows into Pictou Harbour than Caribou Harbour. However, as discussed below, this is not the case. Using data from Pictou Road region, the receiving water density was calculated as 1020 kg/m^3 based on a temperature of 17.6^{o}C and salinity of 28 ppt, which are averages of the observations. With these salinities and temperatures, the effluent is ($1020\ kg/m^3 - 996\ kg/m^3$) = $24\ kg/m^3$ less dense than the receiving waters. According to Stantec, this provides sufficient buoyant mixing to produce far-field dilution factors computed by CORMIX that are within established water quality guidelines for the 100-m mixing zone. Owing to the strong near-field mixing by the three-port diffuser, the plume interacts with the bed up to 25 m away from the outfall. However, the dilution factor of 71 at 10 m indicates this should not be a source of concern for this value of the ambient density.

Rather than using average salinity and temperature values of observations for the ambient, a more conservative scenario for the near-field modeling would have been to use the freshest and warmest observations in the region, which should be 23 ppt instead of 28 ppt and 19.4°C instead of 17.6°C (Appendix B, Preliminary study). This would give a receiving water density that is $4\ kg/m^3$ less dense than the value used in the final study, yielding a less buoyant effluent plume and less near-field dilution. While it is unlikely that the water temperature would be much warmer than 20°C in the region, waters warmer than 20°C would contribute much less to potential reductions in ambient density than lower salinity values. This is because the density can vary by as much as $25\ kg/m^3$ due to the 0-31 ppt salinity range in the region (based on data from Galbraith et al. 2014), while it can only vary by $3\ kg/m^3$ due to the 0-20°C temperature range. In fact, the salinity value of 28 ppt that was used for the scenario is close to the maximum observed salinity in the region of 31 ppt, thus reflecting close to the best- rather than worst-case salinity for buoyancy-driven near-field dilution at site CH-B. A worst-case salinity is likely much smaller given that salinity observations in the East River range from 20 ppt during low-flow periods to as low as 5 ppt during high-flow periods (Preliminary study, p. 2.21). Lower salinity values are also likely near Caribou Harbour, although perhaps not as low given that flows into Caribou Harbour are weaker than those into Pictou Harbour. Nevertheless, all inflows in the region are expected to lower the salinity of the receiving waters surrounding the proposed outfalls in the studies.

The effect of salinity on the near-field dilution is weakest in winter when inflows are at their lowest. Combined with the colder receiving waters, winter ambient density scenarios are not needed given their potential to drive more buoyancy-driven turbulence and near-field dilution. However, given the weaker tidal currents due to ice cover in winter, scenarios would need to be conducted with worst-case winter density values for the ambient and effluent combined with model-derived worst-case weak winter tides during the period of peak ice cover.

In addition to the potential for low salinities to impact the near-field dilution by reducing the effluent buoyancy at site CH-B, low salinities indicate the existence of vertical stratification in which fresher, river water overlies saltier, denser ocean water. For example, observations in the Pictou Road region indicate a top-bottom salinity difference in July 1995 of 7.5 ppt (Preliminary study, p. 2.21), which is the dominant driver of the top-bottom density difference of $5.8\ kg/m^3$ (See Section 3.1 above). The stratification can reduce near-field dilution by trapping the effluent in a layer beneath the ocean surface where the density of the effluent matches that of the water column. Additionally, the trapping leads to far-field transport at depth rather than at the surface, thus having the potential to propagate toward the fresh water source. In the case of site CH-B, this would mean transport of the effluent into Caribou Harbour (See Section 3.1 above for a more thorough discussion of three-dimensional far-field effects). The CORMIX model has the ability to simulate near-field dilution in the presence of vertically-stratified waters, and the manual suggests including these effects when the vertical variation in density is greater than $0.1\ kg/m^3$ (Page 33 of Jirka et al. 1996), significantly smaller than the observed top-bottom density difference of 5.8 kg/m^3 mentioned above. Therefore, worst-case dilution scenarios at CH-B should be devised that take into account the potential for low salinity and stratification arising from high freshwater inflows in the region. These scenarios would need to be devised using results from three-dimensional, far-field modeling.

5. Summary

The MIKE 21 and CORMIX models were used to simulate the distribution of near- and far-field effluent discharged from proposed outfall locations in and near Pictou and Caribou Harbours. Although there are numerous metrics that are commonly used to validate far-field model results like those in the MIKE 21 simulations, these are not calculated in the study. Instead, only qualitative comparisons to observations are made, and these indicate that the far-field model is poorly reproducing the currents and water levels throughout the domain. Therefore, as it is implemented, the far-field model is inaccurate and cannot be trusted to faithfully represent actual circulation and transport dynamics in the region. Given the strong three-dimensional nature of the circulation and transport dynamics due to the winds and fresh water flows in the region, three-dimensional processes are expected to significantly impact the far-field transport. Therefore, the two-dimensional MIKE 21 model is not appropriate for use in this study.

In addition to the inaccurate nature of the far-field model, the scenarios that are presented are not representative of the multitude of processes that can impact the far-field circulation and effluent transport. While there is some qualitative evaluation of the impacts of tidal currents on the far-field fate of the effluent, the two-dimensional nature of the MIKE 21 model makes it impossible to predict the effects of strong winds or strong river inflows, effects that can significantly impact the far-field dynamics. For example, freshwater flows and wind-driven circulation can drive effluent into Caribou Harbour from site CH-B, leading to more accumulation than what might be predicted by the two-dimensional model. Furthermore, although near-field dilution may be accentuated in winter owing to the stronger temperature difference between the effluent and receiving waters, there is no assessment of the potential worst-case winter scenario in which reduced tidal currents due to ice cover may significantly reduce both near- and far-field dispersion. Similarly, while the turbulence and mixing due to storm surges and waves would likely increase near-field dilution, there are no simulations conducted to assess their impact on far-field transport, including the potential for accumulation of effluent in the harbours. Finally, the simulations are not conducted over sufficiently long time periods that are needed to ensure that the simulated far-field dilution factors are in equilibrium, making it impossible to assess the potential for accumulation of effluent in regions of the domain with weaker dispersion and flushing, such as the harbours.

Qualitative representation of the far-field dilution dynamics around site CH-B in the figures indicates fundamental inconsistencies with how the effluent concentrations are being computed and interpreted. The concentrations are unphysically low because the model assumes uniform effluent concentrations within each grid cell. This leads to an over-approximation of the far-field mixing and dilution and overly optimistic conclusions about the far-field dilution factors in the vicinity of the outfall at site CH-B, which are reported to be above 100 in most of the region after a one-month simulation. In reality, the effluent concentrations can vary significantly in the vertical, since effluent plumes can be confined to layers near the surface or mid-water, leading to higher concentrations and smaller, more realistic dilution factors. Due to the artificial dilution, trails of effluent emanating from the outfall are not visible in the figures because their concentrations are too small to appear with the given color scale. Instead, small patches of effluent oscillate with the tides, with some propagating into Caribou Harbour. These indicate the potential for accumulation of effluent in Caribou Harbour by tidal dispersion, an effect that can only be captured with simulations that are run over much longer time periods.

Based on the near-field results obtained with the CORMIX model in the final study, Stantec concluded that the dilution factors near the outfall located at site CH-B are within established water quality guidelines for the 100-m mixing zone. However, the ambient currents and densities supplied to CORMIX are not representative of worst-case near-field dilution scenarios. The currents are based on the average and peak tidal currents at site CH-B over the 31-day simulation period, which are too high because the data include two spring tides. A worst-case tidal current would be better represented by a neap tide during this period, which has smaller currents and is therefore expected to induce less near-field dilution, particularly when accounting for accumulation during slack tide. Weaker tidal currents due to winter ice cover further reduce the potential for near-field dilution, although this scenario is also not investigated. Finally, despite the potential for settling of suspended solids during slack tides within 100 m of the outfall, this is not mentioned in the Stantec studies.

In addition to the overestimated tidal currents, the ambient density supplied to CORMIX is also not representative of a potential worst-case scenario. The salinity used to compute the receiving water density is more representative of the maximum salinity in the region, which gives an effluent that is far too buoyant and thus an overprediction of the near-field buoyancy-driven mixing and dilution. The worst-case salinity, and hence receiving water density, should be much lower given the potential for high river flows to reduce the salinity in the region. Furthermore, high river flows would produce vertical salinity stratification or layering in which fresh water overlies salt water, an effect that can be included in the CORMIX model and further acts to reduce near-field dilution.

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Review of near- and far-field modeling are available at: **https://novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facili ty _Project/comments/6-Ecojustic-comment-B-part-1.pdf**

APPENDIX B-1

Review of the Northern Pulp Nova Scotia Focus Report Section 6.0 and Appendix 6.2 Expanded Air Dispersion Modelling Study

Commentary by Ecojustice

This commentary is provided in response to the Northern Pulp Focus Report and Stantec's Expanded Air Dispersion Modelling Study regarding the air emissions associated with the proposed Effluent Treatment Facility Project. The proposed Replacement Effluent Treatment Facility Project will produce two new sources of air emissions:

1. fugitive emissions from the replacement ETF facility; and
2. emissions of combustion gases from the burning of sludge from the replacement ETF in the power boiler.

Sections 6.1 and 9.2.7 and Appendix 6.2 of the Focus Report estimate the impacts of air pollution from the mill including the proposed new sources from the Replacement Effluent Treatment Facility.

The estimate is based on a revised emissions inventory developed "from a variety of sources and methods"[1] and emissions rates "based on a combination of site-specific data, data from alternative kraft pulp mills, and published emission estimation methods."[2] The chosen emissions inventory and emission rate data are used to drive the air dispersion model to estimate offsite ground-level concentrations.

As the inventory of emission sources and the emission rates used to conduct the air dispersion modelling come from a variety of sources and methods, many of which are not specific to the mill, the estimated ground-level concentrations are highly uncertain. Further uncertainty arises due to use of the chosen model, AERMOD. AERMOD is a simple plume dispersion model that assumes steady-state conditions.[3] However, given the coastal location of the mill and the surrounding complex terrain, a non-steady state model such as CALPUFF that contains modules for complex terrain, overwater and coastal interaction effects may be more suitable and may provide more accurate estimates.[4]

The air dispersion modelling conducted by Stantec does not take into account transitional operating conditions that occur during unit start-up, shut-down, upsets or malfunctions when air pollutant emissions often spike. The modelling appears to assume only normal operating

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[1] Focus Report, Section 6.1, page 108
[2] Focus Report, Section 6.1, page 110
[3] Focus Report, Appendix 6.2, Section 5.1, page 21.
[4] CALPUFF View <https://www.weblakes.com/products/calpuff/resources/lakes_calpuff_view_brochure.pdf>

conditions and must, therefore, be viewed as incomplete and not representative of potential mill operations.

The estimated ground-level concentrations are compared to applicable ambient air quality criteria. Where Nova Scotia or Canadian standards, Stantec uses Ontario Reg. 419/05 standards for some contaminants.[5] The air quality analysis predicted emissions of ammonia, calcium oxide, hexavalent chromium, manganese, chloroform, benzo(a)pyrene, and total reduced sulphide above the Ontario standards.[6] Some of these contaminants, specifically hexavalent chromium (CrVI) and benzo(a)pyrene are known human carcinogens (Group 1) according to the classification by the World Health Organization International Agency for Research on Cancer.[7]

Section 6.1 of the Focus Report downplays the risk of these exceedances, stating that the frequency of the exceedances of health-based- standards occurred at discrete receptors less than 1% of the time but also notes that TRS was predicted to exceed the odour-based 10-minute standard more frequently.[8] The discrete receptors are the locations of residences near the North Pulp mill.

In terms of the amount of the exceedances and the frequency of the exceedances, total reduced sulphur (TRS) presents the greatest risk. As acknowledged on page 38 of Expanded Air Dispersion Modelling study, the effects of exposure to TRS are similar to the effects of exposure to hydrogen sulphide (e.g., irritation, respiratory and central nervous system effects). Although the TRS 10-minute standard is based on odour impacts, there have been many documented incidents of acute health effects from exposure to low concentrations of TRS, including incidents that have resulted in charges against facilities for releases of TRS compounds that have impacted neighbouring communities.[9]

The exceedances of TRS are estimated to occur frequently and at concentrations far greater than the standard at several homes (receptors). For example exceedances are noted of up to 19 percent of the time at receptor five and as much as 18 times the standard at receptor three. The most impacted home is estimated to experience an exceedance of the 10-minute odour based standard by as much as 13 times 19 percent of the time. Other receptors also have high predicted impacts from TRS either in the amount over the standard, or frequency, or both.[10]

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[5] Focus Report, Appendix 6.2, page vi and revised table 6.1 (6.1 rev.1)

[6] Focus Report, Appendix 6.2, page vi and 37

[7] <https://monographs.iarc.fr/list-of-classifications>

[8] Focus Report, p. 110.

[9] Ontario Ministry of the Environmental and Climate Change, Court Bulletin, "Refinery, Shell Canada fined $500,000 for Permitting a Discharge of Odour into the Environment", November 27, 2015, online: <https://news.ontario.ca/ene/en/2015/11/refinery-shell-canada-fined-500000-for-permitting-a-discharge-of-odour-into-the-environment.html>. Ontario Ministry of the Environmental and Climate Change, Court Bulletin, "Pulp and Paper Mill fined $175,000 for Environmental Protection Act Violations"< https://news.ontario.ca/ene/en/2018/11/pulp-and-paper-mill-fined-175000-for-environmental-protection-act-violations.html>

[10] Focus Report, Appendix 6.2, Tables 6.2 and 7.1

Ontario also has a ten-minute odour based standard of 13 μg/m^3 for Hydrogen Sulphide (H_2S) that is not referred to in the report.[11] If half of the composition TRS is H_2S, the ten-minute H_2S standard would also be exceeded at the receptors.

Conclusion

The air quality analysis included with the Focus Report should be considered unreliable and incomplete. The input data is not site-specific and the chosen model is not appropriate for a coastal location with complex terrain. Transitional operating conditions such as unit start-ups and shutdowns when air emissions peak were not considered. Even given these limitations the air dispersion modelling predicted exceedances of several air pollutant standards include cancer-causing substances benzo(a)pyrene and hexavalent chromium. The analysis also estimated that several residents would experience frequent and elevated concentrations of highly odorous reduced sulphur compounds resulting in an unacceptable adverse impact on the community.

November 3, 2019

Ecojustice
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Toronto Ontario, M5G 2C8

[11] O. Reg. 419/05: Air Pollution – Local Air Quality, Schedule 3.

APPENDIX B-2

APPENDIX C-1

Comments on the Focus Report

By

November 8, 2019

I am writing in relation to the Focus Report on Northern Pulp's Proposed Replacement Effluent Treatment Facility Project. My name and I live in Three Brooks. My house is a tidal tributary of Caribou Harbour. Spring through fall, on the water every day.

Since I live close to the harbour and spend much of my time on or in the water I feel quite passionately against the pumping of pulp effluent into the Northumberland Strait and I urge you once again to reject the proposal.

I am writing this letter with emphasis on 3 of the terms of reference.

Term of Reference *"2.3 Submit data regarding the* ***complete physical and chemical characterization*** *of NPNS' raw wastewater (ie., influent at Point A for the Project),* ***to support the assessment of the appropriateness of the proposed treatment technology****. The influent characterization results must be compared against the proposed treatment technology specifications."*

The proposed treatment facility falls short of acceptable with respect to AOX removal (concentration measurements and lack of AOX degradation) and dangerous nitrogen and phosphorous loads that could lead to eutrophication and possible harmful algal blooms (HABs).

The proposed treatment facility is **not appropriate** because it will not sufficiently remove AOX which is composed of toxic organic chlorides including PCBs and chlorinated dioxins and furans. Nor does the facility remove excess nitrogen and phosphorous which can lead to eutrophication and ultimately harmful algal blooms (HABs).

1. **AOX Removal**

AOX is a term for a general group of organic compounds that contain 1 or more halogen atoms (in the case of bleached pulp effluent the halogen is predominately chlorine). In general, the compounds in this category are hydrophobic meaning they will adhere to fatty tissue, sediment or plant life.

Retention Time Comparison:
One of the factors affecting the amount of AOX in the water is the length of time the effluent is allowed to settle, often referred to as retention time. The authors use Point A for untreated effluent and use Point C (Boat Harbour influent) to represent the treated effluent (page 24 of the Focus Report, Figure 2.3-1).
Point C has a much longer retention time (8.5 days) which allows for the settling out of the heavier molecular weight AOX compounds compared to the proposed new ETF (less than 13 hours - Focus Report page 45). Given this fact, one can conclude that the AOX concentrations entering the marine environment from the proposed ETF will be higher than KSH predicts, and that the risk presented by such substances is greater than predicted. It is important to note that the higher the flow, the less retention time is available, which is counter to cleaning up the effluent.

Lack of AOX Degradation:
In Appendix 2.3 page 6 the authors claim the AOX is degraded into Cl- ions and carbon dioxide by photochemical and biological processes

This claim is not tenable. By the authors' own admission there can be up to 663 kg/day released into the Northumberland Strait (Focus Report, Table 2.4-3). Any AOX that can be degraded is done so during the retention time. This time is longer, as discussed above, in the current system than it will be in the proposed process. In fact, the authors show (Appendix 2.4, page 13, Table 1-5) that the concentration of AOX is lower in the current system (87 kg/day) than what was produced by Veolia (less than or equal to 225 kg/day). The RWS study shows 663 kg/day so the AOX released at the outfall could be more than half a metric tonne per day.

They claim that proof of the degradation is that the values for chloride ion are much greater at Point A than in the raw water (Appendix 2.3, page 6). The values for chloride are higher at Point A because chloride is produced during the bleaching process using ClO_2 as the bleaching agent which is what is used at Northern Pulp. The high chloride results are what we would expect based on the bleaching chemistry. Not because the AOX is degraded.

Persistent Organic Pollutants, Bioaccumulation and Biomagnification
Most AOX are toxic to marine and human health and some are considered Persistent Organic Pollutants (POPs). Persistent organic pollutants are organic compounds that do not degrade by chemical, biological, or photolytic processes.
Under the United Nations environmental program the Stockholm Convention lists 12 original, plus 16 newly classified compounds as Persistent Organic Pollutants (POPs). (1) Included in the initial 12 are hexachlorobenzene; polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans and PCBs which are also found in the pulp effluent. Because of their persistence and lipid solubility they tend to bioaccumulate. POPs have been found in the deep ocean so they do not just disappear no matter how dilute the concentration.(2)
The chlorinated dibenzo-p-dioxins (CDDs) that are eaten by marine organisms biomagnify in the food chain. The half-life in the human body for the family of

compounds known as CDD is anywhere from 5 to 15 years. (3) The ETF project entails continuous release of these harmful compounds into the Northumberland Strait. They will bioaccumulate over time and create an escalating risk as the flow continues year over year. This fact alone dictates that dilution is not the solution for pollution when it comes to chemicals that bioaccumulate.

Incorrect Sampling Technique:
The sampling reported in the Focus Report (Appendix 2.3 Pg 104 of 541 Job#B9C9662 , Pg 368 of 541 Job#B9E4451, Pg 413 of 541 Job#B9E4487, Pg 497 of 541 Job#B9E4476 , pg 541 of 541 Job# B9E4405) was done using HDPE containers. Sampling for halogenated organic compounds is typically carried out using amber glass bottles (4, 5) because the AOX molecules of interest are known to adhere to surfaces that are less hydrophilic. They stick to plastic, organic tissue (like plankton, fish and plants), sediment and HDPE. We would expect the AOX numbers to be higher if they used the proper glass bottles for sampling.

Nitrogen and Phosphorous
In Appendix 2.4 at page 10 the authors admit there is a large variation in the phosphorous content of the untreated effluent (0.12 to 5.8 mg/l) and they will not be able to attain the decreased level. Rather, they used the value from Point C (1.5 mg/L where the effluent has already settled for 8.5 days). Point C is once again not representative of actual effluent content and it is clear the phosphorous content will be variable and high.

Excessive amounts of nitrogen and phosphorous lead to algal blooms which deplete the area of oxygen and create "dead zones" in the ocean where many species can no longer live or thrive. The algal blooms can produce toxins which lead to health issues for marine life and ultimately to humans who ingest them. Algal blooms containing toxins are referred to as harmful algal blooms (HABs). Different ratios of nitrogen to phosphorous will encourage different species of algae growth. This phenomenon is not completely understood and is a current area of research. Not all algae contain toxins at all times but it is unpredictable and can change at any time. Alexandrium spp. and Pseudonitzschia spp. are both known to be present in the Northumberland Strait. (6) They have been known for producing paralytic shellfish poisoning and the neurotoxin domoic acid respectively. When conditions are not favourable for algae growth they remain in the environment as cysts. When favourable conditions arise they grow. Nitrogen and phosphorous in the effluent will surely lead to an increase in the number of blooms. With an increase in the number of blooms there is a chance that the HABs will also increase.

2. Baseline studies for fish and shellfish

"9.1 ***Complete baseline studies for fish and shellfish tissue*** *(via chemical analysis) of representative key marine species important for commercial, recreational and Aboriginal fisheries in the vicinity of the proposed effluent pipeline and diffuser location."*

It is important to note not all of the chemicals present in the effluent are tested nor are the chemical components of the effluent fully understood. The following statement is from a *Canadian Environmental Protection Act* Priority Substances List assessment report(7): *"Although approximately 250 individual compounds have been characterized in bleachery effluents, they have been estimated to represent only 10 to 40% of the total low molecular weight materials present."*
I am not confident that we truly know the effect of the chemical mixture on biological systems and therefore cannot confidently predict the risks associated with effluent exposure.

It should be noted that "not detected" does not mean the substance is not present. They are known to be generated during the pulping process and the amounts of each individual substance changes based on the type of wood that is used. Some toxins are capable of accumulating in fish up to 25 000 times the concentration in water.(7) Given that the proposed treatment facility only removes about half of the organic chemicals that will be released into the Northumberland Strait, we need further investigation into the long-term health effects before the risks can be predicted accurately.

The experiments used to determine the effect of stress (toxins, temperature, salinity, pH, turbidity, etc.) on an organism have come a long way since the early 1990s. Consequently, the Acute Lethality test (LC50) should no longer be considered sufficient. Sublethal exposure may still affect the physiology and gene expression of the fish and/or shellfish and more work is required to understand this. We know many of the halogenated organic compounds affect the reproductive and immune systems, and can lead to developmental disorders or cause cancer. Gene expression experiments help gain a better understanding of the exposure effects on protein and enzyme production which gives us an idea of how the effluent will influence the function of biological processes. Popesku et al (8) look at the effects of pulp effluent (3 Kraft and 2 Thermomechanical) on gene expression of the neuroendocrine brain of fathead minnows. They conclude that pulp effluent does inhibit spawning by females by decreasing the levels of key enzymes in the hypothalamus. They conclude that effluents contain neuroactive substances that have yet to be characterized which is made more difficult because of the complex mixture that composes pulp mill effluent. The paper by Brockmeier et al (9) use gene expression to investigate exposure of mosquitofish to kraft pulp mill effluent on the Fenholloway river and demonstrates endocrine disrupting properties of the pulp mill effluent. They found 121 genes upregulated (over-expressed) and 91 genes downregulated by effluent exposure. Sixty-two of the genes are involved in metabolic pathways and are consistent with experimental results of the fish exposed to androgens. They conclude the effluent is responsible for masculinizing the female mosquitofish.
In order to understand and assess the risk presented by the effects of effluent components, further gene expression profiling experiments must be performed on fish and shellfish that are exposed to the effluent at concentrations consistent with what will exit at the diffuser as final effluent, and not once it is diluted. The results should then be compared to those from unexposed samples from the same species.
While the toxicity of each individual compound can be taken into account, as I mentioned in my comments on the EARD, the cumulative **effect of the mixture of toxins** in the

effluent on sea life and ultimately human health is unknown and the risk cannot be assessed with the information as summarized in the Focus Report and EARD. (10)

3. Assessment of impacts on Human Health

9.2 Commence a Human Health Risk Assessment (HHRA) to ***assess potential project-related impacts on human health****. The risk assessment must consider human consumption of fish and other seafood, consumption of potentially contaminated drinking water, exposure to recreational water and sediment, outdoor air inhalation, and any other potential exposure pathways. The analysis must inform the identification of contaminants of concern and updating of the receiving water study.*

In Appendix 9.2, Table A.6a the dioxin 2,3,7,8-TCDD is flagged as a contaminant of potential concern in the seafood ingestion pathway and is present in the effluent sought to be discharged at the outfall for the proposed ETF. This compound, 2,3,7,8-tetrachloro dibenzo-p-dioxin (2,3,7,8-TCDD), is the most toxic of the dioxins known. It is believed to cause liver damage, increased risk of diabetes and abnormal glucose tolerance along with possible reproductive or developmental effects as demonstrated in animal studies and may increase the risk of cancer in people. (3) As a CDD it is included in the POP as designated by the Stockholm convention mentioned above.

In Appendix 9.2, Table A-4 the authors maintain that total phosphorous is not a parameter considered to be of potential human health concern.
"Phosphorus is a required dietary mineral. Phosphorus exists in the environment as phosphate anion, where it acts as a nutrient, and has not been associated with adverse effects in humans. Human health concerns are primarily related to increased productivity (eutrophication) in aquatic systems, which is outside the scope of this human health risk assessment (CCME, 2004)."

The conclusion is not accurate: Eutrophication is an issue. Various levels of nitrogen and phosphorous will lead to algal blooms and potentially **harmful** algal blooms (HABs). (11, 12, 13, 14, 15)

Comments on Table: Understanding Water Measurement Units

As a final point, I have attached a revision to the Table found at page xix of the Focus Report as Appendix 1 to these comments. In my view, the time analogy presented in that table is misleading and fails to properly depict the presence and significance of various compounds in the effluent. The Dillon table suggests that the presence of certain compounds is miniscule and they are therefore harmless. This is dangerous and misleading as the risks from many of these substances is very high even at extremely low concentrations. My revised table provides a better summary based on molecules per litre and molecules per day of these substances. I provide further explanatory comments following my revised table.

Conclusion

Thank you for taking the time to read this letter and please consider that we could potentially be destroying the sensitive aquatic ecosystem of the Northumberland Strait and rendering it uninviting for aquatic species and human recreation if the current proposal is granted. We could also be poisoning and/or killing the fish and thereby poisoning ourselves. I beg you to ensure the proper and current experiments are performed before pulp effluent is pumped into the strait. It is my opinion that the limits of allowable toxins and effects of said toxins are not well established and some risks remain unidentified, while others are much more significant than predicted in the Focus Report and EARD.

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Appendix 1

	Symbol	Multiplying Factor	Exponent Form	Parameter Measurements	Units	Part per	**molecules per L** (assume ave molecular weight of 300)	**molecules/day** (assume ave. molecular weight of 300 and 85 million litres per day)
Base Unit	*Base unit*	1	1.00E+00	gram/litre	g/L	1 part per thousand	2,047,000,000,000,000,000,000	174,000,000,000,000,000,000,000,000
deci	d	0.1	1.00E-01	decigram/litre	dg/L	1 part per ten thousand	204,700,000,000,000,000,000	17,400,000,000,000,000,000,000,000
centi	c	0.01	1.00E-02	centigram/litre	cg/L	1 part per hundred thousand	20,470,000,000,000,000,000	1,740,000,000,000,000,000,000,000
milli	m	0.001	1.00E-03	milligram/litre	mg/L	1 part per million (ppm)	2,047,000,000,000,000,000	174,000,000,000,000,000,000,000
micro	u	0.000001	1.00E-06	microgram/litre	ug/L	1part per billion (ppb)	2,047,000,000,000,000	174,000,000,000,000,000,000
nano	n	0.000000001	1.00E-09	nanogram/litre	ng/L	1 part per trillion (ppt)	2,047,000,000,000	174,000,000,000,000,000,000
pico	p	0.000000000001	1.00E-12	picogram/litre	pg/L	1 part per quadrillion (ppq)	2,047,000,000	174,000,000,000,000,000

For the purpose of this exercise I used an average molecular weight of 300. The calculation is shown below.

As you can see, in the mg/L range, the number of molecules per litre is in the billions of billions order of magnitude! My point is that a part per million is not as dilute a solution as the time analogy would imply. So, even if we assume the best case scenario after "cleanup" is correct, the amount of AOX is estimated to be approximately 1.02mg/L (which calculates to 87kg/day) from Table 2.3-3 we can expect somewhere around 2 billion billion halogenated molecules per litre (that is 174 trillion trillion halogenated molecules per day).

The number of molecules present in a given mass is dependent on the chemical structure (number and type of atoms that make up the molecule), therefore, an average molecular weight of 300 was used. Typically, in chemistry terms, we refer to that as 300 grams per mole (or 300g/mol).
If molecular weight is half of the assumed value, ie half of 300 is 150, the final number of molecules per litre would be doubled. Conversely, if the molecules were larger, say a MW 600, then molecules per litre would be halved.

Calculation:
Molecular weight: 300g/mole
Avogadro's number: 6.022×10^{23} molecules/mole (this is a constant)

molecules/gram: 6.022×10^{23} molecules/mole ÷ 300g/mole = 2.007×10^{21} molecules/g
molecules/mg: 2.007×10^{21} molecules/g x 0.001g/mg = 2.007×10^{18} molecules/mg
molecules/L in a 1 ppm (mg/L) solution:
2.007×10^{18} molecules/mg x 1.02 mg/L = 2.047×10^{18} molecules/L
molecules/day in a 1ppm (mg/L) solution at a flow rate of 85 million L/day (peak flow, page 38 Focus Report):
2.047×10^{18} molecules/L x 85,000,000L/day = 1.74×10^{26} molecules/day

APPENDIX C-2

supported customers and salespeople in North America

APPENDIX D-1

Fisheries and Oceans Canada / Pêches et Océans Canada
Ecosystems and Oceans Science / Sciences des écosystèmes et des océans

Gulf Region

Canadian Science Advisory Secretariat
Science Advisory Report 2018/029

ASSESSMENT OF THE SOUTHERN GULF OF ST. LAWRENCE (NAFO DIV. 4T) SPRING AND FALL SPAWNER COMPONENTS OF ATLANTIC HERRING (*CLUPEA HARENGUS*) WITH ADVICE FOR THE 2018 AND 2019 FISHERIES

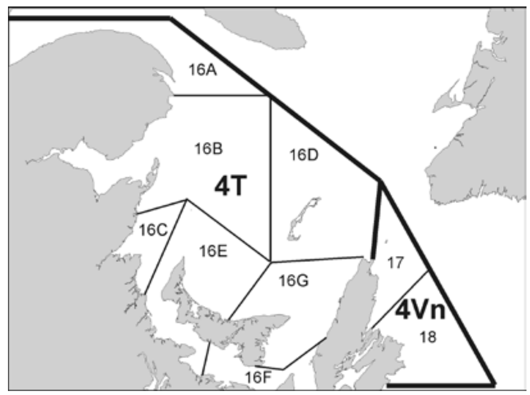

Figure 1. NAFO Divisions 4T and 4Vn and the corresponding herring fishery management zones.

Context:

The stock area for southern Gulf of St. Lawrence Atlantic Herring extends from the north shore of the Gaspe Peninsula to the northern tip of Cape Breton Island, including the Magdalen Islands (Fig. 1). Available information suggests that adults overwinter off the east coast of Cape Breton primarily in NAFO Division 4Vn. Southern Gulf of St. Lawrence herring are harvested by a fixed gear (gillnet) fleet on spawning grounds and a mobile gear (purse seine) fleet (vessels >65') in deeper water. The fixed gear fleet harvests almost exclusively the spring spawner component in the spring, except for June, and almost exclusively the fall spawner component in the fall. The mobile fleet harvests a mixture of spring and fall spawner components during their fishery. The proportions of spring and fall spawner components in the catch vary according to season. In recent years, spring herring have been sold primarily for bait but historically were also used for the bloater (smoked herring), and filet markets. Fall landings are primarily driven by the roe, bloater and filet markets. Annual quota management was initiated in 1972. In 2017, there were 2,339 fixed gear licenses and 8 seiner licenses.

Assessments of the spring and fall spawning herring from the southern Gulf of St. Lawrence (NAFO Div. 4T) are used to establish the total allowable catch. A meeting of the Regional Advisory Process was held March 15, 2018 in Moncton, N.B. to assess the status of the spring and fall spawner components of 4T herring and to provide advice for the 2018 and 2019 fisheries. Participants at the meeting included DFO Science (Gulf, Newfoundland and Labrador, Quebec Regions), DFO Fisheries Management (Gulf and Quebec Regions), provincial governments, the fishing industry, and aboriginal organizations.

SUMMARY

- Atlantic Herring in the southern Gulf of St. Lawrence are comprised of spring spawning and fall spawning components which are considered to be distinct stocks and as such are assessed separately.
- Fishery dependent indices are an important component of the assessment. Indices such as the commercial gillnet CPUE, may not be proportional to abundance due to changes in catchability over time. For example, catch rates can remain elevated despite decreases in abundance (increased catchability) due to contractions in stock distribution and targeting of aggregations by fishing fleets, as well as due to improved fishing technology and fishing practices.

Spring Spawner Component (SS)

- The preliminary estimated landings of SS herring in 2016 and 2017 were 966 t and 1,189 t, respectively, from annual total allowable catch values of 2,000 t.
- A virtual population analysis model that incorporated changes in catchability in the fixed gear fishery has been used since the last assessment.
- The estimates of Spawning Stock Biomass (SSB) at the beginning of 2017 and 2018 were 11,744 t (95% confidence interval: 6,463 – 28,171) and 12,446 t (95% CI: 6,418 – 30,365), respectively. The SSB has been in the critical zone of the Precautionary Approach framework since 2004 and the probabilities that SSB remained in the critical zone at the beginning of 2017 and 2018 were over 90%.
- The average fishing mortality rates on ages 6 to 8 for the SS exceeded $F_{0.1}$ (the removal reference level in the healthy zone, F = 0.35) during 2000 to 2011. F declined below $F_{0.1}$ in 2012, reaching its lowest value of 0.19. The fishing mortality rate during 2015 to 2017 averaged 0.24 (annual exploitation rate of 0.21).
- Due to variable recruitment in recent years, projections were conducted under three different recruitment scenarios during the projection period: (1) high recruitment, (2) low recruitment, and (3) mixed recruitment.
- SSB at the start of 2019 and 2020 was projected to increase slightly at annual catches less than 500 t, remain roughly stable at annual catches of 1,000 t, but decline at catches of 1,500 t or more. However, uncertainty in projected SSB is high. Even in the absence of any removals of SS herring in 2018 and 2019, the SSB is expected to only increase slightly with a high probability that the stock will remain in the critical zone.
- Since 2009, the TAC has been set to 2,000 t annually. At a catch of 2,000 t, the probability of an increase in SSB ranges from 0% (low recruitment scenario) to 19% (high recruitment scenario) with only a 10% chance of exceeding the LRP even under the high recruitment scenario.
- Elevated fishing mortality, declines in weights-at-age, and variable but low recruitment rates are further impeding the rebuilding of the stock.

Fall Spawner Component (FS)

- The preliminary estimated landings of the FS herring component in 2016 and 2017 were 24,677 t and 20,523 t respectively, from a total allowable catch of 35,000 t annually.

- Beginning in 2015, the FS herring assessment model incorporated the dynamics of three regional sub-stocks (North, Middle, South) which jointly comprise the NAFO Div. 4T stock. The catch options are evaluated at the level of the southern Gulf of St. Lawrence.
- Catchability to the fixed gear fishery was estimated to differ between regions and to have changed over time, being lowest with little variation in the North region in contrast to increases in the Middle and South regions over the time series.
- For the southern Gulf of St. Lawrence, the median estimate of SSB at the start of 2018 is 112,000 t. The probabilities that the SSB was below the Upper Stock Reference (USR) level of 172,000 t at the beginning of 2017 and 2018 were 98% and 97%, respectively.
- The average fishing mortality rate on ages 5 to 10 for the FS exceeded $F_{0.1}$ (the removal reference level in the healthy zone, F = 0.32) from 1994 to 2011 except in 2004, but declined from 2012 to attain the lowest levels in 2016. F averaged 0.20 during 2015 to 2017.
- Estimated abundances of age 4 herring at the start of 2017 and 2018 were very low, but with very large uncertainty.
- The median of the projected SSB at the start of 2019 and 2020 remains below the USR at all annual catch levels of 10,000 t or greater with a probability of at least 90%.
- At catches of 20,000 t (the catch in 2017) in 2018 and 2019, the probability of the SSB remaining under the USR in 2020 was estimated at 94%. At the 20,000 t catch level, the probability of the fishing mortality rate being above the removal rate reference was estimated at 46%. $F_{0.1}$ is a removal reference for when a stock is in the healthy zone of the Precautionary Approach.
- Current retrospective patterns indicate that the assessment model may overestimate the exploitable biomass. Consequently, harvest options presented may be optimistic relative to attainment of management objectives.
- When a stock is below the USR (in the cautious zone), consideration should be given to increasing the SSB. A 5% increase in SSB by 2020 would only be likely (greater than 50%) at annual catches below 16,000 t.
- Elevated fishing mortality, during the mid-1990s to 2010, declines in weights-at-age, and low recruitment rates are contributing to declines in SSB, further impeding the rebuilding of the stock.

INTRODUCTION

The Atlantic Herring (Clupea harengus) is a schooling pelagic species. Age at first spawning is typically four years. The herring population in the sGSL consists of two spawning components: spring spawners (SS) and fall spawners (FS). Spring spawning occurs primarily in April-May at depths <10 m. Fall spawning occurs from mid-August to mid-October at depths of 5 to 20 m. Herring also show high spawning site fidelity. In recent years, the largest spring spawning areas are in the Northumberland Strait and Chaleur Bay and the largest fall spawning areas are in coastal waters off Miscou and Escuminac N.B., North Cape and Cape Bear P.E.I., and Pictou, N.S. When spawned, the eggs are attached to the sea floor.

Herring fisheries in NAFO Div. 4T of the southern Gulf of St. Lawrence (sGSL) are managed across seven herring fishing areas within area 16 (A-G; Fig. 1). The SS and FS herring of the sGSL are considered distinct stocks and are assessed separately. For the fall spawner component, a regionally-disaggregated assessment model (North, Middle, South regions) was first used to update advice for the 2015 fishery (DFO 2015).

Fisheries

Over the period 1978 to 2017, total landings of Atlantic Herring from NAFO Div. 4T and 4Vn peaked at 93,471 t in 1995 and dropped to 20,523 t in 2017 (Fig. 2). A Total Allowable Catch (TAC) for the combined harvest of both components in 4T and 4Vn has been in place since 1972. The total landings have generally been less than the TAC since 1988. The TAC values in 2016 and 2017 were 37,000 t.

In the sGSL, herring are harvested by a gillnet fleet (referred to as “fixed” gear fleet) and a purse seine fleet (“mobile” gear fleet). The fixed gear fishery is focused in NAFO Div. 4T whereas the mobile gear fishery occurs in Div. 4T and occasionally in Div. 4Vn. As in previous years, 77% of the TAC for both seasons was allocated to the fixed gear fleet and 23% to the mobile gear fleet. The majority (73% to 97%) of the reported landings since 1981 have been from the fixed gear fleet with percentages in 2016 and 2017 of 94% and 99%, respectively (Fig. 2). Local stocks are generally targeted by the fixed gear fishery which takes place on the spawning grounds.

Separate TACs for the spring spawner component and for the fall spawner component have been established since 1985. The TACs are attributed to the fishing seasons. Reported landings from the fall season have represented the majority (65% to 98%) of the total landings of sGSL herring throughout the time series (Fig. 2). Landings in the fall fishing season were estimated to have represented 94% and 95% of the total herring harvested in 2016 and 2017, respectively.

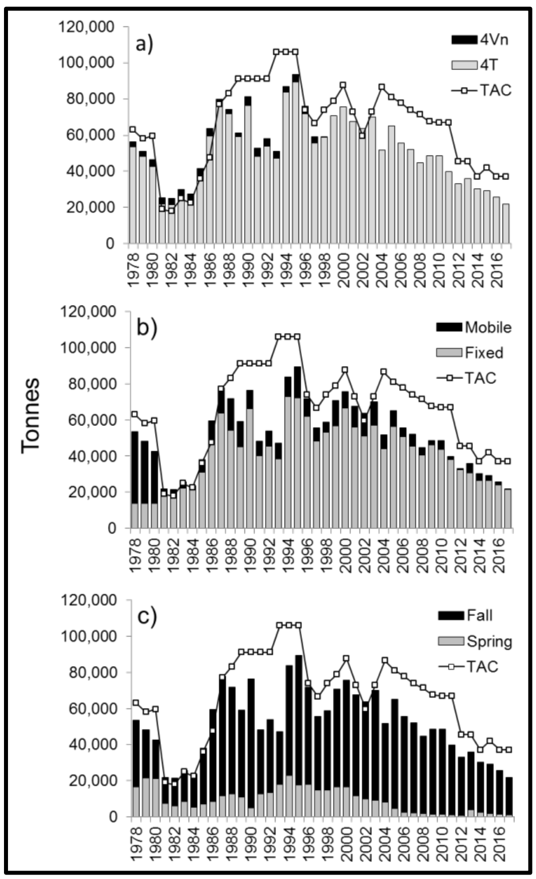

Figure 2. Reported landings (tonnes) of southern Gulf of St. Lawrence Atlantic Herring (spring and fall spawners combined) by NAFO Division (upper panel), by gear fleet (middle panel), and by fishing season (lower panel), 1978 to 2017. In all panels, the corresponding annual total allowable catch (TAC; tonnes) is shown. For landings by season, the landings in NAFO Div. 4Vn were attributed to the fall fishing season. Data for 2016 and 2017 are preliminary.

Spring spawners and fall spawners are not exclusively captured in their corresponding spawning seasons and the landings are attributed to spawning groups based on macroscopic characteristics of individual herring obtained from samples of the fishery catches.

Spring spawner component (SS)

The 2016 and 2017 TAC for the SS herring was set at 2,000 t annually, the same value since 2010 (Fig. 3). The preliminary estimated landings of SS herring in 2016 and 2017 were 966 t and 1,189 t, respectively. With few exceptions, most of the SS herring were estimated to have been landed in the fixed gear fleet over the 1981 to 2017 period. In 2016 and 2017, the fixed gear fleet was estimated to have landed 82% and 96%, respectively, of the total harvests of SS herring (Fig. 3). Generally more than 90% of the SS herring landed by the fixed gear fleet is landed during the spring fishing season, whereas most (> 75%) of the SS herring landed by the mobile fleet is landed in the fall season (Fig. 3).

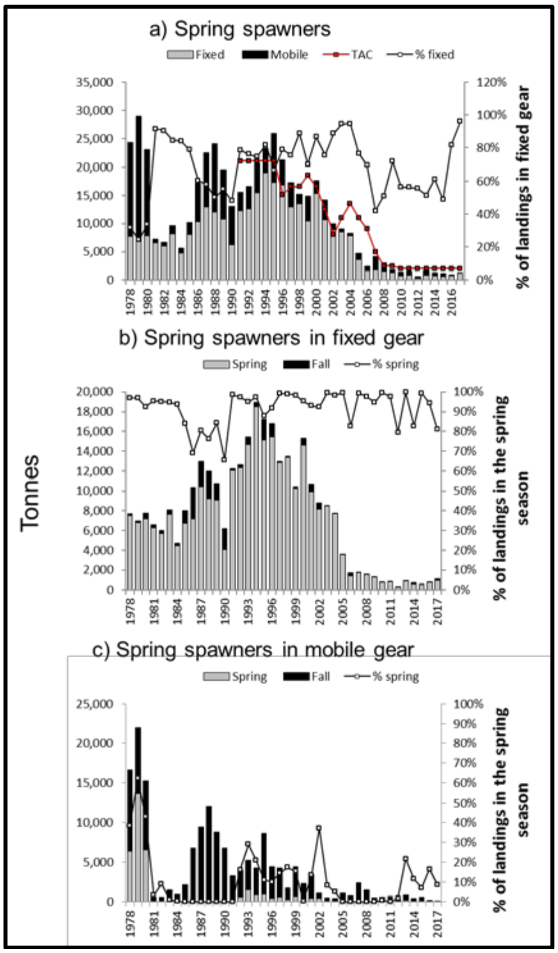

Figure 3. Estimated landings (tonnes) of the spring spawner component (SS) of Atlantic Herring from the southern Gulf of St. Lawrence, 1978 to 2017. The upper panel shows the estimated landings by gear type and the proportion of the landings attributed to the fixed gear fleet. Also shown in the upper panel is the SS herring TAC (red symbols) for 1991 to 2017. The middle panel shows the estimated landings of SS herring in the fixed gear fleet that occurred in the spring fishery season and the fall fishery season as well as the proportion of total SS herring landed by the fixed gear fleet in the spring fishing season. The lower panel shows the estimated landings of SS herring in the mobile gear fleet that occurred in the spring fishery season and the fall fishery season as well as the proportion of the total SS herring landed by the mobile gear fleet in the spring fishing season. For landings by season, the landings in NAFO Div. 4Vn were attributed to the fall fishing season. Data for 2016 and 2017 are preliminary.

Catch-at-age and weight-at-age

The dominant age in the 2016 SS catch was age 7 belonging to the 2009 year-class. In 2017 it was age 5, belonging to the 2012 year-class (Fig. 4).

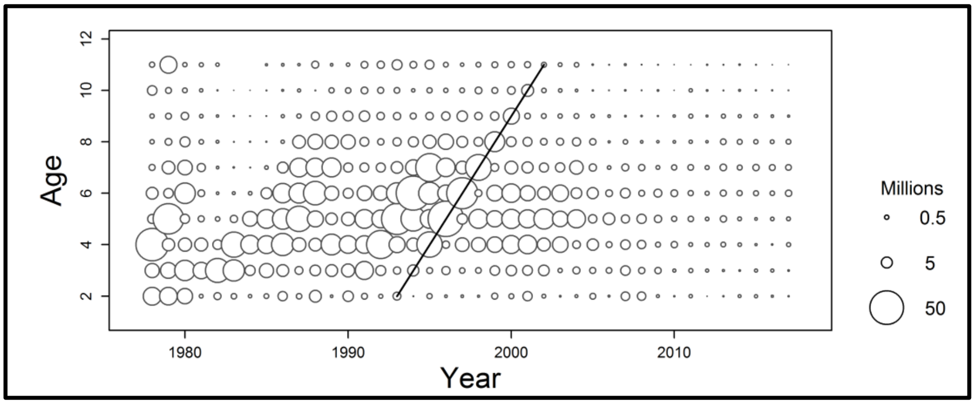

Figure 4. Catch-at-age of the spring spawner component of Atlantic Herring from the southern Gulf of St. Lawrence fishery, all gears combined, 1978 to 2017. Size of the bubble is proportional to the catch numbers by age and year. The diagonal line tracks the most recent strong year-class (1991).

Mean weights-at-age of the SS caught in the mobile and fixed gears in the spring season have declined since the 1990s for mobile gear, and since the mid-1980s for the fixed gear (Fig. 5).

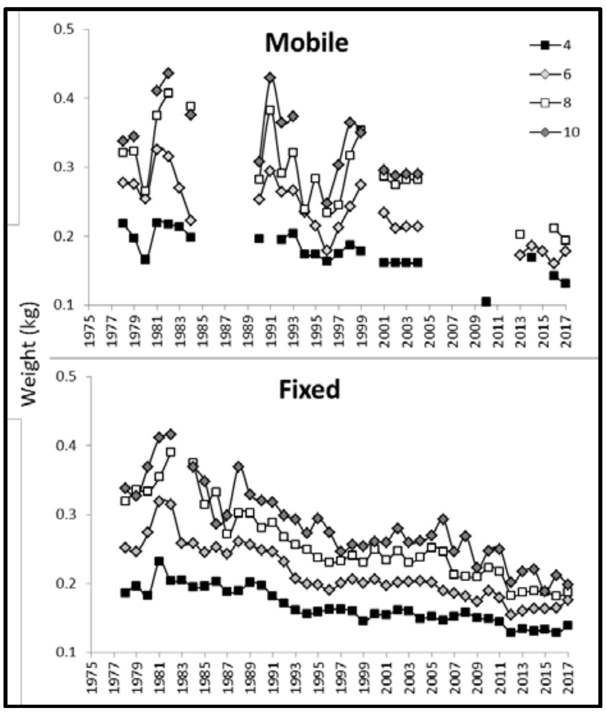

Figure 5. Mean weight (kg) for ages 4, 6, 8 and 10 years of the spring spawner component of Atlantic Herring from the southern Gulf of St. Lawrence sampled from catches during the spring season in the mobile (upper panel) and fixed (lower panel) commercial gears, 1978 to 2017.

Fall spawner component (FS)

The fishery TAC for the fall spawner component is set for the NAFO Div. 4T stock unit. The preliminary estimated landings of FS herring in 2016 and 2017 were 24,677 t and 20,523 t respectively (Fig. 6). The TAC was 35,000 t in 2016 and 2017. With few exceptions, over the 1978 to 2017 period, most of the FS herring were estimated to have been landed in the fixed gear fleet. In 2016 and 2017, the fixed gear fleet was estimated to have landed 94% and 95%, respectively, of the total harvests of FS herring (Fig. 6). The majority (generally almost 100%) of the FS herring captured in the fixed gear fishery are landed during the fall fishing season. The mobile fleet has landed varying amounts of FS herring in the fall, 31% to 45% during 2016 to 2017 (Fig. 6).

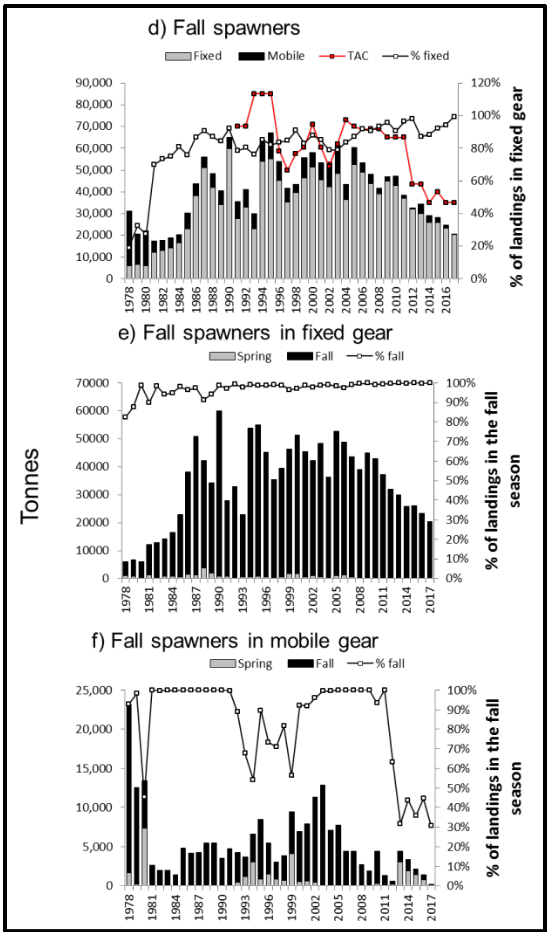

Figure 6. Estimated landings (tonnes) of the fall spawner component (FS) of Atlantic Herring from the southern Gulf of St. Lawrence, 1978 to 2017. The upper panel shows the estimated landings by gear type and the proportion of the landings attributed to the fixed gear fleet. Also shown in the upper panel is the FS herring TAC (red symbols) for 1991 to 2017. The middle panel shows the estimated landings of FS herring in the fixed gear fleet that occurred in the spring fishery season and the fall fishery season as well as the proportion of the total FS herring landed by the fixed gear fleet in the fall fishing season. The lower panel shows the estimated landings of FS herring in the mobile gear fleet that occurred in the spring fishery season and the fall fishery season as well as the proportion of the total FS herring landed by the mobile gear fleet in the fall fishing season. For landings by season, the landings from NAFO Div. 4Vn were attributed to the fall fishing season. Data for 2016 and 2017 are preliminary.

Catch-at-age and weight-at-age

Catches-at-age from the fisheries were compiled by region (North, Middle, South) and year. Catches from the fixed gear fleet were attributed to the region of capture. Catches by the mobile fleet in NAFO Div. 4T were attributed to the region which is most proximate to the location of capture. Catches made in NAFO Div. 4Vn during a winter seiner fishery (prior to 1999) were attributed to each region in proportion to the other catches from each region in the same year.

Catch-at-age and weight-at-age matrices for NAFO Div. 4T FS herring include catches made by both fixed and mobile gear fleets. These were derived using age-length keys and length-weight relationships from sampling for each principal fishing area and season.

Region-specific catches-at-age used in the model fitting for both gears combined are presented in Figure 7. The catches of younger ages (less than 6 years) have recently decreased in the fisheries consistent with the estimated changes in selectivity in the fixed gear fleet and changes in size-at-age of FS herring.

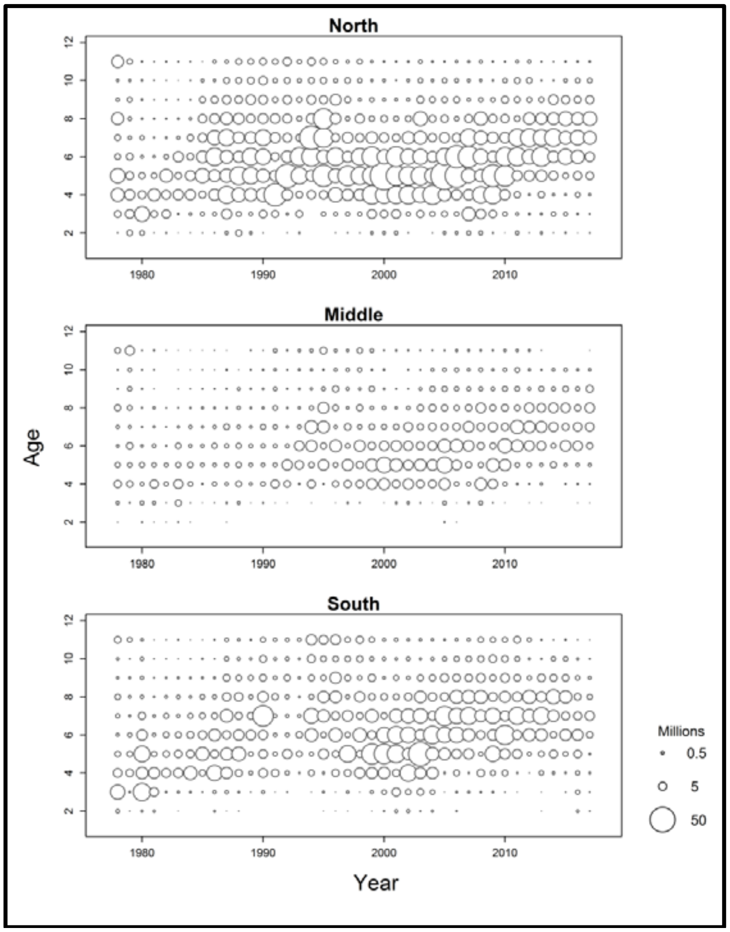

Figure 7. Bubble plots of fishery catch-at-age (number) of the fall spawner component of Atlantic Herring from the southern Gulf of St. Lawrence by region for mobile and fixed gears combined, 1978 to 2017. The size of the bubble is proportional to the number of fish in the catch by age and year. The values indicated at age 11 represent catches for ages 11 years and older.

Mean weights-at-age of FS herring from fixed and mobile gears have declined almost continuously over the period 1978 to 2011 and remain at low levels (Fig. 8). Lower mean weights have a consequence on the estimation of stock biomass when numbers are converted to weight.

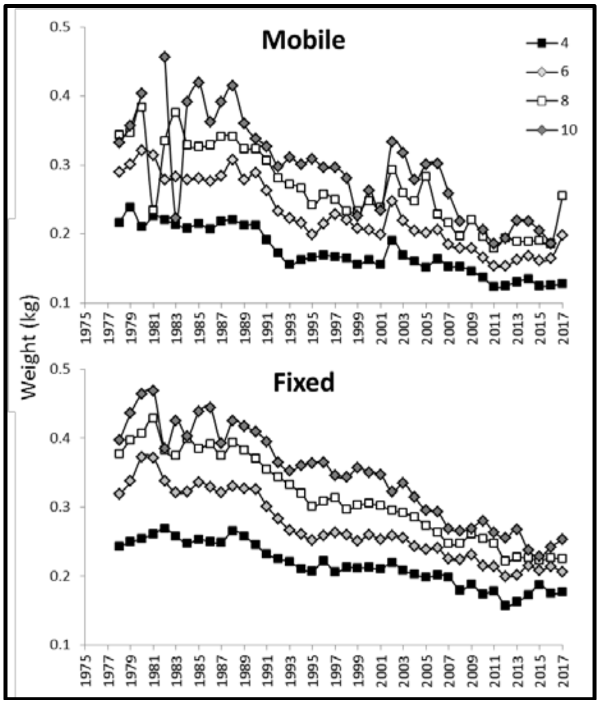

Figure 8. Mean weight (kg) for ages 4, 6, 8 and 10 years of the fall spawner component of Atlantic Herring from the southern Gulf of St. Lawrence sampled from catches in the fall season by the mobile (upper panel) and fixed (lower panel) gear fleets, 1978 to 2017.

ASSESSMENT

The SS herring and FS herring of NAFO Div. 4T are considered distinct stocks and are assessed separately. The assessments of abundance are made using Virtual Population Analysis (VPA) models based on catch-at-age, fishery dependent and fishery independent indices at age. The fishery TAC, and the analysis of catch options presented in this document, are for the spring spawner component and the fall spawner component separately and at the scale of the entire southern Gulf of St. Lawrence.

Indices of Abundance

Telephone survey

A telephone survey has been conducted annually since 1986 to collect information on the fixed gear fishery and opinions on abundance trends. The telephone survey responses include information on fishing effort, in terms of the number of nets, number of hauls, and mesh sizes used, which is used in the derivation of the commercial catch-per-unit-effort (CPUE) indices and in modelling relative fixed gear fishery selectivity in the fall spawner assessment model. The opinion of relative abundance is not used as an index in the population model. Overall, spring fishermen felt that abundances had remained consistent with the previous assessment, however for the fall fishery there was an overall sense of decreased abundance in all regions.

Fishery Independent Acoustic survey (SS and FS herring)

An annual fishery-independent acoustic survey of early fall (September-October) concentrations of herring in the sGSL has been conducted since 1991. The standard annual survey area occurs in the NAFO Div. 4Tmno areas (16B Fig. 1) where sGSL herring aggregate in the fall.

The 2015, 2016, and 2017 acoustic biomass indices for spawning groups combined were 169,635 t, 73,977 t, and 69,023 t, respectively. Based on biological samples, the biomasses in 2015 to 2017 were estimated to have been comprised of 19% SS and 81% FS herring.

Age-disaggregated acoustic indices for ages 4 to 8 are developed for the SS herring component. For the FS herring, the acoustic survey provides an abundance index of recruiting herring at ages 2 and 3 only.

Fishery Dependent Commercial Catch per Unit Effort (CPUE) (SS and FS herring)

Fixed gear catch and effort data were used to construct age-disaggregated abundance indices for SS herring and FS herring, expressed as catch per unit effort (CPUE) with values in kg/net-haul/trip. Age-specific CPUE indices for ages 4 to 10 are used in the assessments of the SS herring and FS herring stock. For the SS herring, an index is estimated for the whole stock area. For the FS herring, indices are calculated for each of the North, Middle, and South regions.

Fishery Independent Experimental Gillnet Indices (FS herring)

Catches from experimental nets are used to estimate the relative size-selectivity of gillnets of different mesh sizes and to produce age-disaggregated abundance indices, by region, as inputs to the fall spawner component assessment model.

Experimental gillnets, consisting of multiple panels of varying mesh size, were fished approximately weekly by fishermen during the fall fishing season. Each experimental gillnet had five panels of different mesh size, from a set of seven possible mesh sizes, ranging from 2” to 2¾” in ⅛” increments. All gillnets had panels with mesh sizes of 2½”, 2⅝”, and 2¾”, plus two smaller mesh sizes that varied among fishermen. The nets were set during the commercial fishery on the fishing grounds. The index is standardized to a one-hour soak time corresponding to the target fishing duration.

Fishery Independent September Bottom Trawl Survey (FS herring)

This sGSL index is used for the fall spawner population model. The annual multi-species bottom trawl survey, conducted each September since 1971, provides information on the relative abundance and distribution of NAFO Div. 4T herring throughout the sGSL. Since 1994, sampling of herring catches has been undertaken to disaggregate catches by spawner group and age. Spawning group assignment and age data were available for 1994 to 2017 for this assessment.

Spring Spawner Component (SS)

Indices of abundance

Acoustic survey

The acoustic survey provides catch rates (in numbers) of SS herring for ages 4 to 8 for 1994 to 2017 (Fig. 9). The combined index was highest in the mid-1990s and subsequently declined and remained at low levels in the 2000s.

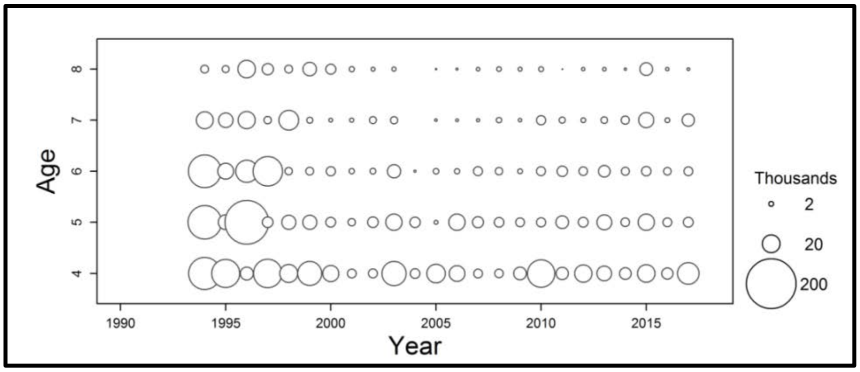

Figure 9. Bubble plot of abundance-at-age (number) from the fisheries-independent acoustic survey for herring spring spawners (SS; ages 4 to 8) in the southern Gulf of St. Lawrence, 1994 to 2017.

Commercial fixed gear catch per unit effort

The CPUE index for SS herring shows internal consistency as the abundance of cohorts is correlated between years, as shown for example for the sequence of catches of the 1988 year class (e.g., age 4 in 1992, age 5 in 1993, Fig. 10). Decreases in the CPUE of younger fish and increases in the CPUE of older fish are noted since 2011 (Fig. 10).

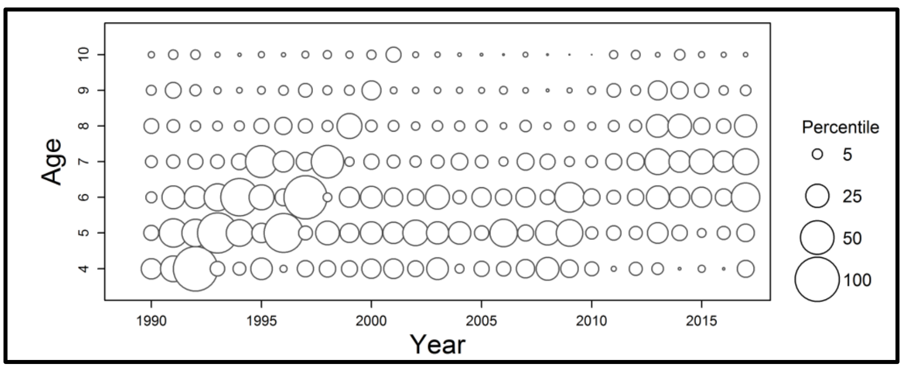

Figure 10. Bubble plot of spring spawner Atlantic Herring fixed gear catch per unit effort values (number per net-haul per trip) at age in the southern Gulf of St. Lawrence, 1990 to 2017. The size of the bubble is proportional to the maximum CPUE index value.

Population model

In the previous assessment (Swain, 2016), time-varying catchability was incorporated in the virtual population analysis (VPA) to improve the residual and retrospective patterns. Fishery dependent indices are an important component of the assessment. Indices such as the commercial gillnet CPUE, may not be proportional to abundance due to changes in catchability over time. Catchability to the fishery is defined as the proportion of the stock removed by one unit of fishing effort. If catchability doubles while abundance remains the same, CPUE will increase even though abundance did not. In the absence of correcting for changes in catchability, CPUE may bias the estimate of abundance.

The VPA model inputs include a natural mortality at all ages set at 0.2, a fishery catch-at-age 2 to 11+ (in numbers), fishery CPUE in numbers at ages 4 to 10 years from 1990 to 2017, and abundance indices at ages 4 and 8 from the fall acoustic survey (1994-2017). Catchability to the fishery, defined as the proportion of the stock removed by a unit of fishing effort, averaged about 0.006 in the 1990s, increasing to a peak of 0.032 from 2007 to 2017 (Fig. 11). Estimated catchability increased as the stock declined below 60,000 t of spawner biomass (Fig. 11).

Fishery catchability has been shown to increase as population size decreases for a number of stocks including herring (Winters and Wheeler, 1985). Reasons for this include:

- The area occupied by a stock usually decreases as stock size decreases, and because fish harvesters target fish aggregations (e.g., spawning aggregations), the proportion of the stock removed by a unit of fishing effort is expected to increase.
- In a gillnet fishery, net saturation at high abundance may also contribute to reduced catchability at high population size.

Independent of changes in SSB, catchability by fisheries may increase over time due to technological improvements and changes in fishing tactics. Other factors might result in declines in catchability, for example the changes in management measures that have occurred in the spring fishery since 2010. These measures included closures of some spawning areas and a requirement that gear be in the water by 6:00 PM and not retrieved before 4:00 AM the next day (preventing the targeting of aggregations overnight).

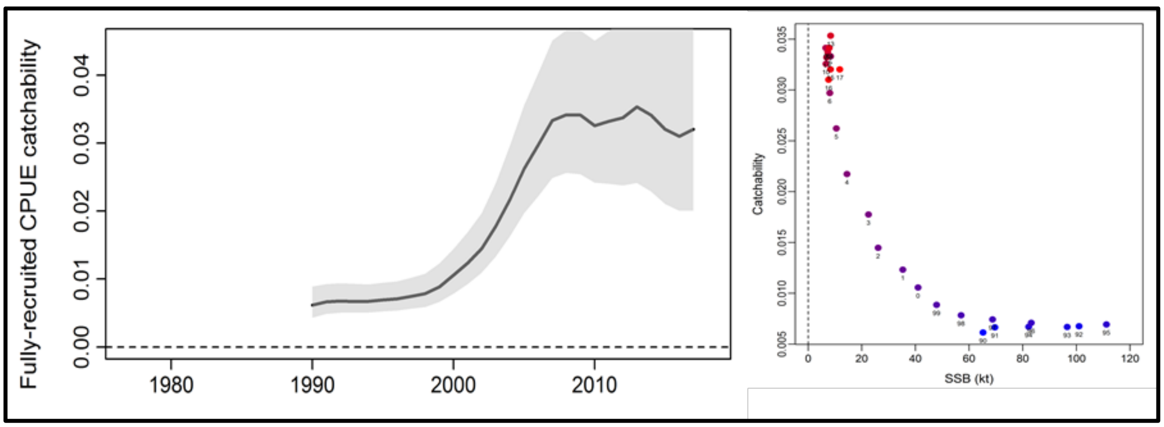

Figure 11. Estimated fully-recruited catchability to the CPUE index of the spring spawner component of Atlantic Herring (left panel) and fully-recruited catchability to the spring spawner gillnet fishery in relation to spring spawner SSB (right panel) for the southern Gulf of St. Lawrence. In the left panel, the line shows the median estimates and shading the 95% confidence intervals.

Recalculating the Limit Reference Point

The limit reference point (LRP) for NAFO Div. 4T herring is based on $B_{recover}$, the lowest biomass from which the stock has been observed to readily recover, calculated as the average of the four lowest spawning stock biomass (SSB) estimates in the early 1980s (i.e., 1980-1983). Consequently, this value is model dependent. If the model changes, stock biomass may be re-scaled upwards or downwards. With the model change initiated in 2016 (DFO 2016) and retained in this assessment, there was a revised value for the biomass in the 1980s. Thus the LRP was re-calculated. The revised LRP is 19,250 t, slightly lower than the former value of 22,000 t.

Spawning Stock Biomass and Exploitation Rate

The estimates of Spawning Stock Biomass (SSB; age 4+) at the beginning of 2017 and 2018 were 11,744 t (95% confidence interval: 6,463 – 28,171 t) and 12,446 t (95% CI: 6,418 – 30,365 t), respectively. These biomasses are higher than the SSBs in 2015 and 2016, however, the stock remains in the critical zone of the Precautionary Approach (Fig. 12). The SSB estimate for 2018 is 65% of the LRP. The probabilities that the projected SSBs were above the LRP at the start of 2017 and 2018 were <11% and 15%, respectively (Fig. 12).

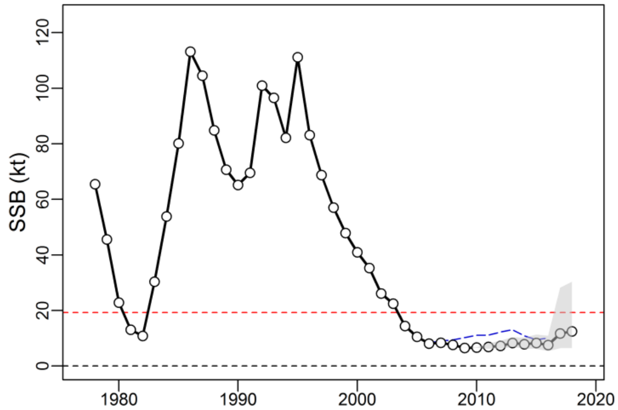

Figure 12. Estimated beginning of the year spawning stock biomass (SSB) of the spring spawner component of Atlantic Herring in the southern Gulf of St. Lawrence, 1978 to 2018. Circles show the maximum likelihood estimates, the solid line is the median of the Monte Carlo Markov Chain (MCMC) values and shading encompasses the 95% confidence interval. The red horizontal dashed line is the Limit Reference Point (19,250 t of SSB). The blue dashed line shows the SSB estimates from the 2016 assessment (DFO 2016).

Estimated fishing mortality rates were high in 1980 and in most years from 2000 to 2011 (Fig. 13), declined to a low value of 0.19 (annual exploitation rate of 0.16) and below the reference removal rate ($F_{0.1}$; F = 0.35 corresponding to exploitation rate of 0.30) in 2012, and has remained below $F_{0.1}$ in subsequent years, with the exception of 2013. Fishing mortality rates in 2015 to 2017 averaged 0.24 (annual exploitation rate of 0.21).

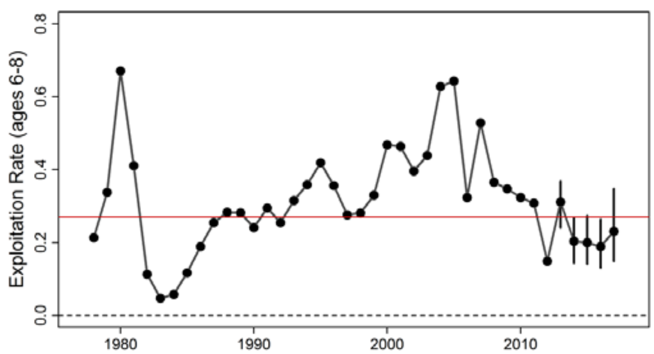

Figure 13. Estimated annual exploitation rates of spring spawning Atlantic Herring aged 6 to 8 years in the southern Gulf of St. Lawrence, 1978 to 2017. Circles are the median estimates and vertical lines their 95% confidence intervals. The red horizontal line shows the reference level annual exploitation rate (0.295 equivalent to F = 0.35) corresponding to $F_{0.1}$.

Recruitment and Recruitment Rates

Recruitment rates (the number of recruits divided by the SSB that produced them) were unusually high in the early 1980s (Fig. 14). Recruitment rates have been much lower since then, though periods of moderately high recruitment rates occurred in the late 1980s and early 1990s as well as during 2005 to 2011. Recruitment rates were lower in 2012 but appear high in 2013 though the uncertainties are very high (wide confidence intervals) for that year. Estimated abundances of age 4 herring at the start of 2017 and 2018 were higher than those since 2005 (Fig. 14). The age 4 abundance in 2018 depends on the assumption that recruitment rate for this cohort equals the average rate for the preceding five cohorts. Recruitment rates and uncertainty vary among these five cohorts resulting in very high uncertainty in age 4 abundance in 2018. If the recruitment rate of the 2013 cohort was instead low, like that of the previous cohort, age 4 abundance in 2018 would be similar to the low 2016 value.

The estimate of spring spawner (4+) abundance for 2017 is 82.9 million fish (Fig.14; median value of 80.2 million with 95% CI: 42.3 – 206.5 million), about 20% of the average spawner abundance during 1985 to 1995.

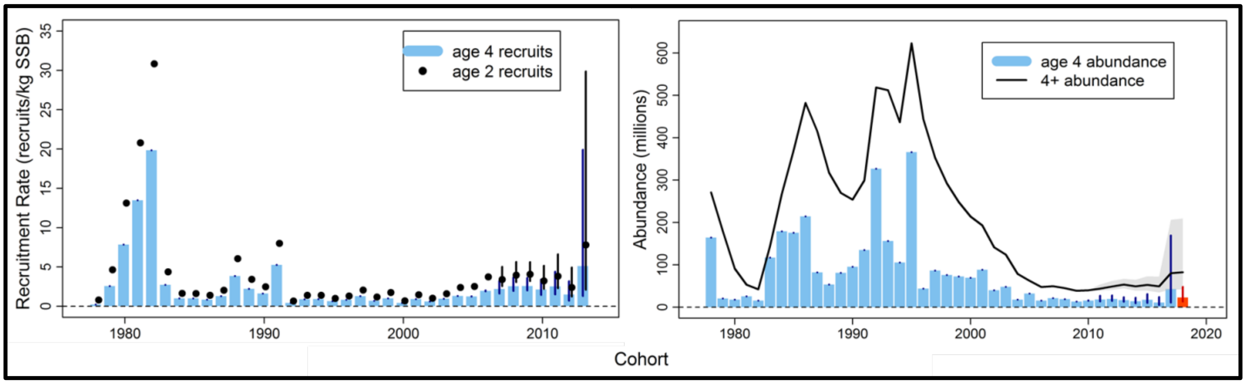

Figure 14. Recruitment rates and beginning of year abundances of the spring spawner component of Atlantic Herring from the southern Gulf of St. Lawrence. The left panel shows recruitment rates at age 2 (circles) and at age 4 (bars) for the 1978 to 2013 cohorts with vertical lines indicating the 95% confidence intervals. The right panel shows the estimated beginning-of-year abundances of 4 year old herring (blue bars) and herring 4 years and older (line) for the spring spawner component of the southern Gulf of St. Lawrence. Bars and the line show the median estimate and vertical lines or shading the corresponding 95% confidence intervals. Age 4 abundance in 2018 (the red bar) was estimated assuming the recruitment rate for this cohort was the average of the rates of the preceding five cohorts.

Projections

The population model was projected forward for two years to the start of 2020 and 10 years to the start of 2027. These projections incorporated uncertainty in the estimates of abundance at age at the beginning of 2018, in the weights-at-age, partial recruitments to the fishery, and recruitment rates (to estimate ages 2 to 4). Projections were conducted at seven levels of annual catch (0 to 3,000 t in increments of 500 t) with the same catch level for the 2018 and 2019 fishing seasons. Projection results depend strongly on recruitment rates. Due to variable recruitment in recent years, projections were conducted for three recruitment scenarios during the projection period: (1) high recruitment rate scenario (2007 to 2012 cohorts), (2) low recruitment rate scenario (1999 to 2005 cohorts), and (3) mixed recruitment rate scenario (1999 to 2012 cohorts).

SSB was projected to increase slightly at annual catches of 0 and 500 t, remain roughly stable at a catch of 1,000 t, and decline at catches of 1,500 t or more (Fig. 15). However, uncertainty was high. The probability of an increase in SSB between the beginning of 2018 and the beginning of 2020 decreased from 80% at 0 t of catch to 49% at 1,000 t of catch and 11% at 2,500 t of catch under the high recruitment scenario. At the mixed and low recruitment scenarios, the probability of the SSB increasing in the absence of fishery removals (0 t) was 58% and 39%, respectively (Fig. 15; Table 1).

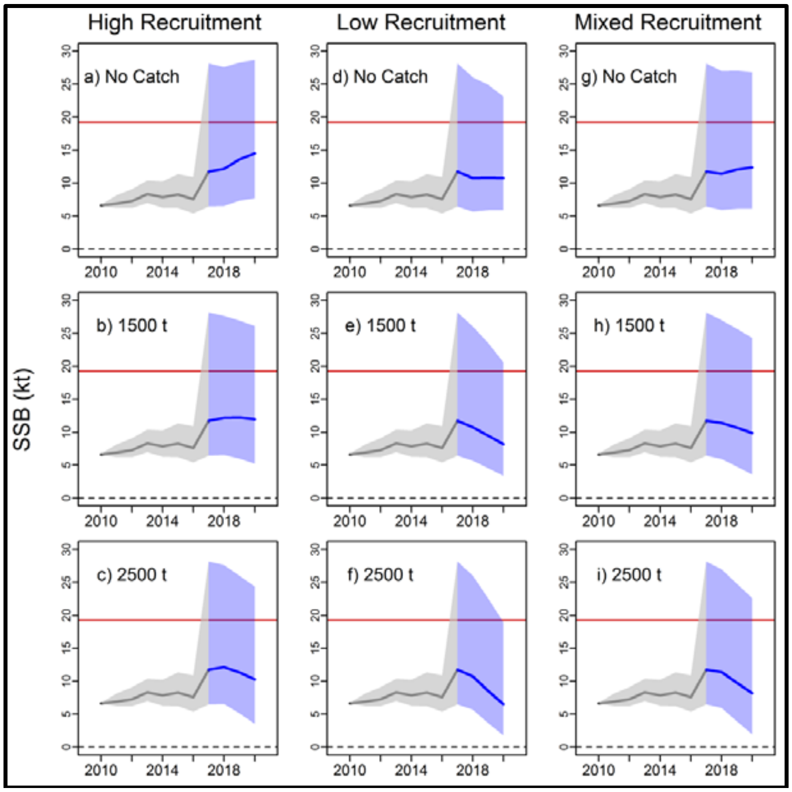

Figure 15. Projected spawning stock biomass (SSB in kt) of spring spawning Atlantic Herring from the southern Gulf of St. Lawrence for three recruitment scenarios (columns) and at various catch levels (rows) in 2018 and 2019. Lines show the median estimates of the beginning-of-year SSB and shading the 95% confidence intervals of these estimates (based on MCMC sampling). Grey shading indicates the historical period and blue shading indicates the projection period. The red horizontal line in each panel is the limit reference point (LRP) value of 19,200 t.

Risk analysis of catch options

All catch levels in 2018 and 2019 (including no catch) and recruitment rate scenarios indicate little probability that SSB would exceed the LRP at the start of 2020 (for high recruitment 20% at 0 t of catch, 8% at 2,500 t of catch; at low recruitment 6% at 0 t of catch, 2% at 2,500 t of catch) (Table 1). By 2027, the probability of exceeding the LRP was most favorable (>= 50%) under the high recruitment scenarios and low catches (<1,500 t), however at the low recruitment scenarios even with no catch there was only a 13% probability of SSB exceeding the LRP (Table 1).

There is no chance that the population would be at or above the Upper Stock Reference (USR) in 2020 even with no catch regardless of the recruitment rate scenario. At the high recruitment rate scenario, there is an 11% probability of SSB exceeding the USR by 2027 with no catch whereas at the low recruitment rate there is 0% chance (Table 1).

For the low recruitment rate scenario, the probability that age 6 to 8 fully recruited *F* in 2019 would be greater than the removal rate reference level of $F_{0.1}$ (0.35) was essentially zero at 1,000 t or less of catch, increasing to 9% at 1,500 t of catch, and rising to 57% at 2,500 t of catch.

Since 2009, the TAC has been set to 2,000 t annually. At a catch of 2,000 t, the probability of an increase in SSB after 2019 ranges from 0% (low recruitment rate) to a high of 19% (high recruitment rate) depending on the recruitment rate scenario. At 2,000 t of annual catch, there is at most a 10% chance of exceeding the LRP and the probability of SSB exceeding the LRP by 2027 ranges from 2% (low recruitment) to 38% (high recruitment). Furthermore at 2,000 t there is at best a 4% chance of reaching the USR by 2027 (Table 1).

Table 1. Risk analysis table of probabilities (%) of increases in SSB, of SSB being greater than the LRP (i.e., the SSB not in the critical zone), of SSB being greater than the USR (i.e., the SSB in the healthy zone), and of fully-recruited fishing mortality rate ($F_{6\text{-}8}$) being above $F_{0.1}$ for differing fixed catch options in 2018, 2019, and 2027 for the spring spawner component of Atlantic Herring from the southern Gulf of St. Lawrence according to three recruitment rate scenarios. The recruitment rate scenarios are: A) High recruitment rate scenario (2007-2012 cohorts), B) low recruitment rate scenario (1999-2005 cohorts), and C) mixed recruitment rate scenario (1999-2012 cohorts). nd means not considered.

			Catch option (t)						
Scenario	State of stock	Year	0	500	1,000	1,500	2,000	2,500	3,000
A	SSB increasing	2018	91%	80%	63%	44%	28%	16%	nd
		2019	80%	66%	49%	32%	19%	11%	nd
	SSB > LRP	2019	16%	15%	13%	12%	11%	10%	nd
		2020	20%	17%	14%	11%	10%	8%	nd
		2027	87%	76%	63%	50%	38%	29%	21%
	SSB > USR	2019	0%	0%	0%	0%	0%	0%	nd
		2020	0%	0%	0%	0%	0%	0%	nd
		2027	11%	9%	6%	5%	4%	3%	2%
	$F_{6\text{-}8}$ > 0.35	2018	0%	0%	0%	4%	22%	48%	71%
		2019	0%	0%	0%	3%	18%	39%	60%
		2027	0%	0%	1%	10%	30%	51%	69%
B	SSB increasing	2018	53%	25%	8%	1%	0%	0%	nd
		2019	39%	18%	5%	1%	0%	0%	nd
	SSB > LRP	2019	7%	6%	6%	5%	5%	5%	nd
		2020	6%	5%	4%	3%	3%	2%	nd
		2027	13%	7%	4%	3%	2%	1%	1%
	SSB > USR	2019	0%	0%	0%	0%	0%	0%	nd
		2020	0%	0%	0%	0%	0%	0%	nd
		2027	0%	0%	0%	0%	0%	0%	0%
	$F_{6\text{-}8}$ > 0.35	2018	0%	0%	0%	6%	31%	58%	78%
		2019	0%	0%	0%	9%	33%	57%	74%
		2027	0%	0%	29%	73%	91%	96%	98%
C	SSB increasing	2018	68%	52%	37%	23%	13%	7%	nd
		2019	58%	43%	28%	17%	10%	5%	nd
	SSB > LRP	2019	11%	10%	9%	8%	7%	7%	nd
		2020	12%	10%	8%	7%	6%	5%	nd
		2027	54%	40%	28%	19%	12%	9%	6%
	SSB > USR	2019	0%	0%	0%	0%	0%	0%	nd
		2020	0%	0%	0%	0%	0%	0%	nd
		2027	2%	1%	1%	1%	1%	0%	0%
	$F_{6\text{-}8}$ > 0.35	2018	0%	0%	0%	5%	26%	53%	75%
		2019	0%	0%	0%	6%	26%	49%	68%
		2027	0%	0%	7%	35%	62%	79%	90%

Fall Spawner Component (FS)

The FS herring assessment considers three regions (North, Middle, South) which cover the entire NAFO Div. 4T area as three independent populations. The regions are defined on the basis of traditional herring spawning beds and fishing areas: North (Gaspe and Miscou; 4Tmnopq), Middle (Escuminac-Richibucto and west Prince Edward Island; 4Tkl) and South (east Prince Edward Island and Pictou; 4Tfghj) (Fig. 16). The choice of three regions was dictated by geographic proximity of spawning beds and is the finest level of disaggregation that can presently be supported by the available data.

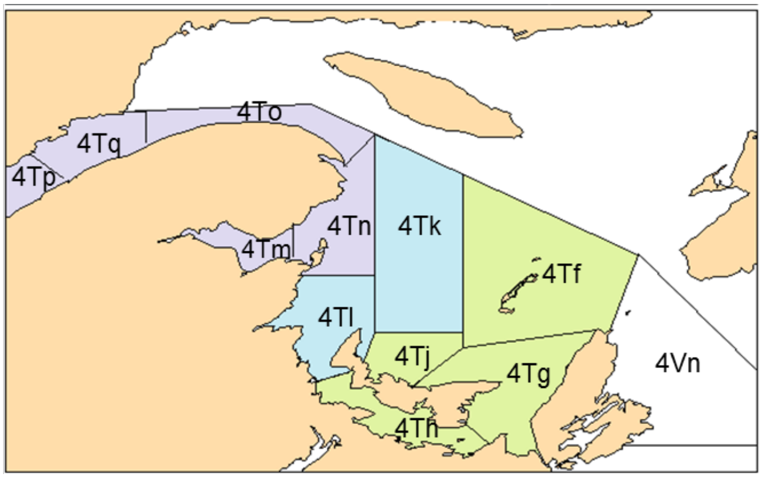

Figure 16. Correspondence between the herring fishing areas and the three regional groups (by colour shading) used in the assessment of the fall spawner component of Atlantic herring from the southern Gulf of St. Lawrence. Fishing areas in each region are described in the text above.

Indices of abundance

Acoustic survey

For the FS assessment model, the acoustic survey provides a useful abundance index of recruiting herring (ages 2 and 3) for the entire NAFO Div. 4T stock unit (LeBlanc et al. 2015). It is not considered a useful abundance index for older ages given that the survey is limited to a restricted portion of the sGSL at a time when older herring are distributed and spawning in areas throughout the sGSL. The index of three year olds was relatively high in 2015, with relatively smaller abundances for both age classes in 2016 and 2017 (Fig. 17).

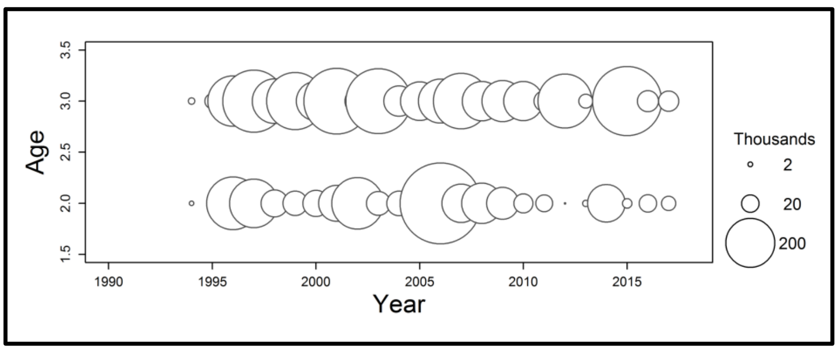

Figure 17. Bubble plot of the index of abundance (number of fish) of fall spawning herring at age 2 and 3, from the fisheries-independent acoustic survey for fall spawners, 1994 to 2017.

Commercial fixed gear catch per unit effort

Decreases in the CPUE of younger fish and increases in the CPUE of older fish were noted for the FS herring (Fig. 18). In the North region, CPUE indices for ages 6 to 8 in 2016 and 2017 were lower than in previous recent years. CPUE values in the Middle region were higher in 2016 than in the previous recent years but declined in 2017. CPUE values in the South region were higher in 2017 than in 2016 but both years were lower than most of the previous years.

In the North and Middle regions, catches of FS in 2016 were dominated by age 6 and 7 and in 2017 by ages 7 and 8 (2009 and 2010 year-classes). In the South region, catches of FS in 2016 and 2017 were dominated by age 7 and 8 respectively (2009 year-class).

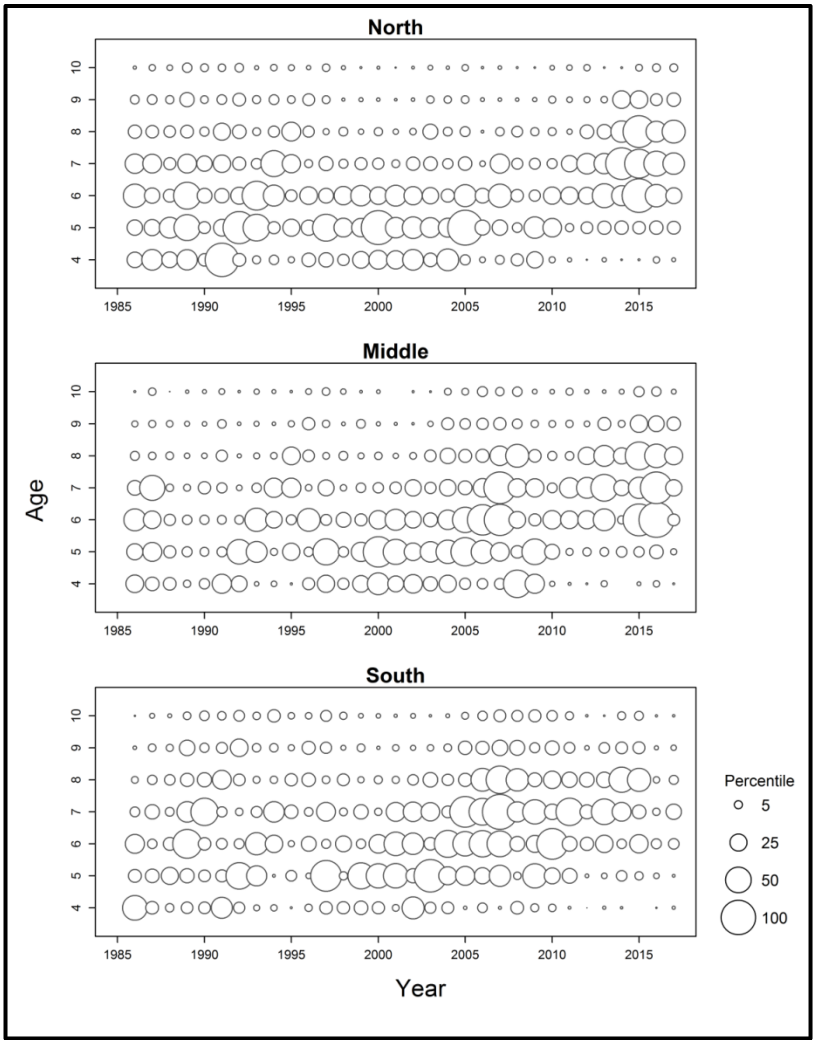

Figure 18. Fall spawner (FS) herring fixed gear age-disaggregated catch per unit effort values (number per net-haul per trip) by region (upper panel North, middle panel Middle, and lower panel South) in the southern Gulf of St. Lawrence, 1986 to 2017. The size of the bubble is proportional to the CPUE index value.

Experimental gillnet indices

The experimental gillnet indices suggest an increase in young herring (ages 2 to 4) until 2009, after which the numbers declined, with proportional catches of herring 5 to 9 generally increasing from 2010 to 2017, in all regions (Fig. 19).

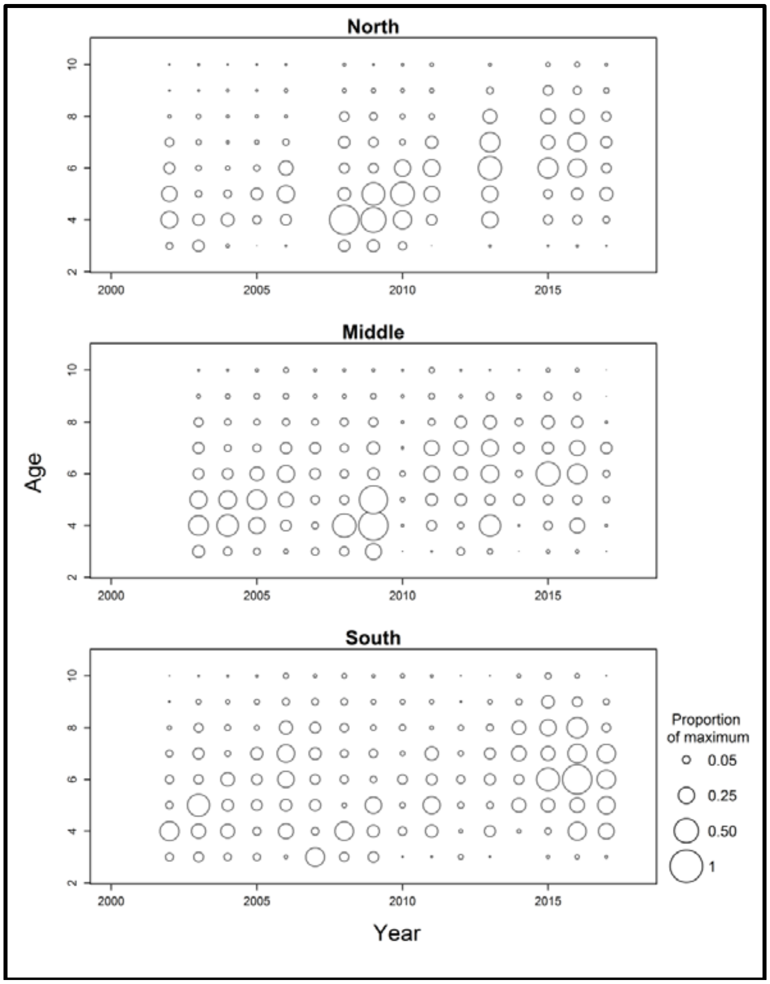

Figure 19. Bubble plots of catch-at-age indices (number) of fall spawner herring from the experimental gillnets by region (upper panel North, middle panel Middle, and lower panel South) in the southern Gulf of St. Lawrence, 2002 to 2017. The size of the bubble is proportional to the index value.

Fishery Independent September Bottom Trawl Survey

The index suggests an increasing trend in four year old FS herring from the mid-1990s to 2011, and generally higher abundance of six year old FS herring in the 2000s compared to the 1990s (Fig. 20).

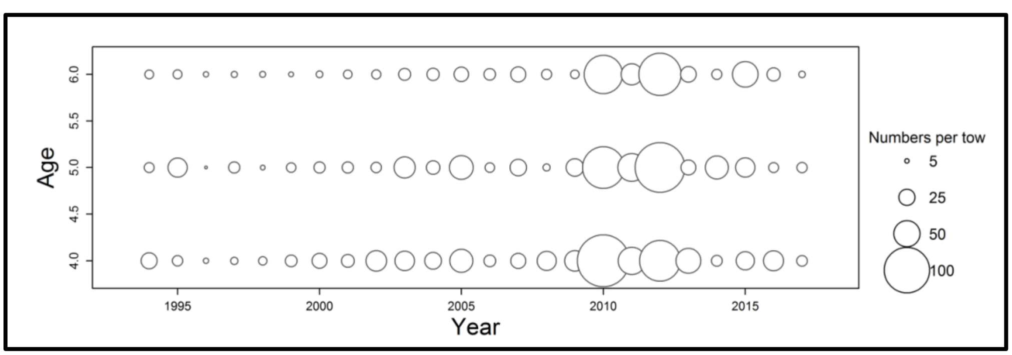

Figure 20. Multispecies bottom trawl survey abundance index (number of fish per standardized tow) for fall spawning herring ages 4 to 6 years in the southern Gulf of St. Lawrence, 1994 to 2017.

Population model

A virtual population analysis (VPA) as described in DFO (2015) was conducted for three regions and then combined to estimate the overall FS herring abundance in NAFO Div. 4T. Natural mortality at all ages and in all regions was set at 0.2. Data inputs were fishery catches at ages 2 to 11+ (in numbers), fishery CPUE in numbers at ages 4 to 10 years from 1986 to 2017, catch rates at age in experimental nets (ages 3 to 9 or 10, 2002 or 2003 to 2017, with indices missing in some years in some regions), abundance indices at ages 2 and 3 from the fall acoustic survey (1994 to 2017), and catch rates at ages 4 to 6 in the September bottom trawl survey. Separate fishery catch-at-age, CPUE indices from the gillnet fishery, and indices from the experimental nets were derived for each of the three regions. The acoustic and bottom trawl survey indices were considered abundance indices for the sum of the three regions.

Additional inputs included the proportion of gillnets with 2 $^5/_8$ inch mesh in each region in each year (Fig. 21) and relative selectivity to the gillnet fishery by age, year, and mesh size (Fig. 22). As a result of the changes in size at age over time, the relative selectivities in the two main gillnet mesh sizes used in the fixed gear fishery have also changed over time, generally declining over the time series for ages 4 to 6 and declining since the late 1990s for ages 8 and 10 in the 2 ¾ inch mesh gear (Fig. 22).

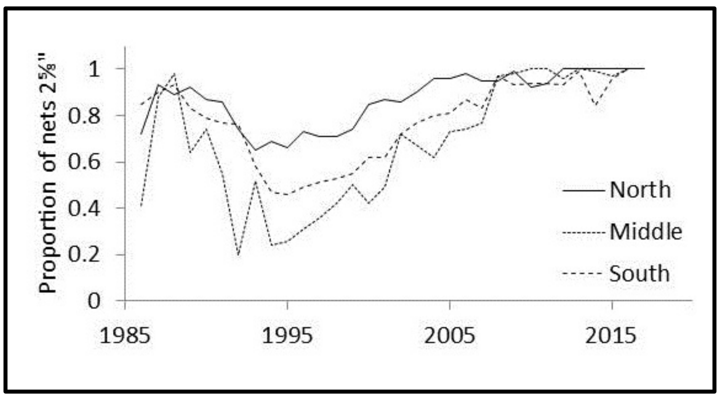

Figure 21. Variations by region in the proportions of gillnets with mesh sizes 2 $^5/_8$ inches used in the fall herring fishery season in the southern Gulf of St. Lawrence, 1986 to 2017. It is assumed that all other nets used were of mesh size 2 ¾.

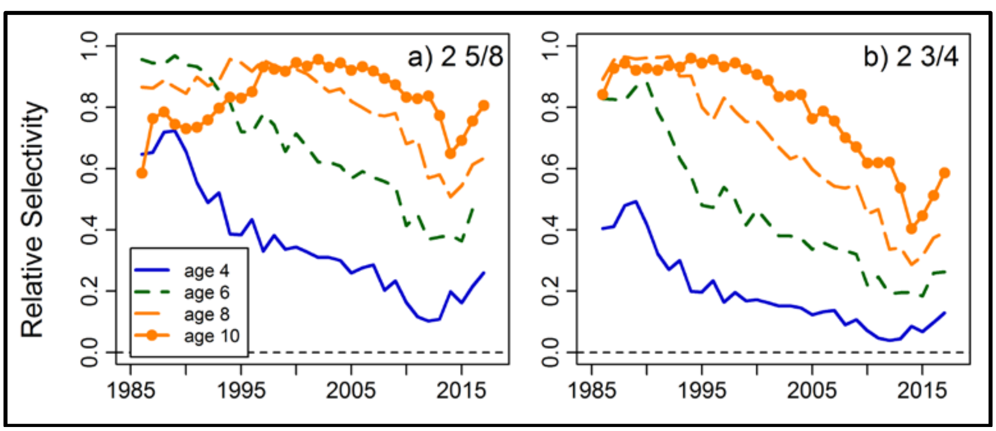

Figure 22. Changes in relative selectivity of fall spawning herring aged 4, 6, 8 and 10 years to gillnets with mesh sizes of 2 $^5/_8$ inches (left panel) or 2 ¾ inches (right panel) in the fall herring fishery of the southern Gulf of St. Lawrence, 1986 to 2017.

Similar to the results for 2016 (DFO 2016), the model diagnostics indicated an adequate fit to the observations. There was no severe blocking of residuals for the commercial CPUE indices. Fits to the CPUE indices were reasonably good, with predicted values consistent with the general trends in the indices. Retrospective patterns were present but negligible for the Middle region and greatest for the North region, though not in a consistent direction.

Estimated changes in catchability (*q*) to the gillnet fishery differed between regions (Fig. 23). Catchability was lowest and varied little over time in the North region. Catchability in the South region increased over time, primarily between 1995 and 2010 but has decreased recently. Estimated catchability was greatest in the Middle region except for a brief period in the mid-2000s.

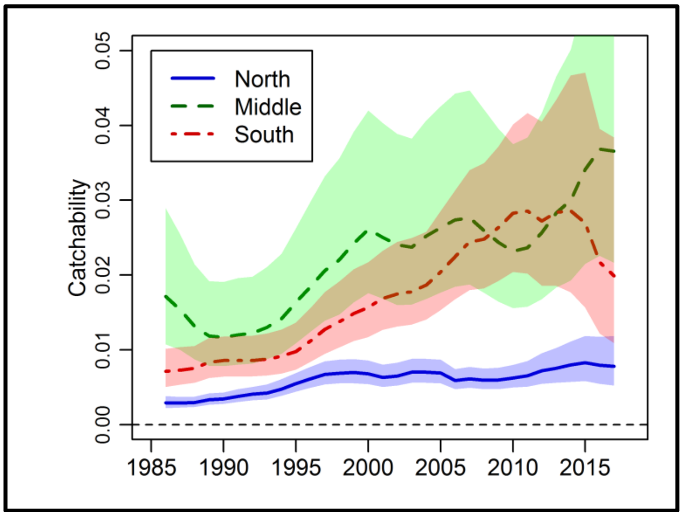

Figure 23. Estimated fully-recruited catchability (q) of fall spawner herring to the fall gillnet fishery in three regions (North, Middle and South) of the southern Gulf of St. Lawrence, 1986 to 2017.

Catchability to fisheries is expected to change over time for a number of reasons including a common inverse relationship between catchability and population size, and improvements in fishing technology and tactics. Variation in *q* within the Middle and South regions was independent of variations in stock biomass suggesting that much of the increase in *q* in these two regions is related to technological improvements and changes in fishing tactics.

Recalculating the Limit Reference Point

The limit reference point (LRP) in 4T herring is $B_{recover}$, the lowest biomass from which the stock has been observed to readily recover, and it is calculated as the average of the four lowest spawning stock biomass (SSB) estimates during the early 1980s (i.e., 1980-1983). Consequently, this value is model dependent. If the model changes, stock biomass may be re-scaled upwards or downwards. With the model change initiated in 2015 (DFO 2015) and retained in this assessment, there was a revised value for the biomass in the 1980s. Thus the LRP was re-calculated and the revised LRP is 58,000 t, slightly greater than the former value of 51,000 t.

Spawning Stock Biomass and Exploitation Rate

Estimated SSB in the North region was at a high level from the mid-1980s to the early 1990s and declined to a moderate level from the mid-1990s to the late 2000s (Fig. 24). Estimated SSB in this region declined continuously during 2012 to 2018, with the median estimate reaching low levels not observed since the early-1980s. In the Middle region, estimated SSB increased gradually from 1980 to the late 2000s, but declined by about 60% during 2009 to 2018. SSB in the South region was at a relatively high level from about the mid-1980s to the late 2000s, however, estimated SSB declined during 2009 to 2015. In 2016, SSB began to increase in the South region, however, the estimate has very high uncertainty in this region. Summed over the three regions, the median estimate of total SSB at the start of 2018 is 112,000 t. The estimated probabilities that total SSB was below the USR of 172,000 t at the beginning of 2017 and 2018 are 98% and 97%, respectively.

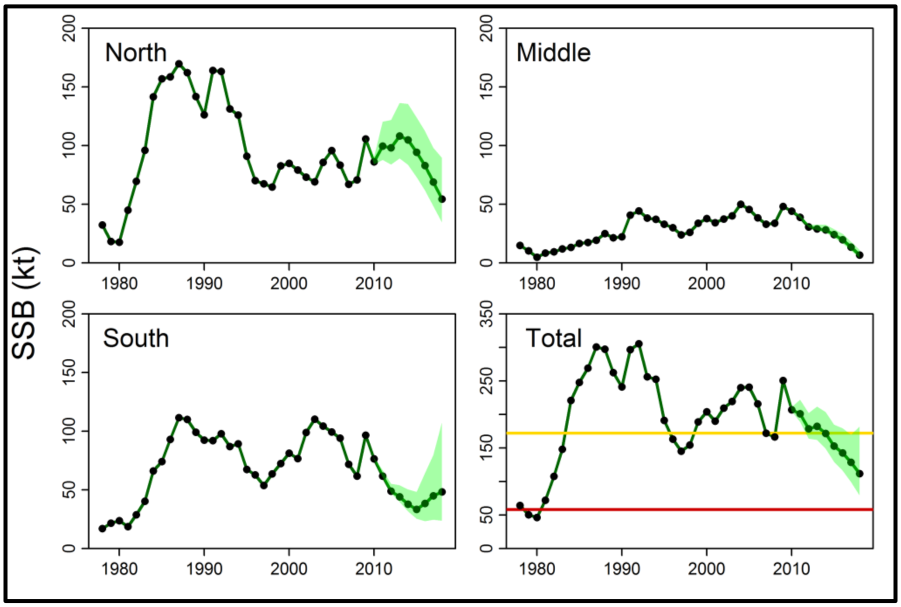

Figure 24. Estimated spawning stock biomass (SSB) of fall spawning herring by region and overall (Total) for the southern Gulf of St. Lawrence, at the beginning of the year 1978 to 2018. The line and circles show the median estimates and the shading their 95% confidence intervals. In the bottom right panel for Total, the yellow horizontal line is the upper stock reference level (USR) and the lower red horizontal line is the limit reference point (LRP).

Estimated fishing mortality rates (*F*; ages 5 to 10) declined to a relatively low level in the North (0.22 in 2017) region but in the Middle and South regions they remained relatively high and consistent until 2017 (Fig. 25). In the Middle region, *F* increased sharply to 0.95 in 2017, whereas in the South region it decreased to 0.10 in 2017 (Fig. 25). The average fishing mortality rate on ages 5 to 10 over all three regions (weighted by region-specific abundances of 5 to 10 year olds) exceeded $F_{0.1}$ (F = 0.32; the reference level in the healthy zone) during 1994 to 2011, except in 2004, but declined after 2011 to attain its lowest levels in 2016 (F = 0.18; Fig. 25). The probability that the overall *F* for ages 5 to 10 exceeded the $F_{0.1}$ value in 2017 was 20%.

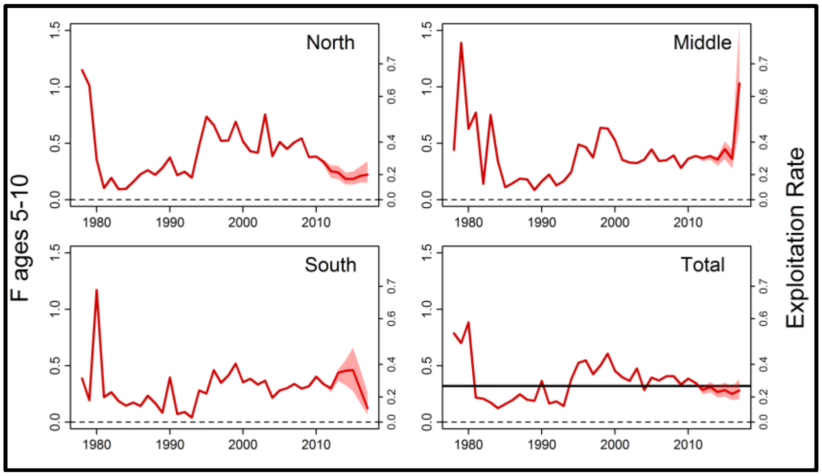

Figure 25. Estimated age 5 to 10 fishing mortality rates (instantaneous rate F in left axes and as annual exploitation rate in right axes) of fall spawning herring by region and averaged over regions (weighted by region-specific abundance at ages 5 to 10 years) in the southern Gulf of St Lawrence, 1978 to 2017. Lines show the median estimates and shading their 95% confidence intervals. The horizontal line in the bottom right panel (Total) shows the reference removal rate level of $F_{0.1}$ (F = 0.32, an exploitation rate of 27% annually) applicable in the healthy zone.

Recruitment and Recruitment Rates

The three most recent estimates of recruitment rate (2012 to 2014 cohorts; recruit abundance divided by the SSB producing them) were among the lowest observed in the North and Middle regions. The estimates for these three cohorts were average in the South region, though the estimates were extremely uncertain (Fig. 26). Summed over all three regions, total recruitment rates for the 2012 to 2014 cohorts were among the lowest observed.

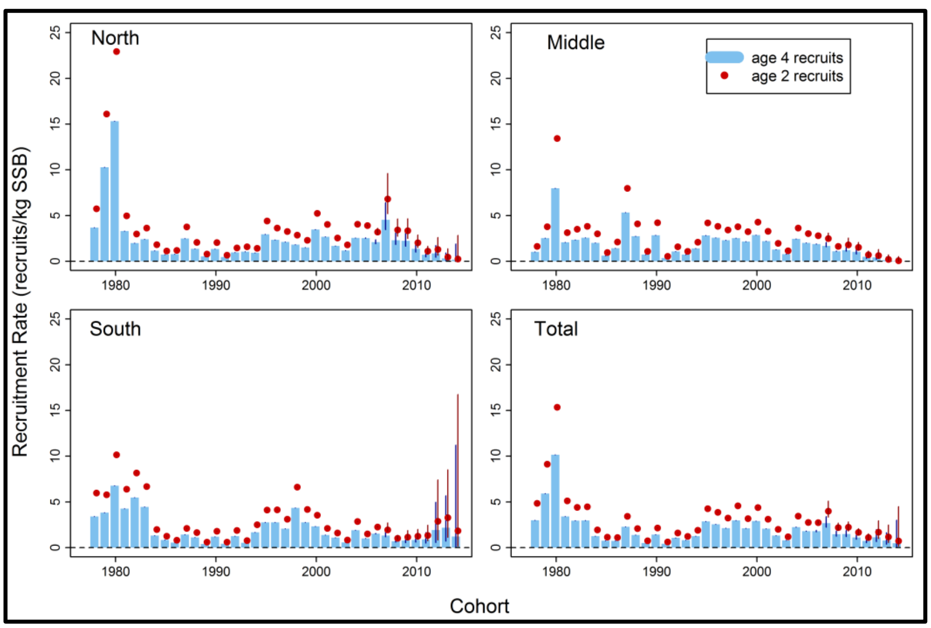

Figure 26. Estimated recruitment rates to age 2 (circles) and age 4 (bars) for fall spawning herring by region and summed (Total) over regions in the southern Gulf of St. Lawrence, for the 1978 to 2014 cohorts. Vertical lines are the 95% confidence intervals.

Estimated abundances of FS age 4 and older have declined in the North and Middle regions since 2013 and 2009, respectively (Fig. 27). In the South region, the abundances declined during 2004 to 2015 but increased recently, however, the estimates have very high uncertainty in this region since 2015 (Fig. 27).To a large extent, this reflects reductions in the recruitment of 4-year-old herring. In all three regions, estimated abundances of age 4 herring for the last three years (2016 to 2018) are among the lowest observed and comparable to the low levels estimated for the late 1970s.

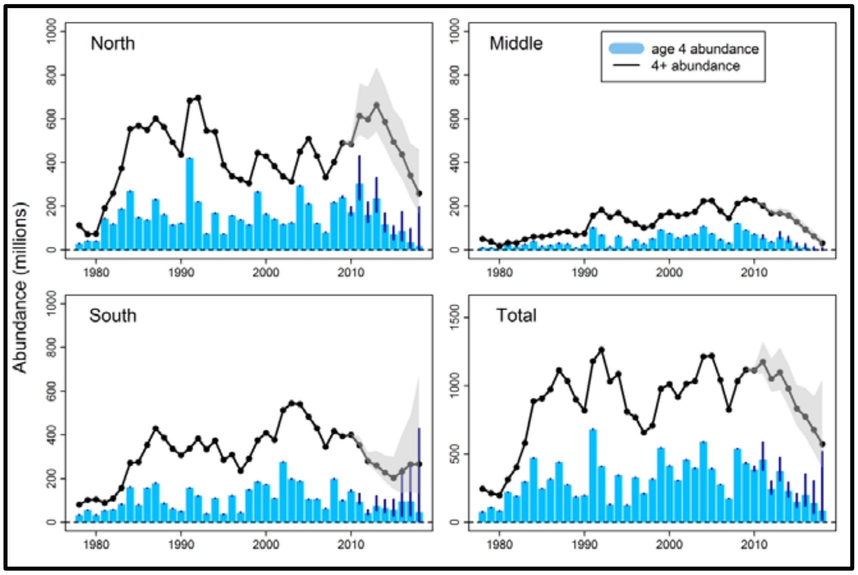

Figure 27. Estimated abundances of fall spawning herring at ages 4 and for ages 4+ by region and for the entire (Total) southern Gulf of St. Lawrence at the beginning of the year, 1978 to 2018. Line and circles (age 4+) and bars (age 4) show the median estimates and shading or vertical lines show the 95% confidence intervals.

Projections

The fishery TAC for the fall spawner component is set at the level of the entire NAFO Div. 4T stock unit. The three region-specific models were projected forward to the start of 2020. Uncertainties incorporated in projections included estimates of abundance at age at the beginning of 2018, weights-at-age, partial recruitment to the fishery, and recruitment rates (to estimate age 2 abundance). Summed over all three regions, the median estimate of SSB at the start of 2020 was projected to be below the USR at all catch levels between 10,000 and 50,000 t (Fig. 28).

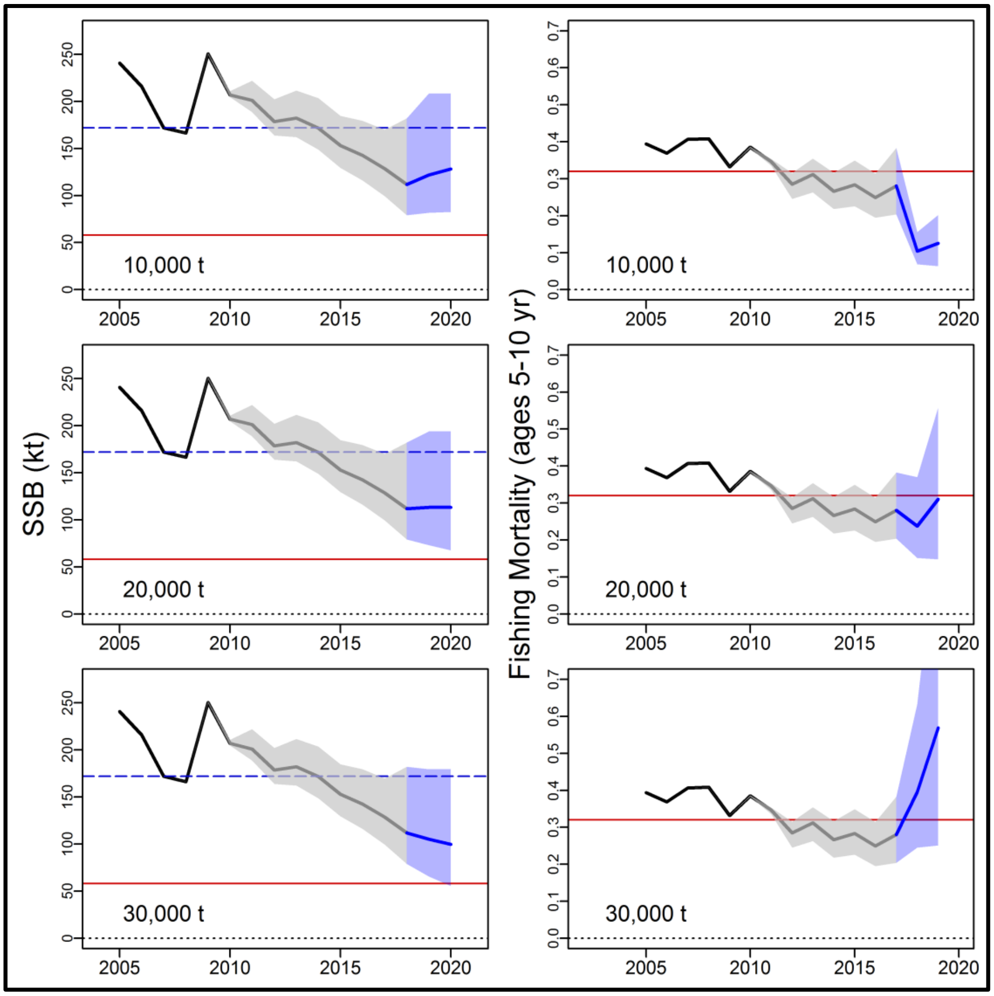

Figure 28. Spawning stock biomass (SSB in kt; left panels) and ages 5 to 10 fishing mortality rates (F; right panels) of fall spawner Atlantic herring from the southern Gulf of St. Lawrence for three catch levels in 2018 and in 2019. In all panels, lines show the median estimates and shading the 95% confidence intervals of these estimates (based on MCMC sampling). Black lines and grey shading indicate the historical period whereas blue lines and shading show the projection period, respectively. In the left panels, the blue dashed line is the upper stock reference (USR) and the red horizontal line is the limit reference point (LRP). In the right panels, the red horizontal line is the removal rate reference level ($F_{0.1}$; F = 0.32).

Risk analysis of catch options

The probability that SSB would be below the USR at the start of 2020 increases from 90% at 10,000 t of catch to 99% at 50,000 t of catch. At a catch of 20,000 t (the catch in 2017) in 2018 and 2019, this probability would be 94% (Fig. 29). At catch levels from 10,000 to 20,000 t in 2018 and 2019, the median value of weighted average *F* for ages 5 to 10 over all regions in 2019 was less than 0.32, i.e. the probability that F would exceed $F_{0.1}$ < 50%.

The probability that SSB would be below the LRP in 2020 ranged from 0% at 10,000 t to 17% at 50,000 t. A 5% increase in SSB by 2020 would only be likely at catches below 16,000 t whereas a decrease in SSB is probable at catches of 24,000 t and above.

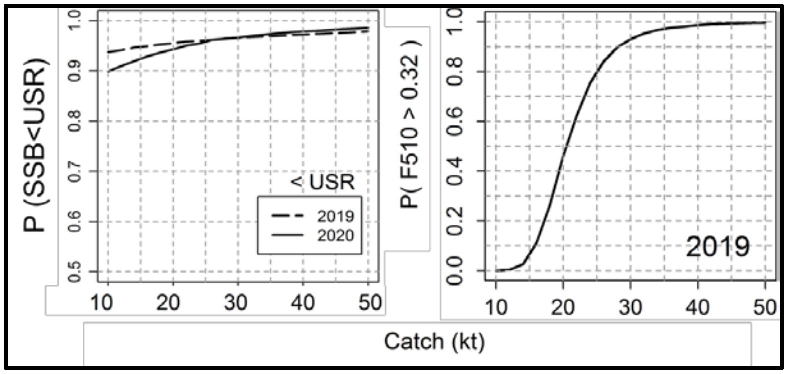

Figure 29. Risk analysis of annual fixed catch options for 2018 and 2019 for the FS herring component of the southern Gulf of St. Lawrence. The left panel shows probabilities that total SSB at the start of 2019 and 2020 will be below the USR. The right panel shows probability profile of average F for ages 5 to 10 in 2019 being greater than the reference level F = 0.32 ($F_{0.1}$).

Sources of Uncertainty

Fishery dependent indices, such as the commercial gillnet CPUE indices, may not be proportional to abundance due to changes in catchability over time. On one hand, catch rates can remain elevated despite decreases in abundance (increased catchability) due to contractions in stock distribution and targeting of aggregations by fishing fleets, as well as due to improved fishing technology and fishing practices. On the other hand, catch rates can be negatively affected by boat limits, saturation of nets at high abundance, and closure of prime fishing areas that redirect fishing effort to other locations. Catch rates calculated on the basis of realized landings and available fishing effort information would be subject to such effects. The estimation of time-varying catchabilities in the SS and FS assessments accounts for some of the effects listed above.

The commercial CPUE calculations are subject to uncertainty. The estimates are based on regional average seasonal values of fishing effort data (number of nets, number of hauls, and net length of gillnets) from the telephone survey rather than trip specific information. Trips with no catch were not documented prior to 2006 and therefore are not incorporated in the effort data. No information is collected on the soak time of nets. There are also potential inconsistencies in the reporting of effort data within and among regions and seasons.

The new modelling approach considers the dynamics of fall spawning herring in three regions. The dynamics are modelled independently among regions and assume closed populations after recruitment at age 2. This is a strong assumption that can have consequences on region-specific estimates of abundance and dynamics. Empirical evidence for spawning bed fidelity has been documented in fall spawning herring based on tagging studies. Nevertheless, elemental analyses of otolith structures did not detect region-specific differences among fall spawners despite showing distinct differences between spring spawners and fall spawners in the sGSL. Genetic research has been unable to identify population-level differences between regions for fall spawners.

The weight-at-age of herring has declined and remains at near record low levels. The causes of these declines in weight-at-age and the consequences to recruitment rate are unknown.

Catches of herring in bait fisheries are presently not accounted for in the assessments of either spring or fall spawner components. Catches in these fisheries are meant to be recorded in harvester logbooks but compliance with the requirement to complete and return logbooks is low. Catches of herring in the bait fishery are expected to be much lower than landings in the commercial fishery, nonetheless this unaccounted fishing mortality constitutes a source of uncertainty in the total fishing mortality.

Uncertainty in recruitment rate in both the SS and FS leads to uncertainty in projections as these are heavily reliant on the recruitment rate selected. In this assessment, three recruitment scenarios were used for the SS assessment to account for variation in recruitment rates among years. In the FS assessment, an intermediate recruitment rate value was used as it appears that the most recent estimates of recruitment rate were biased low and would result in overly pessimistic projections.

The model assumes that natural mortality was constant over time. Retrospective patterns from previous assessments indicated a change in dynamics over time which could be associated with changes in catchability of the commercial cpue index (q) or natural mortality (M). A model that incorporated time varying change in q rather than M resolved the non-stationarity problem. This does not mean that M did not change but the current data and information used in the model only resolve one or the other. Future research should also consider whether M has changed in this ecosystem and what information could be used to incorporate this dynamic in the population model.

In the previous assessment, the fall spawner abundances were declining with the estimate at the end of 2015 just below the USR. In this assessment, the median of the 2014 and 2015 estimates are below the USR. The declining trend in status has continued into 2018. Given this decline in absolute level of abundance from the previous assessment, it is possible that the current biomass values from the model are overestimated. This overestimation of the biomass will result in an underestimate of the risk of failing to achieve defined management objectives for different catch options for 2018 and 2019 although the extent of the bias is not known.

CONCLUSIONS AND ADVICE

Spring Spawner Component (SS)

The spring spawner component trajectory with respect to spawning stock biomass and fishing mortality levels is shown in Figure 30. The stock has been in the critical zone (SSB < LRP = 19,250 t) since 2004 with fishing mortalities above the $F_{0.1}$ level until 2010. Since 2010 F has decreased and remained at levels below $F_{0.1}$.

SSB at the start of 2019 and 2020 was projected to increase slightly at annual catches less than 500 t, remain roughly stable at annual catches of 1,000 t, but decline at catches of 1,500 t or more. However, uncertainty in projected SSB is high. Even in the absence of any removals of SS herring in 2018 and 2019, the SSB is expected to only increase slightly with a very high probability (90%) that the stock will remain in the critical zone.

Fishing mortality on the SS herring in recent years was estimated at 0.24, low relative to the history of the fishery but still high for a stock in the critical zone. Elevated fishing mortality and declines in weight-at-age are also exacerbating the reductions in SSB.

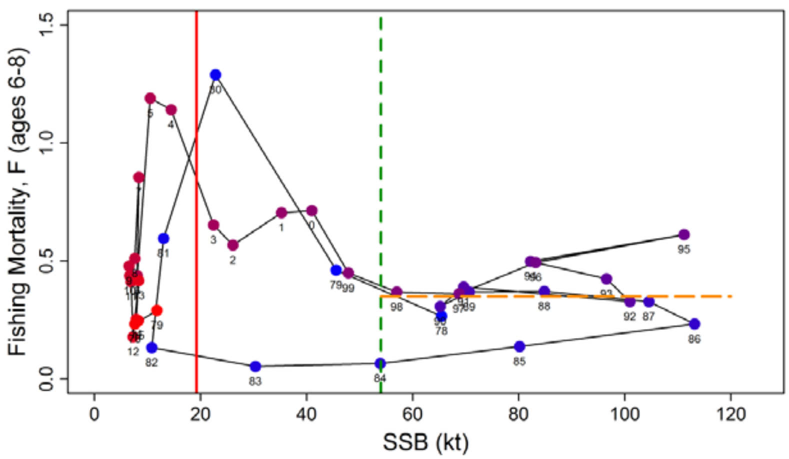

Figure 30. The southern Gulf of St. Lawrence Atlantic Herring spring spawner component trajectory in relation to spawning stock biomass (SSB, kt = thousand t) and fishing mortality rates for ages 6 to 8 years. The solid red vertical line is the LRP (19,250 t), the green dashed vertical line is the Upper Stock Reference (USR = 54,000 t), and the dashed horizontal line is the removal rate reference value ($F_{0.1}$ = 0.35). Point labels are years (83 = 1983, 0 = 2000). Colour coding is from blue in the 1970s and early 1980s to red in the 2000s.

Fall Spawner Component (FS)

The fall spawner component trajectory with respect to spawning stock biomass and fishing mortality levels is shown in Figure 31. The median estimate of the SSB has generally been in the healthy zone (SSB > 172,000 t) over its history with few exceptions but the median estimate of SSB has been in the cautious zone since 2015. Fishing mortality rates generally exceeded the removal rate reference from the mid-1990s to 2011 but were below the reference level from the early 1980s to the mid-1990s and since 2011.

The median SSB estimate at the start of 2019 and 2020 was projected to remain in the cautions zone (below the USR) even at catch levels of 10,000 t. At a catch of 20,000 t (the catch in 2017) in 2018 and 2019, the probability of the SSB being in the cautious zone in 2020 was estimated at 94%, and the probability of the fishing mortality rate being above the removal rate reference was estimated at 46%.

Fishing mortality on the FS herring averaged 0.20 since 2012, just over half of the $F_{0.1}$ removal reference level.

Declining abundance at age 4 in recent years, resulting from declining recruitment rates, has contributed to the decline in SSB for this stock. The causes of the low recruitment rates for the FS herring component are unknown. Declines in weight-at-age are also exacerbating the reductions in SSB. Fishing mortality rates in excess of $F_{0.1}$ from the mid 1990's to 2010 have also contributed to reductions in SSB.

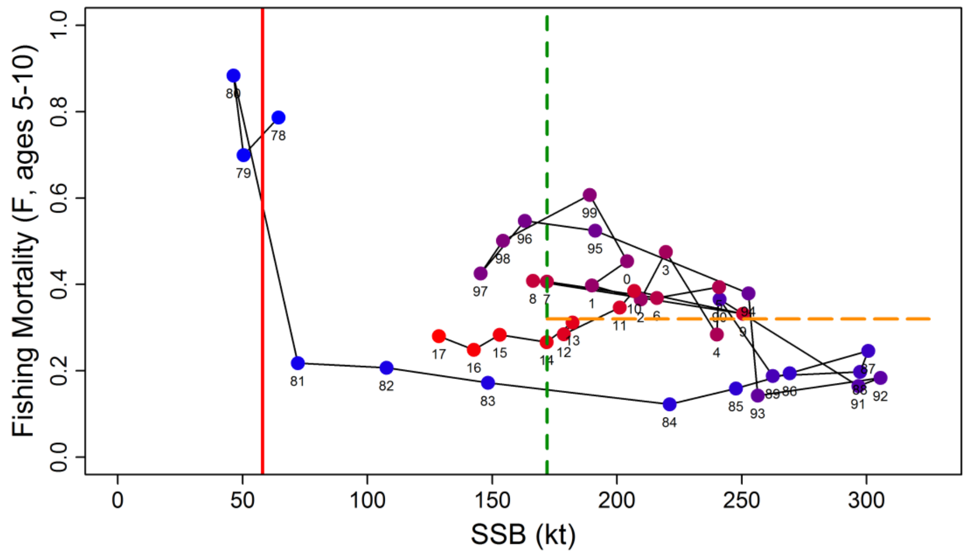

Figure 31. The southern Gulf of St. Lawrence Atlantic Herring fall spawner component trajectory in relation to spawning stock biomass (SSB, kt = thousand t) and fishing mortality reference levels. The solid red vertical line is the LRP (58,000 t), the green dashed vertical line is the Upper Stock Reference (USR = 172,000 t), and the dashed horizontal line is the removal rate reference value ($F_{0.1}$ = 0.32). Point labels are years (83 = 1983, 0 = 2000). Colour coding is from blue in the 1970s and early 1980s to red in the 2000s.

SOURCES OF INFORMATION

This Science Advisory Report is from the March 15, 2018 regional science peer review meeting on the Assessment of stock status of Atlantic herring (*Clupea harengus*) from the southern Gulf of St. Lawrence (NAFO Div. 4T-4Vn) to 2017 and advice for the 2018 and 2019 fisheries. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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APPENDIX D-2

Fisheries and Oceans Canada | Pêches et Océans Canada

Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Research Document 2016/097

Gulf Region

Estimation of local spawning biomass of Atlantic Herring from acoustic data collected during fall commercial gillnet fishing activities in the southern Gulf of St. Lawrence (NAFO Div. 4T)

Tobie Surette, Claude LeBlanc, Ross Claytor and Jenni McDermid

Fisheries and Oceans Canada
Gulf Fisheries Centre
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Moncton, New Brunswick, E1C 9B6)

November 2016

Canada

Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the Secretariat.

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ABSTRACT

In partnership with Fisheries and Oceans Canada (DFO), fish harvesters participating in the Atlantic herring (*Clupea harengus*) fall fishery in NAFO Div. 4T surveyed five spawning grounds in the southern Gulf of St. Lawrence using acoustic sounders over the course of their regular fishing activities from 2002 to 2012. Using a statistical method developed for Fisherman's Bank, seasonal biomass was estimated for all five spawning grounds. Acoustic data from each area was processed and analyzed to produce nightly biomass estimates for a subset of days over the season. Missing biomass values were simulated using a Bayesian time-series model, then grouped by spawning aggregation using a spatial-temporal clustering model. Seasonal biomass estimates were then produced by year and region. While this approach showed some promise, the model did not provide realistic results for two of the five regions. Furthermore, there are also underlying methodological and biological issues which raise significant doubts as to the comparability of results among regions. Given the inconsistencies in model performance and the underlying issues with the data it was decided that these data could not be used to develop a time series of local abundance indices for herring as part of the fall herring stock assessment. Recommendations are made to aid in future spawning bed specific acoustic surveys.

Estimation de la biomasse du stock de reproducteurs de harengs de l'Atlantique à l'échelle locale à partir des données acoustiques recueillies au cours des activités de pêche commerciale au filet maillant d'automne dans le sud du golfe du Saint-Laurent (division 4T de l'Organisation des pêches de l'Atlantique Nord-Ouest (OPANO))

RÉSUMÉ

En partenariat avec Pêches et Océans Canada (MPO), les pêcheurs participant à la pêche d'automne du hareng de l'Atlantique (*Clupea harengus*) dans la division 4T de l'OPANO ont effectué des relevés dans cinq frayères du sud du golfe du Saint-Laurent en utilisant des sondeurs acoustiques pendant leurs activités de pêche courantes entre 2002 et 2012. À l'aide d'une méthode statistique conçue pour le Fisherman's Bank, on a estimé la biomasse saisonnière pour les cinq lieux de frai. Des données acoustiques de chaque zone ont été traitées et analysées afin de produire des estimations de la biomasse chaque nuit pour un sous-ensemble de jours au cours de la saison. Les valeurs de la biomasse manquantes ont été simulées à l'aide d'un modèle bayésien d'ajustement des séries chronologiques puis classées par groupement de poissons en frai à l'aide d'un modèle de regroupement spatiotemporel. Les estimations de la biomasse saisonnière ont ensuite été produites par année et par région. Bien que cette méthode se soit révélée assez prometteuse, le modèle n'a pas fourni des résultats réalistes pour deux des cinq régions. De plus, il y a aussi des problèmes méthodologiques et biologiques sous-jacents qui soulèvent de sérieux doutes quant à la comparabilité des résultats entre les régions. Compte tenu des irrégularités dans le rendement du modèle et des problèmes sous-jacents liés aux données, il a été décidé que ces données ne pouvaient pas être utilisées pour élaborer une série chronologique d'indices de l'abondance locale du hareng dans le cadre de l'évaluation du stock de reproducteurs d'automne de hareng. Des recommandations sont formulées pour faciliter les relevés acoustiques propres aux frayères à venir.

INTRODUCTION

Population biomass and fishing mortality estimates are key components of fishery management decision frameworks, and are necessary for developing harvest control rules based on defined reference points (DFO 2006). The risk of not achieving sustainability objectives when fisheries occur on discrete spawning grounds increases when information is only obtained for large scale processes. Managing diverse herring spawning grounds for sustainability is important for conserving intraspecific biodiversity and adaptive potential (Sinclair 1988; Stephenson et al. 2001).

Until 2014, the stock assessment for the southern Gulf of St. Lawrence (sGSL) fall Atlantic herring (*Clupea harengus*) stock used a population model adjusted to annual gillnet catch-per-unit-effort (CPUE) from all spawning grounds combined and management provides Total Allowable Catch (TAC) advice based on the overall sGSL biomass (LeBlanc et al. 2015). There are concerns that gillnet CPUE does not track population biomass well, because fisheries that target spawning aggregations often exhibit hyperstability, where CPUEs remain elevated even as stock abundance declines (Erisman et al. 2011; Swain 2016).

Acoustic data from fishing vessels have been used to analyze school morphology characteristics, spatial patterns, relative changes in school density (Shen et al. 2008) and to develop estimates of abundance (Melvin et al. 2002; Honkalehto et al. 2011). Derivation of an annual seasonal index of biomass of herring from fishery acoustic data have been problematic for two reasons (Claytor and Clay 2001). First, the behaviour of herring gradually accumulating on spawning grounds prior to spawning, if not accounted for, can lead to multiple counts of the same fish which leads to over-estimation of biomass. Second, missing data created by weather, equipment malfunction, fishery closures, and other reasons create a source of uncertainty and potential biases in biomass and exploitation rate estimates.

From 2002 to 2012, acoustic data were collected from commercial gill netting vessels while fishing on the five major Atlantic herring fall spawning areas located within the coastal waters of the sGSL. The fall spawning areas were Miscou (NB), Escuminac and Richibucto (NB), Fisherman's Bank (PEI), West PEI, and Pictou (NS) (Fig. 1). Acoustic data were to be collected according to a protocol described in Claytor and Allard (2001) for the purpose of developing a time series of local abundance indices for herring as part of the fall herring stock assessment. The objectives of this research document were to analyze the collected acoustic data and determine whether they could be used to derive an index of local abundance. Nightly biomass estimates were derived following a defined protocol (Claytor and Clay 2001) and an analytical method (Surette et al. 2015) was applied to estimate spawning bed specific estimates of annual abundance and area-specific estimates of exploitation rates for five sGSL fall spawning grounds. This novel method was developed to account for some aspects of herring spawning behaviour and includes many sources of uncertainty in its final inferences.

METHODS

Atlantic herring from the sGSL are comprised of two spawning components, a spring spawning component and a fall spawning component (Scott and Scott 1988; Messieh 1988). Both spawning components have preferred spawning seasons and specific grounds. Herring show a high degree of fidelity to a specific spawning season and spawning ground once they have spawned (Wheeler and Winters 1984; McQuinn 1997; Brophy et al. 2006). Herring spawn in temporally discrete groups, separated by several days to weeks in a single spawning season (Ware and Tanasichuk 1989). Genetic and morphometric differences found in spawning herring were consistent with a replacement period of 6 days or less (McPherson et al. 2003). Fall spawning occurs from mid-August to mid-October, at depths of 5 to 25 m (Messieh and MacDougall 1984). The fall spawning component is the focus of this study.

Fisherman's Bank has been the focus of numerous prior studies on herring spawning behaviour. In situ observations showed that a spawning event and the creation of the associated spawning bed took place over the course of a single day (Messieh 1988). Between 1985 and 1995 the number of spawning beds surveyed on Fisherman's Bank per season varied from a minimum of 1 to a maximum of 7, with few cases of simultaneous spawning events (Table 1). Spawning season length (i.e., between the first and last spawning event) varied from 6 to 29 days (Cairns et al. 1996).

Herring spawn in multiple waves during the course of the season. Incoming schools of herring create spawning aggregations over spawning beds, and may be joined by further schools accumulating over several days. Herring subsequently dissipate after spawning, as evidenced by the low frequency of spawned herring in fishery catches. To avoid double-counting of fish during the accumulation phase, observations need to be partitioned by spawning waves. The method previously applied to Fisherman's Bank (Surette et al. 2015) is applied in this study to the other four spawning areas surveyed.

OVERVIEW OF ANALYSIS

The goal of the analysis is to estimate the total fall spawning biomass from a set of nightly acoustic observations. Seasonal biomass requires a daily tally of all incoming or outgoing fish over spawning grounds for each region. The data presents two difficulties. Firstly, biomass estimates are only available for nights where the participating fish harvester was active. Secondly, spawning aggregations contain a mixture of fish which entered the grounds during the previous 24 hours and those from days prior.

The analysis proceeds in three steps. The first is to process and analyze the nightly acoustic data for each region in order to obtain a nightly biomass estimate. The method is described in Claytor and Clay (2001). The second step is to use a model to simulate values for nights with missing observations. The third step is to partition nightly biomass into distinct spawning waves using a spatial-temporal model. This step provides estimates of recruitment and escape biomasses which are then summed into a seasonal estimate. Uncertainty due to missing observations and clustering were incorporated in each step of the analysis.

ACOUSTIC DATA ANALYSIS

Two data sources were used in the following model: region-specific landings from the sGSL fall gillnet fishery and region-specific acoustic data from participating fishing vessels. Nightly landings were obtained from dockside monitoring data compiled and archived by the Department of Fisheries and Oceans Statistics Branch. The acoustic data was obtained from one or two fishing vessels per night from each spawning ground (Fig. 2). Acoustic calibration, data collection and processing, as well as the method for calculating nightly biomass, are described in Claytor and Clay (2001).

Nightly biomass model

Observations from each day of the spawning season are required for calculating the seasonal biomass. Missing observations occurred due to logistical problems (e.g., equipment failure, vessel electrical problems), weekend fishery closures, inclement weather or the fishery attaining its quota before the end of the spawning season. Missing nightly biomass values were inferred using a time-series model.

Let b_{ijk} be the nightly biomass estimate for day *i*, year *j* and region *k*. Zero values and positive values of b_{ijk} were modeled separately. Let $z_{ijk} \sim Bern(\pi_{jk})$ be a binary random variable indicating whether b_{ijk} is zero ($z_{ijk} = 1$) or one ($z_{ijk} = 0$). For each year and region, positive values of b_{ijk} are assumed to be log-normally distributed realisations from a first order autoregressive process (AR(1)):

$$\varepsilon_{ijk} \sim N(\phi_k \varepsilon_{i-1,jk},\ \sigma_\varepsilon^2)$$

$$\mu_{ijk} = \alpha_{jk} + \varepsilon_{ijk}$$

$$b_{ijk} \mid z_{ijk} = 0 \sim LN(\mu_{ijk},\ \sigma^2)$$

where the log-linear annual means $\alpha_{jk} \sim N(\mu_{\alpha,}\sigma_\alpha^2)$ were given a hierarchical prior, with $\mu_\alpha \sim N(0, 10^4)$ and $\sigma_\alpha^2 \sim InvGam(10^{-4}, 10^{-4})$, the AR(1) process error was given a prior of $\sigma_\varepsilon^2 \sim InvGam(10^{-4}, 10^{-4})$, the AR(1) autocorrelation parameter a prior of $\phi_k \sim U(0, 1)$, the nightly observation error parameter was given a prior of $\sigma^2 \sim InvGam(10^{-4}, 10^{-4})$ and the prior probability of observing a zero was given a hierarchical prior of $\pi_{jk} \sim Beta(a, b)$ with $a \sim Exp(1)$ and $b \sim Exp(1)$. An error (CV = 0.15), based on empirical considerations (Claytor and Allard 2001) was added to each nightly biomass as a proxy for estimation error. If landings were reported for a given night, missing observations were assumed to be drawn from a truncated distribution and these were used to inform missing observations by serving as lower bound in a censored log-normal distribution. When landings exceeded nightly biomass estimates, the latter were treated as missing values. The above model differed slightly from the one presented in Surette et al. (2015) which made no provision for autocorrelation between observations and had no inter-regional hierarchical priors as it was applied to Fisherman's Bank region only. The OpenBUGS code for this model is found in Appendix A.

For the purposes of this study, the fishing season was defined as a period of 28 days starting at the opening date of the fishery. The sampling period by participating vessels covers the potential spawning period of herring for each spawning area. The seasonal distribution of acoustic data samples for each region is shown in Figure 2.

Spatial-temporal clustering model

The locations of nightly aggregations were calculated directly from acoustic density data, as a density-weighted average of GPS coordinates. These coordinates were used as inputs in a spatial-temporal clustering model, used for partitioning observed spawning aggregations by spawning wave. Under this model, a temporal sequence of spatially proximate aggregations would likely be grouped together as a single spawning wave, while those which are spatially distant would not. Such structural features in the data aid in probabilistically inferring the spawning wave with which missing observations are associated. The model formulation is as follows.

Let x_{ijk} and y_{ijk} represent the horizontal and vertical coordinates (in UTM projection, NAD83, zone 20, scaled to kilometers) of the aggregation locations for day *i* of the fishing season at year *j* within spawning region *k*. The coordinates were modeled as random walks with heterogeneous variances:

$$x_{ijk} = x_{i-1,jk} + \varepsilon_{ijk}^x, \text{ with } \varepsilon_{ijk}^x \sim \mathrm{N}(0, \sigma_{s_{ijk}}^2)$$

$$y_{ijk} = y_{i-1,jk} + \varepsilon_{ijk}^y, \text{ with } \varepsilon_{ijk}^y \sim \mathrm{N}(0, \sigma_{s_{ijk}}^2)$$

where ε_{ijk}^{x} and ε_{ijk}^{y} are independent normal random variables, each with two variance parameters $\sigma_0^2 < \sigma_1^2$ which were given uninformative priors of $\mathrm{InvGam}(10^{-4}, 10^{-4})$. The choice of variance parameter used is controlled by a binary random variable s_{ijk}, modeled as a 2-state Markov chain s_{ijk}. Formally,

$$s_{ijk}|s_{i-1,jk} = 0 \sim \mathrm{Bern}(\pi_{0\mathrm{k}})$$

$$s_{ijk}|s_{i-1,jk} = 1 \sim \mathrm{Bern}(\pi_{1\mathrm{k}})$$

where state 0 indicates that the aggregation location from day *i* belongs to the same spawning wave as that of previous day and state 1 indicates that it belongs to a new spawning wave. The transition probabilities were given hierarchical priors of $\pi_{0k} \sim \mathrm{Beta}(a_0, b_0)$ and $\pi_{1k} \sim \mathrm{Beta}(a_1, b_1)$ with $a_0 \sim \mathrm{Exp}(1)$, $a_1 \sim \mathrm{Exp}(1)$, $b_0 \sim \mathrm{Exp}(1)$ and $b_1 \sim \mathrm{Exp}(1)$. The probability parameter $\pi_{0\mathrm{k}}$ controls the residence time of sequences within spawning events while $\pi_{1\mathrm{k}}$ controls how often an aggregation will be remain within the current spawning event, given that a new spawning event has just occurred. The spawning event to which an observation from day *i*, year *j* and region *k* belongs, labelled c_{ijk}, is the cumulative sum of the corresponding elements of s_{ijk} over the season:

$$c_{ijk} = \sum_{m=1}^{i} s_{mjk} \ + \ 1$$

This model was nearly identical to that presented in Surette et al. (2015), except for the hyperpriors placed on the transition probabilities and variance parameters, to allow for some pooling of information across regions.

For both the nightly biomass and spatial clustering model, posterior samples were drawn via Monte Carlo Markov Chain (MCMC), with a burn-in sample of 5,000 iterations, plus a further draw of 100,000 samples which were thinned to one out of every twenty samples, for a total of 5,000 posterior samples. The OpenBUGS code (Lunn et al. 2000) for this model is found in Appendix B.

Seasonal biomass calculation

Simulations of nightly biomasses for each night of the season and their corresponding spawning wave identifications provided the input for calculating a seasonal spawning biomass. Each day of an event was assumed to be either a recruitment day, whereby a quantity of fish enter the aggregation, or an escape day, where fish exit the aggregation. For the first day of the event, biomass was considered to be recruitment. For subsequent days, recruitment and escape days were determined by comparing the biomass from day *i+1* (b_{i+1}) with the residual biomass of the day *i*, expressed as the difference of the biomass from day *i* (b_i) and the landings (l_i). If b_{i+1} was larger, it was interpreted as a recruitment day, otherwise it was an escape day. This recruitment was calculated as the difference between the biomass b_{i+1} and the residual biomass r_i. The seasonal biomass is defined as the sum of the recruitment biomasses.

A minimum sequence of three days was imposed for a simulated spawning event to be considered valid in the summation of seasonal spawning biomass. Sequences less than three days were ignored in the summation, and were considered as roaming fish not actively participating in a spawning event.

RESULTS

A log-scale scatterplot of landings versus estimated nightly biomass is shown in Figure 3. The correlation between the two values is weak; high biomass estimates do not imply high landings. Despite efforts to have good coverage of the spawning aggregation by the participating fish harvesters, 22% of nightly biomass estimates were less than the reported nightly landings. In the most severe cases, the biomass estimates were 10 to 50 times less than the landings. Estimates of biomass from the Miscou spawning area showed the largest discrepancies between biomass and landings.

The spatial distributions of spawning aggregations used in the spatial-temporal clustering model are shown in Figure 4 for each spawning region. Each region has its particular characteristics. Where Fisherman's Bank has clusters of locations strongly associated with a submerged ridge, Miscou has a more diffuse distribution across a large area. The distribution in Pictou is stretched out along the coast, and the fleet tends to move as schools of herring migrate through the region during the season. The distribution in the Escuminac region is composed of a northern and southern component. West PEI shows a more complex distribution of scattered locations and a small patch to the Northwest.

Summary statistics for the main model parameters are shown in Table 2.

For the nightly biomass model, credibility intervals showed that the auto-correlation parameter ϕ was not significant for Escuminac, Fisherman's Bank and West PEI, while it was marginally significant for Pictou and significant for Miscou. Variation in the biomass estimates was high and this was reflected in the posterior credibility intervals of missing observations. As an example, boxplots of posterior estimates for Miscou in 2006 are shown in Figure 5. The auto-correlation in the posterior simulations aided in the interpolation of missing values for Miscou. For other regions, the simulations for missing observations are nearly independent (i.e., their posterior means and variances are similar). Actual observations, shaded in grey, had the assumed baseline CV of 0.15.

For the spatial-temporal model, the error parameters σ_0 and σ_1 indicate the amount of distance change (in kilometers) between adjacent pairs of nightly spawning aggregations. Since the coordinates are modelled as a Gaussian random walk, the values of σ_0 and σ_1 are estimates which indicate that points along the walk will occur within σ_0 (intra-aggregation) and σ_1 (new aggregation) kilometers of the previous coordinate in 68% of cases. The intra-event distance parameter σ_0 was 0.53 km in Fisherman's Bank. In terms of surface area, this corresponds roughly to 0.88 km² at 68% areal coverage or 3.52 km² at 95% coverage, assuming a circular distribution of points. These values correspond well with spawning bed surface area estimates from previous studies (Table 1), which ranged from 0.36 km² to 1.44 km². We expect the spatial distribution of aggregations over and around spawning beds to be larger in extent than that of the spawning beds themselves. The σ_0 values for other regions were somewhat larger, from 0.68 km in West PEI to 1.46 km in Pictou. The extra-event distance parameter σ_1 showed more variability, going from 4.39 km in Fisherman's Bank to 24.0 km in Pictou. This parameter reflects the regional extent of coverage, with fish harvesters travelling significantly more during the season in some regions than in others.

The intra-event transition probability π_0 controls the residence time of aggregations within spawning events while the transition probability π_1 controls how often sequences of new spawning aggregations occur. Mean intra-event transition probabilities π_0 were generally high, from 0.81 for Fisherman's Bank, 0.87 for Escuminac and 0.88 for West PEI. The probability value for Miscou was exceptionally high at 0.97, while Pictou was very low with 0.55. The transition probabilities π_1 were more consistent between regions, ranging from 0.41 for Pictou to 0.65 in West PEI (Table 2).

The estimated number of spawning events for each spawning region by year is shown in Table 3. In general, the number of events was 3 or 4 events per 28-day period, the exception being Miscou, with generally one or two spawning events per period, owing to its high intra-event transition probability of 0.97.

Combining the nightly biomass and the spawning event inferences, seasonal biomass estimates for each region and year were obtained. Boxplots of seasonal estimates by spawning region by year are shown in Figure 6. Escuminac shows a downward trend in abundance during 2002 to 2010, with a slight increase in the last years. The estimates for Pictou fluctuate during the first half of the series and have increased in the past four years. Fisherman's Bank shows no overall trend but the last two years show low values with respect to the rest of the series. Estimates for West PEI are fairly stable, but show a slight decreasing trend across the series. Estimates for Miscou varied in the first half of the series, were low in 2008 and 2009, rose in 2010 and 2011, and then was reached a minimum in 2012. Given the variability in the inferred missing nightly biomasses (Fig. 5), the variability of the seasonal biomasses is correspondingly high. For comparison, the means of observed nightly biomass estimates, unadjusted for spawning events are shown in Figure 7. These trends are broadly similar to those of estimated seasonal biomasses.

The exploitation rate was calculated by dividing the total seasonal landings (for the same 28 day period as used in the model) by the seasonal biomass estimate. Boxplots of the exploitation rates by spawning area are presented in Figure 8. The scale of exploitation rates estimates varies among regions, with Escuminac and West PEI being somewhat lower than in other regions. Exploitation rate estimates in West PEI show an increasing trend. Escuminac, Fisherman's Bank, and Pictou show low rates for the last two years.

There are a number of caveats to consider in the interpretation of these results (both seasonal biomass and exploitation rates).

DISCUSSION

Science advice should be tailored to the management strategy. Currently, a reference removal rate is applied to a NAFO 4T Atlantic herring biomass estimate and a historical sharing formula is used to partition the TAC among the fleets from different regions. In this study, we evaluated the possibility of including spawning ground acoustic biomass indices as an additional element to the fall herring stock assessment and the subsequent science advice that could aid in partitioning the TAC. For the presented method to play such a role, seasonal biomass estimates must be comparable and be on the same scale among regions. How these estimates would actually be used to partition the TAC is beyond the scope of this review. We have thus restricted our discussion to the robustness of the science advice that could be provided using this model.

For seasonal biomass estimates to be valid and comparable across spawning areas, underlying assumptions of the model must be respected. The main assumptions are:

- nightly landings are accurate,
- nightly biomass estimates are unbiased estimators of true biomass in each spawning area,
- the models used are an adequate representation of the processes (e.g., spawning behaviour, fishing fleet dynamics, etc.) generating the observations and adequately account for double-counting, missing observations, and other potential sources of error,
- the study period captures the majority of spawning activity, and

- sampling methods and biological processes are sufficiently similar across regions that meaningful comparisons can be made.

For the fall herring fishery, there is little concern of bias in landings as there is 100% dockside monitoring, documented conversion factors, and controls on catch recording because nightly or weekly quotas are used to manage the fishery.

A working hypothesis for calculating the seasonal biomass is that nightly biomass estimates are on the same scale as landings. However, comparison of nightly biomass values with landings showed that these were underestimated in at least 22% of cases. These discrepancies were more prevalent in Miscou than in other regions. This percentage is probably higher given that nightly exploitation rates of 80% or larger are probably unreasonable in most regions.

Participating fish harvesters were to follow to a protocol for a complete fishery survey over each night of scanning, as defined in Claytor and Allard (2001). This protocol called for sampling vessels to collect acoustic data before and after a management-imposed nightly boat limit was caught. An incomplete survey was said to occur if the data collection was terminated when the boat limit was caught. If this protocol was properly adhered to, nightly biomass could be estimated from acoustic data before any fishing has occurred followed by a removal estimate after fishing activity has ceased. However, timing of data collection and discussions with fish harvesters indicated that acoustic scanning of spawning aggregations was generally performed during fishing activities, rather than before and after as the original protocol stated. Thus the data collection occurs as fish are actively being exploited, rather than in the pre- and post-fishing condition. Nightly biomass estimates were calculated using all validated acoustic data, irrespective of the time it was gathered or with reference to fleet fishing activities. Also, scanning during peak fishing activities is problematic because placement of gillnets over concentrations inhibits the ability of the sampling vessel to scan over the whole concentration. Thus the exploited spawning aggregation may be inadequately covered by the acoustic vessel, which may result in an underestimation of nightly biomass. In addition to possible bias in observed spawning aggregations, the presence of unobserved aggregations would also lead to underestimates of nightly biomass. This would be an issue where herring schools are more fragmented and spread out over spawning grounds. This would also have implications for fishing fleets which exploit them, in that these would also tend be more fragmented and widely distributed over spawning grounds. The sampling vessel in such cases would have had limited ability to cover the entire fleet activities. It is also possible that some spawning aggregations remain undetected by any portion of the fleet during a night of fishing in each region.

Biases could arise from the acoustic data itself, such as variability in backscattering in high target concentrations, the relationship between target strength and fish size, and acoustic extinction from near surface reverberation (Fréon and Misund 1999; Simmonds and MacLennan 2005; Brehmer et al. 2006; Boswell et al. 2008). Variability arising from these factors are minimized because the 28-day study period is relatively short, we are dealing with a single species in a well-defined phase of its life history (spawning) with a relatively restricted size-distribution, and the equipment is calibrated against objects of known target strength.

BIOMASS MODEL

The biomass model was developed as a way of inferring nightly biomass over the study period. However, there are two issues with the approach. The first is a potential sampling bias and the second is a lack of structure in the observations by which to make strong inferences.

The variability in nightly biomass estimates is very high with estimates ranging from 0 to over 33,000 tons. There was little evidence of temporal trends or autocorrelation in nightly biomass estimates making it difficult to infer missing biomass values. This may have some implications with respect to the assumed process of accumulating waves of herring into spawning aggregations, in that residence times of herring within an aggregation may be relatively short, though uncertainties in the nightly biomass estimates as discussed above prohibit a strong conclusion.

Given that fishing is not independent of the quantity of fish, biases may arise through temporal sampling biases, given that sampling is not randomly distributed throughout the season. Such biases may be minimized by high sampling rates (i.e., most every weekday throughout the season) but the temporal pattern of coverage varies from year to year and by region. There is little indication that the survey season was cut short by attainment of the quota. Only West PEI showed a lower sampling density during the last week of the study period. Ideally, surveys would have been conducted daily or randomly within the potential spawning period of herring.

The length of the 28-day period is supported by the spawning event study on Fisherman's Bank (Cairns et al. 1996) and average length of recent fishing seasons. Biases may occur if the start date of the fishery is offset from major waves of spawning activity or if major spawning waves occur after the study period. Given the general absence of trends in the nightly biomass values, we are unable to comment on whether the study period encompasses the majority of spawning activity within each region. A strong economic argument could be made that the fishery depends on a fishing season that is timed with spawning activity, and after 28 days fishing activity has generally tapered to low levels.

SPATIAL-TEMPORAL MODEL

The spatial-temporal model was developed to identify local spawning aggregations as a precursor to assessing fish which are present in aggregations over multiple days (i.e., double-counting). The spawning behaviour assumptions in the model are justified in Fisherman's Bank (Cairns et al. 1993, 1996), however these biological assumptions have not been independently confirmed.

For a modelling perspective, spawning events in Escuminac, West PEI and Fisherman's Bank have similar spatial extents and residence times (Table 2). As a consequence, the relative scaling between the observations and the estimated seasonal biomass is expected to be similar. The spatial extent between spawning event aggregations in Fisherman's Bank of 0.53 km (or 1.06 km at two standard deviations) are consistent with previous estimates of spawning bed size, 0.92 (+/- 0.65) km^2 (Cairns et al. 1996). Cairns et al. (1993, 1996) also found that the observed number of spawning beds per season was between 1 and 7 from 1985 to 1995 on Fisherman's Bank. These values are consistent with our annual average of 3.7 spawning events over the 28 day estimation period. West PEI and Escuminac produced results that were within the expectations from model assumptions.

In Miscou, the model was deemed inconsistent with biological knowledge as the fitted parameters implied long, protracted spawning events spanning large spatial areas. As a consequence, seasonal estimates were essentially the sum of recruitment days over each 28 day sampling season. The distribution of sampling and fishing effort at Miscou shows little clustering of fishing aggregations, which are otherwise present in other regions (Fig. 4). The presence of such spatial features is assumed by the model. This suggests that spawning aggregations in Miscou may follow different spatial dynamics than in other regions. Miscou also had a lower sampling density than other regions (Fig. 2), so that the seasonal estimates for certain years (e.g., 2007 with no observations, 2010 and 2011 with three observations each) are more a reflection of the hierarchical prior for the mean nightly biomass values rather than actual observations. Furthermore, Miscou landings surpassed nightly biomass estimates more frequently than in other regions. Consequently, the data collected from Miscou do not satisfy the model assumptions.

Pictou fishing locations were spread out along the coast and around Pictou Island (Fig. 4). While this data set is richer, spatial clusters and therefore spawning aggregations, were found to be of short duration resulting in approximately half of the schools being classified as roaming, non-spawning fish. These in turn were not considered in the biomass summation, implying that the downward scaling between observed nightly biomass and seasonal biomass was more severe in Pictou than in other areas. Whether this is due to true differences in herring reproductive behaviour, or that the sampling fish harvester is simply more apt to change locations over such a wide area, remains unclear.

These results suggest that seasonal biomass estimates for Miscou and Pictou are not on the same scale as other regions. The model does not appear to produce valid results in these regions.

Given the inconsistencies in model performance and the underlying issues with the data, this project could not be used to develop a time series of local abundance indices for herring as part of the fall herring stock assessment.

SUMMARY AND RECOMMENDATIONS

Summary of results

- Results for Fisherman's Bank, Escuminac, and West PEI are comparable. Seasonal biomass estimates are comparable if sampling methods and biological processes are also comparable.
- Results for Miscou and Pictou spawning components indicate a mismatch between model output and known spawning biology and behaviour.

Recommendations for future analyses

- Possible biases in nightly biomass estimates need to be assessed.
- Observed aggregations need to be well covered by the sampling vessel to ensure edges of observed schools are well defined in the available acoustic data sets, and determine if spatial structure of available data shows evidence of partial coverage or differences between years or regions.
- Some effort must be made to verify that there are no other spawning aggregations in the area which are unaccounted for. The existence of such unobserved aggregations might be inferred from local fleet dynamics, i.e., logbooks or VMS data.
- Uncertainty in the seasonal biomass is in large part driven by variability in observations. An experiment could be conducted where the sampling vessel is active over as many nights as possible over the season. This data set could then be used to test the robustness of the model at varying proportions of missing observations.
- Nightly spawning aggregations may be better characterized by multiple rather than a single coordinate point, to account for more complex local spatial distributions such as when multiple schools are present in an area.

Recommendations for improving the data collection protocols

- Develop clear protocols for ensuring that fishing surveys are complete and that a method for evaluating this completeness is identified.
- Two possibilities for obtaining these data are noting fishing location in logbooks and by VMS recording.

- This protocol will include comments on the number of vessels required and fishery reporting that includes location of catch.
- Strict adherence to protocols in particular that acoustic surveys should be completed prior to conducting the nightly fishing activity.
- Periodic structured surveys might be undertaken over the entire potential spawning area during the spawning season. It is recommended that it be performed once a week on each spawning bed during weekend fishery closures, and also one week prior and two weeks after end of fishing season, assuming a seven day turnover rate.

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TABLES

Table 1. The number and mean surface area of spawning beds detected from Fisherman's Bank spawning bed surveys (Cairns et al. 1996).

Year	Number	Area (km^2)
1985	5	0.36
1986	1	1.10
1987	4	0.52
1988	4	0.84
1989	5	0.81
1990	7	0.70
1991	5	1.08
1992	4	1.44
1993	5	1.22
1994	6	1.26
1995	2	0.64

Table 2. Posterior means (95% credibility intervals in parentheses) for selected nightly biomass and spatial-temporal model parameters.

Region	ϕ	σ_0	σ_1	π_0	π_1
Escuminac	0.24 (-0.16 ,0.66)	0.98 (0.85 ,1.12)	16.08 (12.93 ,20.06)	0.87 (0.81 ,0.93)	0.45 (0.27 ,0.65)
Fisherman's Bank	0.01 (-0.44 ,0.49)	0.53 (0.41 ,0.68)	4.39 (3.6 ,5.45)	0.81 (0.71 ,0.9)	0.52 (0.31 ,0.74)
Miscou	0.61 (0.25 ,0.85)	1.46 (1.29 ,1.65)	24.0 (16.45 ,36.27)	0.97 (0.94 ,0.99)	0.48 (0.16 ,0.86)
Pictou	0.48 (0.1 ,0.76)	0.86 (0.66 ,1.12)	8.32 (7.28 ,9.53)	0.55 (0.39 ,0.7)	0.41 (0.26 ,0.58)
West PEI	0.45 (-0.07 ,0.79)	0.68 (0.56 ,0.83)	13.67 (10.59 ,18.2)	0.88 (0.82 ,0.93)	0.65 (0.45 ,0.85)

Table 3. Estimated number (standard error in parentheses) of spawning events for each spawning region by year.

Year	Miscou	Escuminac	West PEI	Fisherman's Bank	Pictou
2002	2.5 (0.7)	3.0 (1.0)	3.2 (1.1)	2.6 (0.8)	3.8 (1.1)
2003	1.1 (0.2)	3.9 (0.5)	2.7 (0.8)	3.7 (1.0)	3.9 (1.0)
2004	1.6 (0.7)	1.6 (0.7)	4.3 (0.5)	3.5 (0.9)	4.2 (1.1)
2005	1.1 (0.3)	3.7 (0.7)	2.5 (1.0)	3.1 (1.1)	3.2 (0.9)
2006	1.0 (0.1)	3.2 (0.8)	3.0 (0.2)	4.1 (1.0)	3.7 (1.0)
2007	1.1 (0.3)	1.4 (0.6)	2.9 (1.0)	4.3 (0.9)	3.3 (1.0)
2008	2.0 (0.3)	3.7 (0.7)	4.1 (0.9)	3.8 (0.8)	4.2 (1.0)
2009	1.0 (0.2)	3.5 (0.6)	3.8 (0.5)	4.1 (1.0)	4.4 (1.0)
2010	1.3 (0.5)	3.5 (0.8)	2.4 (0.6)	3.4 (1.0)	3.9 (1.2)
2011	2.0 (0.3)	4.0 (0.7)	3.0 (0.9)	4.0 (0.9)	3.4 (0.7)
2012	2.3 (0.6)	2.7 (0.7)	3.2 (0.8)	4.0 (1.0)	4.2 (1.1)

FIGURES

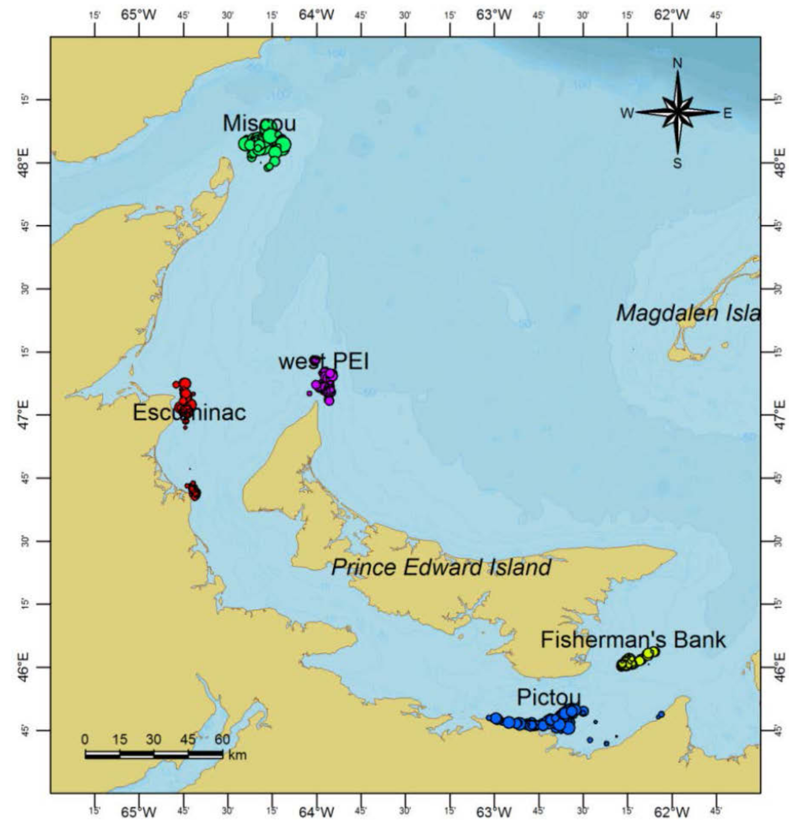

Figure 1. Herring fall spawning locations in NAFO 4T.

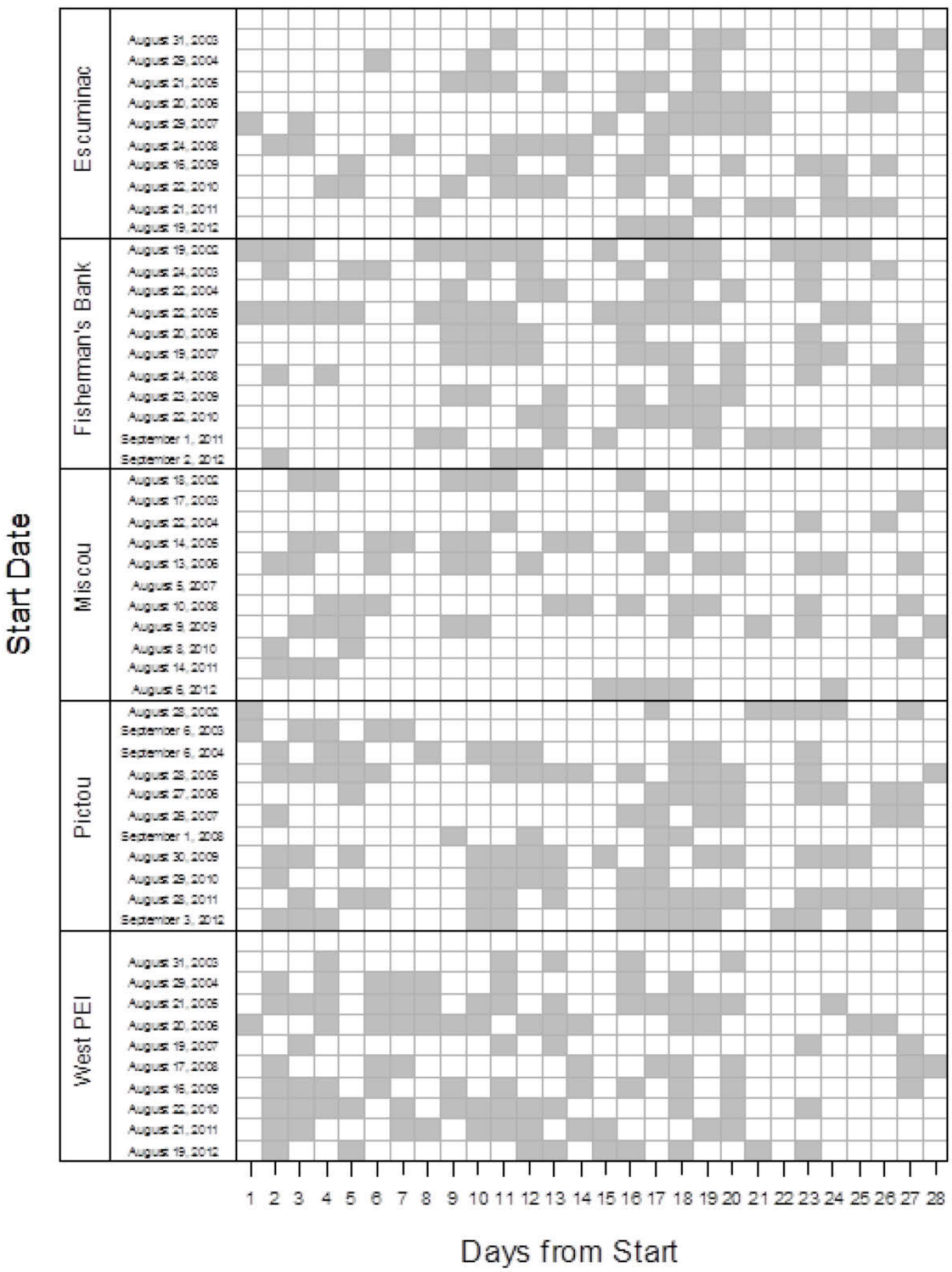

Figure 2. Seasonal pattern of nightly observations (grey squares) used for the analysis for each 28-day period by year and spawning region.

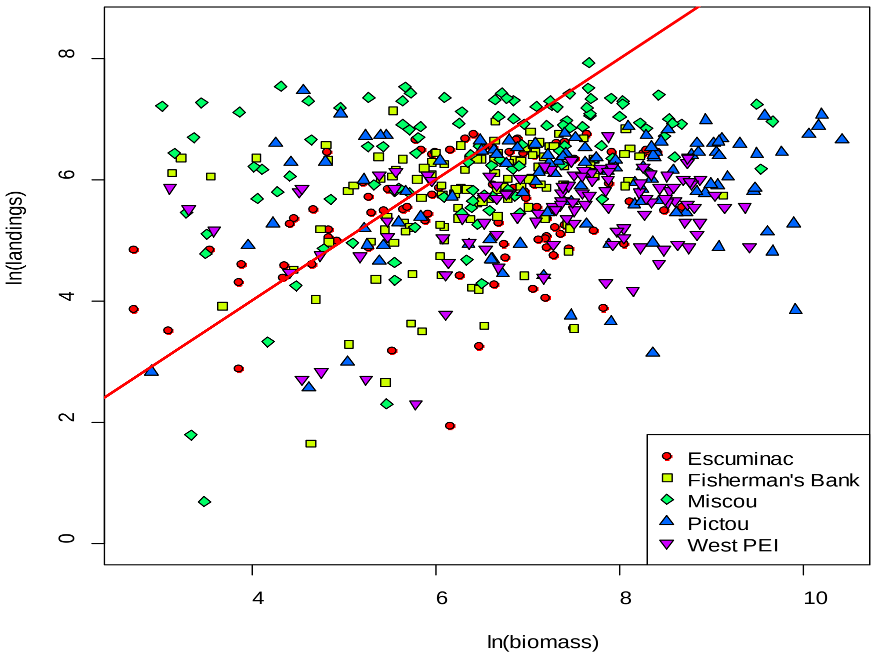

Figure 3. Nightly landings versus nightly biomass estimates for each spawning region for all years combined on the log-scale. The red line is the boundary where nightly landings equal nightly biomass estimates. For points above the line, the nighty landings are greater than the nightly biomass estimates and for points below the line the nightly landings are less than the nightly biomass estimates.

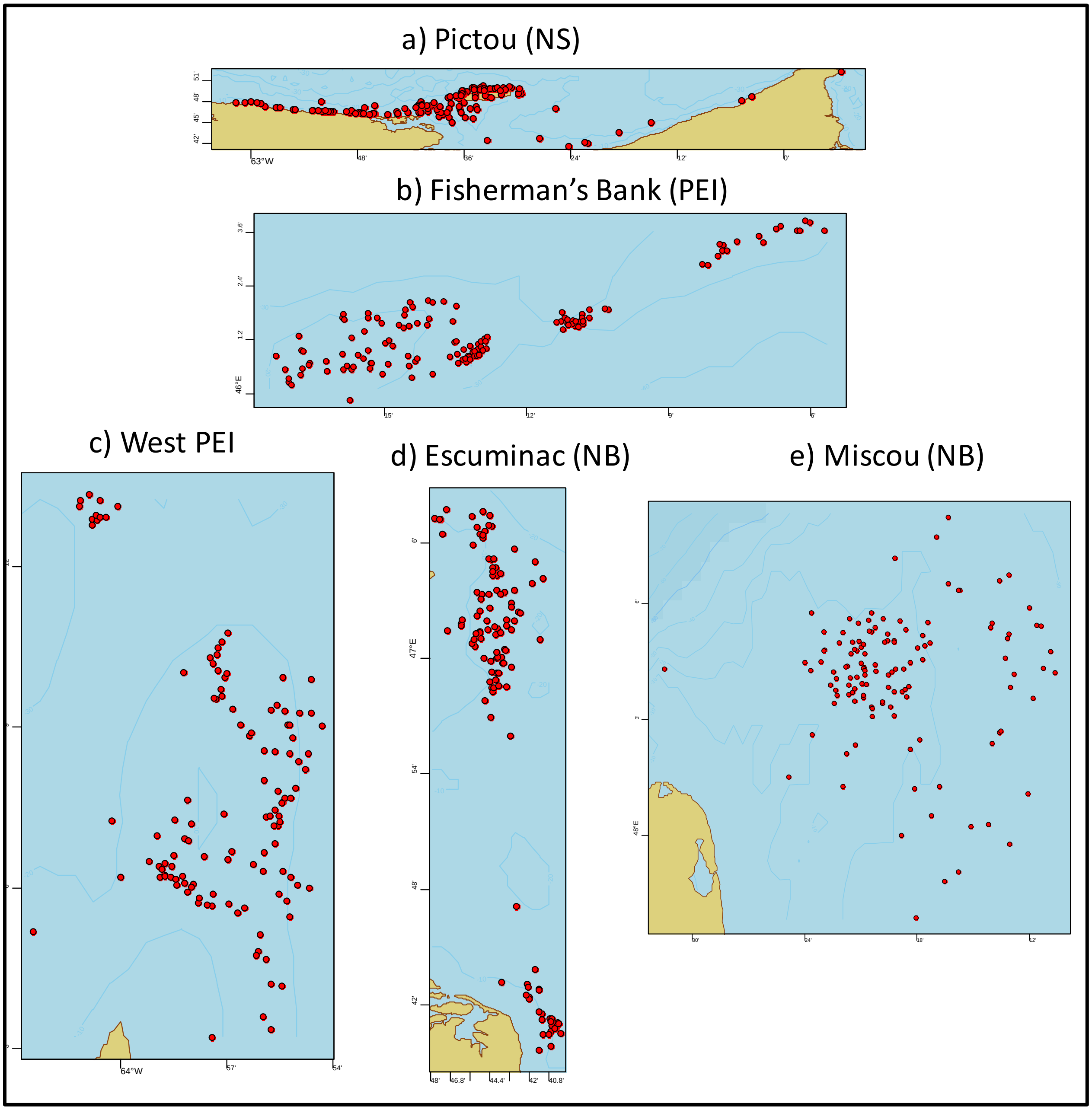

Figure 4. Distribution maps of estimated nightly school locations for each spawning area for all years combined.

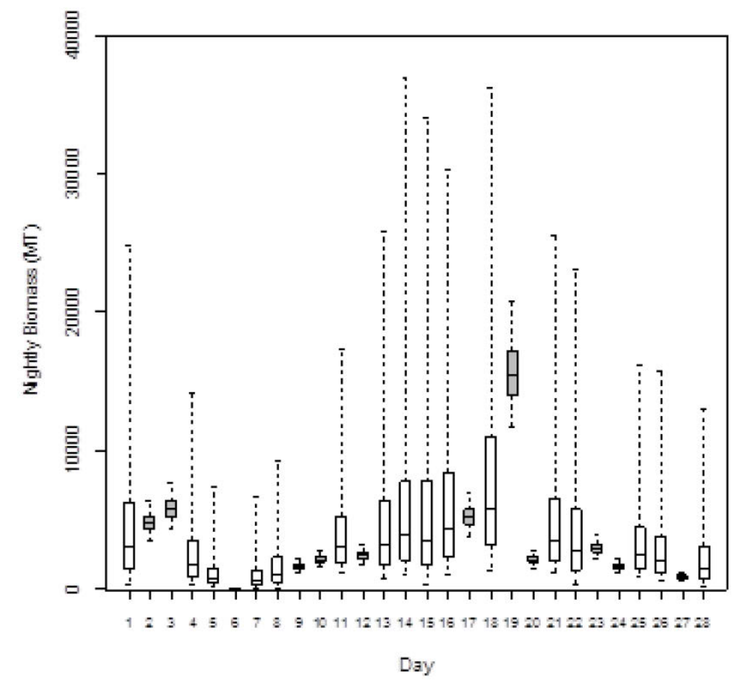

Figure 5. Boxplot of posterior MCMC simulated nightly biomass observations (in grey) and missing values (in white) for Miscou in 2006. Boxplots indicate the median, interquartile range (box) and 95% credibility intervals (whiskers).

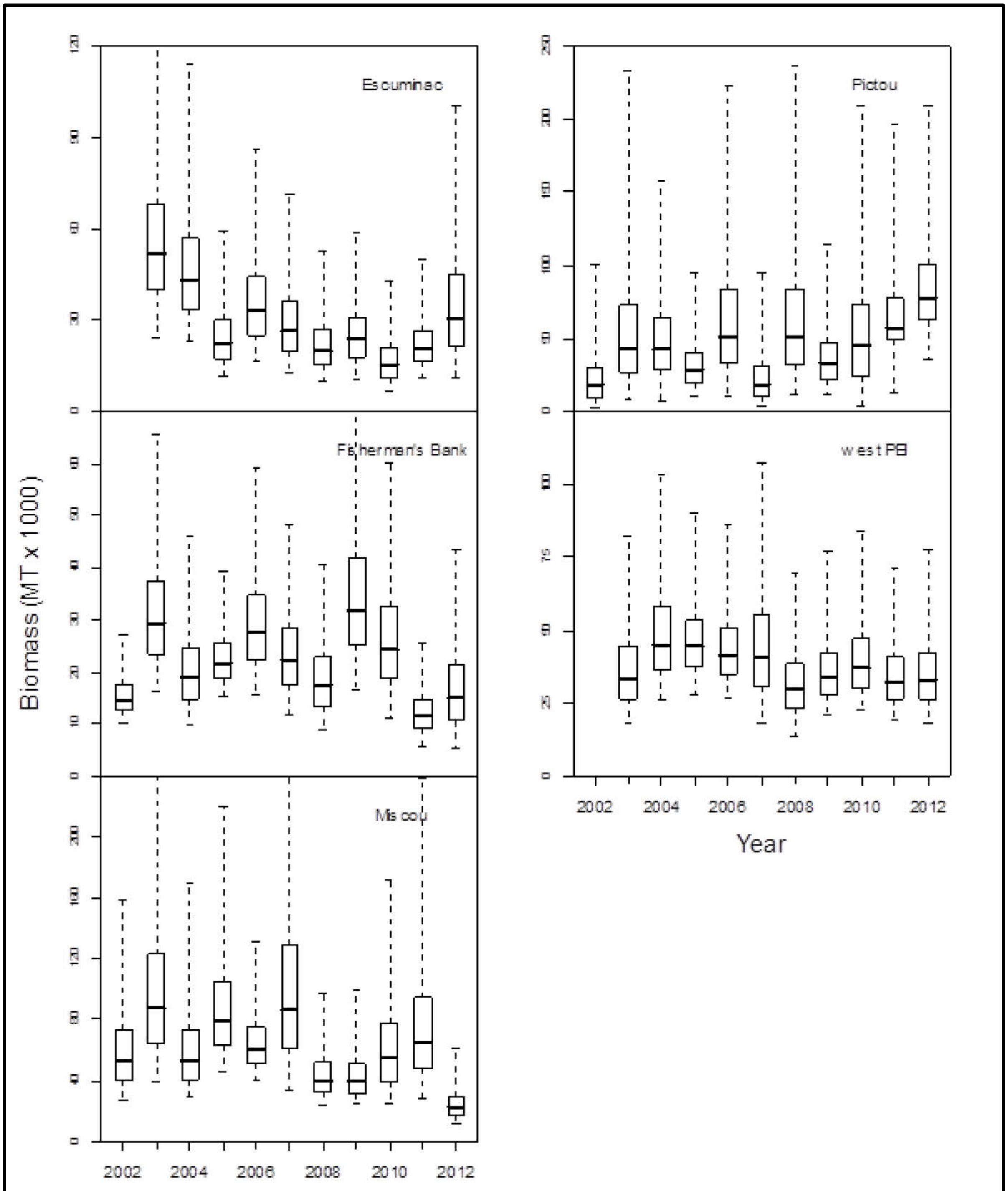

Figure 6. Seasonal biomass estimates by year obtained from MCMC posterior simulations (n = 5,000) for the five spawning areas. Boxplots indicate the median, interquartile range (box) and 95% credibility intervals (whiskers).

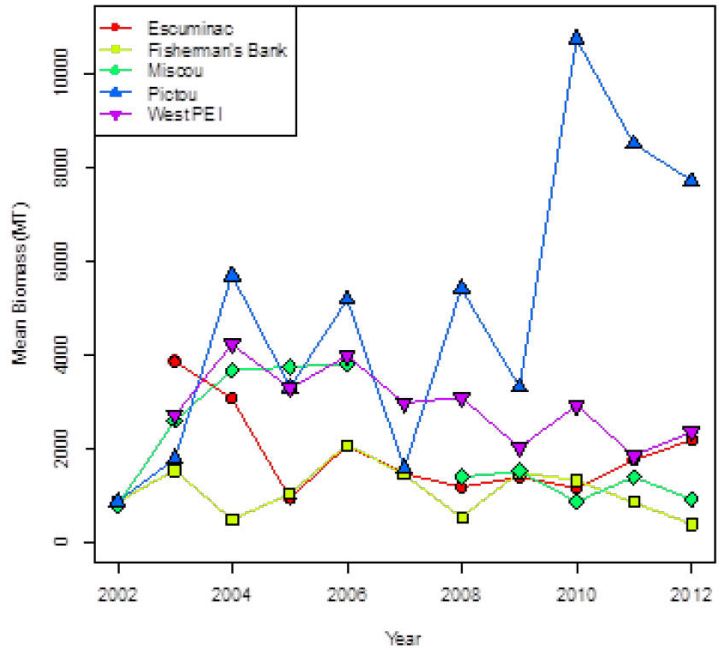

Figure 7. Mean observed nightly biomass for each spawning area by year.

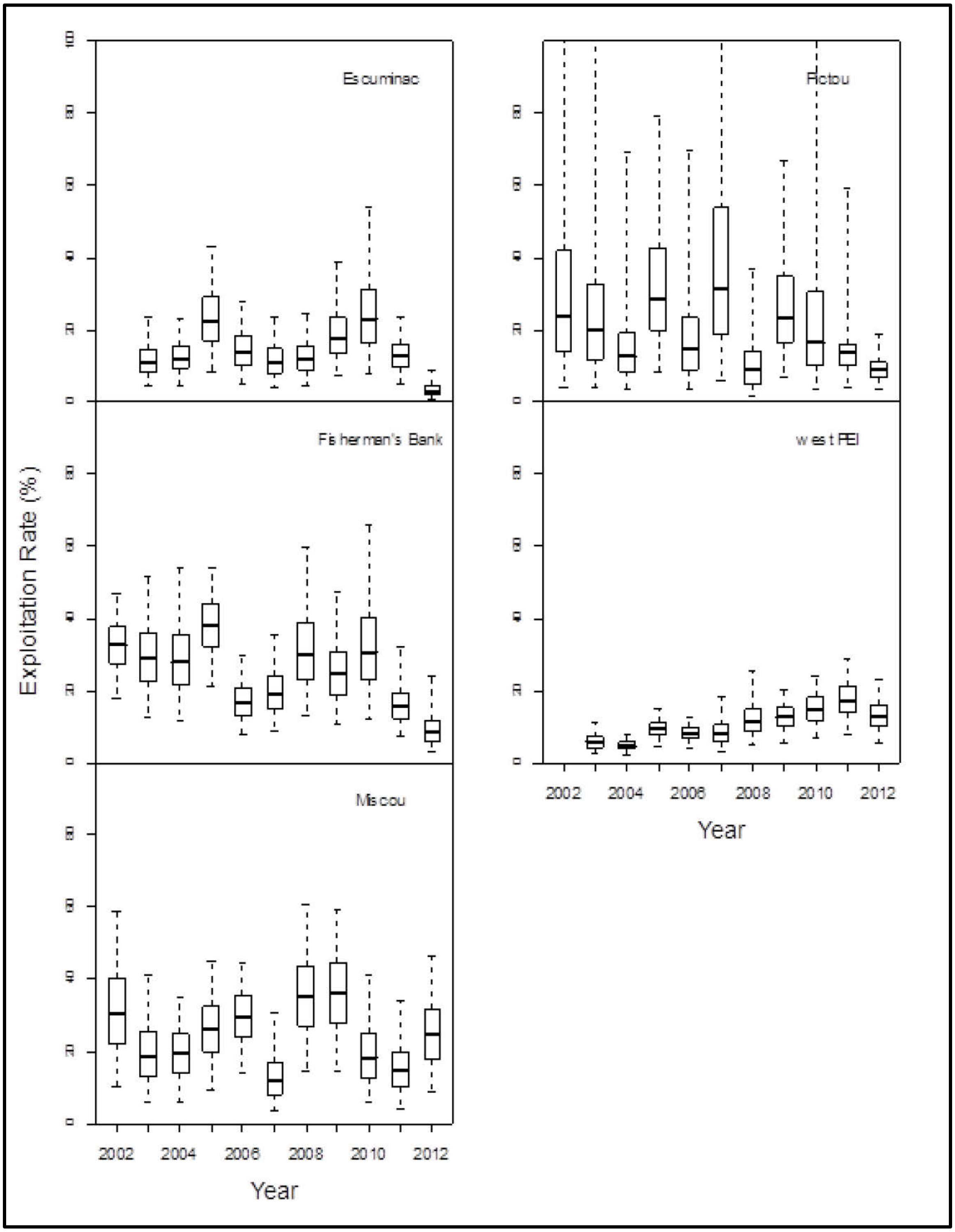

Figure 8. Exploitation rates by year obtained from MCMC posterior simulations (n = 5,000) for the five spawning areas. Boxplots indicate the median, interquartile range (box) and 95% credibility intervals (whiskers).

APPENDICES

APPENDIX A. OPENBUGS CODE FOR THE NIGHTLY BIOMASS MODEL.

```
# Prior over zero proportions:
alpha.pi ~ dexp(1)
beta.pi ~ dexp(1)
for (i in 1:n.region){
    for (j in 1:n.year){
        pi[i,j] ~ dbeta(alpha.pi, beta.pi) } }
# Hierarchical mean prior
mu.mu ~ dnorm(0, 0.01)
tau.mu ~ dgamma(0.1, 0.1)
sigma.mu <- pow(tau.mu, -2)
for (i in 1:n.region){
        phi[i] ~ dunif(-1,1)
        tau.eps[i] ~ dgamma(1,1)
        tau.eps.global[i] <- (1-pow(phi[i], 2)) * tau.eps[i] }
for (i in 1:n.region){
    for (j in 1:n.year){
        mu.year[i,j] ~ dnorm(mu.mu, tau.mu)
        eps[i,j,1] ~ dnorm(0, tau.eps.global[i])
        for (k in 2:n.day){
        mu.eps[i,j,k] <- phi[i] * eps[i,j,k-1]
        eps[i,j,k] ~ dnorm(mu.eps[i,j,k], tau.eps[i]) }
        for (k in 1:n.day){
        mu[i,j,k] <- mu.year[i,j] + eps[i,j,k] } } }
# Prior observation error
tau.b ~ dgamma(0.1, 0.1)
var.b <- 1 / tau.b
sigma.b <- sqrt(var.b)
# Additional observation error parameters
cv.mu <- -log(pow(0.15,2) + 1) / 2
cv.tau <- 1 / log(pow(0.15,2) + 1)
# Observation error model
for (i in 1:n){
        b[i]  ~ dlnorm(mu[region[i], year[i], day[i]], tau.b) I(L[i], )
        z[i]  ~ dbern(pi[region[i], year[i]])
        cv[i] ~ dlnorm(cv.mu, cv.tau)
        biomass[day[i], year[i], region[i]] <- (1-z[i]) * b[i] * cv[i] }
```

APPENDIX B. OPENBUGS CODE FOR THE SPATIAL-TEMPORAL CLUSTERING MODEL.

```
# Prior over transition probabilities
for (i in 1:2){
        alpha.p[i] ~ dexp(1)
        beta.p[i] ~ dexp(1)
    for (k in 1:n.region){
        P[k,i] ~ dbeta(alpha.p[i], beta.p[i]) } }
# Define Markov probability transition matrix
for (k in 1:n.region){
        T[k,1,1] <- P[k,1]
        T[k,1,2] <- 1 - P[k,1]
        T[k,2,1] <- P[k,2]
        T[k,2,2] <- 1 - P[k,2]}
# Define state of initial distance observation
for (j in 1:n.year){
    for (k in 1:n.region){
        S[1,j,k] <- 1
        C[1,j,k] <- 1 } }
# Define the Markovian state vector of observations
for (i in 2:n.day){
    for (j in 1:n.year){
        for (k in 1:n.region){
        S[i,j,k] ~ dcat(T[k, S[i-1,j,k],1:2])
        C[i,j,k] <- C[i-1,j,k] + (S[i,j,k]-1) } } }
# Spatial extent of spawning event
for (m in 1:2){
        alpha.tau[m] ~ dexp(1)
        beta.tau[m] ~ dexp(1)
    for (k in 1:n.region){
        tau[k,m] ~ dgamma(alpha.tau[m], beta.tau[m])
        sigma[k,m] <- pow(tau[k,m], -0.5) } }
# Coordinate random walk
for (j in 1:n.year){
    for (k in 1:n.region){
        x[(j-1)*n.day*n.region + (k-1)*n.day + 1] ~ dnorm(0, 0.001)
        y[(j-1)*n.day*n.region + (k-1)*n.day + 1] ~ dnorm(0, 0.001) } }
for (i in 2:n.day){
    for (j in 1:n.year){
        for (k in 1:n.region){
        x[(j-1)*n.day*n.region + (k-1)*n.day + i] ~
        dnorm(x[(j-1)*n.day*n.region + (k-1)*n.day + i - 1], tau[k,S[i,j,k]])
        y[(j-1)*n.day*n.region + (k-1)*n.day + i] ~
        dnorm(y[(j-1)*n.day*n.region + (k-1)*n.day + i - 1], tau[k,S[i,j,k]]) } } }
```

APPENDIX D-3

DIOXINS AND FURANS

The Issue

Dioxins and furans are common names for toxic chemicals that are found in very small amounts in the environment, including air, water and soil. As a result of their presence in the environment, they are also present in some foods.

Exposure to dioxins and furans has been associated with a wide range of adverse health effects in laboratory animals and humans. The type and occurrence of these effects typically depend on the level and duration of exposure.

Background

There are 210 different dioxins and furans. All dioxins have the same basic chemical "skeleton," and they all have chlorine atoms as part of their make-up. Furans are similar, but have a different "skeleton". These substances vary widely in toxicity. The one considered most toxic is referred to as 2,3,7,8-tetra-chlorodibenzo-p-dioxin, or simply TCDD.

The biggest source of dioxins and furans in Canada is the large-scale burning of municipal and medical waste. Other major sources include:

- the production of iron and steel
- backyard burning of household waste, especially plastics
- fuel burning, including diesel fuel and fuel for agricultural purposes and home heating
- wood burning, especially if the wood has been chemically treated
- electrical power generation
- tobacco smoke

Dioxins can also be produced from natural processes, such as forest fires and volcanic eruptions. Most dioxins are introduced to the environment through the air. The airborne chemical can attach to small particles that can travel long distances in the atmosphere, which means that Canadians may also be exposed to dioxins and furans created in other countries.

These substances work their way up the food chain by moving into and remaining stored in body fat. Because of this, people actually take more dioxins and furans into their bodies through food than through air, water or soil. Ninety per cent of people's overall exposure to dioxins is estimated to be from the diet. Meat, milk products and fish have higher levels of dioxins and furans than fruit, vegetables and grains.

The Health Effects of Dioxins and Furans

Scientists have studied the effects of dioxins and furans on laboratory animals. They have also researched the health effects on people exposed to dioxins through industrial accidents, contaminated food, and occupational exposure to certain herbicides prior to improved manufacturing processes that have reduced these contaminants.

The studies show that dioxins and furans have the potential to produce a range of effects on animals and humans. Health effects associated with human exposure to dioxins include:

- skin disorders, such as chloracne
- liver problems
- impairment of the immune system, the endocrine system and reproductive functions
- effects on the developing nervous system and other developmental events
- certain types of cancers

It is important to remember that with all toxic substances, including dioxins, the risk of health effects depends on many factors, including:

- the way a person is exposed (e.g., through food, air, water, etc.)
- how much a person is exposed to, and when (e.g., whether it is a large amount on one occasion, or daily exposure to small amounts, etc.)
- individual susceptibility, including general state of health
- whether the person is also exposed to other substances that may be associated with health effects

These issues are very complex. Scientists do not have all of the answers, but they agree that exposures to dioxins and furans should be kept as low as possible.

Dietary Exposure to Dioxins and Furans

For most people, about 90% of overall exposure to dioxins comes through diet. The Joint Expert Committee on Food Additives, an expert group of the World Health Organization and the Food and Agriculture Organization of the United Nations, has set a "tolerable monthly intake" level for dioxins, furans and similar substances.

The "tolerable" level (meaning no serious health effects are expected) is 70 picograms per kilogram of body weight / month. This is roughly 2.3 picograms per kilogram of body weight / day. A picogram is one-trillionth of a gram.

Studies done between 1998 and 1999 in two Canadian cities showed that the average dietary intake of dioxins, furans and similar substances was 0.62 picograms per kilogram of body weight /day. This is well within the level considered tolerable by Joint Expert Committee on Food Additives.

Minimizing Your Risk

If you are concerned about exposure to dioxins and furans, consider taking the following steps:

- Prepare meat and fish in a way that minimizes your exposure by trimming visible fat from food. Bake, broil, roast, barbecue or microwave instead of frying, and drain off extra fat after cooking.
- Follow the advice in Canada's Food Guide to Healthy Eating, and enjoy a variety of foods. Vegetables, fruit and grains contain fewer dioxins and furans than meat, milk products and fish.
- Follow provincial/territorial government advisories about eating certain types of fish.
- Do not burn garbage, especially construction materials that might contain wood preservatives or plastic.
- Limit the amount of wood you burn in your fireplace or stove, and learn about wood-burning techniques that release fewer dioxins. For more information about safer wood burning techniques go to the Need More Info section below.
- Do not smoke, and keep your family away from second-hand smoke as much as possible.

By taking these steps, you can reduce your family's exposure to dioxins and furans, and help to limit the overall release of these substances into the environment.

The Government of Canada's Role

The Government of Canada is working to control, and if possible eliminate, releases of these substances into the environment to help protect Canadians against harm from dioxins and furans. Actions to date include:

- Guidelines to minimize the release of dioxins and furans from municipal solid waste and hazardous waste incinerators.

- Regulations requiring the virtual elimination of dioxin and furan releases from pulp mills.
- Virtual elimination of dioxins and furans from pest control products used in Canada.
- Active support for international agreements to reduce releases of these substances on a global basis.

These efforts are working. The latest inventory shows a 60 percent decrease since 1990 in the overall release of dioxins and furans from sources within Canada. Also, the levels of dioxins and furans in Canadian human milk, which were already low, went down by roughly 50 percent between the 1980s and the 1990s. It is expected that levels of dioxins in various sources in Canada will continue to decline in conjunction with ongoing pollution prevention and control activities.

The Government's work to control sources of dioxins and furans in Canada continues. A federal-provincial task force has updated the inventory of sources for these substances, and Canada-wide standards are being established to address releases from remaining manufactured sources. In addition, the Government is continuing to carry out food monitoring activities to identify, control and if possible, eliminate previously unknown sources of dioxin contamination.

Also, Health Canada is doing a comprehensive reassessment of the risks posed by dioxins. In the meantime, Health Canada has adopted the Joint Expert Committee on Food Additives' tolerable monthly intake for dioxins as a guideline for Canadians.

Need More Info?

For more information, contact:
Health Canada's Management of Toxic Substances Division
Room A724,
Jeanne Mance Building #19
Tunney's Pasture Ottawa, ON
K1A 0K9 (613) 957-3127

Health Canada's Food Program Web site at:
http://www.hc-sc.gc.ca/fn-an/index_e.html

Canada's Food Guide to Healthy Eating at:
http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/index_e.html

Environment Canada, Persistent Organic Pollutants - POPs at:
http://www.ec.gc.ca/pops/index_e.htm

For tips on safer ways to burn wood, visit Natural Resources Canada, Burn it Smart at:
http://www.burnitsmart.org/

For more on the health effects associated with exposure to dioxins, see the following:

The World Health Organization's "Safety Evaluation of Certain Food Additives and Contaminants" at
http://www.inchem.org/documents/jecfa/jecmono/v48je20.htm

The World Health Organization's " Dioxins and their effects on human health"
http://www.who.int/mediacentre/factsheets/fs225/en/index.html

The U.S. Environmental Protection Agency's "Draft Dioxin Reassessment"at:
http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=55265

United States National Academy of Sciences Report, Dioxins and Dioxin-like Compounds in the Food Supply: Strategies to Decrease Exposure at:
http://www.iom.edu/report.asp?id=13097

For information on herbicide use at National Defence, see the National Defence Web site at:
http://www.forces.gc.ca/site/Reports/defoliant/index_e.asp

For additional articles on health and safety issues go to the It's Your Health Web site at:
www.healthcanada.ca/iyh
You can also call toll free at
1-866-225-0709
or TTY at 1-800-267-1245*

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APPENDIX D-4

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Pêches et Océans Canada

Ecosystems and Oceans Science
Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Research Document 2016/044

Gulf Region

Identification and Characterization of Important Areas based on Fish and Invertebrate Species in the Coastal Waters of the Southern Gulf of St. Lawrence

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May 2016

Canada

Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research documents are produced in the official language in which they are provided to the Secretariat.

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ABSTRACT

Identification and designation of Ecologically and Biologically Significant Areas (EBSA) is recognized both nationally and internationally as a useful tool for aquatic resource conservation, management, and planning. In eastern Canada, previous work focused on offshore waters with the highly productive coastal areas intentionally excluded. The aim of this study was to apply the EBSA criteria of uniqueness, aggregation, and fitness consequences to the coastal area of the southern Gulf of St. Lawrence. The criteria were applied to 32 fish and 23 benthic invertebrate taxa to identify important areas (IA). Based on data from multi-species surveys and literature reviews, three IA were identified in order of precedence: Northumberland Strait, St. George's Bay, and water at the eastern end of Prince Edward Island. These IA stood out primarily due to the presence of likely-endemic species (i.e. lady crab and winter skate), and all three IA had previously been identified as EBSA. Although not identified as IA, special consideration could be assigned to Chaleur Bay and the Shediac Valley for their importance in the migration of several anadromous species.

Identification et caractérisation de zones d’intérêt basées sur les espèces de poissons et d’invertébrés dans les eaux côtières du sud du golfe du Saint-Laurent

RÉSUMÉ

L’identification et la désignation des zones d’importance écologiques et biologiques (ZIEB) est reconnu nationalement et internationalement comme étant un outil efficace pour la conservation des ressources aquatiques de même que pour la gestion et la planification. Dans l’est du Canada, les travaux antérieurs portaient principalement sur le milieu hauturier alors que le milieu côtier hautement productif avait été intentionnellement mis de côté. L’objectif de cette étude visait à appliquer les critères d’unicité, d’agrégation et de conséquences sur la valeur adaptative des ZIEB dans la zone côtière du sud du golfe du Saint-Laurent. Ces critères ont été considérés en lien avec 32 espèces de poissons et 23 espèces d’invertébrés benthiques afin d’identifier les aires d’importance (AI). Selon les données des relevés de recherche plurispécifique et d’une revue de la littérature, trois AI ont été identifiées en ordre de précédence : le détroit de Northumberland, la baie St. George et les eaux de l’extrémité est de l’Île-du-Prince-Édouard. Ces trois AI se démarquent principalement par la présence d’espèces présumées endémiques (c.-à.-d. le crabe calicot et la raie tachetée) et toutes les trois ont précédemment été identifiées à titre de ZIEB. Bien qu’elles ne sont pas identifiées comme AI, la baie des Chaleurs de même que la vallée de Shédiac pourraient bénéficier d’une considération particulière pour leur importance lors de la migration de plusieurs espèces anadromes.

INTRODUCTION

Canada's Oceans Act (1997) authorizes the Department of Fisheries and Oceans (DFO) to provide enhanced protection to areas of the oceans and coasts that are ecologically or biologically significant through mechanisms such as Marine Protected Areas. Ocean areas can be ecologically or biologically "significant" because of the functions that they serve in the ecosystem and/or because of structural properties (DFO 2004). Identifying Ecologically and Biologically Significant Areas (EBSA) is not a general strategy for protecting all habitats and marine communities that have some ecological significance. Rather, it is a tool for calling attention to an area that has particularly high ecological or biological significance, to facilitate provision of a greater-than-usual degree of risk aversion in management of activities in these areas (DFO 2004).

DFO established criteria to identify EBSA (DFO 2004) and applied these to features in the Gulf of St. Lawrence (DFO 2006). Ten EBSA were identified, all offshore (DFO 2007, Savenkoff et al. 2007). There were many discussions during the 2006 meeting regarding the inclusion of coastal areas in the EBSA evaluation for the Gulf but no consensus was reached on how to consider the ecological and biological significance of coastal and estuarine areas within a classification system that is based primarily upon the relationship with large scale oceanographic features or processes (DFO 2006). The review at that time excluded coastal features such as barachois, salt marshes, and eel grass beds on the premise that they may have a high local significance but they likely do not have a substantive effect on the functioning of the much larger oceanic ecosystem (DFO 2006).

Following several EBSA exercises within Canadian waters, a reflection was made on the overall efficiency of the EBSA process and to provide guidance in future application its criteria (DFO 2011). It was recognized that the three primary criteria (aggregation, uniqueness, and fitness consequences) were applicable to coastal habitat with the acknowledgment that some ecological functions and processes in these systems differ from comparable ones in marine systems (DFO 2011). It was also proposed to use heat maps to illustrate the different criteria when possible.

The identification of EBSAs in the coastal zone is necessary to complete the ecological profile of the estuary and the Gulf of St. Lawrence and for the planning of the network of marine protected areas. In order to determine if the coastal zone meets the EBSA criteria, a zonal peer review meeting was held in Mont-Joli, Quebec in December 2014 (DFO 2015). A two-step approach was considered during the meeting. The first step was to agree on a definition of the coastal zone and to identify and describe the data sets that could be used to apply the EBSA criteria to the coastal zone. The second step was a formal review process of the data and information applied to the EBSA criteria to yield a number of important areas (IA). This study presents the information, data, and analyses considered for the identification of IA in the southern Gulf of St. Lawrence (sGSL) based upon invertebrates and fishes.

MATERIALS AND METHODS

STUDY AREA

Standardized data from three surveys were used for modeling to predict the probability of detecting the presence of a taxon in a standardized tow. Survey data and environmental variables were defined for the same 2.5 x 2.5 km (6.25 km2) grid derived by Dutil et al. (2012) for the entire sGSL. The study area was defined as waters between 0 and 40 m deep (mean value of the cell) within the sGSL but excluded estuaries and semi-enclosed embayments. The estuary/coastal area boundaries were determined by the presence of barrier islands or peninsulas, and cells with centroids inside of those features were removed. Also, cells east of New Carlisle along the Gaspé Peninsula and east of Cape North in Cape Breton (i.e., outside the sGSL) were removed. The final grid for the sGSL coastal study area was comprised of 4,486 cells (Fig. 1).

DATA SOURCES

Quantitative data were retrieved from three surveys:

- the annual September bottom trawl survey in the sGSL (RV survey);
- the annual Northumberland Strait bottom trawl survey (NS survey); and
- two recent scallop-dredge surveys.

These surveys record data on most of the animal species captured and have substantial sampling effort within the coastal waters of the sGSL. The shallow-water depth threshold (roughly 4 m chart datum) for the small-boat surveys (NS, scallop-dredge) was determined by the draft of the survey ships. The RV survey was designed to survey waters deeper than ~20 m. The survey catch data were transformed to presence-absence for modeling purposes. The annual snow crab survey was not considered for this study because nearly all stations are in water >40 m deep.

Annual September bottom trawl survey in the sGSL (RV survey)

A bottom-trawl survey of the sGSL has been conducted in September since 1971 and provides the longest time-series of distributions and relative abundances for fishes and invertebrates in the sGSL. The RV survey follows a stratified random design, with stratification based on depth and geographic area. Twenty-four strata have been fished since 1971 and three inshore strata were added in 1984.

The RV survey uses the same standardized fishing procedures each year: a 30-minute tow at a speed of 6.5 km/h. Five ships using two types of trawls (“Yankee-36” and “Western IIA”) have been used during the time series. Corrections and adjustments for net efficiency, net swept area, and vessel effects are described by Hurlbut and Clay (1990), Benoît and Swain (2003a), and Benoît (2006). The difference in catchability of certain species based on the time of day was assessed by Benoît and Swain (2003b).

Between 100 and 200 tows were attempted during the RV survey each year (Fig. 2). Because of issues with data quality and accuracy in the identification of some species, only data collected between 1976 and 2013 were used in this study.

Northumberland Strait bottom trawl survey (NS survey)

Between July and August, the demersal community of the Northumberland Strait was sampled annually since 2000. Two bottom trawls were used, depending upon the survey’s goals. For all years except 2010 and 2011, when a Nephrops trawl was used, the survey gear was a number 286 bottom trawl equipped with rockhopper footgear (rockhopper trawl). The NS survey area (Fig. 3) was overlain with a 3.7 x 3.7 km grid (starting point 46°30’ N; 64°00’ W), establishing over 1,100 possible sampling stations (Voutier and Hanson 2008; Bosman et al. 2011; Kelly and Hanson 2013a, b). The study area was originally divided into nine strata, based on bottom composition and water mass characteristics, and surveys followed a random block sampling design. Starting in 2010, some strata were dropped and stations were randomly selected (at a reduced sampling intensity) from within the original grid (see Rondeau et al. 2014 for details).

During the NS survey, the rockhopper trawl was towed for 15 minutes at a speed of 4.6 km/h. However, because of the gap under the rollers, the net was inefficient at catching Atlantic rock crab (*Cancer irroratus*), a species that plays an important role in the coastal ecosystem in terms of energy cycling (Hanson et al. 2014; Rondeau et al. 2014). To address this shortcoming, a Nephrops trawl that digs into the bottom (Conan et al. 1994), and is more efficient at capturing crabs, lobster, and many other benthic organisms, was used in 2010 and 2011 (Hanson *et al.* 2014; Hanson and Wilson 2014). The Nephrops trawl was towed at a speed of 3.7 km/h for only 5 minutes because large amounts of sediment and debris were retained. Between 101 and 255 valid tows were done per survey from 2000 to 2013 (Fig. 3).

Scallop-dredge survey

A scallop-dredge survey was conducted in 2012 and 2013 to gather information on the distribution and abundance of adult and juvenile sea scallop (*Placopecten magellanicus*) within the sGSL. The survey gear was an 8 bucket Digby-type dredge (total length of 3.3 m) fitted with a Vexar® mesh liner (mesh size of 12-14 mm) to retain scallop recruits and small benthic species. The dredge was towed for 2 minutes at a speed of 3.7 to 4.6 km/h at 67 randomly selected stations in Northumberland Strait (2012) and at 87 stations in Chaleur Bay (2013) (Fig. 4).

SPECIES SELECTION

Sampling protocols for multi-species surveys specified that all organisms encountered be identified to the lowest practical taxon (typically species). Unfortunately, identification effort and taxonomic expertise has not been constant throughout the RV survey time series. Nevertheless, with a few exceptions, most fish species encountered are thought to have been accurately identified to species level over the years and as such were considered as the primary source of information. One exception is the combination of blueback herring and alewife to match commercial catch recordings (where they are called “gaspereau”). Some deep-water species were eliminated from the analysis even if they were caught at the margin of the study area to minimize their influence on the modelling predictions. Hereafter, fish and invertebrate species or taxa were identified by their common names. Based on the three benthic surveys, there were usable data for 32 fish taxa (Table 1). The final species selection was done after consultation with peers following a CSAS meeting on the application of EBSA criteria to the coastal area (DFO 2015).

The list of invertebrates was more difficult to establish. For the RV survey, a consistent effort to identify and record catch information on invertebrate taxa only started in 1989. Hence, invertebrate data prior to 1989 were not considered. In the NS survey, most of the sampling in the early years was focusing at large decapod crustaceans and fishes. Data from American lobster, Atlantic rock crab, snow crab, lady crab, and toad crab sampled in 2003, and between 2005 and 2013, were used. For small-bodied taxa, only data starting in 2010 were considered reliable. Invertebrate data from both years of the scallop-dredge survey were retained. Furthermore, some species or taxa still needed to be removed from the potential data set because of uncertainties in their identification. In some instances, species were only identified to a higher taxonomic level (e.g., sponges, sea anemones) which most likely includes both coastal and deep water taxa. Since the latter was not considered in our analysis, species identified at high taxonomic levels (i.e., above genus level, excepting mussels) were not selected. As for fish species, recognized deep water invertebrate species were excluded from the analysis (e.g., sea potato *Boltenia ovifera*, Iceland scallop *Chlamys islandica*) and the final list of species retained was vetted by peers. For this study, 23 invertebrate species and/or taxa (Table 2) were included. Over 18 shrimp species can be found in the sGSL, and some (especially *Crangon* *septemspinosa*) are known to play an important role in the coastal-ecosystem food web (Hanson 2011; Kelly and Hanson 2013a; Hanson and Wilson 2014; Hanson et al. 2014;). Unfortunately, because of data availability issues, it was not possible to incorporate the information on shrimp in the analysis.

Information on the selected species of fish and invertebrate from the three surveys was transformed into presence-absence data and a minimum of ten occurrences was arbitrarily selected as the threshold for a taxon to be retained for modeling.

DATA PROCESSING AND MODELING

The presence-absence data were modeled to predict the probability (0 to 1) of detecting a taxon in a standardized tow within a grid location. In addition to environmental variables, spatial and gear effects were included as predictors. Five environmental variables from Dutil et al. (2012) known to or are presumed to affect species distributions were included in the model testing:

- mean water depth in the grid cell,
- mean bottom temperature at the mean water depth within the grid cell,
- mean bottom salinity at the mean water depth within the grid cell,
- mean tidal current (cm/sec) associated with the “principal lunar semi-diurnal” component of the tide (M2), and
- mean annual wind speed (m/sec).

Generalized Additive Models (GAM) were used to model binary presence-absence data. Using a forward stepwise approach, the model having the lowest total Akaike information criterion (AIC, Burnham and Anderson 2002) value over the 14 selected taxa (Table 3) was selected and used for spatial predictions.

Smoothing terms over space (i.e. latitude and longitude coordinates converted into UTM), water depth, bottom temperature, bottom salinity, tidal current and annual wind speed were included were added one by one, choosing the smoothing term which contributed to the largest decrease in AIC value at each step or until the total AIC increased. The selected model was:

Presence ~ s(T_BOT_MEAN) + s(DEPTHMEAN) + s(x, y) + gear

where s(T_BOT_MEAN) is an additive smoothing term for mean bottom water temperature, s(DEPTHMEAN) is a smoothing term over water depth, s(x,y) is a spatial smoothing term and gear is an additive term denoting the type of gear used. The data from each survey is not on the same scale, the gear effects correct for (logit) linear differences in scale, such that any linear transform of data observations applied to surveys other than the reference survey leave the end result unaffected, as the gear effect parameters will scale accordingly in the estimation.

The selected model was applied to all data available from the coastline up to the 60 m isobaths, the data between 40 m and 60 m were included so as to obtain a better adjustment at the margins of the study area (i.e. near 40 m). Contour maps of the restricted study area (0-40 m) were then produced using the predicted probability of capturing a given taxon for a standard tow of 1.75 nautical miles (nm) with a Western IIA trawl (as used in the RV survey) for each grid cell. Since lady crab and mud crab were not caught in the RV survey, their predictions were based on Nephrops trawl of standard tow length 0.125 nm from the NS survey rather than the Western IIA trawl.

The predicted species distribution from the model depended on the spatial and temporal occurrence of the survey sampling stations; therefore, the predicted species distribution could be misleading if sampling was limited or absent (i.e., upper Chaleur Bay, western Cape Breton and a caution for the northern part of Magdalen Islands). Sampling gear can also affect the catchability, therefore, the observed species occurrences can be affected by the spatial distributions of the gear used. Contour maps for all species and taxa were either presented in the analysis section of this document or in Appendix 1.

Biodiversity contour maps were produced separately for fish and invertebrate taxa by summing single-taxon predictions by grid cell, which yielded the number of taxa expected to be captured in a grid cell. For invertebrates, since many different species were encompassed within a single taxon (e.g., toad crab includes *Hyas araneus* and *H. coarctatus*; Table 2), and many groups were not included (e.g., shrimps, polychaetes), the biodiversity indicator displayed on the map is severely underestimated and should be interpreted as a “pseudo-diversity” map. This is also true to a lesser extent for the fish “pseudo-diversity” map because only a few fish taxa were comprised of more than one species (Table 1).

When considering 55 species or taxa for the identification and characterization of potential IA in the coastal zone of the sGSL, special considerations must be made for the species-at-risk. However, the EBSA process is separated from the one dealing with critical habitat designation under the Species at Risk Act (SARA). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has already evaluated twelve fish species identified in this IA process and are suspected of being at risk of extinction or extirpation (Table 4). However, at the moment only three species are assigned a status under SARA, one has been rejected (winter skate; Canada Gazette 2010), and the others are still under consideration. Data on five of the twelve species evaluated by COSEWIC were available from our trawl surveys; for the remaining seven, capturability was very low or nil (e.g., bluefin tuna *Thunnus thynnus* and white shark *Carcharodon carcharias* are fast-swimming pelagic species that have never been captured in our survey trawls).

EVALUATION CRITERIA

To identify important areas (IA), the evaluation of the coastal waters in the sGSL was based on the same three criteria or dimensions proposed for EBSA (DFO, 2004): uniqueness, aggregation, and fitness consequences. These criteria have already been used for the identification of mid-shore and offshore EBSAs, and they could be equally applied to coastal waters (DFO, 2011). It must be recognized that to identify IA, the ecological consequences of a severe perturbation in that area would be greater than an equal perturbation of most other areas in the region. An IA should be different from unexceptional areas; in the latter case, this does not make the area an unimportant area.

Based on the uniqueness criterion, an area would be deemed important if it contains unique, rare, or distinct characteristics when compared to other areas in the region. Either the biological processes that are taking place in such an area, or the species that are present, should reveal some uniqueness. Special considerations at the species level were given to rare and/or potential endemic species as well as species evaluated under COSEWIC or SARA.

For the aggregation criterion, the species as well as the pseudo-diversity contour maps were used to identify areas of high abundance (concentrations), and where the greatest number of species occurred. These observations, however, only reflect the period when the data were collected, i.e., during the summer months. Additional information from the literature (Appendix 2), commercial landings, traditional ecological knowledge and expert opinion were considered to fill the gaps and increase the reliability of the overall evaluation.

The fitness consequences criterion was used to identify key or important areas where crucial life history activities are undertaken. The criterion was divided into five ecological functions:

- feeding,
- reproduction,
- nursery area,
- migration, and
- seasonal refugia.

Based on the available literature, the connectivity among the areas where these ecological functions were observed was also discussed. Fishes are mobile and several areas can serve as locations for different ecological functions. In contrast, the majority of the invertebrate species are either sessile or are benthic with minimal seasonal movements (i.e., can be considered sedentary), and a single site serves for most fitness functions. Information on invertebrates was mainly considered for the aggregation criterion (the pseudo-diversity contour maps); however, uniqueness was applicable for the lady crab, a likely undescribed endemic whose entire distribution is within Northumberland Strait (Voutier and Hanson 2008).

ANALYSIS

GENERAL CHARACTERISTICS OF THE STUDY AREA

The coastal zone was defined as the area with waters ≤40 m deep (DFO 2015). Consequently, this coastal zone actually comprises areas where the warm surface waters contact the bottom (typically ≤30 m) and includes much of the transition zone between the surface layer and the cold intermediate layer (CIL; Gilbert and Pettigrew 1997). Hence, fish species that prefer cold and tolerate low temperatures occur at the shallow edge of their distributions in the coastal zone but most of the population is located in or below the CIL. In contrast, the species that prefer warm waters have the deep-water boundary of their distribution within the transition zone. Finally, diadromous species are a major component of the warm-water fish community, and are all but absent from the cold-water community. The study area, except for the Magdalen Islands (Fig. 5), includes rivers large enough for spawning by anadromous fishes and there is relatively little difference in species diversity of anadromous species. A major exception is the Miramichi River, which is the only known spawning area for striped bass and American shad.

The shallow coastal zone is characterized by seasonal extremes in environmental conditions. During summer months, bottom-water temperatures can exceed 21°C in many areas (often >25°C in embayments and estuaries) while there is an extended period of land-fast and sea ice during winter with bottom water temperatures as low as ca. -1.7°C. The areas exposed to sea ice are subjected to moving ice and ice ridges that can cause bottom scouring down to 20 m depths (Brown et al. 2001; Forbes et al. 2004; Prisenberg et al. 2006). In addition, there is extensive down-welling of ice crystals during storms. Contact with ice or exposure to water below the freezing point of fish tissue can be fatal and consequently most fishes migrate out of the danger zone for the winter months (Clay 1991) often following well-defined migration corridors.

The sGSL is characterized by an array of different environments and habitats but some features of its coastal zone need to be emphasized. Within the study area, Northumberland Strait (Fig. 5) is the only area bounded by land on two sides and it is characterized by almost 100% warm and shallow (<30 m) habitat. There is a prominent cool-water (10-12°C during summer) upwelling area near Wood Island that corresponds to the end of a narrow channel running along the southeastern shore of Prince Edward Island (PEI). Part of that trench is deeper than 40m and has been excluded from the study area (Fig. 1). The blocking in 1954 of the Canso Strait by a causeway created a major disruption in St. George's Bay (Fig. 5) as it closed an important migration route for many long-distance migrants (e.g., the three *Alosa* species, Atlantic saury, butterfish, and perhaps bluefin tuna). The coastal area west of Cape Breton is limited to a narrow band with limited presence of shallow water (Fig. 1). One distinctive feature of the Magdalen Islands is the near-absence of freshwater input in the coastal habitat resulting in the near absence of anadromous species.

ECOLOGICAL PROPERTIES

Uniqueness

White hake (Fig. 6) and winter skate (Fig. 7), two suspected undescribed endemics, now occur at very low abundance, and there has been severe range compression to small areas where the population remnants are concentrated (COSEWIC 2005, 2013; Kelly and Hanson 2013a, 2013b). The areas occupied by those two species are therefore unique as they represent their last stronghold.

St. George's Bay and the eastern end of Northumberland Strait constitute the only remaining spawning area for white hake (Fig. 6) as well as a critical summer feeding area (COSEWIC 2013). When migrating out to the Laurentian Channel and Cabot Strait for the winter, adults go through the Northumberland Strait and then follow the west coast of Cape Breton.

While formerly widespread, winter skate is now mainly restricted to the western half of Northumberland Strait (Fig. 7) where they feed and release most of their eggs. In late autumn, they spread from the shallow waters of Northumberland Strait out into the deeper waters of the sGSL; however, some remain in waters ≤ 40 m deep.

The sGSL also shelters a lady crab that is likely an undescribed endemic species (Voutier and Hanson 2008; J.-M. Gagnon, Canadian Museum of Nature, Ottawa) (Fig. 8). Should there be a negative effect that eliminates the lady crab population in the Strait, this would represent a species extinction. The lady crab population from the Northumberland Strait has not been assessed by COSEWIC.

Aggregation

Given the endangered status of white hake population (COSEWIC 2013), concentrations of this species, especially the juveniles, in Northumberland Strait, St. George's Bay and east of PEI (Fig. 6) increase the importance of these areas. The species also formerly occupied the Shediac Valley (Fig. 5), which is no longer the case (Benoit et al. 2003; Swain et al. 2012).

Juvenile Atlantic cod occur at the shallow edge of the CIL and well into the transition zone waters (Fig. 9), and large numbers of age-0 (semi-pelagic) individuals occur in warm waters such as Northumberland Strait. Aggregations of juvenile Atlantic cod occur east of PEI but that is only one of many areas of aggregation (Hanson 1996; Benoit et al. 2003; Darbyson and Benoit 2003). In autumn, juvenile Atlantic cod follow after the adults and they appear to concentrate north of the Magdalen Islands and along the edge of the Laurentian Channel for the winter. Mixed groups of adult and juvenile Atlantic cod return to the sGSL in spring, shortly after the ice melts.

Atlantic halibut is not a coastal species per se; however, part of the population occurs closer to shore in the Gaspe and Cheticamp troughs during summer and early autumn (Benoit et al. 2003; Darbyson and Benoit 2003). Based on our data, the Atlantic halibut was mostly observed in the waters from northeastern New Brunswick (NB), on the north side of PEI, and east of the Magdalen Islands (Fig. 10).

Most individuals from the Atlantic salmon, alewife, and American eel populations that migrate into the Restigouche River, to either spawn (anadromous) or feed (catadromous), must congregate, even temporarily, in Chaleur Bay and this area would be important for their fitness. Unfortunately, the map generated from our alewife data (Fig. 11) does not reflect this expectation because data were collected mostly in the summer months. The aggregation of alewife occurs in a brief period during spring and is limited geographically; hence, it is unlikely that it could be observed in the traditional bottom trawl surveys, i.e., illustrating data limitation. Similarly, the entire breeding population of American shad and striped bass must cross the eastern NB area to access their single spawning site in the Miramichi River (Chaput and Bradford 2003; Douglas et al. 2009; COSEWIC 2012b; DFO 2014a), so this transition area is important in terms of the aggregation of those species.

Although our contour map for butterfish (Fig. 12) suggests a single aggregation within Northumberland Strait, they also occupied several other areas in the summer and the fall. However, other than occasional captures in the Miramichi Estuary (Hanson and Courtenay 1995), they have not been captured in areas west of North Point, PEI (Benoit et al. 2003; Darbyson and Benoit 2003).

The pseudo-diversity contour map for fish (Fig. 13) indicated the greatest numbers of species were captured in the Northumberland Strait, St. George’s Bay, and Chaleur Bay. Based on the available data, numerous species found in these areas were indeed very abundant (e.g. Atlantic herring, longhorn sculpin, rainbow smelt, alewife, winter flounder) and therefore had a very high predicted probability of capture. Aggregation of fish species was less important around the Magdalen Islands mostly because of the absence of anadromous species. Coastal waters west of Cape Breton are restricted to a very narrow band and limited data were available from our surveys to generate the model’s predictions which could explain why fewer species seemed to be present in that area.

The pseudo-diversity contour map for invertebrates suggests that relatively high numbers of species occur in the Shediac Valley, Chaleur Bay, and just south of the Magdalen Islands; and that lower numbers of species are present in the Northumberland Strait, St. George’s Bay, and eastern PEI (Fig. 14). This is quite the opposite of the results based on fish species (Fig. 13). The invertebrate pseudo-diversity contour map seems to be driven by the high number of echinoderm species in our database, and transient invertebrate species (i.e., at the upper limit of the CIL). Sea stars, sea cucumbers, and sea urchins are easy to identify compared to many other taxa that were not included in this evaluation, such as shrimps, polychaetes, small crustaceans (i.e., mysids, cumaceans, and amphipods), sponges, sea anemones, tunicates, and small mollusks. Thus, the pseudo-diversity contour map for invertebrates based on the available information is a biased representation of the coastal invertebrate community and is a severely biased indicator of the aggregation criterion. Consequently, it should not be considered in the identification and characterization of coastal IA.

Fitness consequences

Feeding

The majority of the research trawl surveys occur between early July and late September. Thus, summer species’ distributions represent areas where fishes are observed actively feeding and growing. With a few exceptions, fishes that remain in the sGSL during winter do not feed or feed at greatly reduced levels.

Adult white hake currently only feed in St. George’s Bay and the eastern end of Northumberland Strait (Fig. 6) so key food source for that species might only be available there; however, their main prey are Atlantic herring and Atlantic mackerel, two widespread species (Hanson 2011). It is recognized that there are high concentrations of forage fish in St. George's Bay such as juvenile and adult Atlantic herring, Atlantic saury, and juvenile alosids in autumn and spring. This area along with the eastern end of Northumberland Strait is critical to the fitness of the white hake population since the remnant of the adult population feeds there and it is two of the three locations, along with Shediac Valley, where juveniles feed. There is an October feeding migration of juvenile white hake into estuaries of Northumberland Strait and up to at least the Miramichi Estuary (Hanson and Courtenay 1995; Bardford et al. 1997; Swain et al. 2012) adjacent to the Shediac Valley (Fig. 5).

The western end of Northumberland Strait is the only feeding area for the lady crab (Voutier and Hanson 2008) and the summer feeding area for the remnant population of winter skate (Kelly and Hanson 2013a, 2013b), both species having a high likelihood to be undescribed endemics. The warm water (probably too warm for most of the transition water/CIL species), sand substrate, and currents result in Northumberland Strait being the only area suitable for lady crabs north of the United States eastern seaboard (with the exception of a small population in Minas Basin) (Voutier and Hanson 2008).

Large proportions of the alewife (Fig. 11), windowpane flounder (Fig. 15), rainbow smelt (Fig. 16), and American shad populations also feed within Northumberland Strait, where there also are high concentrations of forage fish such as juvenile Atlantic herring (McQuinn et al. 2012). The area is also used consistently for feeding by most anadromous species. Rainbow smelt are very common in the <35 m depths in bottom trawl surveys and occur along all the shoreline of the sGSL except the Magdalen Islands (Fig. 16) during the ice-free season. Typically, there are large concentrations of rainbow smelt feeding in waters <30 m deep in Chaleur Bay, eastern NB, and throughout Northumberland Strait (Benoit et al. 2003; Bosman et al. 2011; Savoie 2014a). Juvenile rainbow smelt have the same general distribution of adults once they enter full salt water, but the juveniles tend to be closer to shore.

There are at least four marine fish species (transient marine species) that enter the sGSL coastal waters to feed during summer months: bluefin tuna, butterfish, Atlantic saury, and spiny dogfish (Appendix 2). The bluefin tuna and Atlantic saury are pelagic species and not captured in DFO trawl surveys but based on commercial and reported commercial fisheries landings (DFO 2010; Vanderlaan et al. 2014) feeding aggregation information could be deduced. The largest numbers of bluefin tuna occur along the north coast of PEI and at the eastern end of the Strait where they feed actively. The Shediac Valley is the third high-density feeding areas for bluefin tuna (based on landings) within the sGSL making those areas rather important for the fitness of that species. Atlantic saury is noteworthy for its feeding concentrations during autumn in a small area of St. George's Bay (Chaput and Hurlbut 2010; DFO 2010) - they presumably enter and exit along the west coast of Cape Breton. Butterfish enter the sGSL sometime during summer with very small numbers caught in the NS survey, and from central Strait to St. George's Bay (Fig. 12) in September and October. Large incursions of spiny dogfish occur when its population in adjacent ecosystems is at high levels (COSEWIC 2010b). Spiny dogfish mainly occur during late summer and autumn in coastal waters from Miscou Island through Northumberland Strait and the north Shore of PEI to eastern PEI, with a concentration on the east side of the Magdalen Islands (Benoit et al. 2003; COSEWIC 2010b) (Fig. 17). During autumn, these aggregations of spiny dogfish likely are concentrating on spawning aggregations of Atlantic herring.

A group of anadromous species does not leave the sGSL and uses the coastal zone as their primary open-water feeding area. Some species tend to stay very close to shore (e.g., striped bass and brook trout) and others are simply poorly sampled (e.g., Atlantic tomcod and threespine stickleback), because much of the population occurs, again, close to shore or is pelagic (not mutually exclusive mechanisms), resulting in the absence or quasi-absence of these species in our research trawl surveys.

Migration corridors

Of the fish species that show significant seasonal movements, most appear to undergo diffuse migration between summer feeding areas and overwinter refuges. There are notable exceptions. The entire near-shore area from Gaspé to roughly the Margaree Estuary in Cape Breton represents the seasonal migration corridor for striped bass (Robinson et al. 2004; Douglas et al. 2009; S. Douglas, Gulf Fisheries Centre, pers. comm.) (Fig. 18); however, this species does not move out of the sGSL. American eel, the three alosid species, butterfish, Atlantic saury, and spiny dogfish, all are thought to migrate along the coast, and especially in Northumberland Strait, to the west coast of Cape Breton and then out along the northern tip of Cape Breton. Atlantic cod shows a similar migration pattern in and out of the sGSL (Hanson 1996; Campana et al. 1999; Comeau et al. 2001). While Atlantic mackerel and bluefin tuna do not necessarily stay in coastal waters when feeding, they mostly pass along the north tip of Cape Breton as they enter and exit the sGSL. White hake also migrate along the west coast of Cape Breton (current low population pattern) and showed a similar migration along the coastal areas of both sides of PEI when population numbers were higher. Thus there clearly is a major migration corridor primarily through Northumberland Strait (and to a lesser degree along the north shore of PEI), along the west coast of Cape Breton, and then a highly significant choke point at the northern tip of Cape Breton Island (Fig. 18).

The three alosid species (alewife, blueback herring, and American shad) undergo long-distance migrations to overwinter well outside the sGSL (Chaput and Bradford 2003; Darbyson and Benoit 2003; McQuinn et al. 2012). The three species spawn in rivers during spring or early summer; the young-of-the-year move down the estuary as they grow; they join the large juveniles and adults in coastal waters (especially in Northumberland Strait) during late summer or early fall, and all sizes leave the sGSL before ice formation. The migration appears to run along the shoreline of the mainland (mainly Northumberland Strait) and, for a while, there can be large numbers concentrated at the eastern end of St. George's Bay. Eventually, all the migrants exit along the west coast of Cape Breton, leaving the sGSL completely during winter. All sizes of alosids return to the sGSL as the ice melts, adults enter freshwater to spawn, and the post-spawners move back down to coastal waters to feed for the summer – along with the immature fishes (Hanson and Courtenay 1995; Bosman et al. 2011; J.M. Hanson, unpublished data). A very large proportion of the populations of the three alosid species, butterfish, striped bass (in the Miramichi River and a few nearby rivers), and adult American eels migrate through the Northumberland Strait in autumn to overwinter or to breeding sites (reverse migrations in spring for diadromous species). For species entering rivers within the Strait, there is no other route so the area is an obligatory passage. Winter skate migrate into the Strait from overwinter areas to feed and breed. As an obligatory passage to local end points (either to breeding, feeding, or overwinter sites), this area is critical for the fitness of many anadromous species, such as striped bass and American shad, and for winter skate.

Atlantic mackerel is also a long distance migrant. They migrate to US coastal shelf region to overwinter, returning in spring to spawn, and both adults and juveniles feed pelagically in the coastal zone all summer (McQuinn et al. 2012; DFO 2014b). Like the three alosid species, the migrants must pass through the choke point at northern tip of Cape Breton (Fig. 18) during both migrations.

As a deep-water species, adult Atlantic cod mainly occur in the cold waters of the CIL although, when population numbers were high, some occurred in the transition waters. The migration path of Atlantic cod is well-known (Swain et al. 1998; Campana et al. 1999; Comeau et al. 2001); the western group moves in waters offshore from the north shore of PEI in October, joins up with eastern group along west coast of Cape Breton, and move to the edge of the Cape Breton Trough up to the north tip Cape Breton in November. The adults migrate ahead of the ice-edge in Cabot Strait as winter progresses and ultimately out onto the Scotian Shelf.

As described earlier, bluefin tuna, butterfish, Atlantic saury, and spiny dogfish are known to enter the sGSL to feed. Presumably, all enter and exit via the passage at the tip of Cape Breton and pass along the west coast of Cape Breton, presumably between the shore and edge of the Laurentian Channel.

Anadromous species spawn in freshwater and have migrations of varying lengths. Corridors leading to those freshwater spawning locations are therefore important for the fitness of the anadromous species in the sGSL. Chaleur Bay is an obligatory passage for salmon, alewife, and American eels going into rivers like the Restigouche, and likely for striped bass during its feeding migrations. Similarly, eastern NB (coastal Shediac Valley) is also an obligatory passage for these species going into other rivers. Furthermore, the Miramichi River is the only known spawning site for striped bass and American shad so the entire population funnels through the area coming either from the northern and southern route (Fig. 18) before entering the river. Young-of-the-year striped bass and American shad move down the river and into the estuary as they grow and then disperse all along the coast in mid-summer (Chaput and Bradford 2003; Robinson et al. 2004). Finally, most of the juvenile and adult alewife and rainbow smelt go through the Miramichi Estuary to migrate into Northumberland Strait to feed during the summer months.

There is an October feeding migration of juveniles of white hake from the Shediac Valley into the Miramichi Estuary (eastern NB) where fish aggregate for a month or so before leaving to overwintering locations (Hanson and Courtenay 1995; Bradford et al. 1997; Swain et al. 2012; COSEWIC 2013). Eastern NB is therefore important for the fitness of this endangered species. Since there is also a feeding migration of juvenile white hake in rivers of Northumberland Strait, that area must also be of some importance.

Atlantic salmon undertakes a long feeding migration. Small juvenile Atlantic salmon (smolts) migrate down the estuaries of their natal rivers during spring. The pelagic smolts from several major rivers apparently congregate for a short time in the Miramichi “outer-bay” area and move as a group across the Magdalen Shallows, crossing to the Strait of Belle Isle, and ending up near Greenland (COSEWIC 2010c). The return migration is not synchronous with fish fresh from the ocean appearing in fresh waters from late June through October. Locations of the adults in transit are poorly understood, and they are all but immune to our survey gears because they are pelagic and fast-moving; hence, possible migration corridors (if any) cannot be inferred. The adults spawn during autumn and the surviving spent fish move back down the estuary during spring (feeding as they go) and out to sea. Some of the spent fish that migrate back to the ocean sea will return to spawn in subsequent years.

Longhorn sculpin, sea raven, yellowtail flounder, windowpane, and ocean pout are widely distributed and most individuals appear to leave the <30 m waters occupied during summer and move to the deeper waters within the sGSL to overwinter with no specific migration corridor (Bosman et al. 2011; Hanson and Wilson 2014). Similarly, the almost ubiquitous winter flounder shows two types of migration to overwinter refuges. Some individuals move to the edge of the Laurentian Channel while others enter estuaries during autumn and exit shortly after ice-melt (Hanson and Courtenay 1995, 1996; Darbyson and Benoit 2003).

Some warm-water coastal-zone species do not appear to migrate (see Appendix 2). Cunner hides under rocks or buries in sediment and enters a state of torpor as water temperatures drop below 5 to 8 °C (Johansen 1925; Dew et al. 1976; Green et al. 1984). Rock gunnel mainly lives under rocks close to shore and inside estuaries (Scott and Scott 1988). Wrymouth live in deep burrows (Scott and Scott 1988). Presumably these species remain in their preferred habitat year-round. Grubby (almost exclusively close to shore and in estuaries) and northern sand lance are not well sampled and their seasonal movements cannot be discerned.

The Canso Strait was most likely an important passageway for many species (e.g., Atlantic herring, Atlantic saury, and *Alosa* spp.) but since its blockage, each side now acts as a retention area (depending on the season) where migratory fish species are caught up until they take an alternative route out and around Cape Breton, i.e., along the west coast of Cape Breton in the sGSL. A significant proportion of the migratory species populations pass along the west coast of Cape Breton. Atlantic salmon populations using the rivers in the area must migrate through St. George's Bay to access spawning endpoints. St. George's Bay formerly was very important for the fitness of species migrating through the Canso Strait but now marine fish are going around Cape Breton following the shore west of Cape Breton or a bit offshore.

Invertebrate species do not show much in the way of seasonal movements although some adult American lobsters do make short seasonal movements to slightly deeper water if cover is not available in the <30 m depths (Bowlby et al. 2007, 2008). Consequently, no area can be identified as being important for the fitness of invertebrate species based on migration.

Spawning locations

Fish populations in the sGSL can be classed in four guilds by spawning behavior; anadromous species, those that do not spawn in the sGSL, species with known spawning beds, and species where no spawning area has been located (the vast majority of species). Anadromous, catadromous, and transient species do not spawn in the sGSL marine coastal habitat and therefore their spawning grounds can be ignored for the purpose of this report. With few exceptions (e.g., Atlantic herring, white hake, winter skate), distinct spawning areas are unknown for most marine resident species.

The St. George's Bay is unique as it is the only remaining breeding location for coastal white hake (Swain et al. 2012; COSEWIC 2013); the entire breeding population is present and the loss of this location would most likely result in the extirpation or extinction of white hake. As the only breeding area for lady crab (Fig. 8) and most of the remnant winter skate population (Fig. 7), the western half of Northumberland Strait is critical for these species. The loss of this breeding area would most likely result in the extinction of lady crab and winter skate. Baie Verte located in central Northumberland Strait (Fig. 5) used to be one of the two known spawning location for white hake (with St. George's Bay) but this function is now lost (Swain et al. 2012).

Atlantic herring (spring and fall spawners) have many spawning beds (e.g., Miscou Island, both ends of Northumberland Strait, Chaleur Bay) (Messieh 1987) but usage is not consistent from year to year. Historically, there have been spring and fall herring spawning beds for the entire sGSL but some of them seem to have disappeared (McQuinn et al. 2012).

Capelin probably spawns on offshore banks and perhaps beaches from Miscou Island to roughly Gaspé Bay; however, actual locations have not been documented.

Winter sampling in the lower Miramichi Estuary has detected Greenland cod and shorthorn sculpin in spawning condition (ripe and running and newly spent; Hanson and Courtenay 1995) but whether winter spawning in the lower section of estuaries is the rule for sGSL populations is unknown.

Beside St. George's Bay and Northumberland Strait, no other areas can be identified as being important for the reproductive fitness of fish species. As for the invertebrate species, very little information on breeding grounds is available. As said previously, most species are sessile or sedentary and will complete their whole life cycle within the same area.

Nursery areas

The possibility of distinct nursery areas has not been investigated for most marine species. Estuaries, for varying lengths of time, represent important nursery areas for all of the diadromous fishes except Atlantic salmon and sea lamprey (whose young pass quickly through the zone en route to marine feeding areas). There are very few juveniles of diadromous species in shallows of St. George's Bay and the Magdalen Islands because of the small number and the total absence of inflowing rivers, respectively. For most species, the juvenile fish essentially share the same locations as the adults although there is a moderate tendency for the juveniles to be in shallower waters.

Distinct nursery areas are known for Atlantic herring, and are located within Northumberland Strait and the end of Chaleur Bay (LeBlanc et al. 1998; Bosman et al. 2011). There are also some concentrations of juvenile herring in St. George's Bay (McQuinn et al. 2012).

For Atlantic cod, the major concentrations of juveniles occur around the north point of PEI, immediately west of the Magdalen Islands, and along the north and east coasts of PEI. Some concentrations of age-0 and small juveniles occur within Northumberland Strait during summer (Bosman et al. 2011).

Juvenile white hake are now only found in three locations: St. George's Bay, Northumberland Strait, and eastern PEI (Hanson and Courtenay 1995; Swain et al. 2012; COSEWIC 2013) with no area being more important than the others for the fitness of the remnant population. The western half and central Northumberland Strait is also the only nursery area for lady crab and remnant winter skate population; meaning it is critical for the fitness of both species. In addition to those two likely-endemic species, there are large concentrations of age-0 and juveniles of the three alosid species and striped bass. High concentrations of adult windowpane (Fig. 15) and winter flounder probably indicate that the area is used as a breeding and nursery area as well as for feeding.

Seasonal refuge

With one exception, there is no significant winter refuge in the coastal zone of the sGSL. Most strictly warm-water coastal fishes migrate to deeper waters outside the coastal area or enter estuaries for the winter, including all of the rare (COSEWIC ranked) or suspected endemic fishes (winter skate and white hake). A few widely-distributed warm-water fishes (e.g., wrymouth, cunner, and rock gunnel) remain in their burrows, hide under rocks, or bury in the sediments to overwinter. Furthermore, seasonal migrations by benthic invertebrate species, including the likely undescribed endemic population of lady crab, are minimal or non-existent. The whole population of lady crab is restricted to the western half of Northumberland Strait year-round so the area is its sole refuge. The fitness (i.e., continued survival) of this species depends on this area.

DISCUSSION

In contrast with the identification and characterization of important areas (IA) in the coastal waters, the workshop held in 2006 (DFO 2007) was not limited by depth, per se. The focus of the 2006 workshop was more "offshore" largely because the RV survey typically has very few sets in water <25 m deep. Nevertheless, two of the ten identified EBSAs (St. George's Bay and the western Northumberland Strait; DFO 2007) occur entirely in waters ≤40 m deep (Table 5). Furthermore, two other EBSA (Western Cape Breton and southwestern coast of the Gulf; DFO

2007) were very large areas that covered much deeper waters (>40 m) but included large portions of coastal waters (Table 5).

Based on the information available, the Northumberland Strait area is the highest ranked IA. Its importance is paramount considering the three evaluation criteria; uniqueness, aggregation and fitness consequences. The high importance in terms of these three criteria is mainly driven by the presence of two likely-endemic species (lady crab and winter skate) in the center and western half of the Strait, and by its being the only remaining spawning location for the coastal white hake (eastern half). Moreover, the only other known spawning location for these white hake was within the Strait in Baie Verte (Swain et al. 2012). In addition, the Northumberland Strait is a major migration corridor for fishes (butterfish, striped bass, *Alosa* spp. and adult American eels) with a bottleneck at both ends. The western part of the Strait was identified as an EBSA (see Table 5) in the 2006 workshop (DFO 2007) mainly because of the presence of the lady crab (Chabot et al. 2007) and remnant winter skate population (Swain and Benoît 2007), and more recently for its importance for small pelagic fishes in the eastern half (McQuinn et al. 2012). However, given the similarity of the oceanographic processes within Northumberland Strait (Chassé et al. 2014), the entire area could be characterized as a single unit.

St. George's Bay was previously identified as an EBSA (St. George's Bay EBSA 2; DFO 2007), and since the entire bay is <40 m, and the same dataset was used, we could also consider it as a coastal IA (Table 5), and de facto as a coastal EBSA. St. George's Bay ranked high because it is part of the only remaining breeding location for white hake, and losing this area would result in its extirpation or extinction (Swain and Benoît 2007). Additionally, concentrations of juvenile white hake are found there. St. George's Bay is an important feeding area for many fishes (e.g., juvenile and adult Atlantic herring, juvenile *Alosa* spp., white hake and Atlantic saury) and many fish species aggregate there during part of their migration in and out the sGSL. The area was designated as an EBSA in 2006 mostly for its major role for meroplankton (largest array and abundance in the sGSL) as well as for its usage by groundfish and pelagic fish (DFO 2007).

The coastal areas at the eastern end of PEI and along the western shore of Cape Breton are encompassed by a much larger area that was identified and characterized as an EBSA (DFO, 2007). At the 2006 EBSA meeting, western Cape Breton was designated as an EBSA (EBSA 1; DFO 2007) because of its major role for meroplankton (with a large array of species), high biomasses and large concentrations of small (<1 mm) and large (>1 mm) meso-zooplankton and its importance to groundfish (Swain and Benoît 2007). The Cape Breton Channel serves as a migration corridor (spring and fall) for many fishes but especially for Atlantic cod and white hake (Swain and Benoît 2007). However, the main ecological functions are more important in the offshore portion of the western Cape Breton EBSA. Indeed, the EBSA is mostly comprised of the deep waters (>40 m) that occur between PEI and Cape Breton rather than coastal waters. Within the context of the current study, the coastal zone (<40 m) along the western coast of Cape Breton is a narrow band, and does not appear to be of critical importance to any of the species considered in the present evaluation; therefore, it would not be designated as IA (Table 5). In contrast, the coastal zone at the eastern end of PEI is wider and is directly connected to the adjacent IAs (i.e., Northumberland Strait and St. George's Bay). Thus, it should be considered an IA (Table 5), mainly because of the presence of white hake, but also due to its importance to pelagic fishes (McQuinn et al. 2012).

Chaleur Bay and the coastal waters west of the Shediac Valley (i.e., eastern NB) should not be considered an IA; however, the deeper waters adjacent to these coastal areas have been identified as EBSA (Table 5) and might warrant special consideration. The relative importance of these areas refers mainly to migratory anadromous species (e.g., Atlantic salmon, alewife, and American eels) going into the Restigouche river and with American shad and striped bass (their only spawning locations in the sGSL) going into the Miramichi River (which also supports much larger populations of salmon, alewife, and American eels than the Restigouche River). These two areas are comprised within the southwestern coast of the Gulf EBSA identified during the 2006 workshop and represent most of its coastal portion (<40 m). The discrepancy between the two evaluations seems to be the depth restriction and additional layers of information. First, the southwestern coast of the Gulf EBSA is influenced by the Gaspé current and both the Miramichi and Restigouche rivers empty into the area creating special physical processes including retention potential, resurgence, and important tidal mixing (DFO 2007). Consequently, with the influence of the Gaspé current carrying nutrients and phytoplankton cells, high phytoplankton concentrations can be observed in the area. That would explain the importance of that area for pelagic fishes (DFO 2007; McQuinn et al. 2012). Second, fishes and invertebrates are high in numbers but the species listed is indicative of species that prefer lower temperatures and thus more abundant, or present, at depth >40 m. Furthermore, Chaleur Bay represents one of the principal wintering areas for juvenile Atlantic herring (DFO 2007; McQuinn et al. 2012), but this occurs in waters >40 m and hence was not considered in our identification for coastal IA (Table 5). Also, the southwestern coast of the Gulf was identified as an EBSA because of a significant feeding area for several marine mammal species, but offshore from Gaspé (DFO 2007), not in the coastal area. Finally, Swain and Benoît (2007) indicated the importance of Chaleur Bay (their IA-7) as low and Shediac Valley (their IA-5) as moderate (Table 5) based on information for demersal fishes.

Finally, coastal areas north of PEI and around Magdalen Islands ranked the lowest as IA based on the three evaluation criteria and all the ecological functions. These locations have no distinctive features and do not seem to be essential for any of the fish or invertebrate species accounted for this evaluation of coastal IA. Similarly, they were not given any special consideration during the identification and characterization process to established EBSA in 2006 (Table 5).

DATA AND RESEARCH LIMITATIONS

The framework and concepts for the identification of IA rely on data availability and quality. Our evaluation had limitations due to gaps in survey coverage in shallow waters of the coastal habitat. For waters < 25 m deep, only Northumberland Strait was well-surveyed; with reasonably good coverage in the eastern half of the Strait only starting in 2005. Waters of Northumberland Strait < 4 m deep could not be sampled due to the draft of the survey trawlers; consequently, distributions of many species described within this study are truncated. Elsewhere in the sGSL (including St. Georges Bay), there is little information for depths < 25 m, and extrapolating the results from this study to the entire coastal zone should be done with caution.

Lack of sampling in the coastal habitat also reflects, among other things, heterogeneous rough bottoms in some areas which prevent sampling by bottom trawls during some surveys. Rocky hard bottoms (e.g., boulder, reefs) in the sGSL are largely located in ≤ 40 m depths. Also, some areas, specifically the western half of Northumberland Strait, could not be sampled during the annual RV survey due to ongoing fishing activities (i.e., the large numbers of lobster traps). Hence, the only information available for this area comes from the NS survey that began in 2000, reflecting inconsistencies in the sampling coverage and sampling gears for the data considered. Filling the data gap in these areas would be difficult for many species.

Trawl efficiency is also an issue for many fish and invertebrate species, especially small bodied species but also for epibenthic (including demersal fishes such as flatfishes) and endobenthic species which are not well-sampled with the trawls used in most multispecies surveys. This is problematic for species such as the sevenspine bay shrimp (*Crangon septemspinosa*) and the Atlantic rock crab that play a critical role in the coastal zone food web (Hanson 2011; Kelly and Hanson 2013a; Hanson and Wilson 2014;Hanson et al. 2014). However, basic information such as abundance and distribution is lacking for these species for most of the sGSL. Information on buried invertebrates (e.g., small and large bivalves, polychaetes, some tunicates, some echinoderms) is also lacking or with very limited spatial coverage even if it is recognized that species of the endobenthos are an important link within ecosystem food webs.

Correct species identification in the different surveys continues to be an issue. Species diversity, even for fishes in our study, is affected by taxonomic shortcomings such as pooling two species for alewife and blueback herring (similar to commercial landings) or the separation of small stichaeids (daubed shanny, stout eel blenny; slender eel blenny, juvenile snakeblenny) that has not been done consistently in the surveys' time series. The issue with the invertebrate data availability bears repeating. Many groups, including higher taxa, are pooled to class or phylum level in the database. In some cases, species-level identification work has been done (e.g., shrimps since 2002) following surveys but their entry into the database has been slow and this information was not available for the present study. With only one shrimp species in the warm-water part of the coastal zone versus at least 14 species occurring in the transition waters and CIL, the difference in biodiversity between the two depth zones is greatly underestimated.

Data-rich areas are more likely to be considered as important, creating a bias compare to data-poor areas. Unique characteristics, evidence of aggregations of some species, and the functionality of an area are easier to identify with a wealth of data and information. Also, the large amount of data on commercial species could predispose the identification of IA to those species and not for whole ecosystem processes.

CONCLUSION

The process for identification and characterization of coastal important areas (IA) reveals three locations that rank high based on fish species and one crab species: Northumberland Strait, St George's Bay, and eastern coast of PEI. These areas stand out primarily because of the presence of likely-endemic species. Chaleur Bay and coastal Shediac Valley are important mainly for the migration of several anadromous species and may warrant some special consideration. The area along the west coast of Cape Breton has a major role as a migration corridor, but more so in the > 40 m deep portion of the area and especially at the "choke point" for many fish species. Finally, there is no evidence to consider northern PEI and Magdalen Islands as IA, as per the previous EBSA identification and characterization meeting in 2006 (DFO 2007).

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TABLES

Table 1. Fish species or group of species considered for modeling.

Common name	Scientific name
Gaspereau	*Alosa pseudoharengus, A. aestivalis*
American plaice	*Hippoglossoides platessoides*
American shad	*Alosa sapidissima*
Atlantic cod	*Gadus morhua*
Atlantic halibut	*Hippoglossus hippoglossus*
Atlantic herring	*Clupea harengus*
Atlantic mackerel	*Scomber scombrus*
Atlantic tomcod	*Microgadus tomcod*
Butterfish	*Peprilus triacanthus*
Capelin	*Mallotus villosus*
Cunner	*Tautoglabrus adspersus*
Daubed shanny	*Leptoclinus maculatus*
Fourbeard rockling	*Enchelyopus cimbrius*
Greenland cod	*Gadus ogac*
Grubby	*Myoxocephalus aenaeus*
Longhorn sculpin	*Myoxocephalus octodecemspinosus*
Lumpfish	*Cyclopterus lumpus*
Northern sandlance	*Ammodytes sp.*
Ocean pout	*Zoarces americanus*
Rainbow smelt	*Osmerus mordax*
Rock gunnel	*Pholis gunnelus*
Sea raven	*Hemitripterus americanus*
Shorthorn sculpin	*Myoxocephalus scorpius*
Snakeblenny	*Lumpenus lampretaeformis*
Spiny dogfish	*Squalus acanthias*
Threespine stickleback	*Gasterosteus aculeatus*
White hake	*Urophycis tenuis*
Windowpane	*Scophthalmus aquosus*
Winter flounder	*Pseudopleuronectes americanus*
Winter skate	*Leucoraja c.f. ocellata*
Wrymouth	*Cryptacanthodes maculatus*
Yellowtail flounder	*Limanda ferruginea*

Table 2. Invertebrate species and taxa considered for modeling.

Taxon or species	Scientific name	Phylum	RV data
American lobster	*Homarus americanus*	Arthropoda	1989-2013
Atlantic rock crab	*Cancer irroratus*	Arthropoda	1989-2013
Lady crab	*Ovalipes c.f. ocellatus*	Arthropoda	NA
Mud crab	*Dyspanopeus sayi*	Arthropoda	NA
Pagurus	*Pagurus sp.*	Arthropoda	1989-2013
Toad crab	*Hyas sp.*	Arthropoda	1989-2013
Sea strawberries	*Gersemia sp.*	Cnidaria	2003-2013
Asterias	*Asterias sp.*	Echinodermata	2004-2013
Blood star	*Henricia sp.*	Echinodermata	1989-2013
Brittle star	*Ophiuroidea*	Echinodermata	1989-2013
Leptasterias polaris	*Leptasterias polaris*	Echinodermata	2004-2013
Purple sunstar	*Solaster endeca*	Echinodermata	2005-2013
Sand dollars	*Echinarachnius parma*	Echinodermata	1989-2013
Scarlet psolus	*Psolus fabricii*	Echinodermata	1995-2013
Sea cucumber	*Cucumaria frondosa*	Echinodermata	1989-2013
Sea urchins	*Strongylocantrotus sp.*	Echinodermata	1989-2013
Spiny sunstar	*Crossaster papposus*	Echinodermata	2005-2013
Mussels	*Mytilus edulis*	Mollusca	1989-2013
Northern moonsnail	*Euspira eros*	Mollusca	1989-2013
Ocean quahaug	*Arctica islandica*	Mollusca	1989-2013
Sea scallop	*Placopecten magellanicus*	Mollusca	1989-2013
Sea slugs	*Nudibranchia*	Mollusca	2002-2013
Whelks	*Buccinum sp.*	Mollusca	1989-2013

Table 3. Test taxa included in the model selection process for selecting the most common best fitting model to be applied to the whole taxa list.

Fish species	Invertebrates species
Alewife	American lobster
American plaice	Atlantic rock crab
Atlantic cod	Lady crab
Atlantic herring	Sea scallop
Rainbow smelt	Snow crab
Winter flounder	Toad crab
Winter skate	
Yellowtail flounder	

Table 4. List of species that have been evaluated by the Committee on the Status of Endangered Wildlife in Canada with their status and year of assessment. Species and populations listed under the Species At Risk Act (SARA) are identified. Species for which trawl-survey data were available to this study are underlined.

Common name	Scientific name	Status	Year of assessment
American eel	*Anguilla rostrata*	Threatened	2012
<u>American plaice</u>	*Hippoglossoides platessoides*	Threatened	2009
<u>Atlantic cod</u>	*Gadus morhua*	Endangered	2010
Atlantic salmon	*Salmo salar*	Special concern	2010
Atlantic wolffish	*Anarhichas lupus*	SARA - Special concern	2003
Bluefin tuna	*Thunnus thynnus*	Endangered	2011
<u>Spiny dogfish</u>	*Squalus acanthias*	Special concern	2010
Striped bass	*Morone saxatilis*	Special concern	2012
Thorny skate	*Amblyraja radiata*	Special concern	2012
<u>White hake</u>	*Urophycis tenuis*	Endangered	2013
White shark	*Carcharodon carcharias*	SARA – Endangered Atlantic population	2006
<u>Winter skate</u>	*Leucoraja ocellata*	Endangered	2005

Table 5. Comparison of the Ecologically and Biologically Significant Areas (EBSA) and important areas (IA) within the southern Gulf of St. Lawrence (sGSL). EBSA locations (as indicated in Figure 5) are based on DFO (CSAS 2007/016), Swain and Benoît (CSAS 2007/012) and McQuinn et al. (CSAS 2012/087), and possible coastal IA based on fish and invertebrate species are from the present study. NB = New Brunswick; PEI = Prince Edward Island.

Locations	Coastal IA	CSAS 2007/016	status	CSAS 2007/012	status	CSAS 2012/087	status
Northumberland Strait	yes	part of EBSA 3	High	IA 3 (part)	High	IA 7, 9, 24	High
St. George's Bay	yes	EBSA 2	High	IA 2	High	IA 7, 9, 24	High
East PEI	yes	Part of EBSA 1	High	None	Low	IA 9, 24 (part)	High
West of Cape Breton	no	Part of EBSA 1	High	IA 1 (part)	High	None	Low
Coastal Shediac Valley	no	Part of EBSA 5	High	IA 5	Moderate	IA 8, 23 and 1 (part)	High
Chaleurs Bay	no	Part of EBSA 5	High	IA 7	Low	IA 3, 12, 1 (part)	High
North PEI	no	None	Low	None	Low	IA 13	Moderate
Magdalen Islands	no	None	Low	None	Low	None	Low

FIGURES

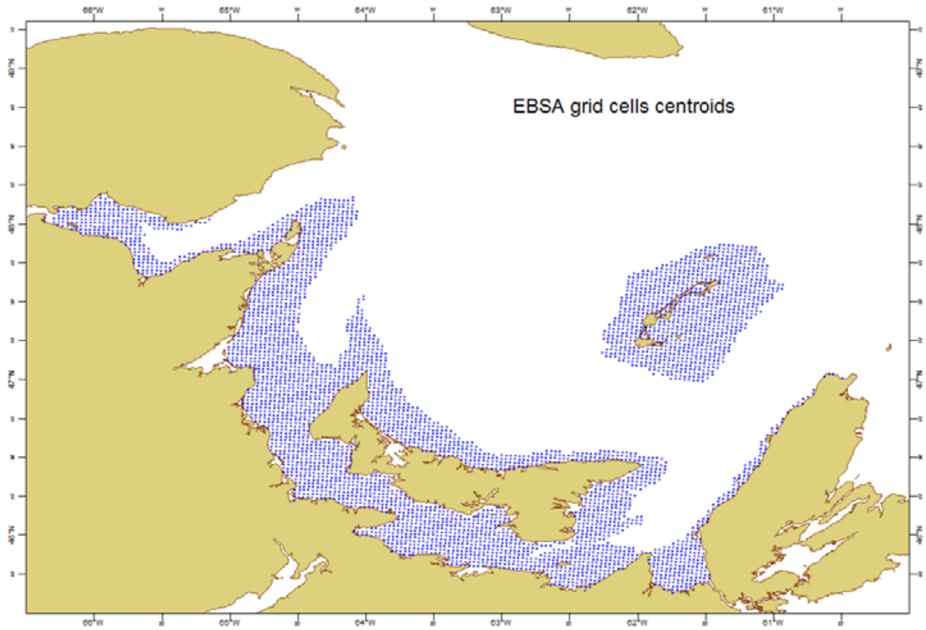


Figure 1. Map of the southern Gulf of St. Lawrence with the cell grid centroids between 0 and 40 m water depth, excluding cells within estuaries and semi-enclosed embayments.

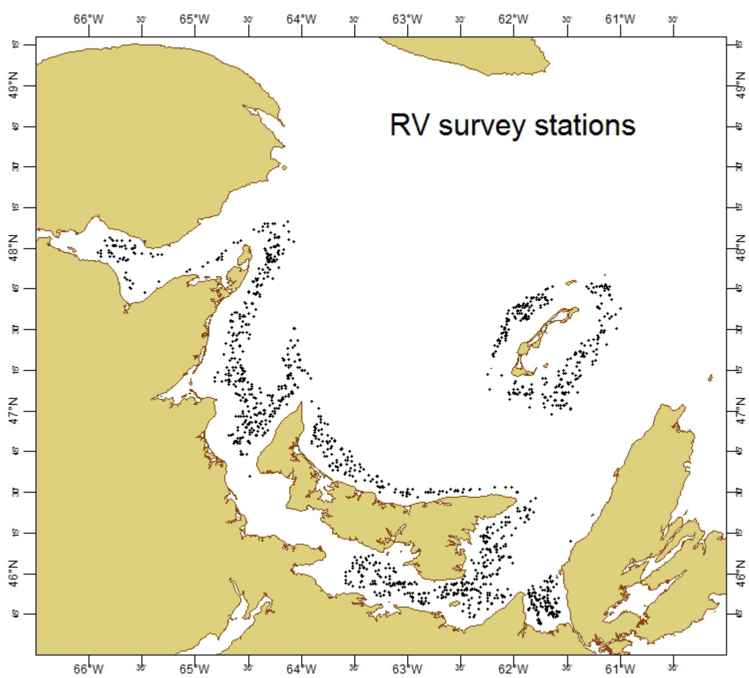


Figure 2. Map of the southern Gulf of St. Lawrence with the annual September bottom trawl survey (RV survey) sampling stations between 0 and 40 m deep, 1976 - 2013. Mid-tow locations were used for plotting the stations.

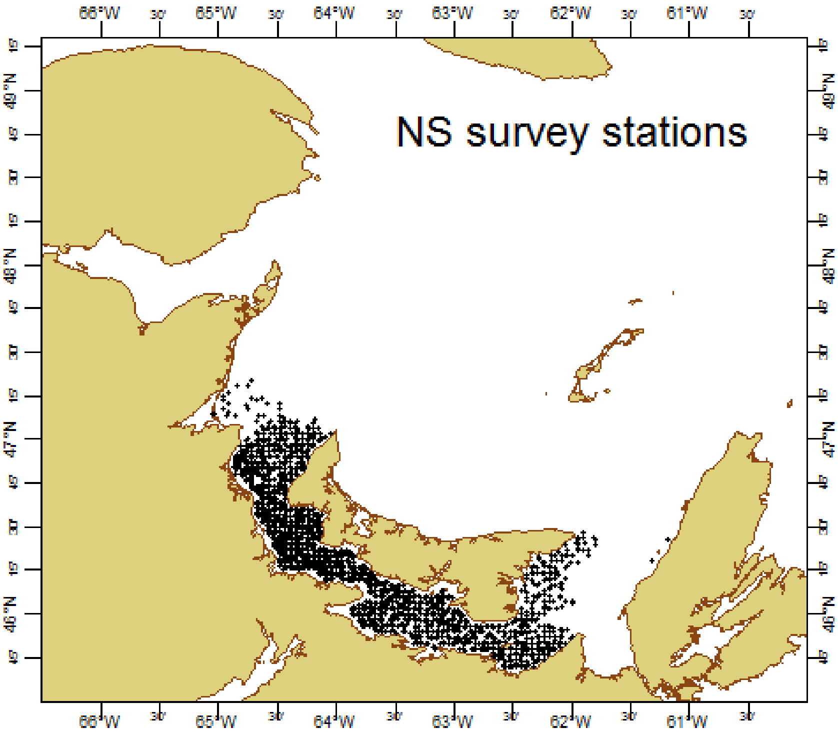


Figure 3. Map of the southern Gulf of St. Lawrence with the annual Northumberland Strait bottom trawl survey (NS survey) sampling stations between 0 and 40 m deep, 2000 - 2013. Mid-tow locations were used for plotting the stations.

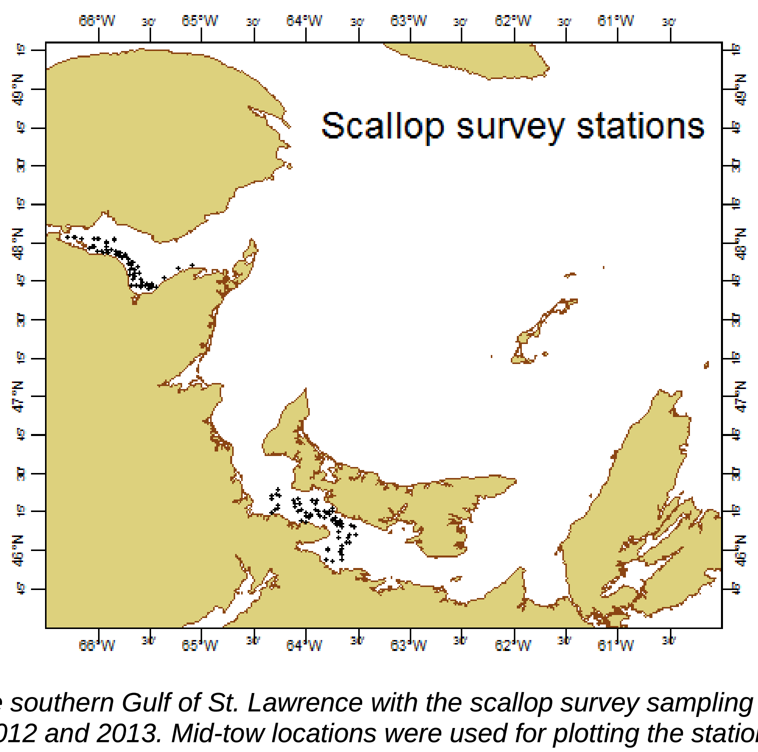


Figure 4. Map of the southern Gulf of St. Lawrence with the scallop survey sampling stations between 0 and 40 m deep in 2012 and 2013. Mid-tow locations were used for plotting the stations.

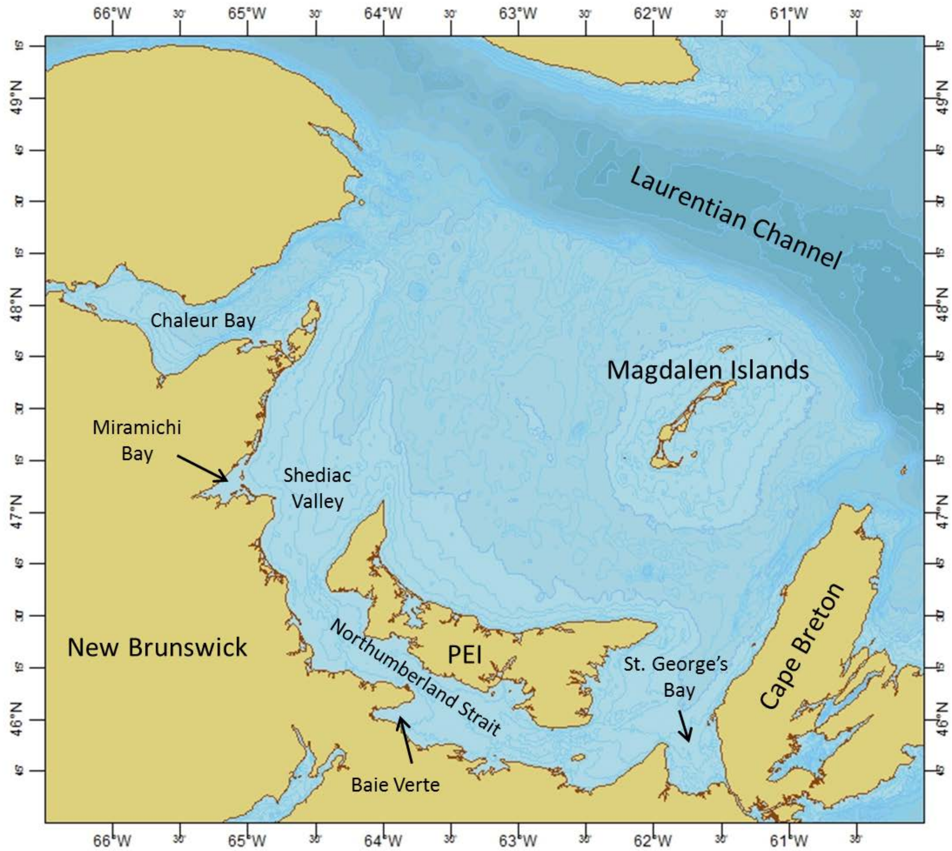


Figure 5. Map of the southern Gulf of St. Lawrence with place names identified. (Prince Edward Island = PEI).

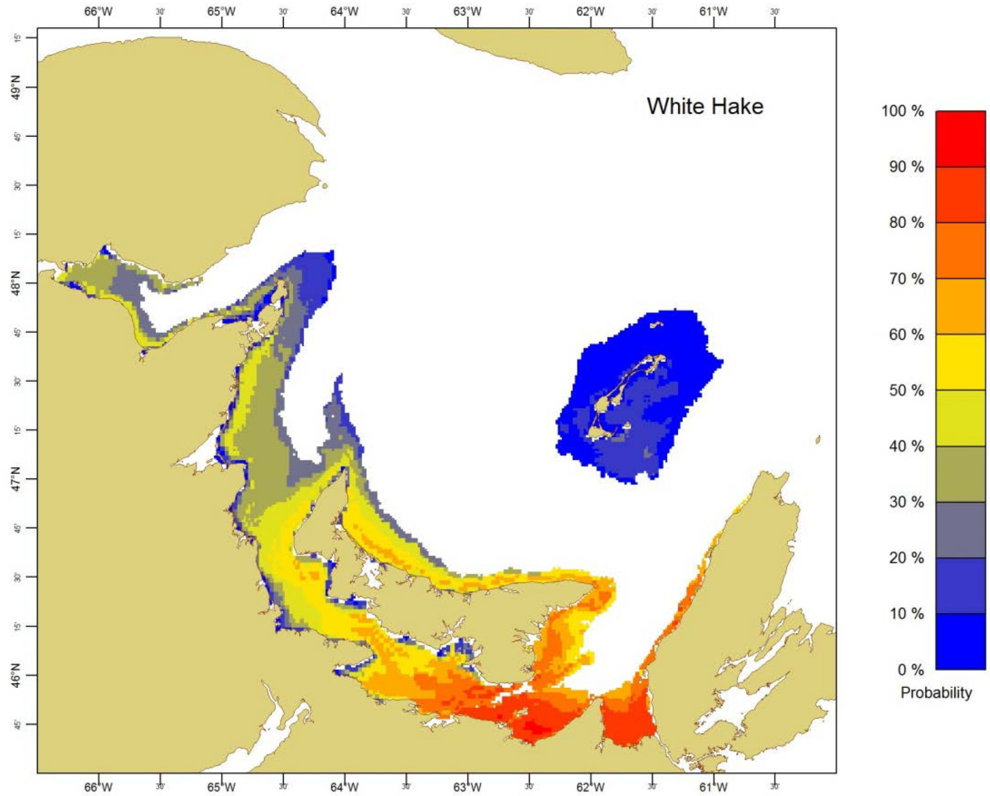


Figure 6. Contour map showing the predicted probabilities of capturing white hake (Urophycis tenuis) during a standard tow, using a Western IIA bottom trawl.

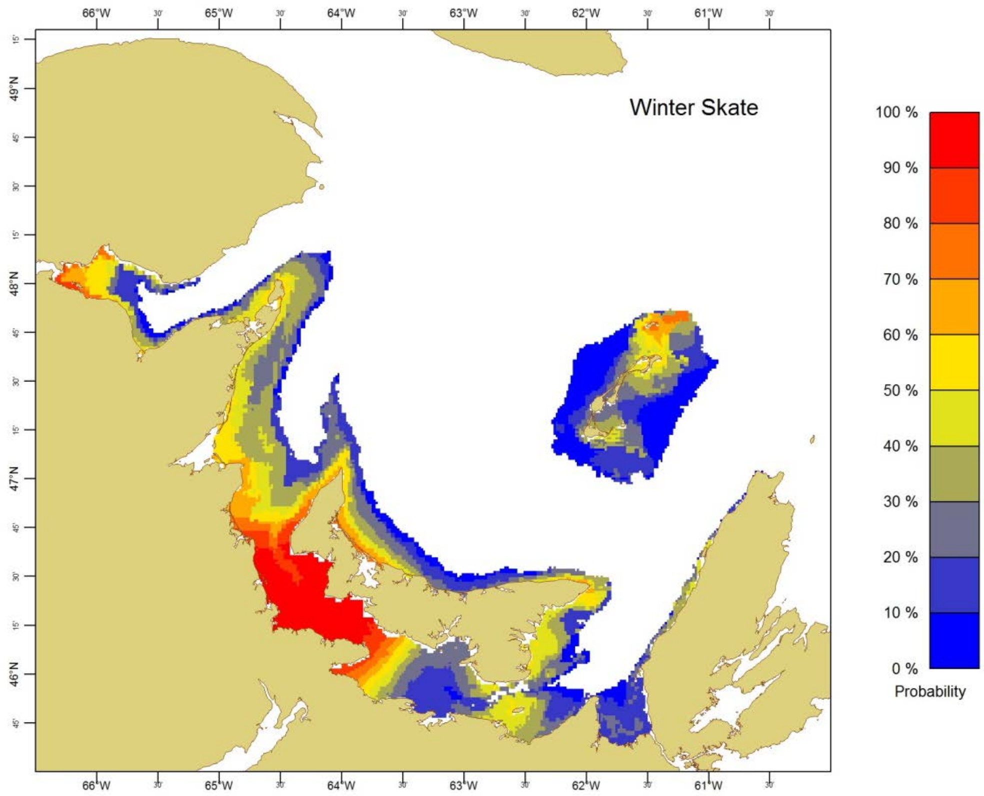


Figure 7. Contour map showing the predicted probabilities of capturing winter skate (Leucoraja ocellata) during a standard tow, using a Western IIA bottom trawl.

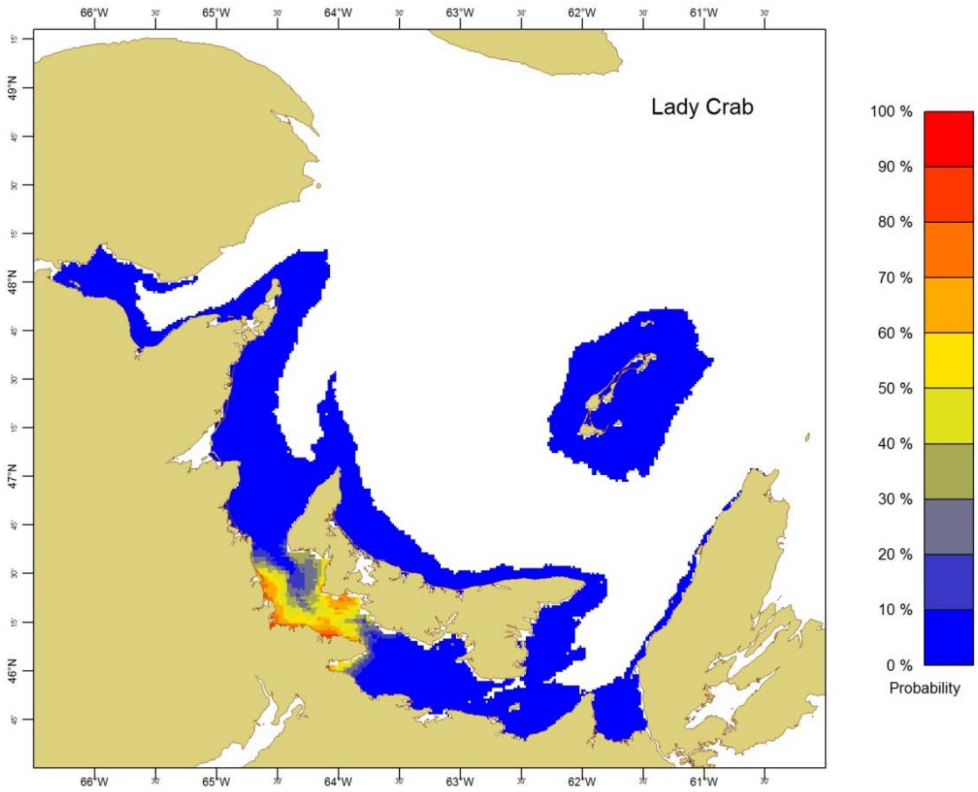


Figure 8. Contour map showing the predicted probabilities of capturing lady crab (Ovalipes ocellatus) during a standard tow, using a Nephrops trawl.

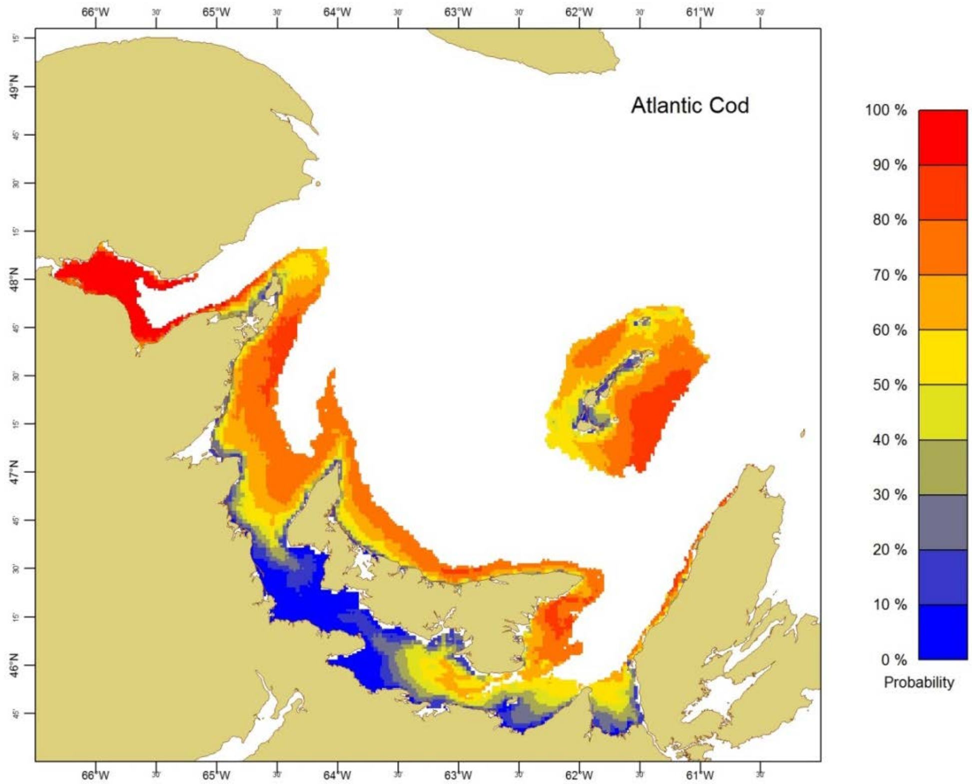


Figure 9. Contour map showing the predicted probabilities of capturing Atlantic cod (Gadus morhua) during a standard tow, using a Western IIA bottom trawl.

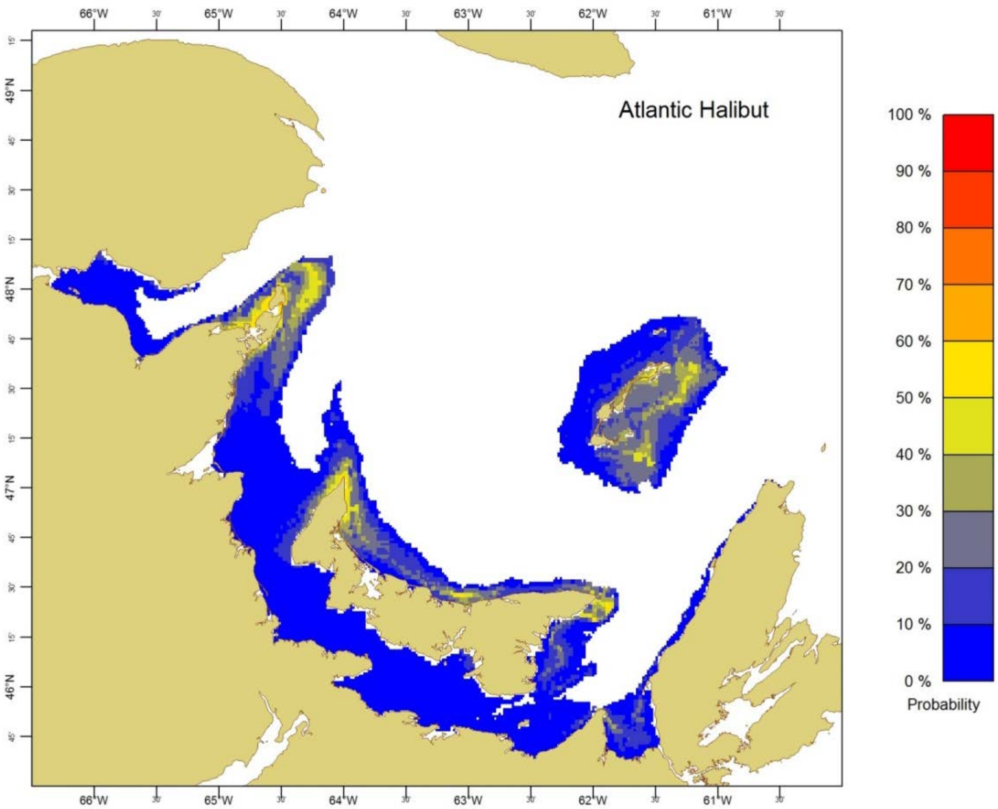


Figure 10. Contour map showing the predicted probabilities of capturing Atlantic halibut (Hippoglossus hippoglossus) during a standard tow, using a Western IIA bottom trawl.

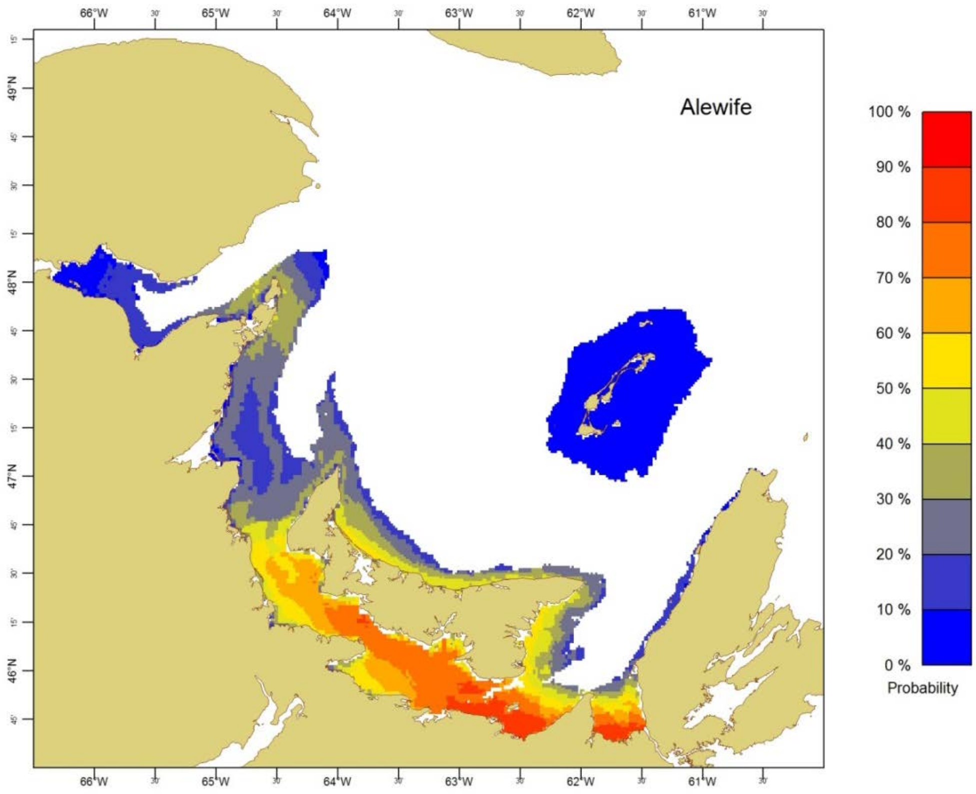


Figure 11. Contour map showing the predicted probabilities of capturing Alewife (Alosa pseudoharengus) during a standard tow, using a Western IIA bottom trawl.

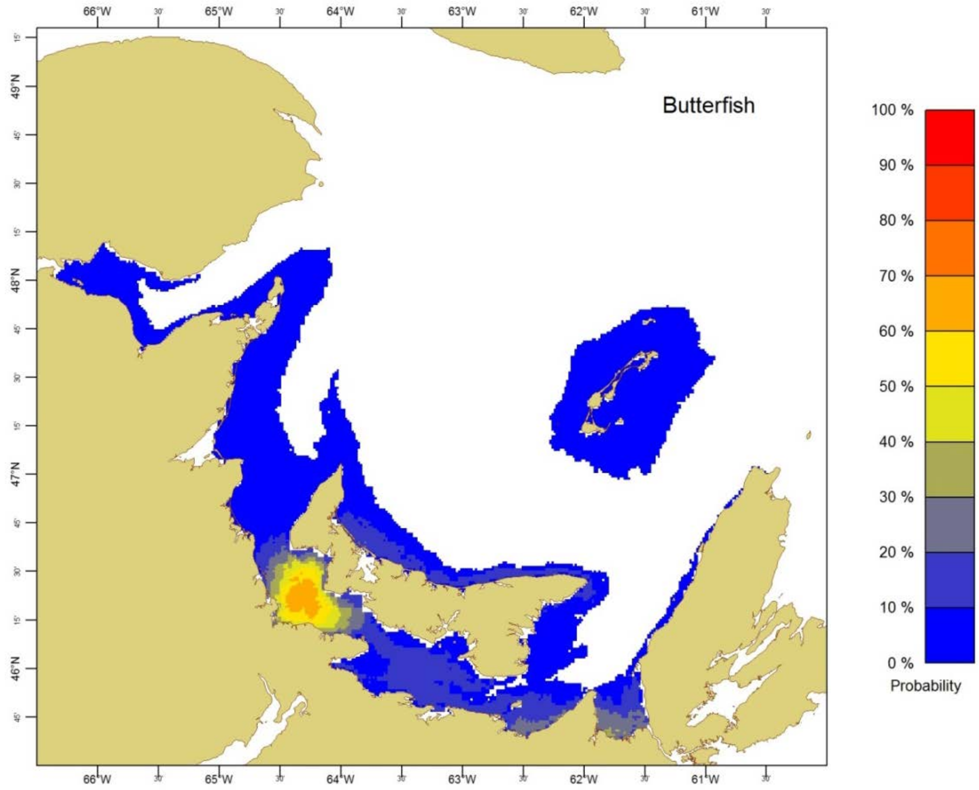


Figure 12. Contour map showing the predicted probabilities of capturing Butterfish (Peprilus triacanthus) during a standard tow, using a Western IIA bottom trawl.

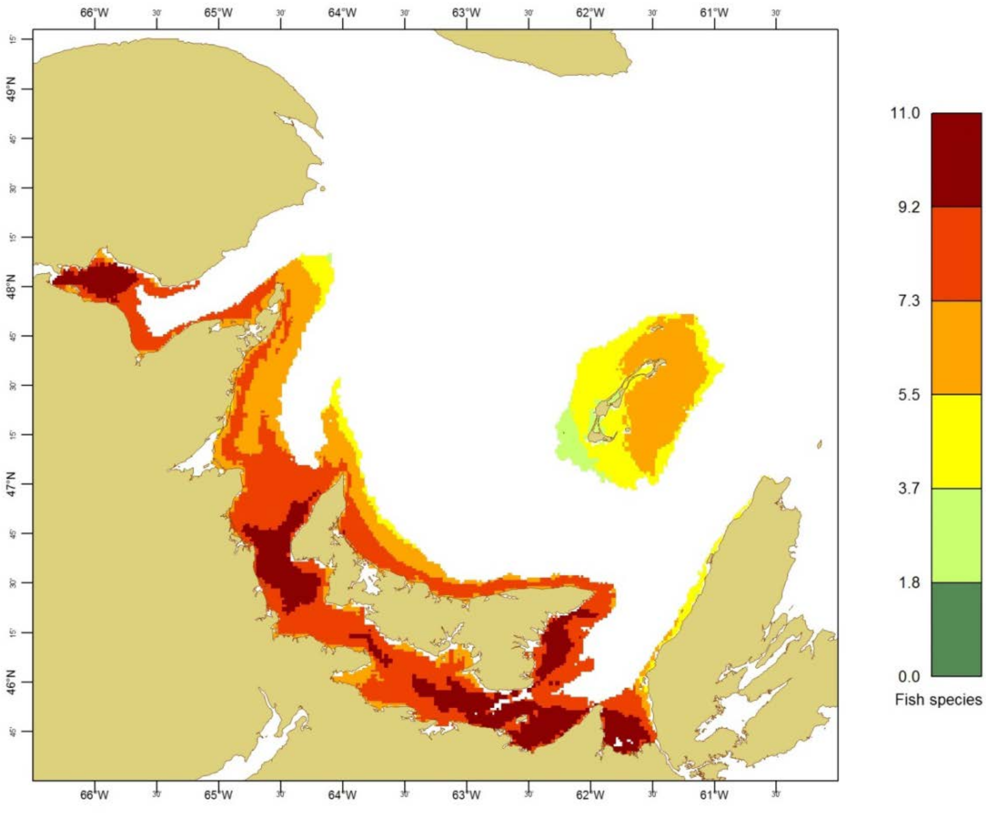


Figure 13. Pseudo-diversity contour map based on the 32 fish species examined.

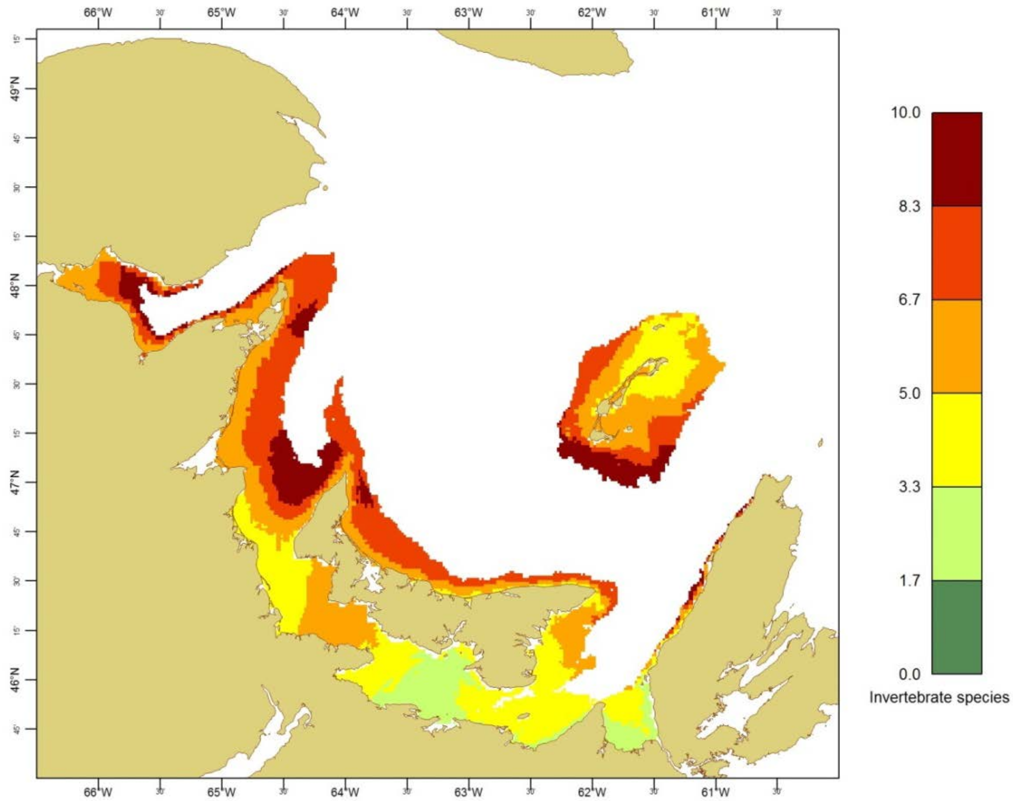


Figure 14. Pseudo-diversity contour map based on the 23 invertebrate species examined.

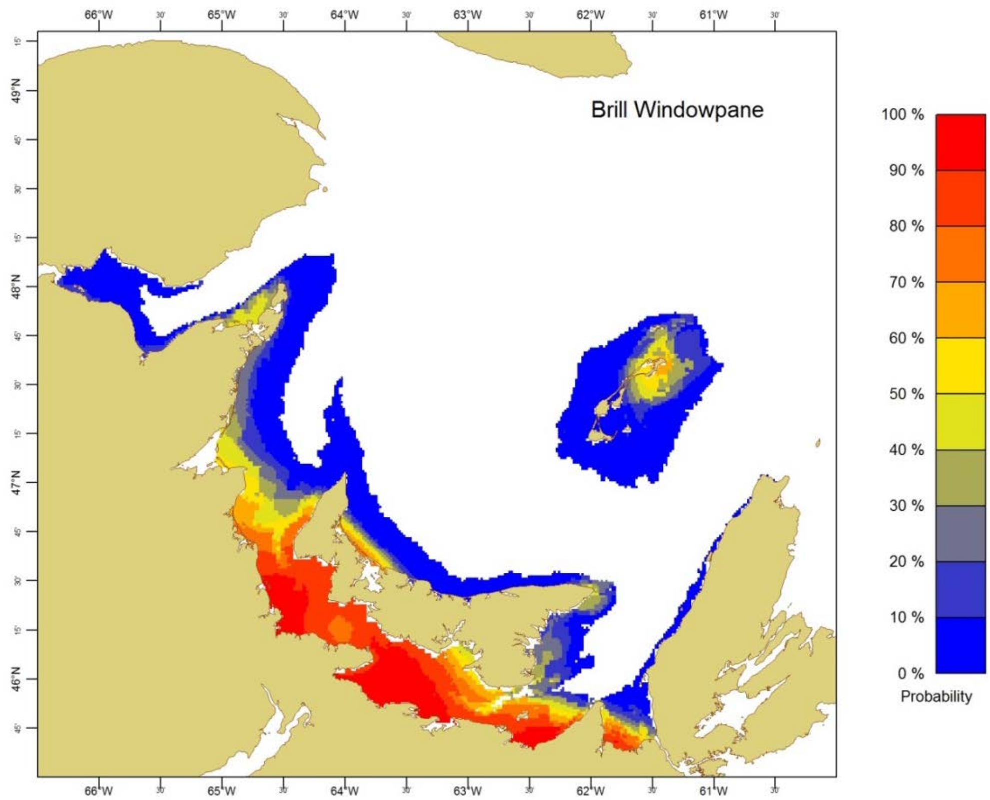


Figure 15. Contour map showing the predicted probabilities of capturing windowpane (Scophthalmus aquosus) during a standard tow, using a Western IIA bottom trawl.

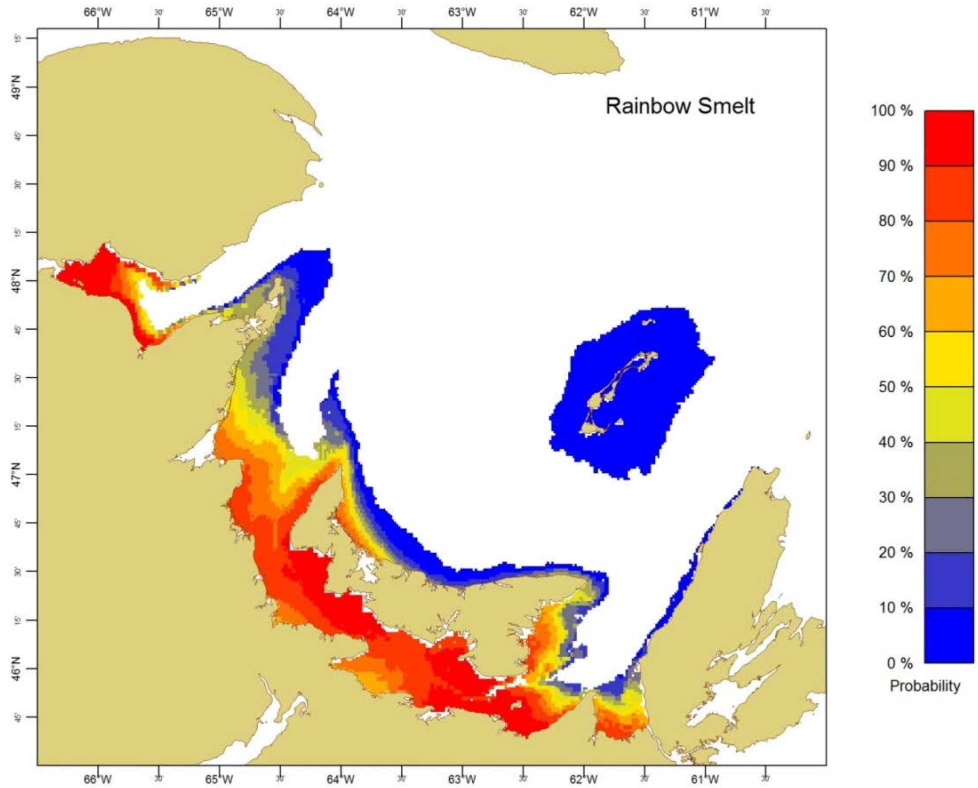


Figure 16. Contour map showing the predicted probabilities of capturing rainbow smelt (Osmerus mordax) during a standard tow, using a Western IIA bottom trawl.

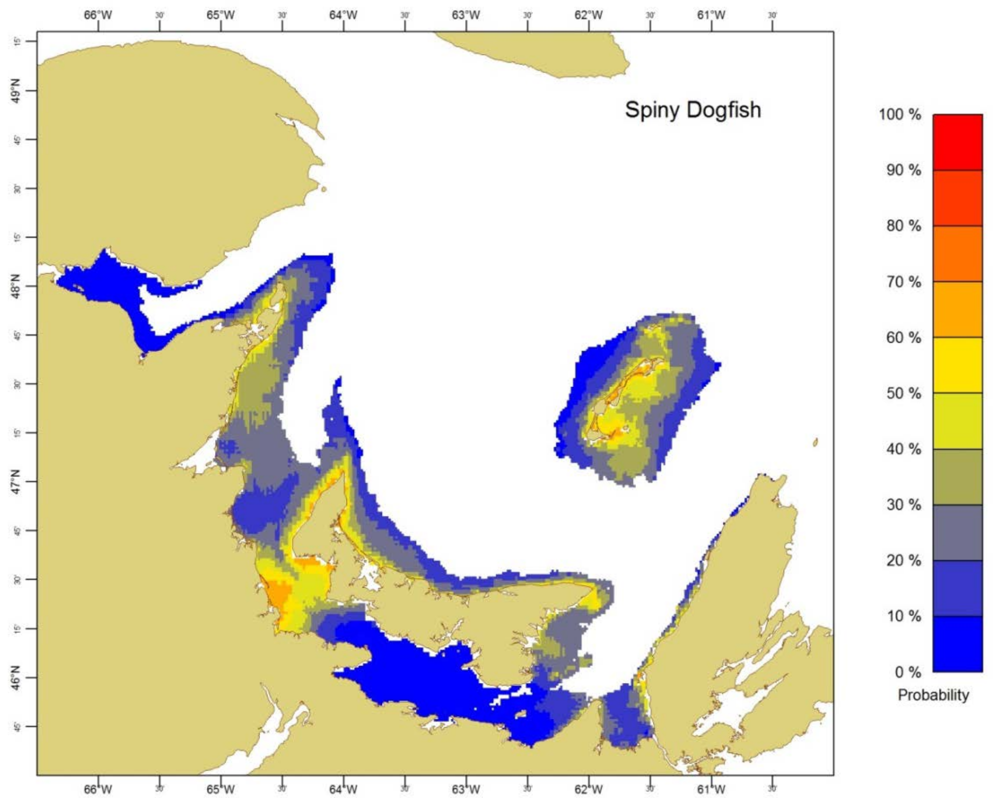


Figure 17. Contour map showing the predicted probabilities of capturing spiny dogfish (Squalus acanthias) during a standard tow, using a Western IIA bottom trawl.

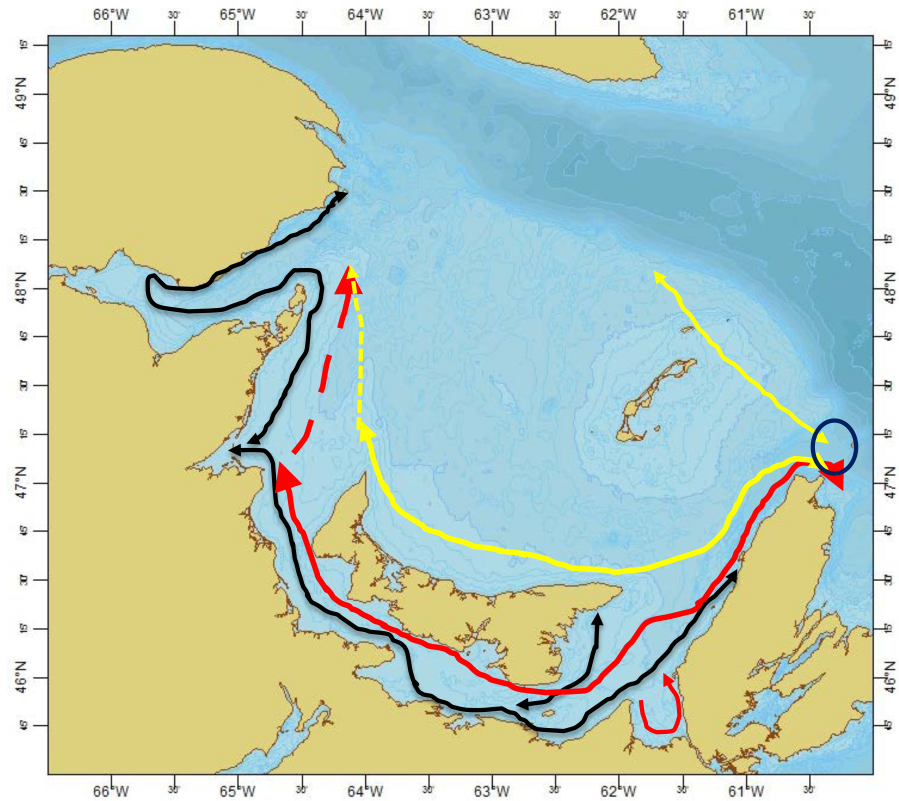
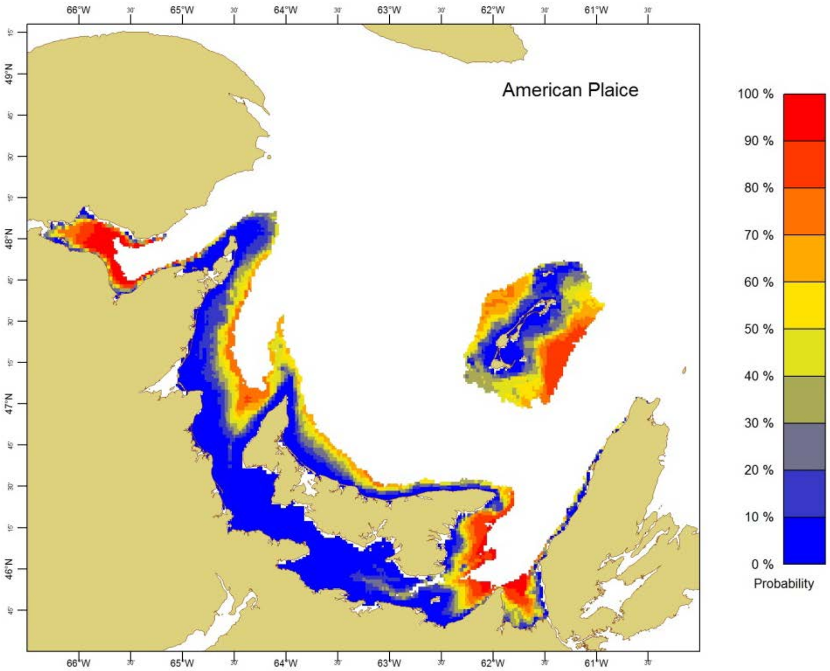


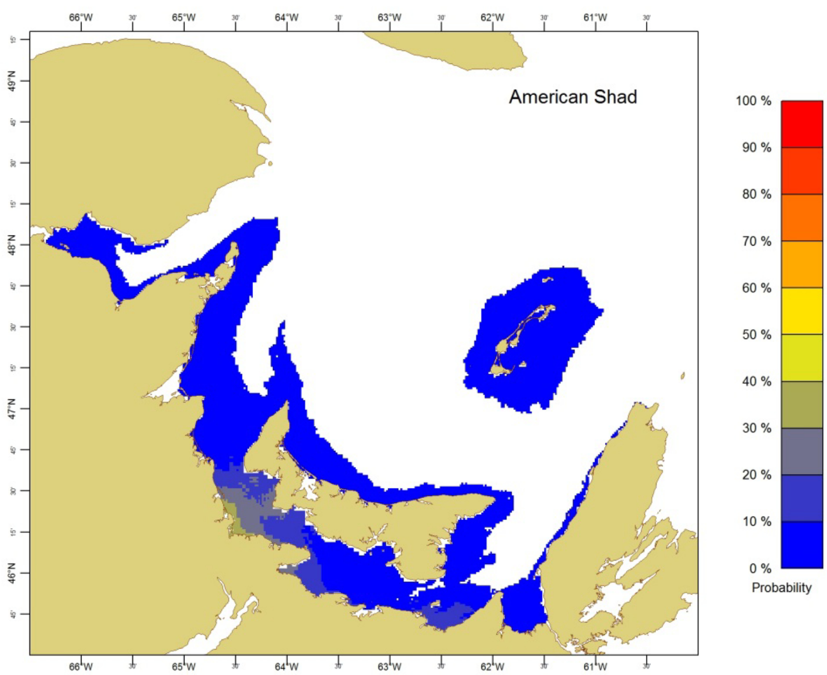
Figure 18. Major migration corridors for striped bass (black) and long distance migrants (red and yellow) with the most important route for anadromous species shown in red. The choke point through which most species presumably pass to exit the Gulf of St. Lawrence (southern route) is indicated by a dark blue circle between the tip of Cape Breton and St. Paul Island. NB. Striped bass migrate very close to shore, usually within several hundred meters, but this could not be shown to scale.

APPENDICES

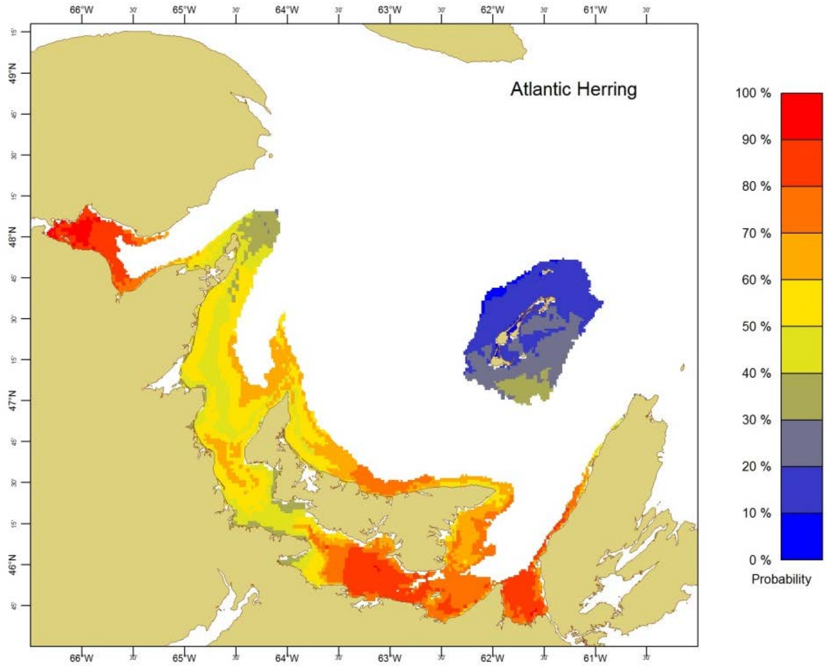
APPENDIX 1: CONTOUR MAPS OF DISTRIBUTION OF FISH AND INVERTEBRATES SPECIES



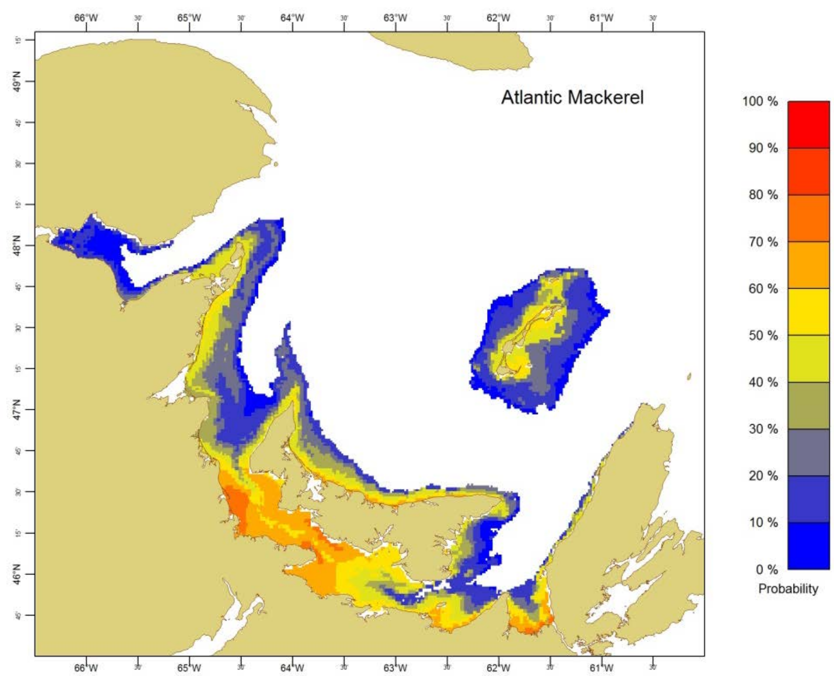
Map 1. Contour map showing the predicted probabilities of capturing American plaice (Hippogloissoides platessoides) during a standard tow, using a Western IIA bottom trawl.



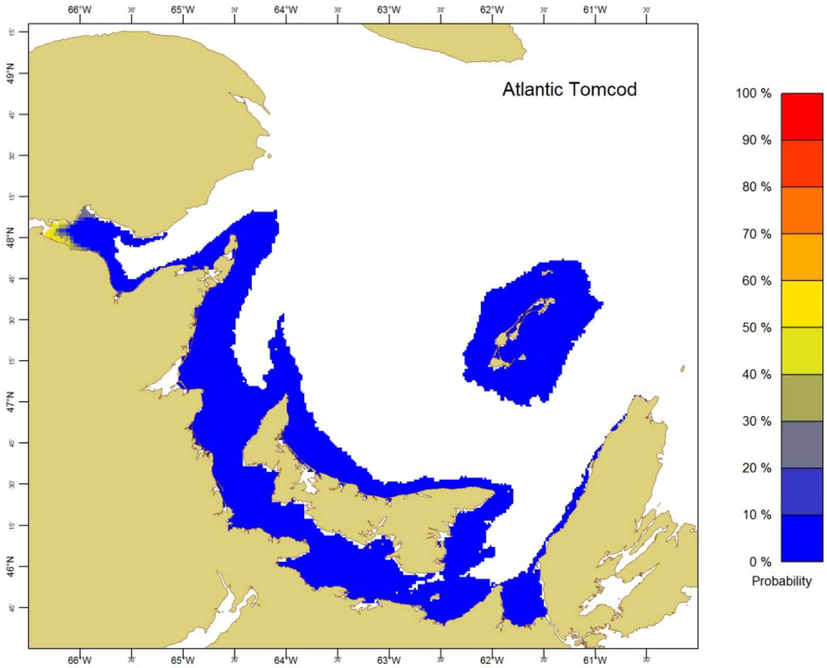
Map 2. Contour map showing the predicted probabilities of capturing American shad (Alosa sapidissima) during a standard tow, using a Western IIA bottom trawl.



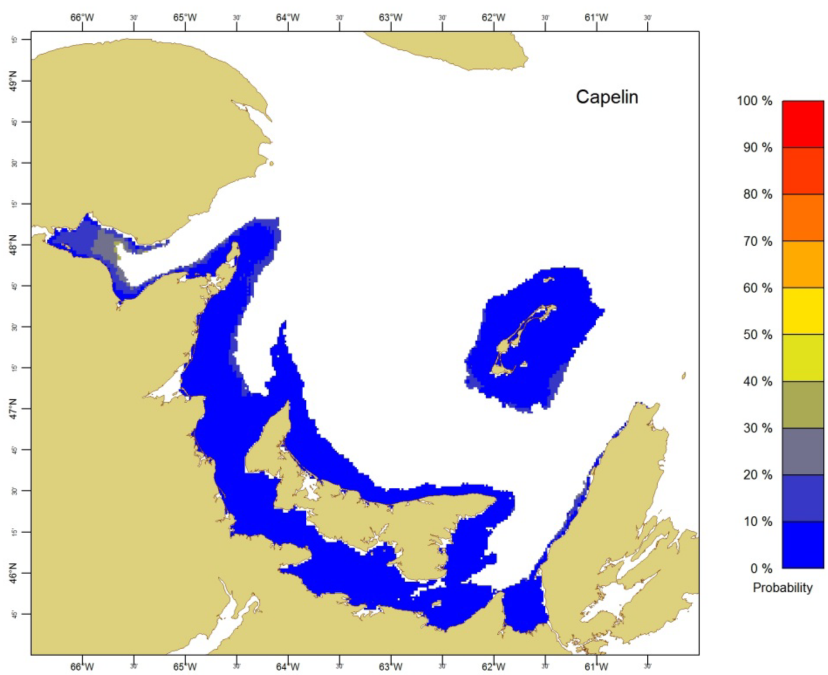
Map 3. Contour map showing the predicted probabilities of capturing Atlantic herring (Clupea harengus) during a standard tow, using a Western IIA bottom trawl.



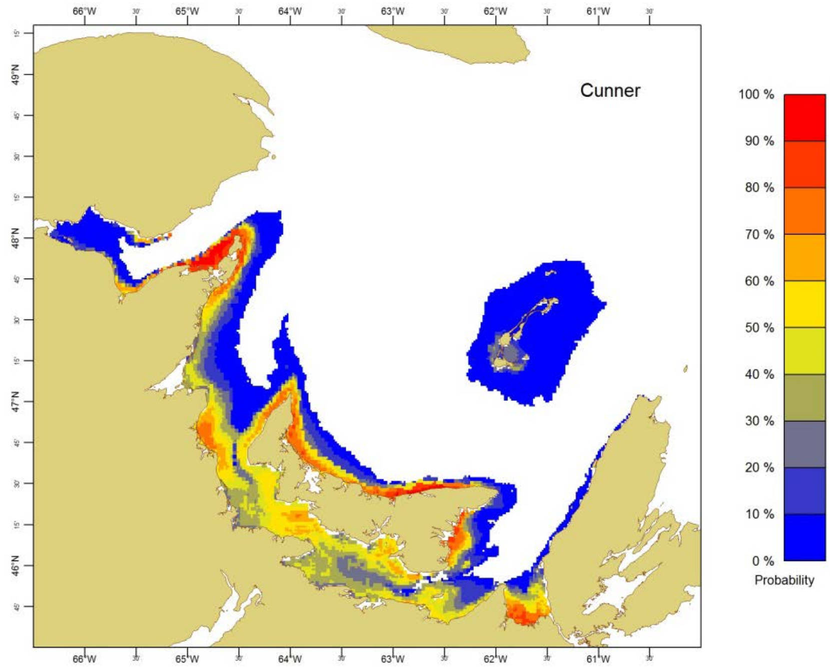
Map 4. Contour map showing the predicted probabilities of capturing Atlantic mackerel (Scomber scombrus) during a standard tow, using a Western IIA bottom trawl.



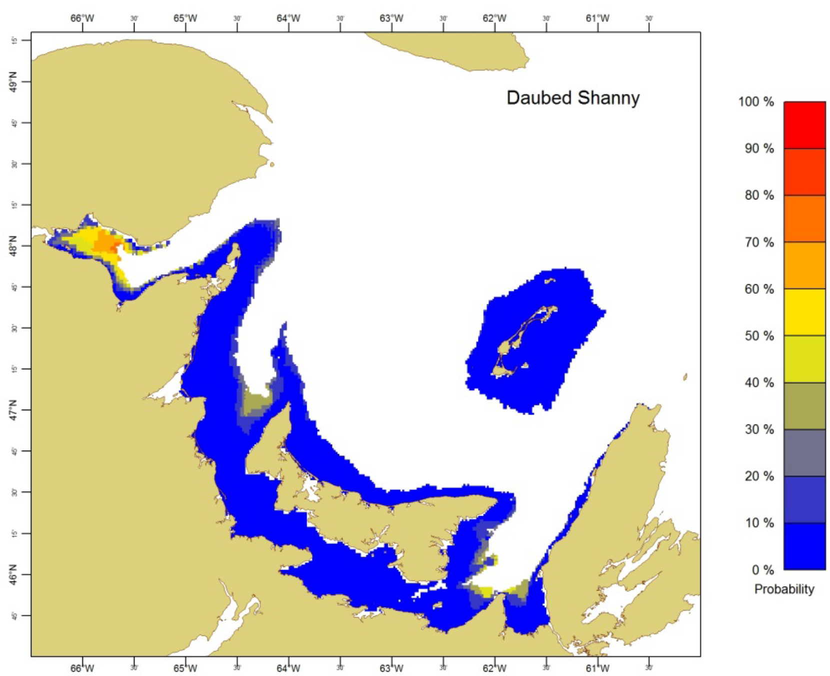
Map 5. Contour map showing the predicted probabilities of capturing Atlantic tomcod (Microgadus tomcod) during a standard tow, using a Western IIA bottom trawl.



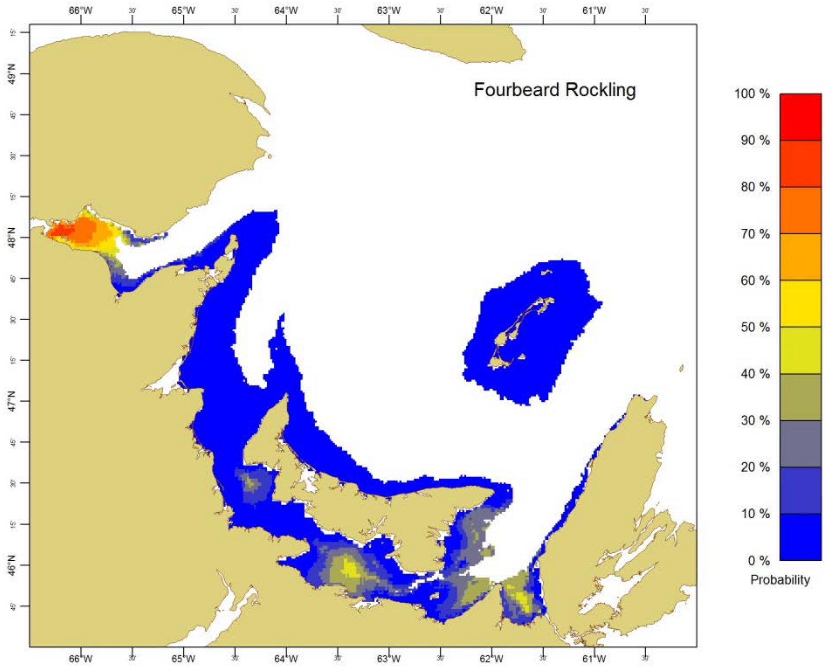
Map 6. Contour map showing the predicted probabilities of capturing capelin (Mallotus villosus) during a standard tow, using a Western IIA bottom trawl.



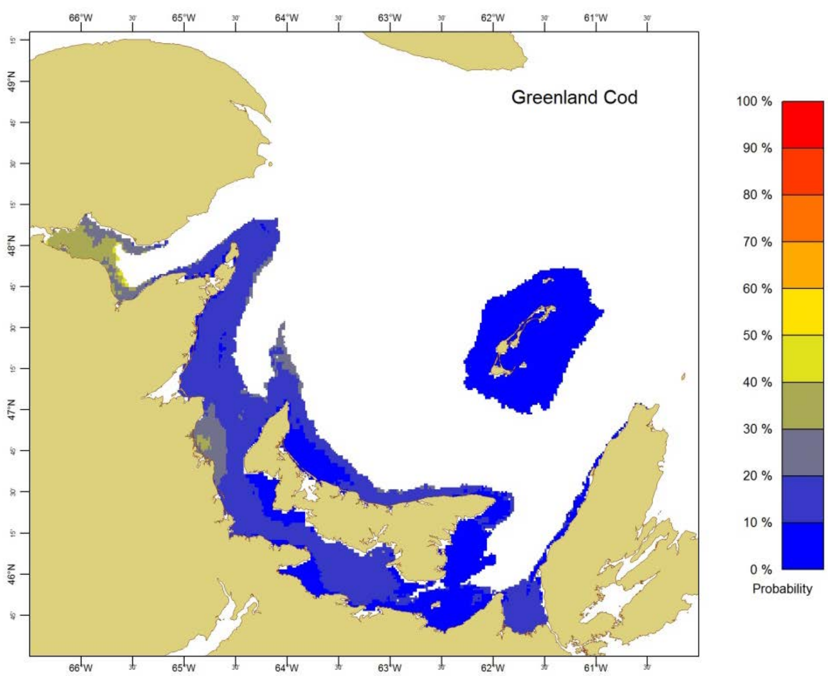
Map 7. Contour map showing the predicted probabilities of capturing cunner (Tautoglabrus adspersus) during a standard tow, using a Western IIA bottom trawl.



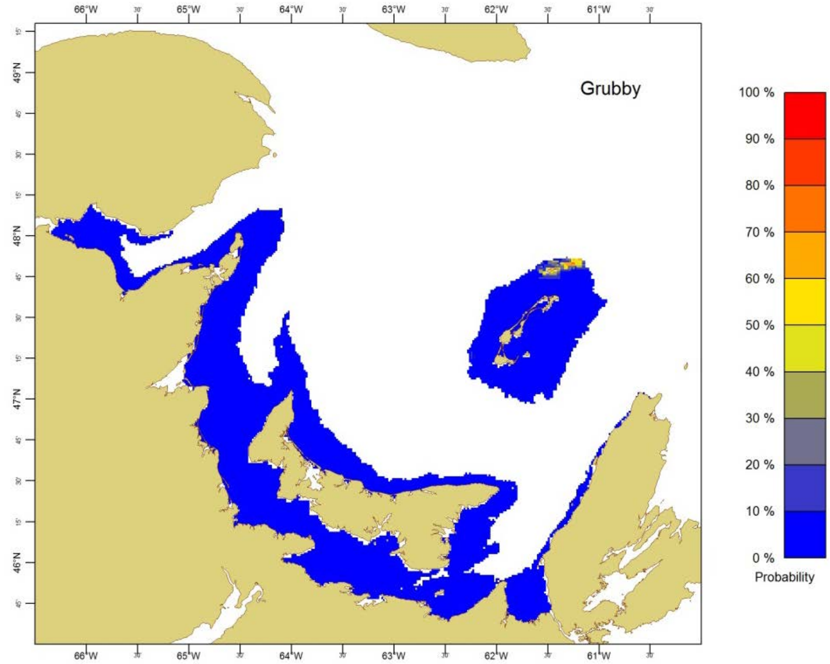
Map 8. Contour map showing the predicted probabilities of capturing daubed shanny (Leptoclinus maculatus) during a standard tow, using a Western IIA bottom trawl.



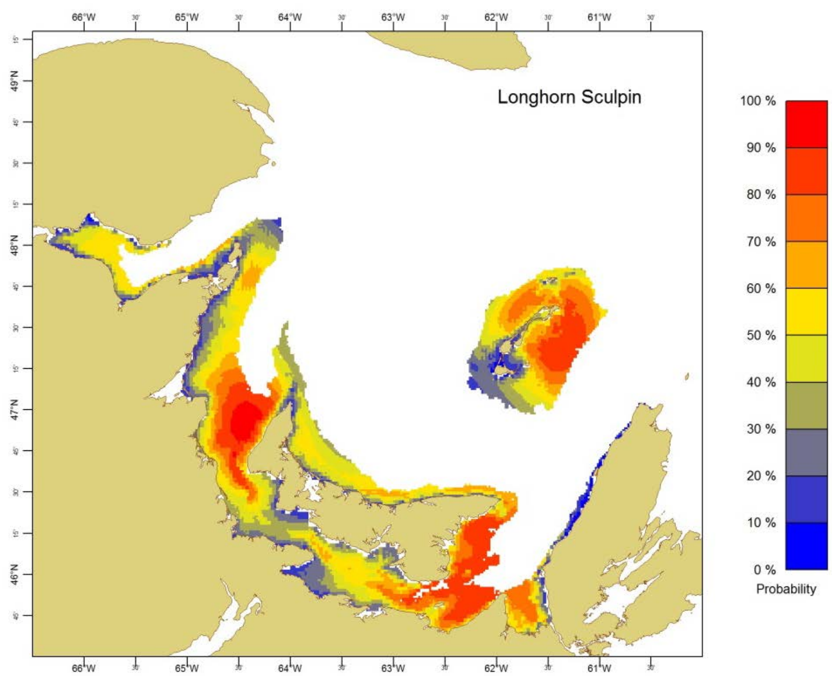
Map 9. Contour map showing the predicted probabilities of capturing fourbeard rockling (Enchelyopus cimbrius) during a standard tow, using a Western IIA bottom trawl.



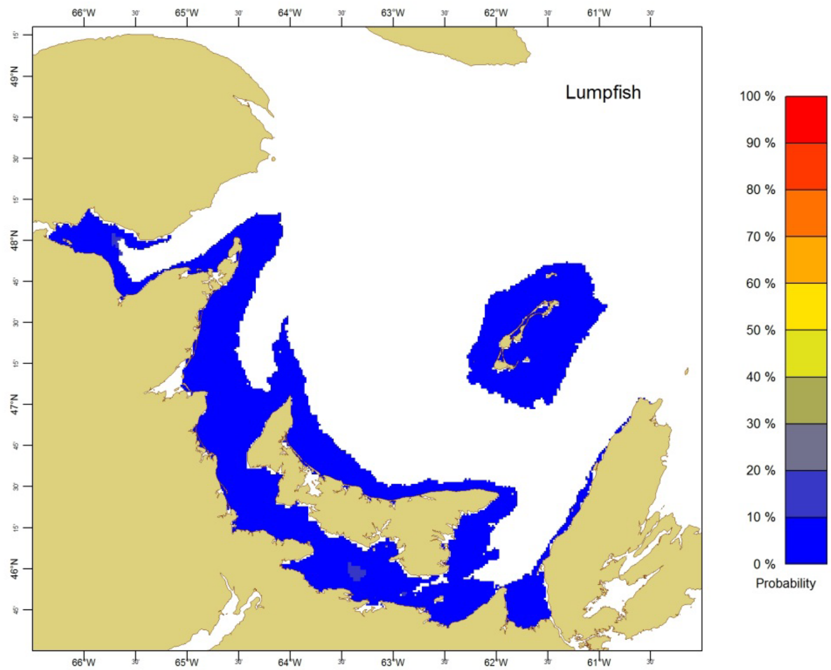
Map 10. Contour map showing the predicted probabilities of capturing Greenland cod (Gadus ogac) during a standard tow, using a Western IIA bottom trawl.



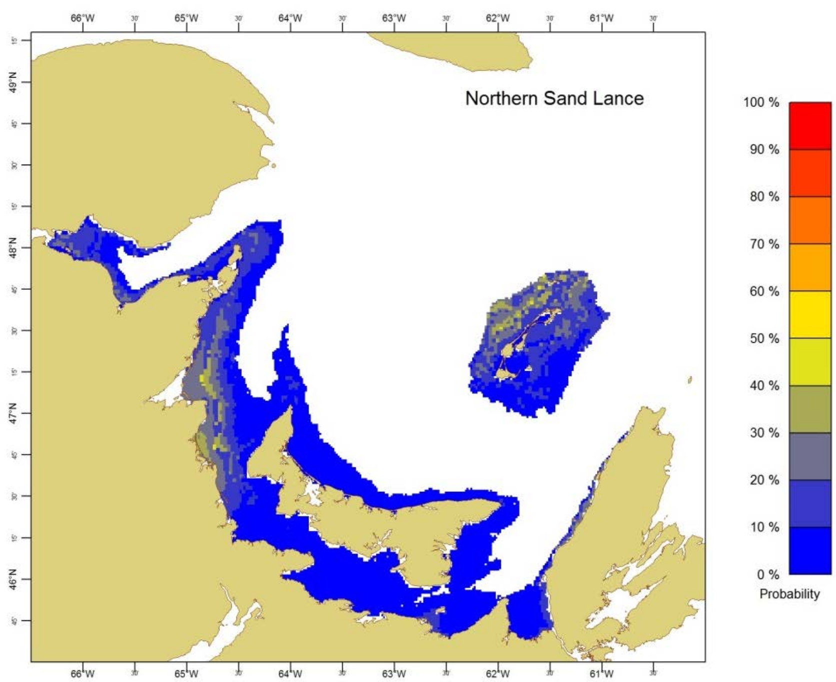
Map 11. Contour map showing the predicted probabilities of capturing grubby (Myoxocephalus aenaeus) during a standard tow, using a Western IIA bottom trawl.



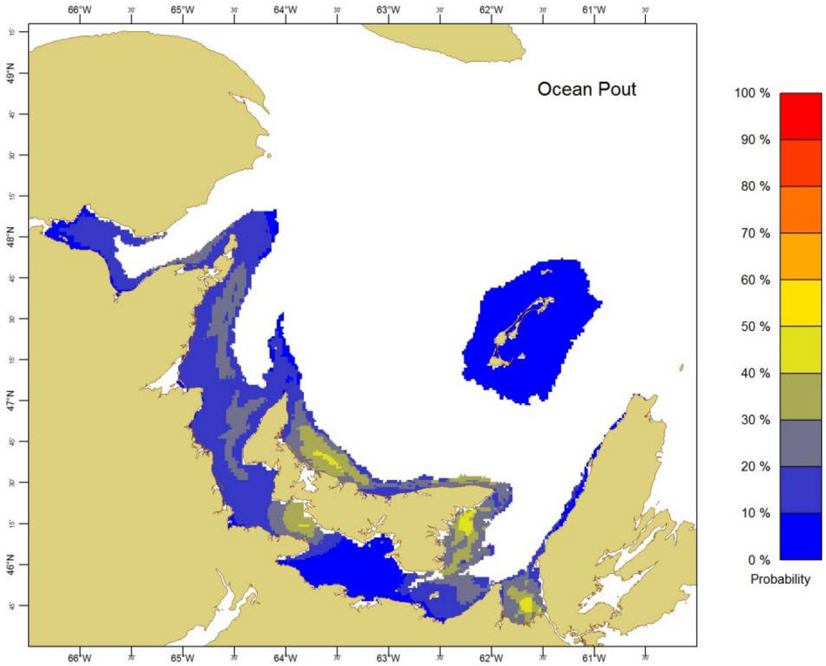
Map 12. Contour map showing the predicted probabilities of capturing longhorn sculpin (Myoxocephalus octodecemspinosus) during a standard tow, using a Western IIA bottom trawl.



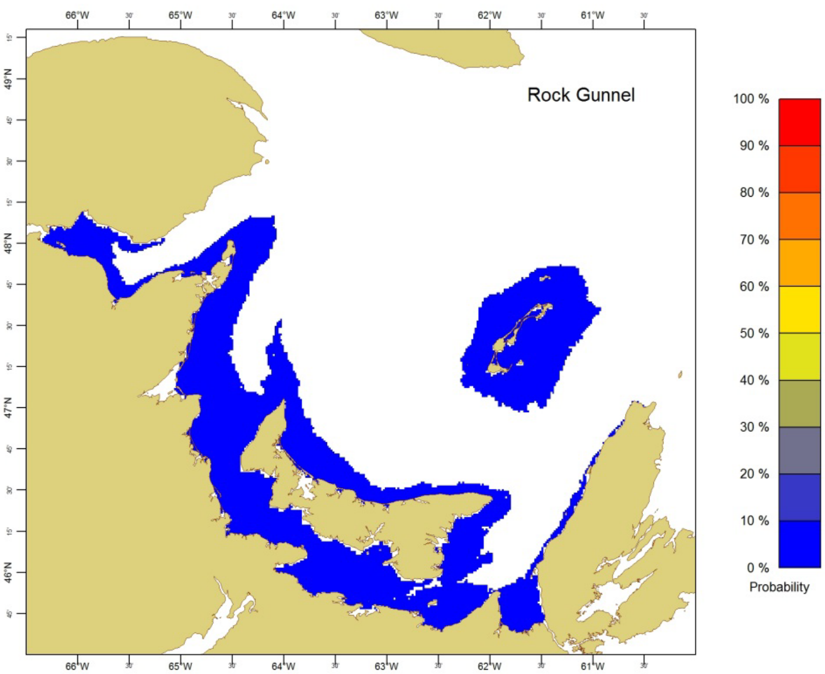
Map 13. Contour map showing the predicted probabilities of capturing lumpfish (Cyclopterus lumpus) during a standard tow, using a Western IIA bottom trawl.



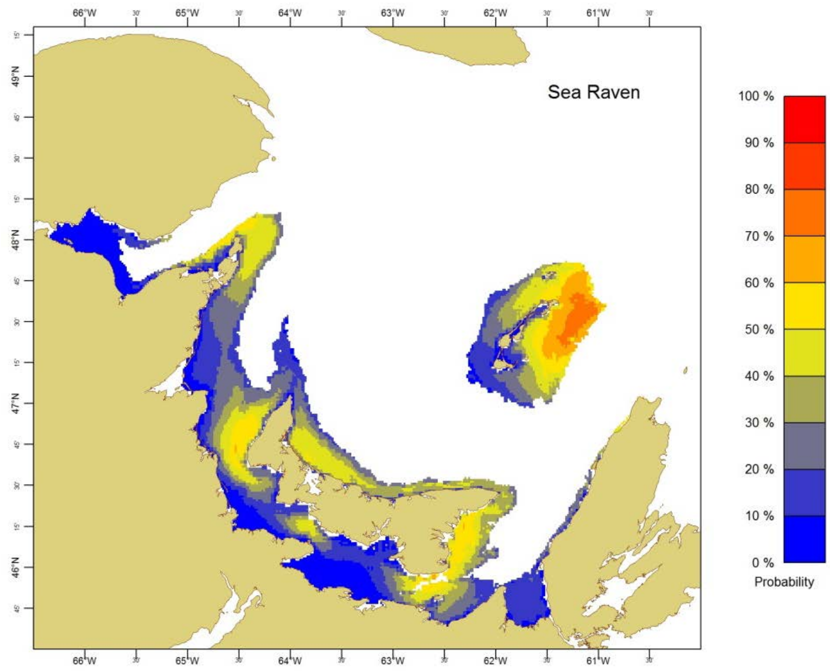
Map 14. Contour map showing the predicted probabilities of capturing northern sand lance (Ammodytes sp.) during a standard tow, using a Western IIA bottom trawl.



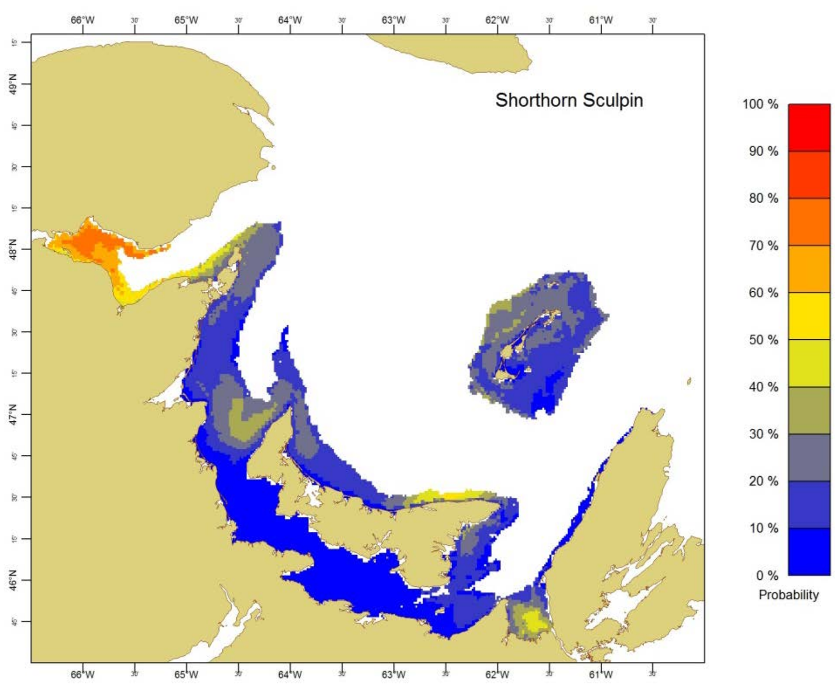
Map 15. Contour map showing the predicted probabilities of capturing ocean pout (Zoarces americanus) during a standard tow, using a Western IIA bottom trawl.



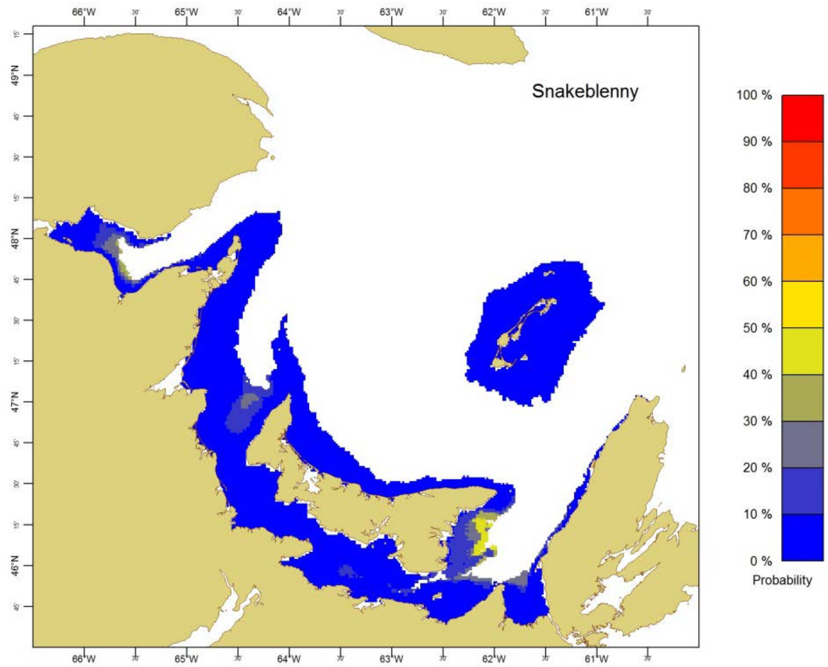
Map 16. Contour map showing the predicted probabilities of capturing rock gunnel (Pholis gunnelus) during a standard tow, using a Western IIA bottom trawl.



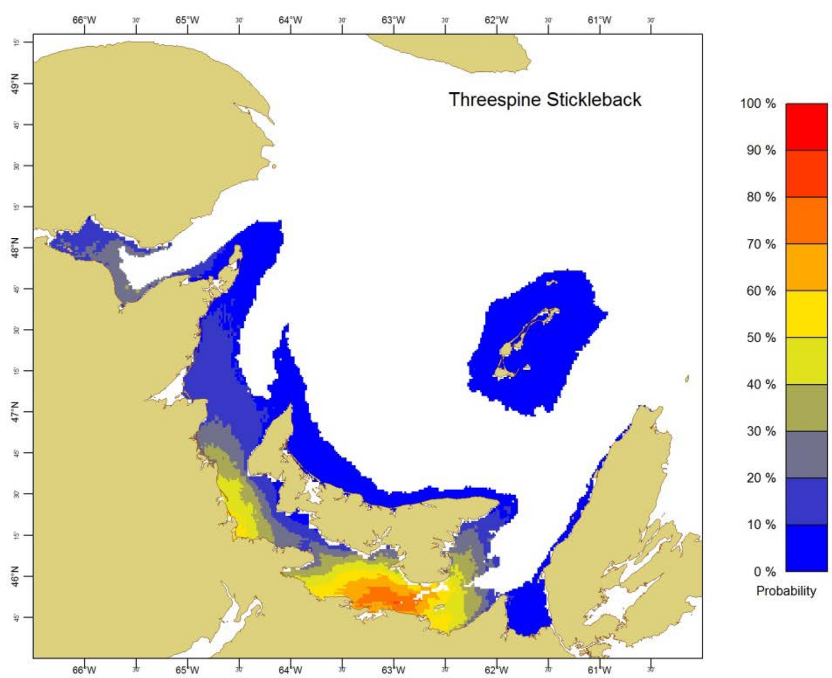
Map 17. Contour map showing the predicted probabilities of capturing sea raven (Hemitripterus americanus) during a standard tow, using a Western IIA bottom trawl.



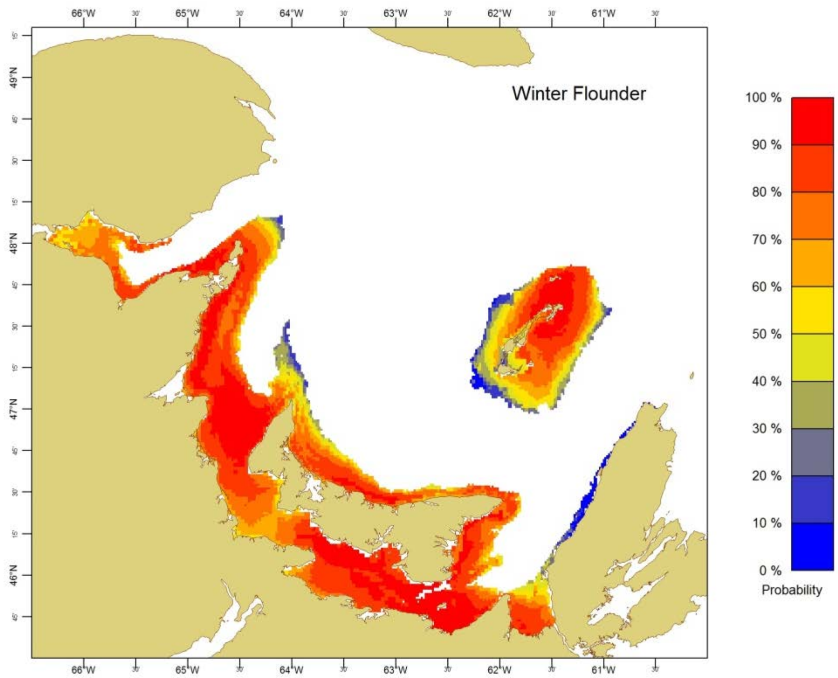
Map 18. Contour map showing the predicted probabilities of capturing shorthorn sculpin (Myoxocephalus scorpius) during a standard tow, using a Western IIA bottom trawl.



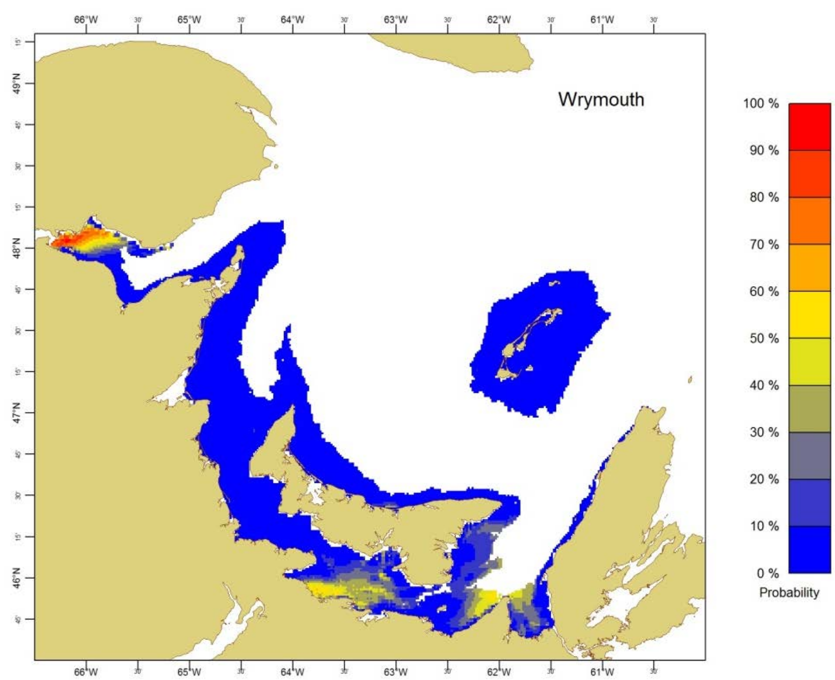
Map 19. Contour map showing the predicted probabilities of capturing snakeblenny (Lumpenus lampretaeformis) during a standard tow, using a Western IIA bottom trawl.



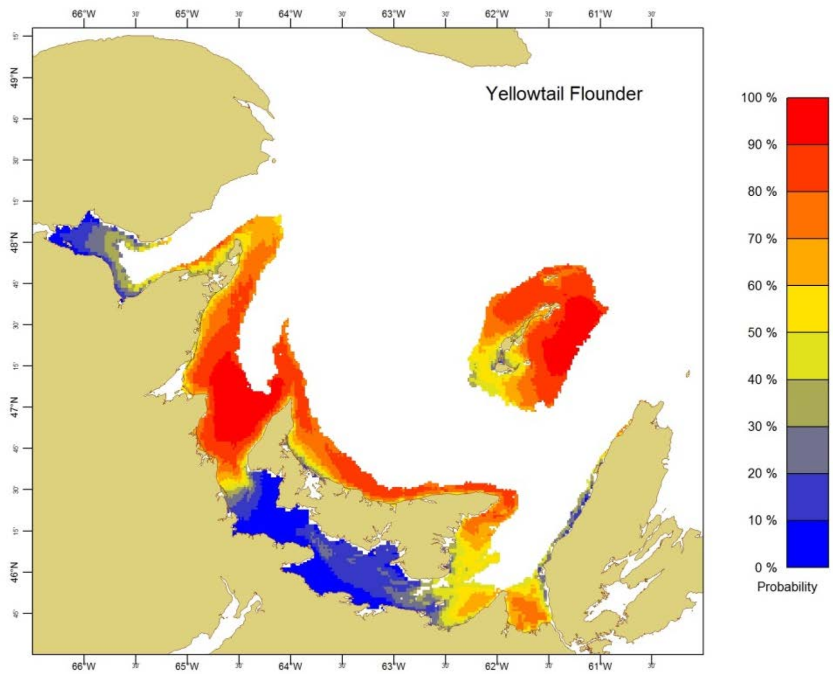
Map 20. Contour map showing the predicted probabilities of capturing threespine stickleback (Gasterosteus aculeatus) during a standard tow, using a Western IIA bottom trawl.



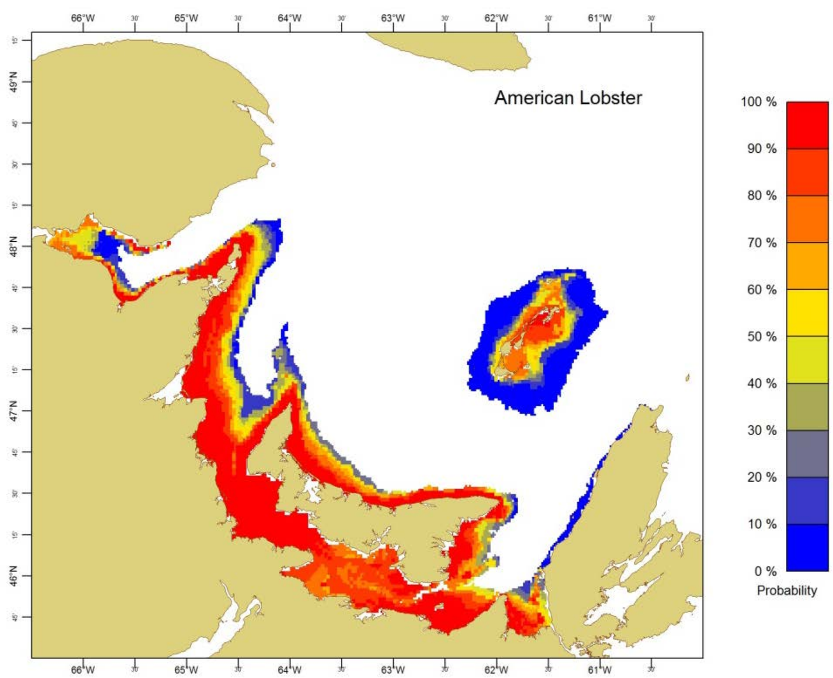
Map 21. Contour map showing the predicted probabilities of capturing winter flounder (Pseudopleuronectes americanus) during a standard tow, using a Western IIA bottom trawl.



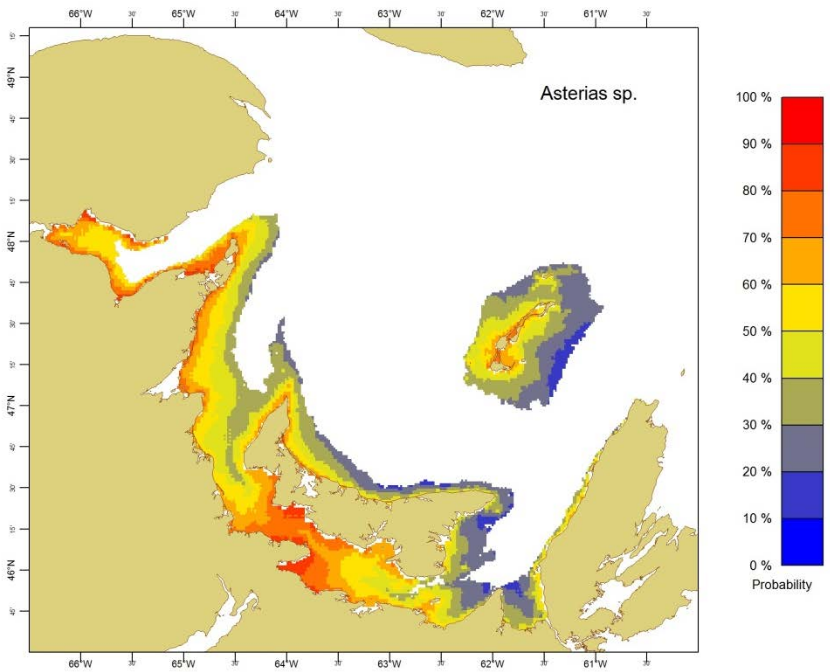
Map 22. Contour map showing the predicted probabilities of capturing wrymouth (Cryptacanthodes maculatus) during a standard tow, using a Western IIA bottom trawl.



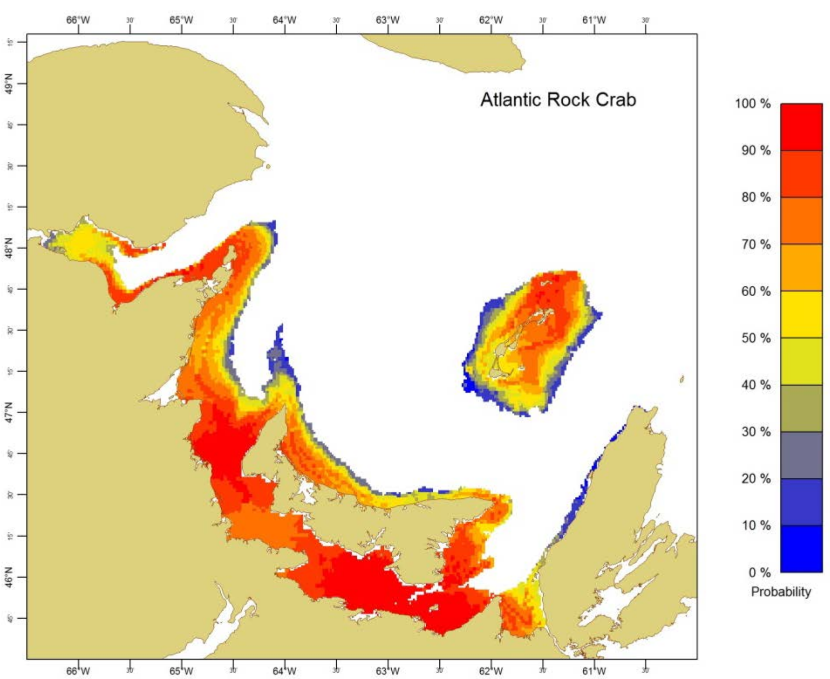
Map 23. Contour map showing the predicted probabilities of capturing yellowtail flounder (Limanda ferruginea) during a standard tow, using a Western IIA bottom trawl.



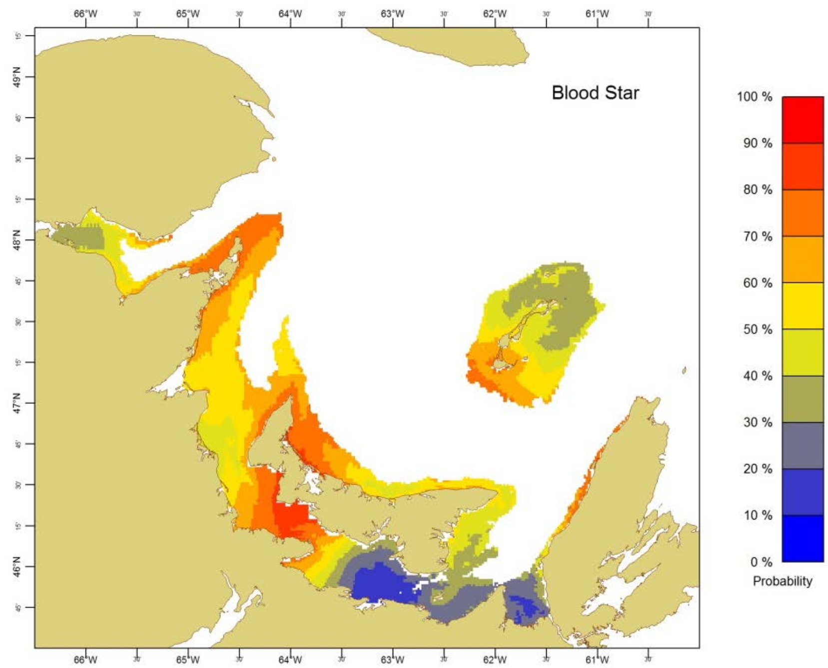
Map 24. Contour map showing the predicted probabilities of capturing American lobster (Homarus americanus) during a standard tow, using a Western IIA bottom trawl.



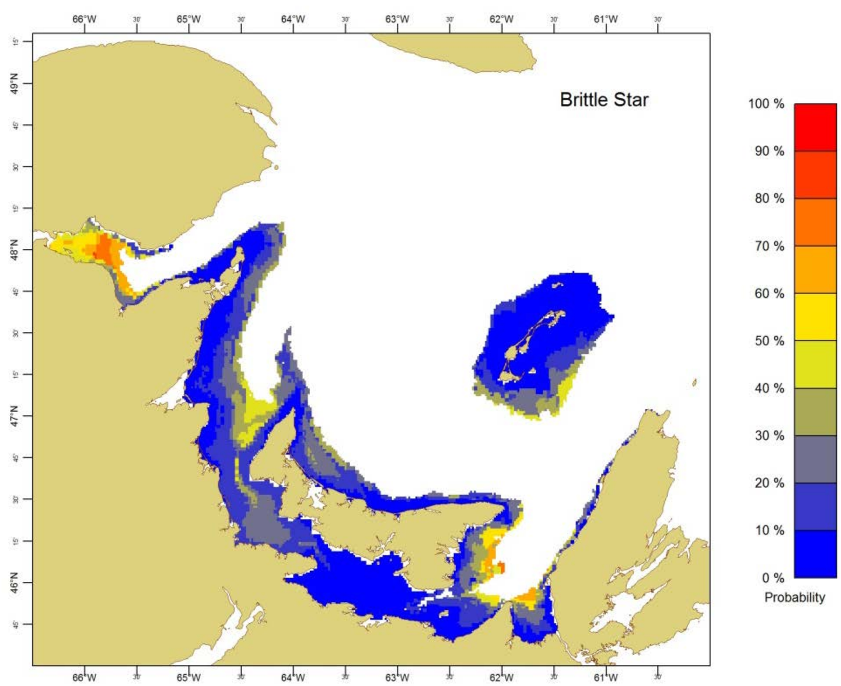
Map 25. Contour map showing the predicted probabilities of capturing asterias (Asterias sp.) during a standard tow, using a Western IIA bottom trawl.



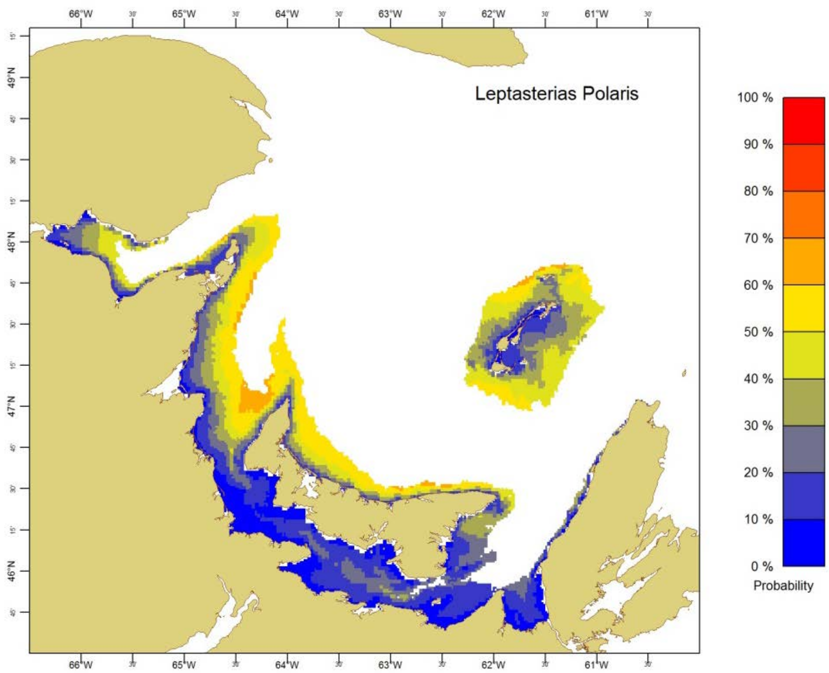
Map 26. Contour map showing the predicted probabilities of capturing Atlantic rock crab (Cancer irroratus) during a standard tow, using a Western IIA bottom trawl.



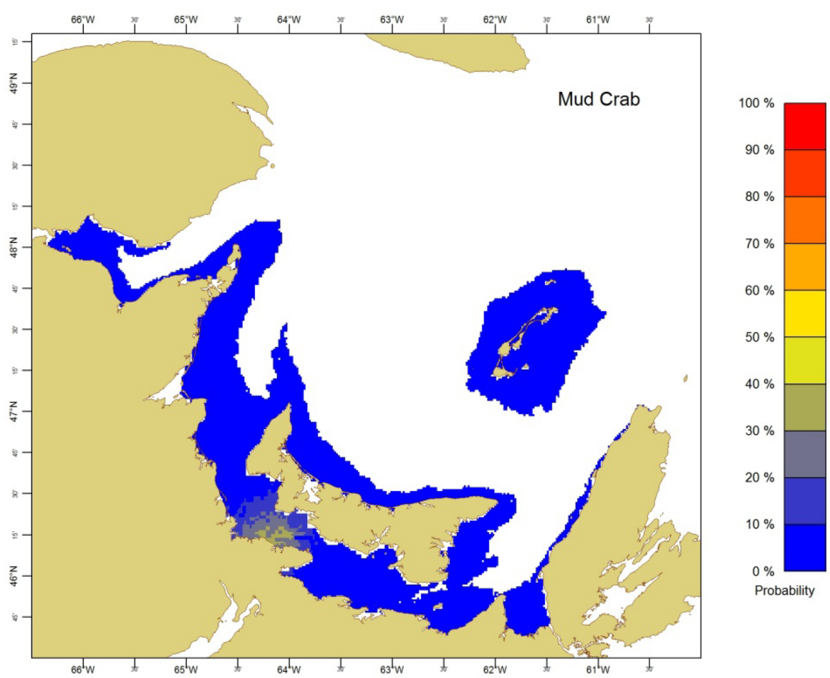
Map 27. Contour map showing the predicted probabilities of capturing blood star (Henricia sp.) during a standard tow, using a Western IIA bottom trawl.



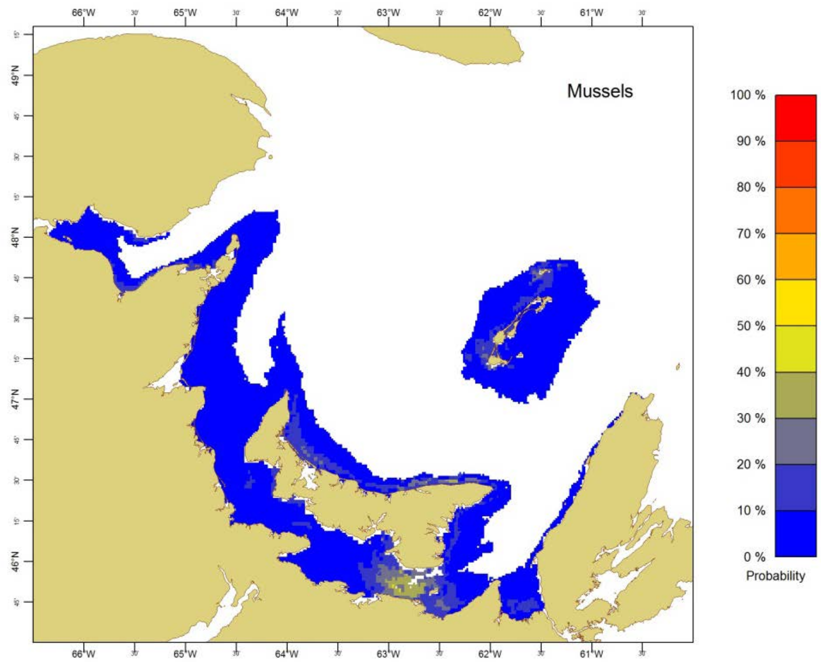
Map 28. Contour map showing the predicted probabilities of capturing brittle star (Ophiuroidea) during a standard tow, using a Western IIA bottom trawl.



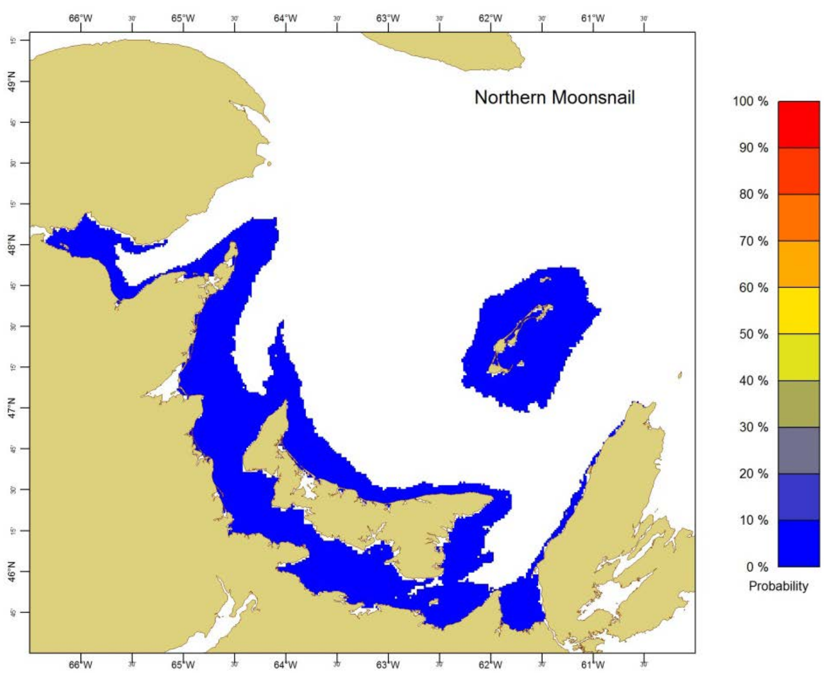
Map 29. Contour map showing the predicted probabilities of capturing polar sea star (Leptasterias polaris) during a standard tow, using a Western IIA bottom trawl.



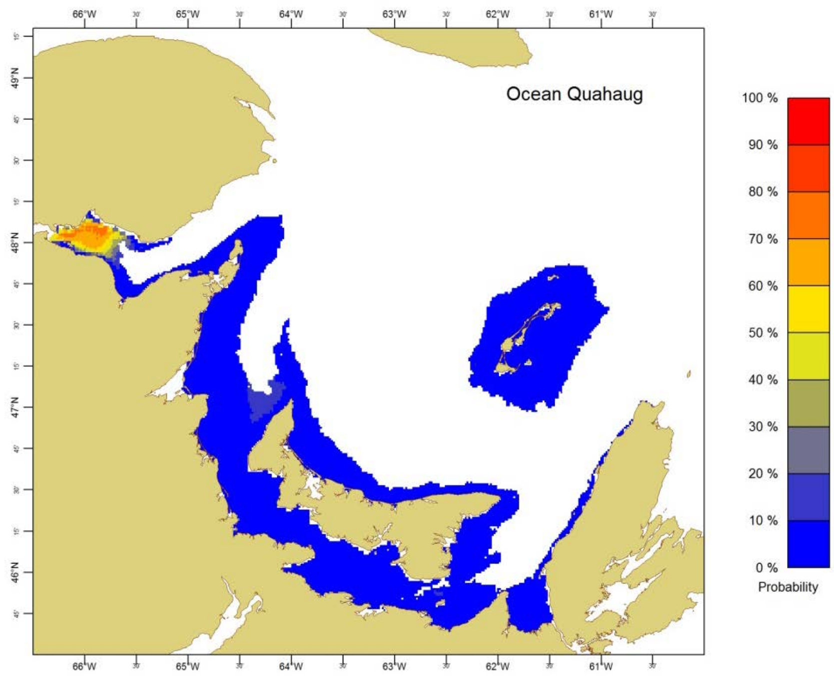
Map 30. Contour map showing the predicted probabilities of capturing mud crab (Dyspanopeus sayi) during a standard tow, using a Nephrops *trawl.*



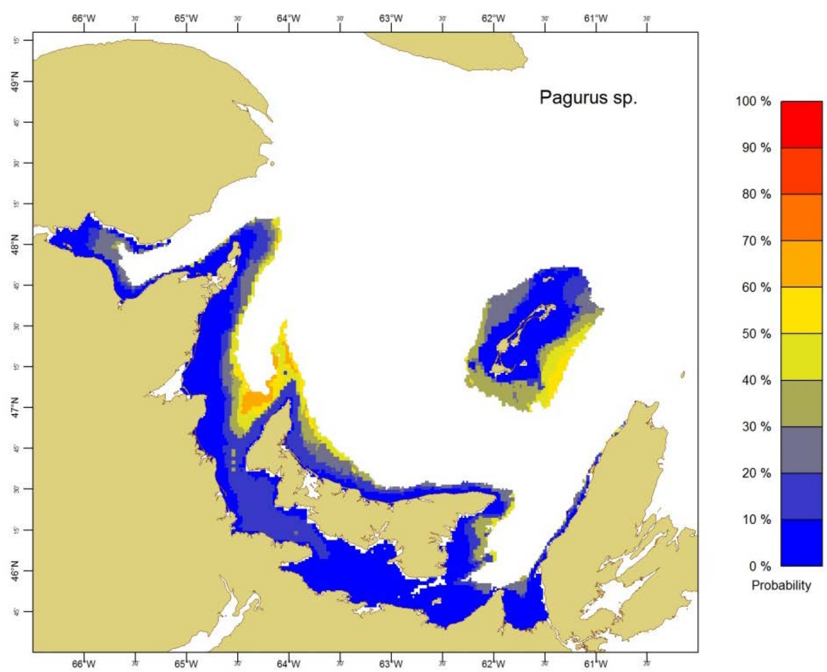
Map 31. Contour map showing the predicted probabilities of capturing mussels (includes Mytilus edulis, Musculus niger and Modiolus modiolus) during a standard tow, using a Western IIA bottom trawl.



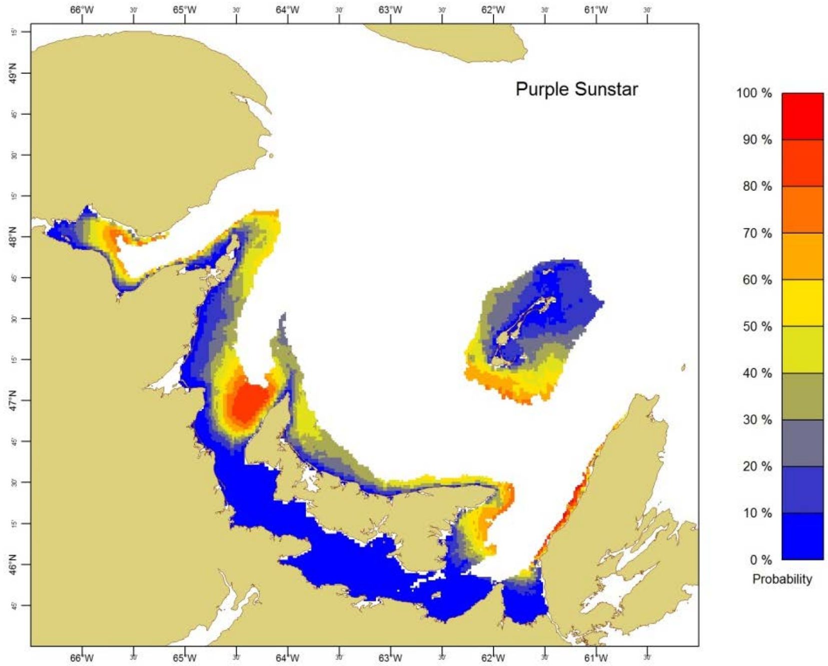
Map 32. Contour map showing the predicted probabilities of capturing northern moonsnail (Euspira eros) during a standard tow, using a Western IIA bottom trawl.



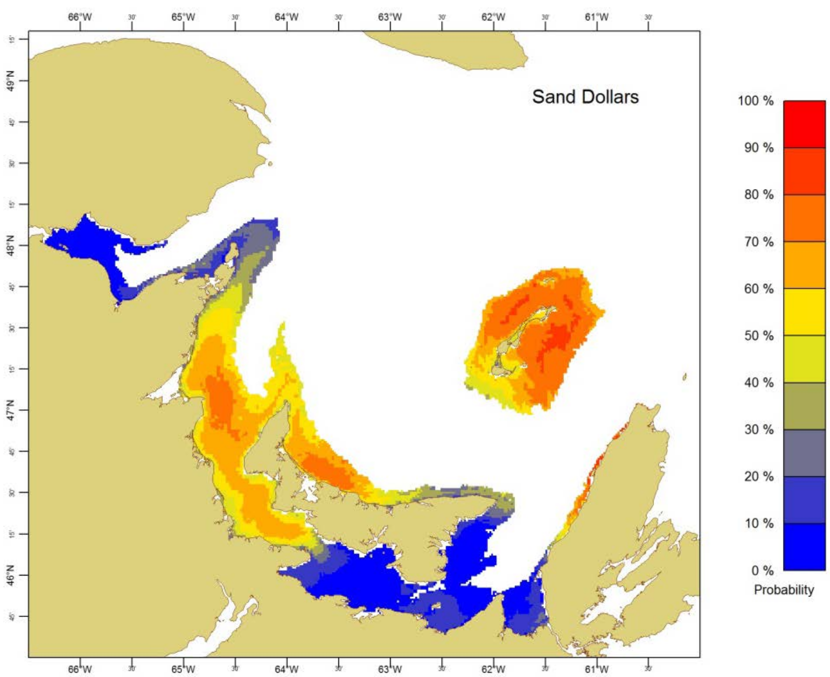
Map 33. Contour map showing the predicted probabilities of capturing ocean quahaug (Arctica islandica) during a standard tow, using a Western IIA bottom trawl.



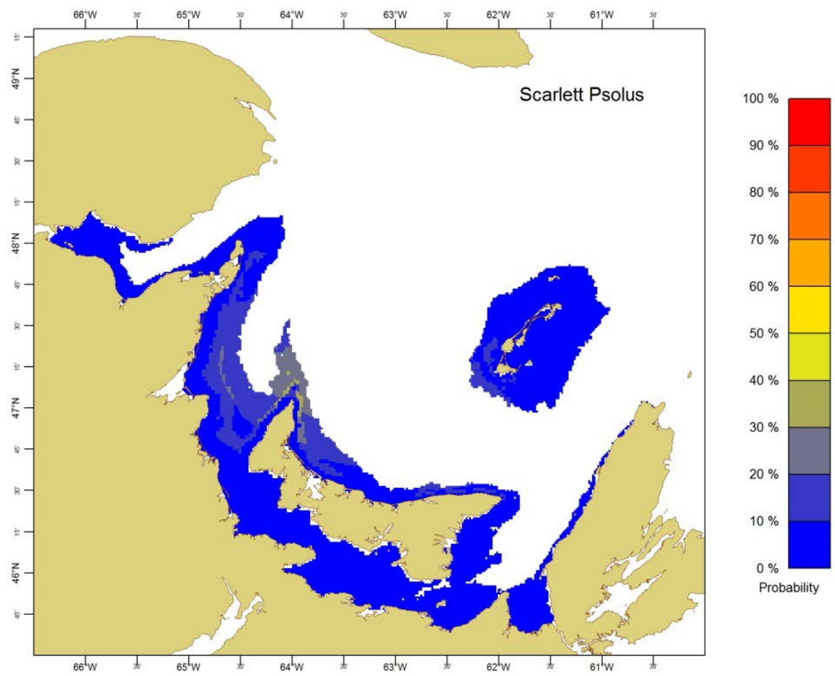
Map 34. Contour map showing the predicted probabilities of capturing hermit crab (Pagurus sp.) during a standard tow, using a Western IIA bottom trawl.



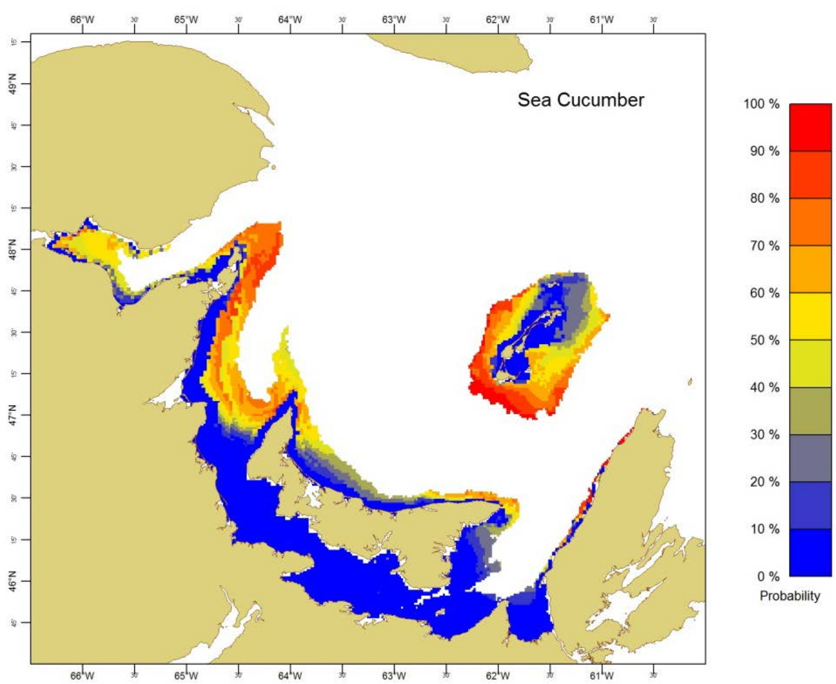
Map 35. Contour map showing the predicted probabilities of capturing purple sunstar (Solaster endeca) during a standard tow, using a Western IIA bottom trawl.



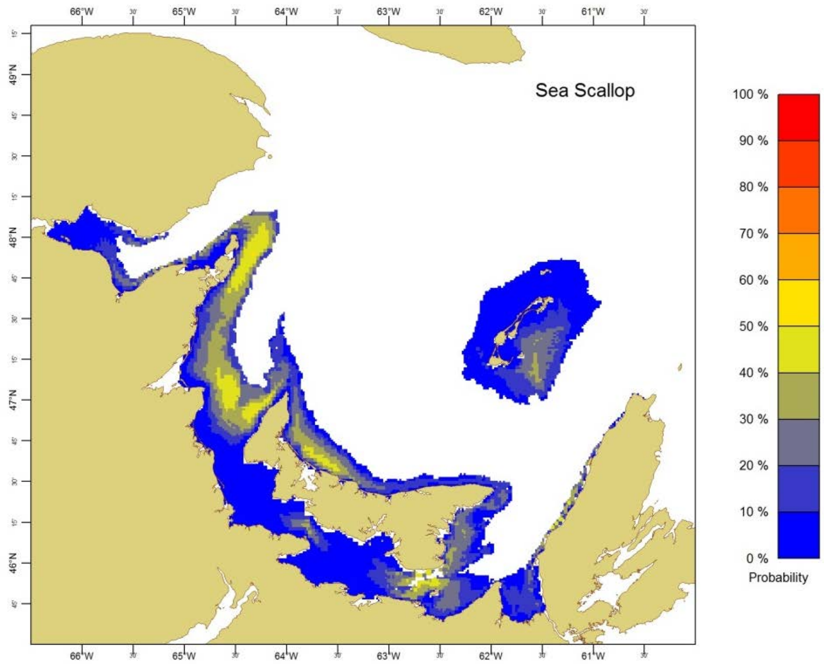
Map 36. Contour map showing the predicted probabilities of capturing sand dollars (Echinarachnius parma) during a standard tow, using a Western IIA bottom trawl.



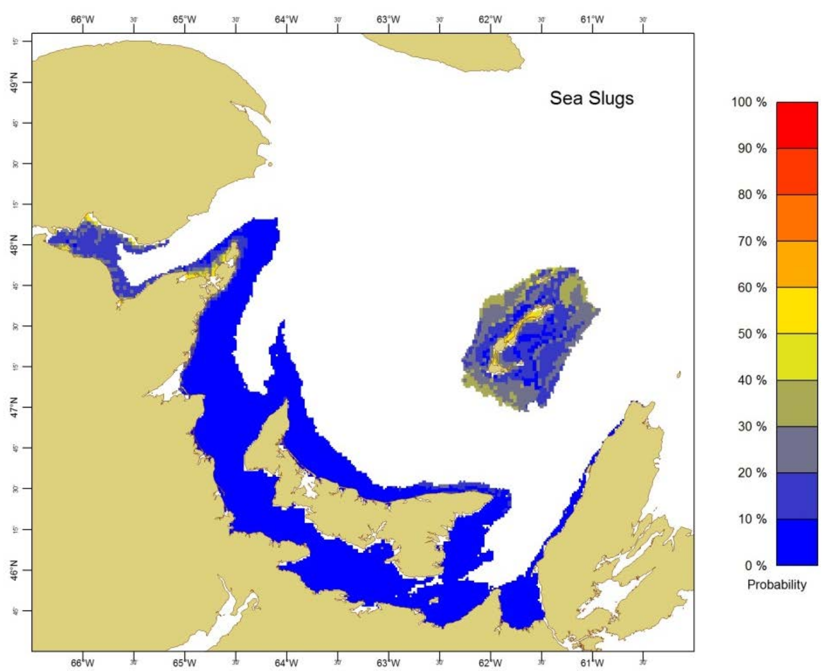
Map 37. Contour map showing the predicted probabilities of capturing scarlet psolus (Psolus fabricii) during a standard tow, using a Western IIA bottom trawl.



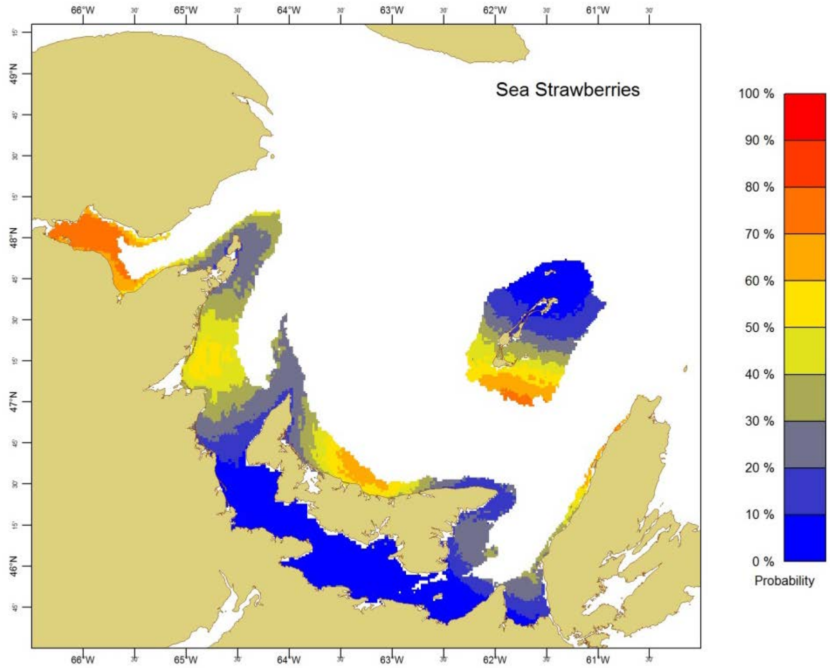
Map 38. Contour map showing the predicted probabilities of capturing sea cucumber (Cucumaria frondosa) during a standard tow, using a Western IIA bottom trawl.



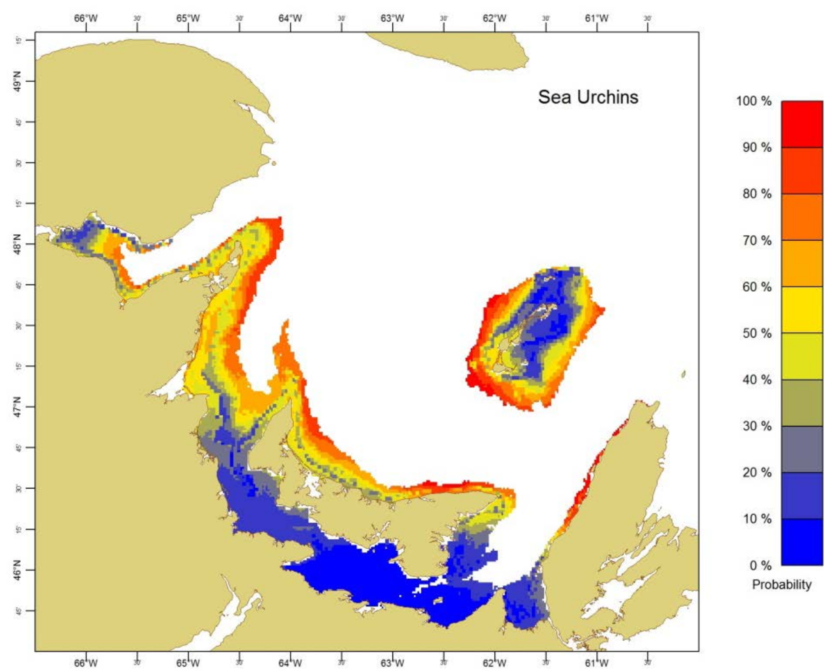
Map 39. Contour map showing the predicted probabilities of capturing sea scallop (Placopecten magellanicus) during a standard tow, using a Western IIA bottom trawl.



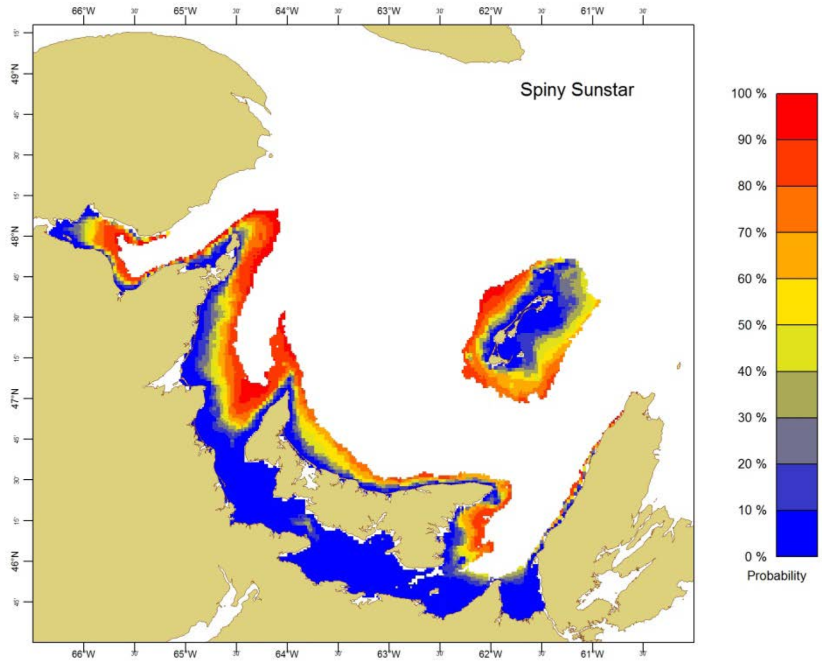
Map 40. Contour map showing the predicted probabilities of capturing sea slugs (Nudibranchia) during a standard tow, using a Western IIA bottom trawl.



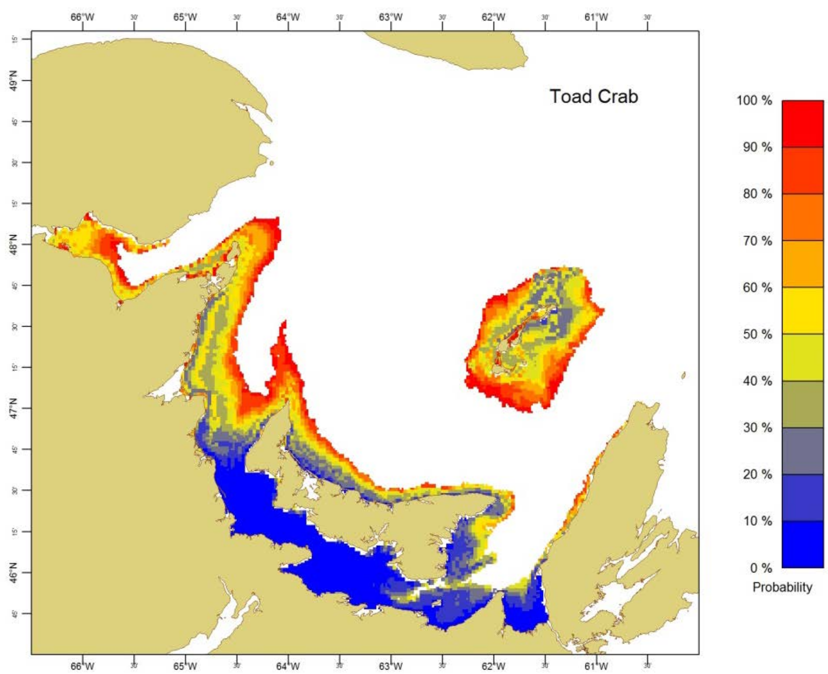
Map 41. Contour map showing the predicted probabilities of capturing sea strawberries (Gersemia sp.) during a standard tow, using a Western IIA bottom trawl.



Map 42. Contour map showing the predicted probabilities of capturing sea urchins (Strongylocentrotus sp.) during a standard tow, using a Western IIA bottom trawl.



Map 43. Contour map showing the predicted probabilities of capturing spriny sunstar (Crossaster papposus) during a standard tow, using a Western IIA bottom trawl.



Map 44. Contour map showing the predicted probabilities of capturing toad crab (Hyas sp.) during a standard tow, using a Western IIA bottom trawl.

Appendix 2. Summary of the available distribution and major habitat information[1] for the fish community (plus lady crab) found in the ≤40 m depth (coastal and upper part of the transition zone) within the southern Gulf of St. Lawrence (sGSL).

Species (reference)[1]	Guild	Portion used	Presence/ Area used
American eel (COSEWIC 2012a; DFO 2013a)	Catadromous Long-distance migrant Adults leave sGSL to breed	Both juveniles and adults transit through the study area on their migrations between oceanic spawning grounds and continental growth areas. Juveniles feed during these migrations but adults do not.	Just passing through Absent around Magdalen Islands
Atlantic salmon (COSEWIC 2010c)	Anadromous Long-distance migrant Juveniles and adults leave sGSL to feed	Pelagic Brief feeding while in transit	Just passing through
Alewife / blueback herring (Bosman et al. 2011; Cairns 1997; Darbyson and Benoît 2003; Hanson and Courtenay 1995; McQuinn et al. 2012)	Anadromous Long-distance migrant Feeding/nursery Leaves sGSL for winter	Shallow warm waters	High concentration in Northumberland Strait Absent around Magdalen Islands Leaves sGSL for winter
American shad (Bosman et al. 2011; Cairns 1997; Chaput and Bradford 2003; Hanson and Courtenay 1995; McQuinn et al. 2012)	Anadromous Long-distance migrant Feeding/nursery	Shallow warm waters	Mainly in East NB and Northumberland Strait Absent around Magdalen Islands Leaves sGSL for winter
Striped bass (Cairns 1997; COSEWIC 2012b; DFO 2014a; Douglas et al. 2009; Robinson et al. 2004)	Anadromous Resident Feeding/nursery.	Very shallow, close to shore	Absent around Magdalen Islands and north of PEI
Threespine stickleback (Bosman et al. 2011; Cairns 1997; Hanson and Courtenay 1995)	Anadromous Resident Feeding/nursery	Very shallow, close to shore	Probably ubiquitous
Atlantic tomcod (Bosman et al. 2011; Cairns 1997; Hanson and Courtenay 1995)	Anadromous Resident Feeding/nursery	Very shallow, close to shore	Absent around Magdalen Islands
Rainbow smelt (Bosman et al. 2011; Cairns 1997; Hanson and Courtenay 1995; LeBlanc et al. 1998; McQuinn et al. 2012)	Anadromous Resident Feeding/nursery	Shallow warm waters	Absent around Magdalen Islands

Species (reference)[1]	Guild	Portion used	Presence/ Area used
Butterfish (McQuinn et al. 2012)	Transient marine species Feeding only	Very shallow and estuaries Pelagic	Mainly around PEI Absent around Magdalen Islands and in Chaleur Bay Leaves sGSL for winter
Atlantic saury (Chaput and Hurlbut 2010; DFO 2010)	Transient marine species Feeding only	Poorly sampled Pelagic	Only in St. George's Bay Leaves sGSL for winter
Spiny dogfish (COSEWIC 2010b)	Transient marine species Feeding only Periodic outbursts	Shallow warm waters Semi-pelagic	Rare in Chaleur Bay Leaves sGSL for winter
Bluefin tuna (COSEWIC 2011; Vanderlaan et al. 2014)	Transient marine species Feeding only	Warm waters Pelagic	Not in Chaleur Bay Leaves sGSL for winter
Atlantic mackerel (DFO 2014b; McQuinn et al. 2012)	Marine resident Long-distance migrant	Warm waters Pelagic	Ubiquitous Leaves sGSL for winter
Juvenile white hake (Bradford et al. 1997; COSEWIC 2013; Hanson and Courtenay 1995; Swain et al. 2012)	Marine resident Winter migration to deeper waters Unique autumn feeding migration into estuaries Possible endemic	Warm waters	Currently, "high" juvenile numbers in St. George's Bay, Northumberland Strait, and east of PEI
White hake (COSEWIC 2013; Hanson and Courtenay 1995; Swain et al. 2012)	Marine resident Winter migration to deeper waters Possible endemic	Warm waters	Formerly ubiquitous. Only spawning site is in St. George's Bay
Winter skate (Clay 1991; COSEWIC 2005; Kelly and Hanson 2013a, 2013b)	Marine resident Spreads to deeper waters for winter but some stay in ≤ 40 m depths Highly likely an endemic	Warm waters	Formerly ubiquitous Now almost exclusively in Northumberland Strait (the only known breeding area)
Lady crab (Voutier and Hanson 2008)	Marine resident No seasonal movement Highly likely an endemic	Warm waters – sand	Entire lifecycle in Northumberland Strait
Cunner (Bosman et al. 2011; Dew 1976; Green et al. 1984; Johansen 1925)	Marine resident No seasonal migration	Warm waters	Ubiquitous
Rock gunnel (Scott and Scott 1988)	Marine resident No seasonal migration	Warm waters, lives under rocks	Likely ubiquitous
Wrymouth (Scott and Scott 1988)	Marine resident No seasonal migration	Warm waters, lives in burrows (need mud)	Found in Chaleur Bay, Northumberland Strait, east of PEI and St. George's Bay
Greenland cod (Bosman et al. 2011; Hanson and Courtenay 1995)	Marine resident No clear seasonal migration	May occur at all depths	Ubiquitous but scarce; may spawn in estuaries during winter

Species (reference)[1]	Guild	Portion used	Presence/ Area used
Windowpane flounder (Hanson and Wilson 2014)	Marine resident Winter migration to deeper waters Small-bodied ecotype	Warm waters	Widely distributed but scarce in Chaleur Bay, north of PEI and west of Cape Breton
Atlantic herring (Bosman et al. 2011; LeBlanc et al. 1998; McQuinn et al. 2012; Messieh 1987)	Marine resident Winter migration to deeper waters	Warm waters to transition zone	Ubiquitous Spawning rare or absent in St. George's Bay, west of Cape Breton and around Magdalen Islands
Juvenile Atlantic herring (LeBlanc et al. 1998; McQuinn et al. 2012; Messieh 1987)	Marine resident Winter migration to deeper waters	Warm waters	Rare or absent in St. George's Bay, west of Cape Breton and around Magdalen Islands
Sea raven (Bosman et al. 2011)	Marine resident Winter migration to deeper waters	Warm waters to transition waters (rare in CIL)	Ubiquitous
Longhorn sculpin (Bosman et al. 2011)	Marine resident Winter migration to deeper waters	Warm waters to transition waters Rare in <15 m depths	Ubiquitous
Winter flounder (Bosman et al. 2011; Clay 1991; Hanson and Courtenay 1995, 1996)]	Marine resident Winter migration into estuaries and to deeper waters	Warm waters to transition waters	Ubiquitous
Yellowtail flounder (Bosman et al. 2011)	Marine resident Winter migration to deeper waters	Warm waters to transition waters Rare <15 m depths	Ubiquitous
Atlantic halibut (DFO 2013b; Savoie 2014a)	Marine resident Winter migration to deeper waters	Warm waters to deep waters Rare <15 m depths	Rare species Absent from central part of Northumberland Strait
Atlantic cod juveniles (Bosman et al. 2011; Hanson 1996, 2011)	Marine resident Winter migration to deeper waters	Cooler waters – some in CIL	0+ in Northumberland Strait and most places; larger juveniles in most places
Ocean pout (Bosman et al. 2011)	Marine resident Winter migration to deeper waters	Cooler waters – some in CIL	Ubiquitous but rare in Northumberland Strait
Shorthorn sculpin (Hanson and Courtenay 1995)	Marine resident No clear seasonal migration	Found in warm and cooler waters	Ubiquitous
Atlantic cod adults (Campana et al. 1999; Comeau et al. 2001; COSEWIC 2010a; Hanson 2011; Swain et al. 1998)	Marine resident Migratory; leave sGSL for winter	Mainly a cold-water species	Ubiquitous in deepest fringe (absent from Northumberland Strait)
American plaice (COSEWIC 2009; Swain et al. 1998)	Marine resident Migratory; move to deeper waters	Mainly a cold-water species	Low numbers in Northumberland Strait

Species (reference)[1]	Guild	Portion used	Presence/ Area used
Capelin (McQuinn et al. 2012)	Marine resident No clear seasonal migration	Mainly a cold-water species	Deepest margins, not in Northumberland Strait

[1] Most of the species listed have substantial use of coastal waters except for the adult Atlantic cod, American plaice and capelin, which are mainly cold-water species. Most distribution data come from the probability maps generated for this study and atlases or survey documents derived from the September trawl surveys and sentinel surveys (Benoît 2006; Benoît et al. 2003; Benoît and Swain 2003a, 2003b; Darbyson and Benoît 2003; Savoie 2014a, 2014b). Supplemental references are provided below the species name. CIL refers to the Cold Intermediate Layer.

APPENDIX E-1

VANCOUVER CALGARY TORONTO OTTAWA HALIFAX

@ecojustice.ca

@ecojustice.ca
520-1801 Hollis St
Halifax, NS B3J 3N4
902-417-1700, ext
File No: 1003

October 10, 2019

The Honourable Minister Gordon Wilson
Department of Environment
Barrington Tower
1894 Barrington Street, Suite 1800
P.O. Box 442
Halifax, NS B3J 2P8
Minister.Environment@novascotia.ca

Environmental Assessment Branch
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8
EA@novascotia.ca

Sent via Electronic Mail

Dear Minister Wilson:

Re: Replacement Effluent Treatment Facility Project – Northern Pulp Nova Scotia Environmental Assessment – Focus Report

We write as counsel for Friends of the Northumberland Strait to request that you grant additional time within the above-captioned environmental assessment process currently underway. Specifically, we request that you:

1. Grant additional time for the submission of public comments, with a new deadline of Monday December 9, 2019; and
2. Add 30 more days to the 25-day period within which the Administrator must submit all comments and a recommendation to you, following close of the public comment period.

As Minister, you may increase the time allotted for public comments, pursuant to section 16(2) of the *Environmental Assessment Regulations*, if the default 30 day period for review is insufficient in a particular case. Likewise, Section 17(2) of the *Regulations* empowers you to allow more time for the Administrator's review of focus reports, when the default regulatory timeframe is insufficient.

In the present case, due to the volume, complexity and highly technical nature of the Focus Report materials submitted by Northern Pulp, more time is clearly required to permit a sufficient and reasonable opportunity for the public to review and comment on the submission, and for those comments to be given serious and fair consideration by the Administrator, and ultimately by yourself.

The Focus Report and supporting materials submitted on behalf of Northern Pulp Nova Scotia amount to well over two and a half thousand pages. The materials involve many scientific disciplines and are not readily accessible or easily understandable by laypeople. Further, the Focus Report, and some of the supporting materials refer the reader back to the original materials filed within Northern Pulp's Environmental Assessment Registration Document (EARD) package submitted in February 2019. As you will be aware, that submission was also very large and consisted of many other scientific reports and technical materials. It is unfair and counterproductive to require the general public to address all of this material within the short time currently allowed.

The Focus Report was made available to the public on the Nova Scotia Environment website on October 3, 2019 at 2:32 pm. The announcement indicates that comments are due on November 8, 2019. It will be essentially impossible for people to fit a comprehensive review of all this material into their daily lives, without more time. As well, while paper copies of the Focus Report package were made available at the New Glasgow and Pictou Libraries, these are available for review only by a few people at a time, and only when the library is open.

Northern Pulp Nova Scotia has had several years to prepare these materials, and was given a second chance in April 2019, via this Focus Report, to attempt to fix all the omissions in its original submission. It is noted that most, if not all, of these materials were prepared with taxpayer monies, yet the average taxpaying resident of Pictou and area will be given almost no time to review them.

As per NSE's "Citizen's Guide to Environmental Assessment," "[p]ublic participation is vital to the success of environmental assessment."[1] In respect of Northern Pulp's original EARD, then Minister Miller acknowledged that it was very difficult for the public to address a submission of this nature, within a short timeframe. She said "I don't know that the public is really going to be able to fully digest everything that's been submitted."[2]

It is clear that this project is highly controversial and has generated a very high level of public interest and concern, within the Pictou area and across Nova Scotia. Serious concerns have also been raised by residents and officials in Prince Edward Island. Appropriately, the Terms of Reference for the Focus Report recommended that Northern Pulp Nova Scotia engage with relevant stakeholders and the Mi'kmaq including Pictou Landing First Nation, and to share relevant studies and reports, in the process of preparing its focus report. However, Northern Pulp has shared nothing with our clients or many other affected groups who have taken a consistent and active involvement in this project and the Environmental Assessment process. Instead, its materials were submitted *en masse* all at once, creating barriers for our clients and for the general public which prevent a thorough and thoughtful review. This approach has also made it very difficult for our clients to receive timely and comprehensive advice from experts in the many fields covered by this submission.

[1] Nova Scotia Environment, *A Citizen's Guide to Environmental Assessment* (Halifax, NS: Nova Scotia Environment, 2017) at p 4. Link to: https://novascotia.ca/nse/ea/docs/EA.Guide-Citizens.pdf

[2] Jean Laroche, "Northern Pulp's plans for pipeline, effluent treatment plant now public," CBC, February 7, 2019.

The additional time requested herein is also appropriate as there are materials promised, but not included in the Focus Report package. For example, it appears that the following materials are to be considered by NSE and Minister but are not included in the package:

1. Appendix 7.2 – states it includes as Appendix A an "Underwater Benthic Habitat Survey Video". However, no such video or link to any such video is included in the package.
2. Appendices 10.1 and 10.2 both refer to reports which are not provided.
3. Appendix 11.1 refers to a Mi'kmaq Ecological Knowledge Study but no such study is included in the package.

We hereby request that all these documents be posted on the NSE website forthwith, and that our clients, and all other affected groups, are given a sufficient opportunity to comment on them, and the public comment period be lengthened as requested.

As well it is unclear as to whether reports are intended to be included, or submitted late, under Appendices 3.3, 3.5, 5.2, 6.1 and 7.5 of the Focus Report. If any such report will be submitted for your consideration, it must also be made available for public comment prior to any decisions being made by you as Minister.

We make these submissions in the alternative to, and without prejudice to, our submissions dated February 12, 2019 and March 8, 2019, and our client's submission of September 27, 2018, in respect of our position that you, as Minister of Environment within the government of Nova Scotia and as a member of cabinet, have shown that a reasonable apprehension of bias exists in relation to this project and that you must recuse yourself from any further decision-making in relation to this environmental assessment process.

On behalf of the Friends of the Northumberland Strait, we therefore ask that you:

1. Provide additional time for the public comment period under section 16 of the *Regulations* such that comments may be submitted no later than Monday, December 9, 2019; and
2. Likewise, under s 17 of the *Regulations*, give the Administrator an additional 30 days, beyond the 25 day period default set out therein, to summarize all comments submitted and provide recommendations to you as Minister of Environment;

Thank you for considering these submissions and we look forward to hearing from you. As time is of the essence in this matter, we ask for a response no later than Tuesday October 15, 2019.

Barrister & Solicitor

Barrister & Solicitor

c. Friends of the Northumberland Strait, by electronic mail

APPENDIX E-2

Royal Gazette

Part I

Volume 228, No. 41
October 9, 2019
Halifax, Nova Scotia
Published by Authority

Index of Notices

IN THE MATTER OF: The *Change of Name Act*, R.S.N.S. 1989, c. 66

This is to certify that on August 2, 2019 at 11:56 in the forenoon change(s) was/were made under the provisions of the *Change of Name Act* for the following individual(s):

From: CAMERON JENAY MULLEN
To: CAMRYN JENAY MULLEN
Year of Birth: 2002, born: HALIFAX, NOVA SCOTIA

This is to certify that on August 2, 2019 at 15:55 in the afternoon change(s) was/were made under the provisions of the *Change of Name Act* for the following individual(s):

From: SAMANTHA NICOLE PRINCE
To: RYLAND DEXTER MALACHAI PRINCE
Year of Birth: 1994, born: WESTMORLAND, NEW BRUNSWICK

This is to certify that on August 9, 2019 at 13:33 in the afternoon change(s) was/were made under the provisions of the *Change of Name Act* for the following individual(s):

From: SHANE PORTER RALPH THOMAS PAUL
To: SHANE PORTER JAMES PAUL
Year of Birth: 2005, born: FREDERICTON, NEW BRUNSWICK

This is to certify that on August 12, 2019 at 14:40 in the afternoon change(s) was/were made under the provisions of the *Change of Name Act* for the following individual(s):

From: NEVILLE CARL TIDD
To: NEVILLE CARL TYR
Year of Birth: 1989, born: HALIFAX, NOVA SCOTIA

This is to certify that on August 12, 2019 at 14:40 in the afternoon change(s) was/were made under the provisions of the *Change of Name Act* for the following individual(s):

From: NORAH ANNETTE CYR
To: NORAH ANNETTE TYR
Year of Birth: 1983, born: MUSQUODOBOIT HARBOUR, NOVA SCOTIA

This is to certify that on August 12, 2019 at 14:40 in the afternoon change(s) was/were made under the provisions of the *Change of Name Act* for the following individual(s):

From: LILITH ILARIA TYR
To: OCTAVIA LILITH ILARIA TYR
Year of Birth: 2016, born: HALIFAX, NOVA SCOTIA

SOUL REAL ESTATE INC.
SPAMADAD CLEANING INC.
SPRING GARDEN CONVENIENCE LTD.
STATE FARM INVESTOR SERVICES (CANADA) INC.
STELLAR LIGHTING (2011) LIMITED
STONE-BURKE CONSULTING GROUP INC.
STONY HOLDINGS INC.
SUBTLE PROPERTIES LTD.
SUNKISSED TANNING LTD.
SUSHI WAY JAPANESE RESTAURANT INCORPORATED
SWEPT TECHNOLOGIES INC.
SYNERGY AEROSPACE CANADA LIMITED
SYNERGY AGRI GROUP INC.
TAP PROJECTS CANADA, INC.
THE FAMILY KNIFE MARKETING CONSULTANCY INC.
THE GAVIN GROUP INC.
THE HILL'S AND BRAS D'OR LAKE VIEW EXPERIENCE LIMITED
THE HIVE HAIR SALON INCORPORATED
THE HOUSE WHISPERER HOME IMPROVEMENT LTD.
THE INQUISITIVE TOY COMPANY INC.
THE KINDER GARDEN PRESCHOOL INCORPORATED
THE PETERSON GROUP INCORPORATED
THE SOCIAL REALTY INC.
TIAZ HOLDINGS INC.
TMG THE METLEJ GROUP, PROJECT MANAGEMENT INC.
TOMBOY RENOVATION & DESIGN LTD.
TOTAL PLUMBING INC.
TOULON NB INC.
TRAMPOLINE CREATIVE INC.
TROD HOLDINGS LIMITED
TROY BOWERS INSTALLS INC.
TROY RESTAURANT INC.
TUCKER LAKE PROPERTIES LIMITED
UNIA DEVELOPMENTS LIMITED
VALUE CONVENIENCE STORES INC.
VICTORIA CROSSING LIMITED
VINLAND FARMS LTD.
WALLWRIGHT BUILDERS INC.
WANTECH LIMITED
WCHC HOLDINGS INCORPORATED
WHITE RHINO INC.
WILSON & LOHNES CONSTRUCTION INCORPORATED
WINDSOR CURLING CLUB LIMITED
WORLD SEAFOOD INTERNATIONAL LTD.
WYE ENTERPRISES LIMITED
ZZAP CONSULTING INC.

Dated at Halifax, Province of Nova Scotia, on October 4, 2019.

Registry of Joint Stock Companies
Hayley Clarke, Registrar

October 9, 2019

IN THE MATTER OF: The *Environment Act*, S.N.S. 1994-95, c. 1

Release of Focus Report Pursuant to
the Nova Scotia *Environment Act*

This is to advise that on October 2, 2019, the Minister of Environment received the Focus Report for the Replacement Effluent Treatment Facility Project proposed by Northern Pulp Nova Scotia Corporation in accordance with Part IV of the *Environment Act*.

The Northern Pulp Nova Scotia Corporation Northern Bleached Softwood Kraft pulp mill is located at Abercrombie Point adjacent to Pictou Harbour in Pictou County, Nova Scotia. The proposed project will consist of the development of a new effluent (wastewater) treatment facility (ETF) constructed on Northern Pulp property, and a transmission pipeline that will carry treated effluent overland and in the marine environment and discharge via an engineered diffuser (marine outfall).

The new ETF will employ the AnoxKaldnes BAS™ Biological Activated Sludge process purchased from Veolia Water Technologies, which combines Moving Bed Biofilm Reactor (MBBR) technology with conventional activated sludge. Once treated onsite at Northern Pulp's facility, effluent will be sent through an approximately 15 km long pipeline. The pipeline will enter the south side of Pictou Harbour and make landfall on the north side of the harbour roughly following Highway 106 right-of-way to Caribou, and then re-enters the marine environment adjacent to the Northumberland Ferries marine terminal and continues for approximately 4.0 km through Caribou Harbour to the Northumberland Strait, terminating at an engineered marine outfall.

Copies of the Focus Report may be examined at the following locations:

- Pictou Library, 40 Water Street, Pictou, NS
- New Glasgow Library, 182 Dalhousie Street, New Glasgow NS
- EA website https://www.novascotia.ca/nse/ea/

The public is invited to submit written comments to:

Environmental Assessment Branch
Nova Scotia Environment
P.O. Box 442, Halifax, Nova Scotia B3J 2P8

on or before November 8, 2019, or contact the Department via Fax at (902) 424-6925 or e-mail at EA@novascotia.ca. If you have any EA process questions, please contact us at our Toll-free phone number: 833-424-8694.

All comments received from the public consultation will be posted on the department's website for public viewing. In the case of an individual, the address, email and contact information will be removed before being placed on the website. By submitting your comments, you are consenting to the posting of your comments on the department's website.

October 9-2019

APPENDIX E-3

CBC

Nova Scotia

Minister not considering extension to comment period on Northern Pulp report

Environmental group says volume of documents warrants more time

Michael Gorman · CBC News · Posted: Oct 10, 2019 4:28 PM AT | Last Updated: October 10

The pubic has until 11:59 p.m. on Nov. 8 to submit comments on the Northern Pulp focus report. (David Gutnick/CBC)

comments

Nova Scotia Environment Minister Gordon Wilson is not considering a request to extend the public comment period on the Northern Pulp focus report or the amount of time his department staff has to review people's submissions.

Lawyers for Ecojustice, on behalf of the group Friends of the Northumberland Strait, wrote to Wilson on Thursday requesting 30 additional days for the public comment period and 30 more days for department staff to review submissions.

"It is clear that this project is highly controversial and has generated a very high level of public interest and concern, within the Pictou area and across Nova Scotia," lawyers write in the letter, which was released publicly.

Northern Pulp is seeking approval to build a new effluent treatment facility at its Pictou County mill site, a proposal that includes using a pipeline to move treated effluent to the Northumberland Strait.

The lawyers for the environmental groups say the volume of documents involved — in the range of 2,500 pages — and technical nature of much of the material is cause to give the public more time.

But Wilson noted the public comment period for the mill's previous submission, which his predecessor deemed to be insufficient and thus ordered the focus report, was for 30 days and received about 4,000 submissions.

"We want to hear from Nova Scotians," Wilson told reporters at Province House.

"Thirty days has always been adequate in the past; it's worked very well and I certainly feel that it should meet the requirements this time also."

Environment Minister Gordon Wilson says he thinks 30 days is enough time for people to file comments on the proposal. (Craig Paisley/CBC)

Wilson said the 30-day comment period for a Class 1 environmental assessment is the standard used in the province.

But NDP Leader Gary Burrill said that's precisely the problem.

"This is a major, major project with many, many sides," he said.

"We said from the beginning that a Class 1 assessment will not work to establish the kind of public confidence that you need to get out of an environmental assessment and that's plainly the case now."

Tory Leader Tim Houston agreed, and said it's reasonable for the minister to consider the group's request.

"There's no room for error on this file," he said. "Thirty days is a short time for a document of this significance and this volume."

With no changes to the timeline, the public has until 11:59 p.m. on Nov. 8 to submit comments and Wilson must deliver his decision by Dec. 17.

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APPENDIX E-4

The Star Edition
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THE STAR

HALIFAX

More time needed for review of N Pulp pipeline proposal: communit

By **Taryn Grant** Star Halifax
Thu., Oct. 10, 2019 | 3 min. read

HALIFAX—A community group opposed to Northern Pulp's plan to pump treated effluent into the Northumberland Strait is pressing the Nova Scotia government to give more time for the review of a report that claims there won't be any significant, adverse environmental impacts.

Friends of the Northumberland Strait submitted a letter to Environment Minster Gordon Wilson Thursday morning requesting that he add another 30 days to the public consultation period for thousands of pages of new documents from Paper Excellence, the owners of the Northern Pulp kraft mill in Abercrombie, N.S. The letter also requests an extension to the internal review period.

The documents in question were submitted to the department of environment on Oct. 2 as a supplement to a submission from January. The public currently have until Nov. 8 to submit comments and the minister must announce a decision on the project by Dec. 17.

treatment facility and pipeline without more information. She told Paper Excellence to complete a focus report on the potential environmental and human health impacts of the project.

The public were given 36 days to consult on the focus report, which Wilson said should be enough. It's six days longer than he's legally required to give.

"I feel comfortable that we are giving Nova Scotians an opportunity to reply," he said in an interview at Province House.

Wilson said he expects the planned time-frame "to work for us very well."

James Gunvaldsen Klaassen, a lawyer for the environmental law firm Ecojustice that's representing Friends of the Northumberland Strait, said the window for consultation is more of an issue with the focus report than it was with the initial environmental assessment submission from January.

Paper Excellence released some pieces of the initial submission to the public months before they were formally submitted to the government, giving extra time for review. In an interview, “This time, everything has been (released) in one big blast, and so it’s very difficult to process the entire scope of it in a very short time.”

Gunvaldsen Klaassen said his firm is currently recruiting experts to review the focus report “to make sure (the data) is reliable and that the conclusions that are drawn from the data are also accurate and reasonable.”

“It’s very scientifically complex,” he said. “It requires a lot of thought and considered response, and it's very difficult to do that in the short time that's been permitted thus far."

"I just think this extra time is vital to deal with a submission of this nature, and because of what’s at stake for the strait and for the people that live in that area,” Gunvaldsen Klaassen said.

Paper Excellence is required, by law, to close Northern Pulp’s current effluent treatment facility in Boat Harbour by Jan. 31, 2020. The now-polluted lagoon has significant cultural importance to the Pictou Landing First Nation, and the Mi’kmaw people of that community have been calling for it to be cleaned up for decades.

The proposed alternative would treat effluent on-site at the mill and transport millions of litres of treated wastewater daily through a 15-kilometre pipeline into the Northumberland Strait — a plan that's opposed by environmentalists, fishers and the Pictou Landing First Nation for fear of environmental and human health risks.

Without an effluent treatment facility, the mill — a keystone of the province's forestry industry — cannot operate. According to the focus report, the new effluent treatment facility and pipeline would take 21 months to construct. By that timeline, and with the deadline for closing Boat Harbour about three months away, the closure of the mill, at least temporarily, is an almost certain eventuality.

Taryn Grant *is a Halifax-based reporter focusing on the Nova Scotia legislature. Follow her on Twitter: @tarynalgrant*

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Halifax police chief on three officers arrested in one month: ‘There will be consequences’

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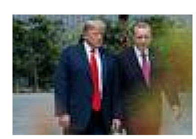

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APPENDIX E-5

@ecojustice.ca

ecojustice.ca
520-1801 Hollis St
Halifax, NS B3J 3N4
902-417-1700, ext
File No: 1003

October 23, 2019

The Honourable Minister Gordon Wilson
Department of Environment
Barrington Tower
1894 Barrington Street, Suite 1800
P.O. Box 442
Halifax, NS B3J 2P8
Minister.Environment@novascotia.ca

Environmental Assessment Branch
Nova Scotia Environment
PO Box 442
Halifax, NS B3J 2P8
EA@novascotia.ca

Sent via Electronic Mail

Dear Minister Wilson:

Re: Replacement Effluent Treatment Facility Project – Northern Pulp Nova Scotia Environmental Assessment – Focus Report

We write further to our letter of October 10, 2019 on behalf of our client, the Friends of the Northumberland Strait in relation to the Northern Pulp focus report. In that letter we asked that you:

1. provide additional time for the public comment period on the focus report, pursuant to section 16 of the *Environmental Assessment Regulations*; and
2. give the Administrator an additional 30 days pursuant to section 17 of the *Environmental Assessment Regulations*, to summarize all comments submitted during the comment period.

Our letter explained why, in our clients' view, more time was essential in the circumstances of this environmental assessment process. We also noted that several documents were missing from the public comment package, making it impossible to comment on such materials within the existing timeframe. Finally, we asked that we receive a response to our letter by October 15, 2019, but none has been received to date.

There is very little time remaining to complete a review of this complex package given the short timeframe you have imposed, and there is insufficient time to fully appreciate and address the multitude of issues that are raised in this complex package. We therefore ask for your response forthwith and without further delay.

Sincerely,

Barrister & Solicitor

Barrister & Solicitor

c. Friends of the Northumberland Strait, by electronic mail

APPENDIX E-6

NOVA SCOTIA
Environment
Office of the Minister

PO Box 442, Halifax, Nova Scotia, Canada B3J 2P8 • www.novascotia.ca/nse

OCT 23 2019

Our File number:
10700-40-55257

Ecojustice
@ecojustice.ca

Dear

On behalf of Premier McNeil, I am responding to your e-mail of October 3, 2019, regarding Northern Pulp's proposal.

Protecting the environment is my first priority. Northern Pulp registered the Effluent Treatment Facility Project for Class I Environmental Assessment (EA) on February 7, 2019, as required under the EA Regulations. On March 29, 2019, Margaret Miller, Minister of Environment at the time, released a decision concerning this review. The Minister determined that the registration information was insufficient to make a decision on the project, and that a focus report was required.

Public input is a key component in decision making. The public comment period as outlined in the EA Regulations is for 30 days. The department posted the Focus Report documents online on October 3, 2019, and Nova Scotians will have until November 8, 2019, to provide comments. That is 7 days longer than required. We started the comment period early because of Nova Scotians' considerable interest in the project. I appreciate your concerns and look forward to receiving your comments. This input will be considered when decisions are made.

Copies of the Focus Report may be examined at the following locations:

- Pictou Library, 40 Water Street, Pictou, NS
- New Glasgow Library, 182 Dalhousie Street, New Glasgow NS
- EA website at http://www.novascotia.ca/nse/ea

The public is invited to submit written comments to:

Environmental Assessment Branch
Nova Scotia Environment
P.O. Box 442, Halifax, Nova Scotia B3J 2P8

on or before November 8, 2019, or contact the Department via Fax at (902) 424-6925 or e-mail at EA@novascotia.ca.

.../2

Your concerns regarding the proposed project are acknowledged and have been included as part of the EA review. Please note that all comments received from the public consultation will be posted on the department's website for public viewing. In the case of an individual, the address, email and contact information will be removed before being placed on the website. On or before December 17, 2019, I will make a decision regarding the proposed project. By submitting your comments, you are consenting to the posting of your comments on the department's website.

Thank you for bringing your views forward. I appreciate your interest in this project.

Sincerely,

Gordon Wilson

Gordon Wilson, MLA
Minister of Environment

APPENDIX E-7

CBC

Northern Pulp's plans for pipeline, effluent treatment plant now public

Environment minister has until March 29 to decide whether plan is acceptable

Jean Laroche · CBC News · Posted: Feb 07, 2019 1:15 PM AT | Last Updated: February 7

Northern Pulp has released details of its plan to build a new effluent treatment plant and discharge pipe. (Jeorge Sadi/CBC)

Nova Scotians now have access to the details of Northern Pulp's controversial plan to build a new effluent treatment plant and discharge pipeline that will empty into the Northumberland Strait.

The Pictou County pulp mill's 614-page document, including 18 appendices, was filed with Nova Scotia's Environment Department a week ago and was posted Thursday on the department's website.

The plan put forward to the Environment Department is to build a "biological activated sludge" treatment facility purchased from a Paris-based multinational corporation called Veolia Water Technologies.

The corporate website says Veolia Water "specializes in water treatment solutions and provides the complete range of services required to design, build, maintain and upgrade water and wastewater treatment facilities for industrial clients and public authorities."

Nova Scotia Environment Minister Margaret Miller said the nearly 2,000-page submission was not a surprise.

"I think it's pretty much what the department was expecting," she said.

Safe drinking water a concern

The treatment facility would be located on Northern Pulp property not far from the existing plant.

The 15.5-kilometre pipeline would run from the new facility along the shoulder of Highway 106 to Caribou before entering Caribou harbour next to the Northumberland Ferries terminal. From there, it would discharge roughly four kilometres into the Northumberland Strait.

A boat doing survey work for the proposed Northern Pulp effluent pipe is tied to the wharf in Pictou, N.S. (Submitted by Ben Anderson)

That route is a concern for the town of Pictou. Mayor Jim Ryan said it means wastewater will be piped over the town's main watershed.

"This particular issue is about safe drinking water," he said in a telephone interview Thursday.

Ryan said he told Northern Pulp general manager Bruce Chapman in November that any plans for a pipe that carries treated or untreated effluent through the watershed would be unacceptable to the town.

Work would take 21 months

Northern Pulp's plan to discharge treated effluent into the strait has also been controversial.

Thousands protested last July over concerns it would hurt the environment. Fishermen had also prevented a survey crew from doing work for the company, but agreed last month to a court injunction ordering them not interfere.

Northern Pulp protesters outside a Supreme Court injunction hearing late last year. (Preston Mulligan/CBC)

Company owners have also sought a one-year extension of the provincial law requiring the mill's current treatment facility in Boat Harbour to close in January 2020. The company has argued it needs more time to build a replacement, but Premier Stephen McNeil has refused to extend the deadline.

According to company documents, the plan is to complete the work within 21 months, starting this spring. That means a working system would not be in place until 11 months — at the earliest — after the provincial government is legally mandated to turn off the tap to the provincially owned treatment plant.

Pipe would mostly be buried

The company has proposed using a polyethylene pipe that's 90 centimetres in diameter to carry the treated effluent from the plant to the dispersal site.

"The terminus of the effluent pipe consists of an outfall location with the three-port diffuser, situated at the depth of approximately 20 [metres]," says the project description.

The plan is to bury the pipe along most of the route, but the company is proposing suspending it to the exterior of the bridge that crosses the Pictou Causeway "due to the limited roadway width."

"The exposed area will be protected from damage by existing guard rails," says the document.

Northern Pulp's proposed route for the effluent pipe would go from a new treatment plant into the Northumberland Strait. (Nic Meloney/CBC)

The company has promised to mark the pipeline location with signs and post markings at public and private roads and water crossings. The system will also need a pumping station which the company states "will operate in a similar manner to municipal pumping station."

Serious impact on lobster 'highly unlikely'

The company said it looked at alternatives to the plan it has submitted for provincial approval, including simply shutting down or creating a closed wastewater recovery system, but none was feasible.

An indication of how much the company wants an extension is the people it has hired to lobby the governing Liberals on its behalf: Kirby McVicar, McNeil's former chief of staff; Stephen Moore, McNeil's former director of communications; and Trevor Floyd, a one-time executive assistant to Health Minister Randy Delorey when he held the environment portfolio.

- **Premier unmoved by Northern Pulp's ask for more time to close waste water facility**

As for concerns expressed by opponents to the plan, the company has included a response to 38 questions or comments, ranging from the possible harm to lobster stocks to heavy metal contamination and the environmental review process.

The company stated "it is highly unlikely that there will be serious impact on lobster," and that heavy metals occurred naturally in the environment "and are released to the environment from a range of human and natural sources."

Public invited to submit comments

As for the review process, Northern Pulp noted it was a provincial process but the Canadian Environmental Assessment Agency would review the company's application to determine whether a federal environmental assessment was necessary.

Nova Scotia Environment Minister Margaret Miller has until March 29 to make a decision on Northern Pulp's plan. (CBC)

The public now has until March 9 to digest the information and submit their comments, either by mail or using an online form.

Miller has until March 29 to decide if the project will be granted conditional environmental assessment approval. Officials in her department will sift through the material to ensure it provides a complete picture of the plan and its potential impact on the environment.

If additional work is needed, they can ask the company to provide it. But Miller said the consultation period would not be extended beyond the 30 days if that were to happen.

She acknowledged the existing file could be a challenge for Nova Scotians to assess.

"I don't know that the public is really going to be able to fully digest everything that's been submitted."

APPENDIX E-8

From: "Environment Assessment Web Account" <EA@novascotia.ca>
To: @ns.sympatico.ca>
Sent: Wednesday, October 23, 2019 1:35 PM
Subject: RE: Northern Pulp - Additional Information Requested

Good afternoon,

The Focus Report and Appendices for the project are posted on our website with the content that was submitted to NSE by the company. The NS EA process does not include a conformity review or other check that the Focus Report contains all of the items listed in the Terms of Reference. Copies of the Focus Report may be examined at the following locations:

- Pictou Library, 40 Water Street, Pictou, NS
- New Glasgow Library, 182 Dalhousie Street, New Glasgow NS

Thank you

From: @ns.sympatico.ca>
Sent: October 16, 2019 12:04 PM
To: Environment Assessment Web Account <EA@novascotia.ca>
Subject: Northern Pulp - Additional Information Requested

Hi: I am a member of Friends of the Northumberland Strait and am writing to you on their behalf. When reviewing the Terms of Reference for the Focus Report to be filed by Northern Pulp, I noted the following requirements:

7.1 Conduct fish and fish habitat baseline surveys for the freshwater environment, **to the satisfaction of Fisheries and Oceans Canada**.

7.2 Conduct fish habitat baseline surveys for the marine environment, **to the satisfaction of Fisheries and Oceans Canada**.

The Focus Report filed by Northern Pulp does not appear to include any information to determine the criteria for the surveys established by Fisheries and Oceans Canada, nor any report from Fisheries and Oceans Canada indicating whether or not the surveys were completed to their satisfaction. This information is important for the public to have in order to conduct a proper review and response to the Focus Report. Where do I obtain this information?

The Terms of Reference also set out the following requirement:

7.3 Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. **Assessment methodology must first be agreed upon by NSE in consultation with relevant federal departments**.

The Focus Report filed by Northern Pulp does not appear to include details of the assessment methodology agreed upon by NSE in consultation with relevant federal departments. This information is important for the public to have in order to conduct a proper review and response to the Focus Report.

Where do I obtain this information?

I look forward to your reply.

Pictou, NS

APPENDIX E-9

From: " @ns.sympatico.ca>
Date: October 24, 2019 11:30 AM
To: "Environment Assessment Web Account" <EA@novascotia.ca>
Subject: Re: Northern Pulp

Thank you for your reply. I wish to advise that I reviewed the Focus Report at the Pictou Library and found that the Figures were blurry and I was not able to read them in their entirety. This will impact the ability of the public to properly respond to the Focus Report. It will impact the ability of the various government departments to respond to the Focus Report as well, including Nova Scotia Environment, if the quality of the Figures in the Focus Report provided for review are similarly blurry.

Please note my concerns for the record.

Thank you,

From: Environment Assessment Web Account
Sent: Wednesday, October 23, 2019 1:35 PM
To: @ns.sympatico.ca
Subject: RE: Northern Pulp

Good afternoon,
The Focus Report and Appendices for the project are posted on our website in the manner that they were submitted to NSE by the company. Copies of the Focus Report may be examined at the following locations:
- Pictou Library, 40 Water Street, Pictou, NS
- New Glasgow Library, 182 Dalhousie Street, New Glasgow NS

Thank you

From: @ns.sympatico.ca>
Sent: October 23, 2019 11:29 AM
To: Environment Assessment Web Account <EA@novascotia.ca>
Subject: Fw: Northern Pulp

I am forwarding an email I sent to you on October 16, 2019 to which I have received no response. Kindly advise where I can obtain clear copies of the Figures. The deadline for public response to Northern Pulp's Focus Report is fast approaching and it is very important that the requested information is provided so that the public has the opportunity to review it and reply appropriately.

Thank you,

From:
Sent: Wednesday, October 16, 2019 11:24 AM
To: EA@novascotia.ca
Subject: Northern Pulp

Hi: I am a member of Friends of the Northumberland Strait and am writing to you on their behalf. When reviewing the Focus Report filed by Northern Pulp, I noted that some of the Figures were blurry and I was not able to read them, particularly the key / legend. See Figure 7.3-1 found on page 124 for one example, but there are others. The Figures are blurry when viewed online and when printed.

Where do I obtain clear copies of these Figures?

Pictou, NS
:elephone
fax

APPENDIX E-10

News release

Northern Pulp Focus Report Submitted

Environment (../search?dept=124)
October 2, 2019 - 11:57 AM

Northern Pulp submitted a focus report for its proposed effluent treatment plant in Pictou County to the Environment Department today, Wednesday, Oct. 2.

The report will be available online within 14 days once department staff have done a preliminary check to confirm it is complete.

Once it is posted online, Nova Scotians will have 30 days to share their comments as part of the environmental assessment process. A decision on the proposed effluent treatment plant will be made within 39 days after the public comment period ends.

Quick Facts:

-- the environment minister directed Northern Pulp to submit a focus report on March 29.

-30-

Media Contact:

Rachel Boomer
Cell: 902-478-9865 (tel:+19024789865)
Email: rachel.boomer@novascotia.ca (mailto:rachel.boomer@novascotia.ca)

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- Search news releases (/news/)
- Archive: news releases from 1995-97 (/news/archive.asp)

APPENDIX E-11

Profile

Printer Version

Profile Info   People Info   Activites Info   Related Reg's Info

PROFILE - FRIENDS OF THE NORTHUMBERLAND STRAIT - as of: 2018-09-06 11:00 AM

Business/Organization Name:	FRIENDS OF THE NORTHUMBERLAND STRAIT
Registry ID:	3320210
Type:	Society
Nature of Business:	
Status:	Active
Jurisdiction:	Nova Scotia
Registered Office:	94 WATER STREET PICTOU NS Canada B0K 1H0
Mailing Address:	PO BOX 1720 PICTOU NS Canada B0K 1H0

PEOPLE

Name	Position	Civic Address	Mailing Address
NICOLE MACKENZIE	Director	613 CENTRAL CARIBOU ROAD PICTOU NS B0K 1H0	
KRISTA FULTON	Director	63 JAMES STREET PICTOU NS B0K 1H0	
LINDA TOWNSEND	Director	1114 HIGHWAY 14 GREENFIELD NS B0N 1N0	
CORINNE MACKEIL	Director	2 BROOK AVENUE LYONS BROOK NS B0K 1H0	
JILL GRAHAM-SCANLAN	Director	388 ELMFIELD ROAD SCOTSBURN NS B0K 1R0	
JILL GRAHAM-SCANLAN	Recognized Agent	388 ELMFIELD ROAD SCOTSBURN NS B0K 1R0	PO BOX 1720 PICTOU NS B0K 1H0

ACTIVITIES

Activity	Date
Incorporated	2018-08-23
Filed Document	2018-08-23

RELATED REGISTRATIONS

There are no related registrations on file for this company.

From:
To: Environment Assessment Web Account
Subject: Comments on Northern Pulps Focus Report
Date: November 8, 2019 9:03:32 PM
Attachments: focus.pdf

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Gulf NS Herring Federation

Pictou, NS

Sent from Mail for Windows 10

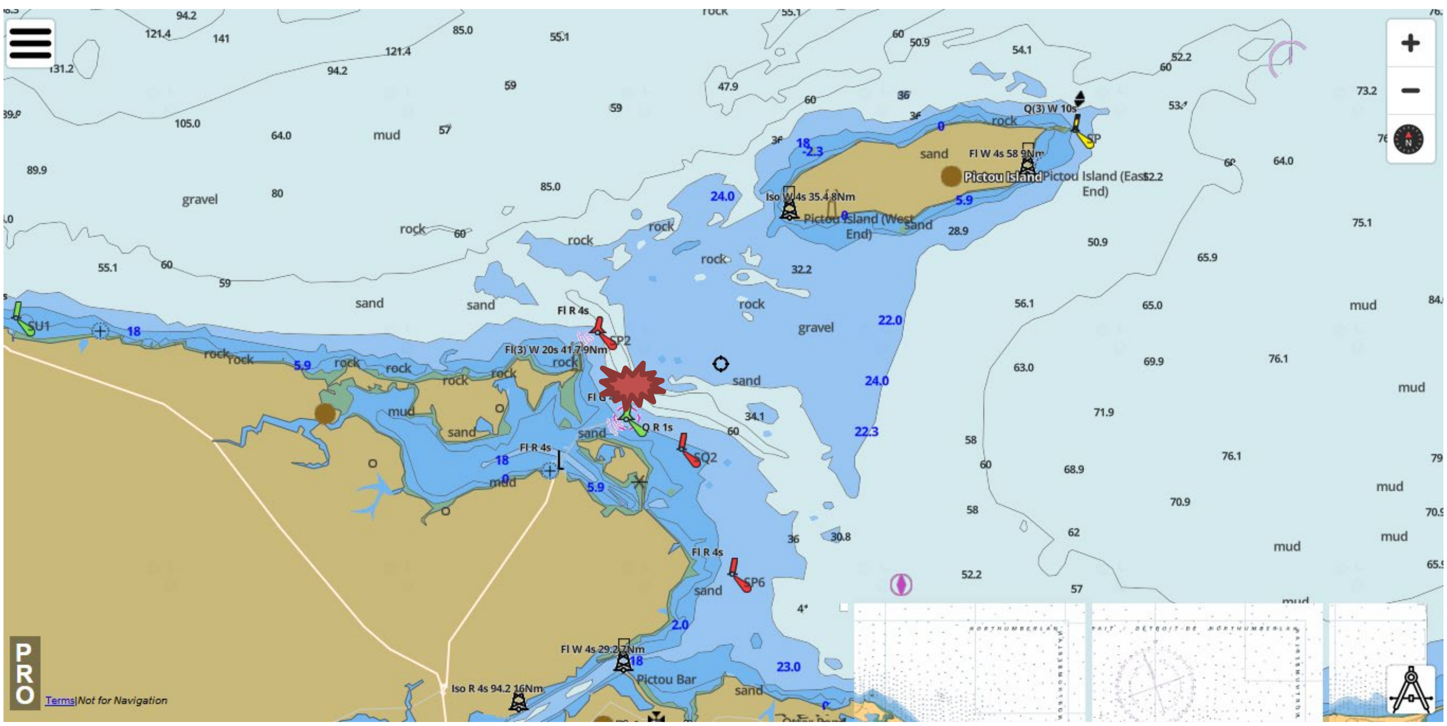
Re: Comments on the " Focus Report Replacement

Effluent Treatment "

Gulf Nova Scotia Herring

Federation

I've been fishing, for the most part, in the area pictured below for the past 45 years. Fishing my own vessel for 32 years for lobster, herring, mackerel, scallops, tuna and groundfish and on other vessels before that. I begin lobster fishing most days fifty (50) meters from the proposed outfall location. This area is one most diverse, dynamic and productive ecosystems in the Eastern Northumberland Strait. Northern Pulp's plan to pump 60 to 90 million liters per/day into this system at the location of the "Red star" below is ludicrous and cannot be considered for many reasons. Contrary to the proponent's claims, the area is extensively fished and sustainably fished and there is no room an effluent pipe here.



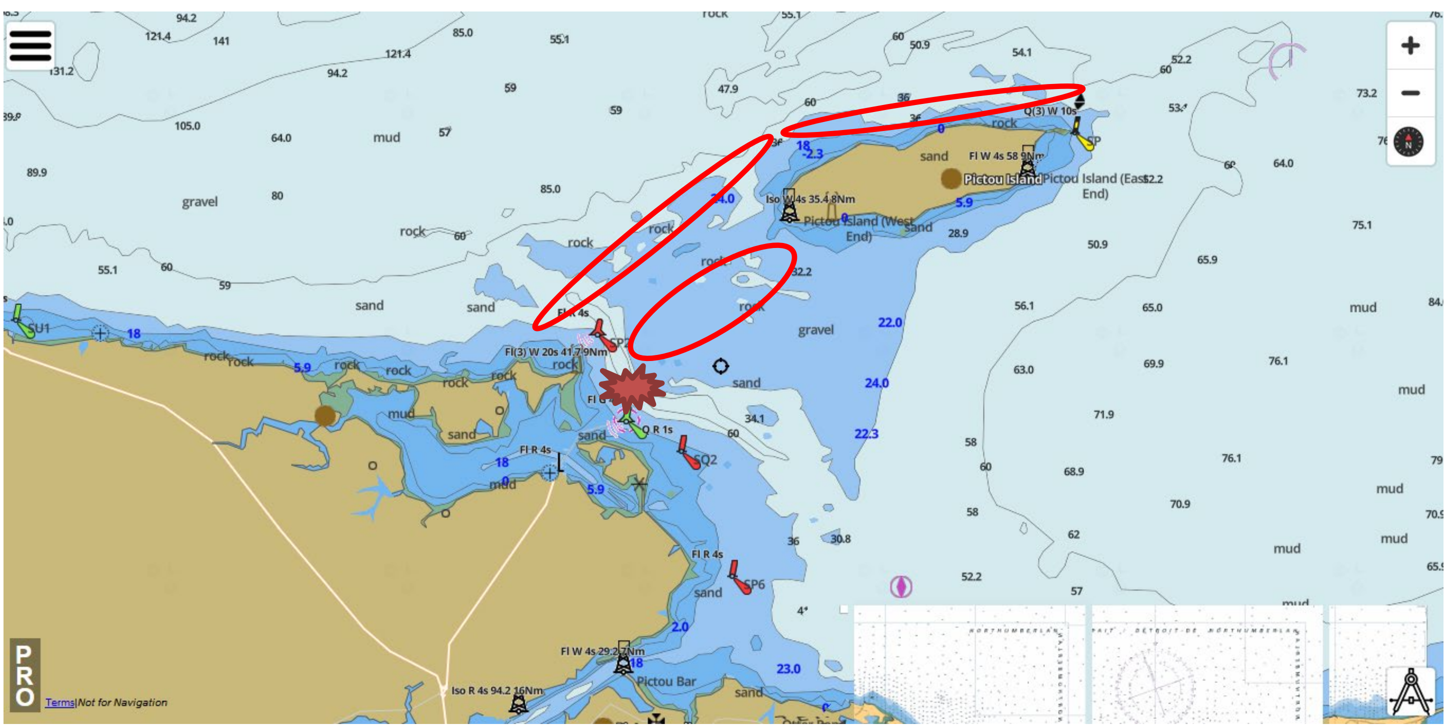
Diversity

The area above contains the <u>spawning and nursery grounds</u> for the commercial species Lobster, Rock crab, Scallop and Herring and many more less commercial species. In September the area to the north and east (in blue) of the proposed outfall, several square kilometers is covered in a carpet of herring spawn 10 cms. thick. For the past three years this area has been the ONLY area in the Eastern Northumberland Strait where this occurs. In July and August lobster are spawning and moulting here. In October/November, in Caribou Harbour, the exact area Northern Pulp plans to dig up, is covered in spawning female rock crab. Information gathered in a few days in May does not provide any real baseline. It's only relevant on that day, and changes drastically the next day.

Dynamic Area

The area of the proposed outfall is one of the most dynamic areas in the Eastern Gulf. The deep channel focuses and delivers large amounts of nutrient rich water to the Pictou Banks (blue area) four times daily with the changing of the tides. It also flows in and out of Caribou Harbour twice each day. The flow changes speed and direction constantly with time and is different every 100 meters in every direction from the proposed outfall.

The Receiving Water Study and the modeling done in this area doesn't begin to show the complexity of this system. The 2D model fails miserably to demonstrate the tidal interactions of the area and presents only a generalized Northwest/Southeast flow. It's very different in real life. The deeper waters both east and west of this area funnel through the channel (lighter blue) and upwelling feeds nutrients to the shallow water ecosystems on either side. This tidal flow also transports larvae to locations favourable to their development in the shallow estuaries nearby. Injecting 4 to 6 tonnes of suspended solids (TSS) and 60 to 90 million liters of effluent per/day into this ecosystem at this point is a dagger in the Heart of the entire system. The upwelling that occurs at each twist and turn of the channel is not accounted for in any of the models. The millions of gallons of water that race into Caribou Harbour twice each day from the outfall area are not shown. These shallow estuaries are where all this TSS (suspended solids) will end up settling. Supplanting larvae and roe in the process.



Productivity

The area pictured above is one of the most productive in the Northumberland Strait. Approximately 25,000 lobster traps are set each spring here. Despite degradation in the entire Gulf landings have been stable or increasing for the past 10 years suggesting that the resource is being harvested sustainably.

The Fall Herring population in the Southern Gulf has been in a steep decline for the last number of years. For the past four years catches in northern Nova Scotia have been predominately (90%) in the circled areas above. In years past spawning occurred in many more places both east and west of this area. This is currently not the case.

The Fisheries Act prohibits dumping deleterious substances on spawning grounds and this is the last major spawning area for herring in the Eastern Gulf. This alone should end this charade. It's also a lobster spawning area.

The Fishery in this area

A few Other Reasons

1. Its meters away from the Scallop Buffer Zone!! A protected area for scallop brood stock 1 mile wide from land that is off limits to scallop fishing and is counted as a Marine Protected Area (MPA) in DFO's grand total of protected areas.
2. Its adjacent to Caribou-Munroe's Island Provincial Park and the beach about a mile from the planned outfall.
3. There are two other Provincial Parks with beaches (Melmerby and Waterside) in the area above.
4. There are 7 or more other public beaches in the immediate area .
5. Its an "Entry Way" to our province and anyone arriving or leaving on the ferry to PEI will sail directly over the outfall, an aroma(tic) welcome to all our visitors for sure.
6. The entire surrounding area (in blue) is a spawning and nursery for lobsters, rock crabs, scallops, herring and many other species.
7. The entire Gulf of Saint Lawrence is in distress from pollution, acid rain, deoxygenation, fertilizer and on and on. It's all cumulative and must stop sooner rather than later.

There are many more good reasons to deny this proposal by Northern Pulp and no "good" reason to support it.

Respectfully

From:
To: Environment Assessment Web Account
Subject: Focus Report Comment
Date: November 8, 2019 9:49:35 PM
Attachments: Focus Report Comment.docx

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From
Nova Scotia Landowners and Forest Fibre Producers Association

We're not qualified to comment on this particular discipline, but we know how to do things. We're fastest-growing FSC group in Canada, ranked third- and fourth in size and growth in North America, on FSC international new standards board in Bonn, winner 2014 Rainforest Alliance Sustainable Standard Setter Award

Northern Pulp says its replacement wastewater facility will meet the world's highest standards of public safety, and the Province says its approval will be determined solely on its scientific merits, not partisan politics.

Our Association, a world leader in innovative sustainable forestry and "the social dynamics to make things happen," accepts both claims at face value, believing in the integrity of our public service and the company.

Our Association has been a strategic partner to keep the mill open because the Boat Harbour Act was a promise to Pictou Landing First Nation that couldn't be kept. It has seriously foreshadowed forestry activity for five years.

Our Association introduced the welfare and future of PLFN as the first priority of the industry strategy. Whatever the outcome, there could be no further abuse of the indigenous community. It proposed a win-win option.

PLFN favours an innovative replacement facility called wetlands engineering, an enclosed system, in a letter to the Environment Minister last March, including the band's commissioned engineering reports. But would NP buy in?

An Association investigation indicated costs were almost the same, and Northern Pulp was enthused by the concept to the point of suggesting a pilot project to determine its efficacy. We spread the word to government and industry.

All the while, Northern Pulp and the Province have been playing out a charade of managing a calamitous government/industry relationship. Environment approval will pipe effluent where half of PLFN's workforce is engaged in the lobster fishery.

None of this is in the public interest. Nowhere in this are we seeing clearly, thinking rationally and acting disinterestedly. Our Association believes there are remnants of the great values that built Nova Scotia but they must be put to work.

From:	
To:	Environment Assessment Web Account
Subject:	CPAWSNS public submission: Effluent treatment project Focus report
Date:	November 8, 2019 11:51:07 PM
Attachments:	Northern Pulp Focus Report_CPAWS submission_November 8, 2019_FINAL.pdf

Dear Minister Gordon Wilson

Please find attached the public submission from the Nova Scotia Chapter of the Canadian Parks and Wilderness Society (CPAWS-NS) for the environmental assessment review of the "Replacement Effluent Treatment Facility Project" Focus Report.

Thank you

www.cpaws.org
twitter: @NSwilderness

CANADIAN PARKS AND WILDERNESS SOCIETY
NOVA SCOTIA CHAPTER

Canadian Parks and Wilderness Society
Nova Scotia Chapter
P.O. Box 51086 Rockingham Ridge
Halifax, Nova Scotia
B3M 4R8

Re: Public comments for "Replacement Effluent Treatment Facility Project" Focus Report

November 8, 2019

Dear Minister Gordon Wilson:

The Nova Scotia Chapter of the Canadian Parks and Wilderness Society (CPAWS-NS) is pleased to provide written comments for the public review of the "Replacement Effluent Treatment Facility Project" Focus Report submitted by Northern Pulp Nova Scotia Corporation.

For the previous round of public consultation, CPAWS-NS focused specifically on potential environmental impacts on wetlands. We identified substantial deficiencies in the content provided by the Proponent and called on the Minister of Environment to require additional information be provided. We were pleased that Nova Scotia Environment concurred with our assessment that there was insufficient information.

The Terms of Reference for the Focus Report provided by Nova Scotia Environment requires the Proponent to undertake a comprehensive wetland baseline survey in order to address the deficiencies in the Environmental Assessment Registration Documents. The Terms of Reference for the Focus Report, dealing specifically with wetlands, state the following:

> *5.1 Complete a wetland baseline survey along the proposed re-aligned effluent pipeline route (if wetlands are expected to be altered).*

CPAWS-NS has reviewed the information provided in the Focus Report dealing with wetlands. This includes information provided about potential impacts on the wetlands, as well as proposed mitigation measures. Unfortunately, once again, we are underwhelmed by the information provided by the Proponent for wetlands. Our concerns are several fold.

5 days in the field is NOT a baseline survey

According to the information provided by the Proponent, only five days of fieldwork was undertaken for the wetland baseline survey. These dates are May 28th, June 4th, 5th, 18th, and July 30th.

> *"Wetland field surveys along the proposed re-aligned effluent pipeline route were conducted on May 28th, June 4th, June 5th, June 18th and July 30th, 2019."* (Page 7, Section 5.1.2, Wetland Baseline Survey appendix)

In total, 19 different wetlands were identified within the pipeline route, including several different types of wetlands. Upon assessing the "Wetland Delineation Data Sheets" provided by the field researchers in Appendix A5.1-A, however, it's clear that the majority of the wetlands within the pipeline route were actually assessed on only one day, July 30th. On that day, 15 wetlands were assessed. It does not appear from these data sheets that any given wetland was assessed more than once. Assuming a 15 hour work day, at best, only 1 hour was spent in each wetland on that day, on average. Assuming a 7.5 hour work day, that number drops to only a half hour in each wetland, on average, maybe less depending upon travel times between the wetlands being sampled. This is a shockingly insufficient amount of time to carry out actual fieldwork for a baseline wetland study, especially for a proposed Undertaking that has serious environmental ramifications. This baseline wetland survey falls far short of the expectations described by the Minister in the Terms of Reference for the Focus Report.

The baseline wetland survey presented by the Proponent is not actually a baseline wetland survey. It's merely a description of the wetlands that occur within the study area, based upon a very quick reconnaissance field visit. I was expecting to see a baseline wetland study that included information collected throughout the field season, for a minimum of at least one year. It is not unreasonable to expect that the wetland baseline study would include detailed hydrological information for each wetland, stratigraphic profiles, vegetation transects and quadrat sampling, and detailed plant community maps, as well as information about hydroseral development. It should be clear from the baseline study how each wetland varies through time, how they respond to different disturbance pressures, how the ecosystems are connected with each other, and which environmental variables determine plant community composition and distribution. Instead, all we get is a plant species list, with no real quantitative information about the wetland communities.

Potential damages to wetlands are NOT described

The information provided by the Proponent describing potential impacts on wetland ecosystems is woefully inadequate. The Focus Report does not provide sufficient information about how the pipeline will potentially damage the wetlands, or how that damage can be properly mitigated or avoided. There is no discussion in the wetland baseline survey about the release of carbon through disturbance to wetlands, or how the pipeline might alter plant communities, hydrologic functions, wildlife movements, or carbon sequestration potential. All that's really provided is a brief description of each wetland based upon a very quick field assessment (19 wetlands surveyed in 5 days).

Without this sort of basic information, it is not possible for the Minister of Environment to formulate a reasonable conclusion about potential impacts on the wetlands from the proposed Undertaking. If you don't have a proper baseline to determine potential impacts, it is impossible to determine appropriate mitigations.

The Proponent acknowledges that wetlands will be altered as a result of this project, thus triggering the requirement for compensation, yet does not describe the nature and magnitude of these disturbances, their severity, or permanency.

> *"It is anticipated that wetland compensation will be required for proposed wetland alterations."* Pg 107 Focus Report

The Nova Scotia wetland policy has a clear requirement to avoid damages to wetlands, then mitigate, and then compensate. By stating that compensation is required, the Proponent appears to be acknowledging that the proposed undertaking will result in disturbances that can be neither avoided, nor mitigated. Yet, there is a paltry amount of information included in the Focus Report that attempts to quantify these damages.

The Proponent seems to acknowledge that they cannot quantify those potential damages/alterations to the wetlands for the Focus Report, stating that they will make that determination after the wetlands have been damaged. They do not, or cannot, state what is the nature of the wetland compensation, or how much will be required. That is unacceptable.

> "*The degree of disturbance in wetlands adjacent to the proposed project footprint area will be assessed prior to and subsequent to construction activities. The condition of the disturbed portions of wetlands will be compared to the conditions of any undisturbed portions of the same wetlands located adjacent to the pipeline footprint….The results of this comparison will be used to measure the effectiveness and efficiency of mitigation measures and to assist in the determination and maintenance of wetland function*." (Pg. 107, Focus Report).

The Proponent MUST determine the potential environmental impacts of the proposed Undertaking on wetland ecosystems for the actual environmental review process, NOT after environmental approvals are received. The Proponent seems to not have determined the full extent of the damages to the wetlands that will occur, and instead, is proposing some sort of experiment to be conducted as the wetlands are being damaged, in order to make that determination.

Additionally, one could argue that a wetland that has been damaged by a pipeline CANNOT also serve as an effective benchmark for measuring disturbance levels. Wetland ecosystems are highly inter-connected. Damaging one part of a wetland with a pipeline will likely damage other parts of the same wetland, even outside of the disturbance footprint of the pipeline itself. Despite this, the Proponent seems to be arguing that these disturbed wetlands are also the non-disturbed baseline for measuring disturbance. That's ridiculous. There is no clear methodology here for understanding the impacts of the proposed pipeline on those wetlands. The Minister cannot, in good conscious, reach a reasonable conclusion about impacts on wetlands based on the little evidence that has been presented.

Only a tiny portion of the overall wetlands have been examined

The Proponent has not assessed the entirety of the wetlands that are to be damaged or altered by the proposed Undertaking. Only the portions within the footprint of the pipeline corridor have been assessed.

> "*Consequently, for many of the wetlands within the proposed re-alignment pipeline route, only a small fraction was available for 'on-the-ground' assessment due to property access restrictions*." (Page 1; Section 5.1.1 Wetland baseline survey appendix)

Wetlands are not isolated ecosystems. Damages occurring in one corner of a wetland will impact other portions of the same wetland. To undertake a wetland baseline study, yet only look at a "small fraction" of those same wetlands is a major deficiency in this research. Thus, the plant species lists that are provided for each wetland are NOT actually plant species lists for those wetlands. Rather, they are plant species lists for a "small fraction" of those wetlands. What occurs within the remaining areas of the same wetlands? The Proponent has not presented that information, so it's reasonable to conclude that they don't know.

The Proponent also acknowledges other challenges as well.

> "*To further compound constraint, the influence of the immediately adjacent Highway 106, and associated ditching, served to hinder the description of a wetlands more natural condition, often limiting observations to the disturbed conditions present along the roadside*". (Page 1; Section 5.1.1 Wetland baseline survey appendix).

If the Proponent had undertaken a proper wetland assessment, including using core transects, the pre-disturbed condition of the wetland could be ascertained. They chose not to do these more detailed analyses, and instead, restricted their fieldwork only to what appears to be a few hours per wetland. The Minister requested a baseline study for wetlands and the Proponent has essentially failed to provide this.

What is the final pipeline route, anyway?

The pipeline route contained in the Focus Report is not the same pipeline route that is contained in the previous Environmental Assessment Registration documents. It was moved from one side of the highway to the other. Will the pipeline route move again? Possibly.

A letter from Nova Scotia Department of Transportation and Infrastructure Renewal, dated September 27, 2019, states the following

> "*This letter confirms that Nova Scotia Department of Transportation and Infrastructure Renewal (TIR) is continuing to hold talks with Northern Pulp regarding a possible pipeline route to the mill's proposed new Effluent Treatment Facility. It is anticipated these talks will continue this fall.*" (Signed Mark S. Peachey, P. Eng., Executive Director, Maintenance and Operations, TIR (First page, Appendix 2.1, On-Land Pipeline Info))

This letter from the Nova Scotia government to the Proponent clearly states that negotiations are on-going to determine the location of the pipeline route. It's absolutely astounding that the Proponent has submitted this Focus Report without knowing where the final pipeline route will be located. This means that the Baseline Wetland Survey presented by the Proponent may not even be valid if the pipeline route changes again.

<u>Conclusion</u>

The Proponent has failed to provide an adequate Wetland Baseline Survey that allows the Minister to properly predict adverse effects or environmental effects related to the proposed Undertaking. This is a violation of the Terms of Reference presented to the Proponent by the Minister for the Focus Report. The Minister cannot approve this project with the information provided. Huge gaps in the wetland assessment remain.

<u>Recommendations</u>

1) The proposed Undertaking should be referred to a full environmental assessment, requiring the completion of an Environmental Assessment Report and referral to the environmental assessment board.

2) The Nova Scotia government should voluntarily request a Federal Environmental Assessment be completed by Impact Assessment Agency of Canada for this proposed Undertaking.

***

Thank you for the opportunity to provide these written comments on behalf of the Nova Scotia Chapter of the Canadian Parks and Wilderness Society.

Sincerely,

CPAWS Nova Scotia

From:	
To:	Environment Assessment Web Account
Subject:	Northern Pulp Focus Report Response
Date:	November 8, 2019 11:58:32 PM
Attachments:	image001.png ECELAW 2019 11 08 Nov Final Letter to EAC re Northern Pulp Focus Report and TOR - Final Version.pdf Pulp and Paper Effluent Regulation Notes EAC ECELAW.pdf EAC March 2019 Submission to NS EA for Northern Pulp Pipe Project.pdf Irving Pulp and Paper"s Pollution Prevention Strategy.pdf Ecology Action Centre Northern Pulp Focus Report Response Nov 8 2019.pdf

Hello,

Please find attached the Ecology Action Centre's letter in response to the Northern Pulp Focus Report, along with the following attachments:

- Letter from East Coast Environmental Law;
- Summary document – Pulp and Paper Effluent Regulations;
- EAC's submission from March 2019; and
- A promotional brochure for an Irving mill.

Thank you.

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November 8, 2019

VIA EMAIL EA@novascotia.ca

Environmental Assessment Branch
Nova Scotia Environment
P.O. Box 442
Halifax, NS, B3J 2P8

Re: Northern Pulp Nova Scotia Corporation's Focus Report - Replacement Effluent Treatment Facility Project

This letter is submitted on behalf of the Ecology Action Centre (EAC), an environmental charity working since 1971 at the local, provincial, national and international level to build a healthier and more sustainable world. EAC's vision is a society in Nova Scotia that respects and protects nature and provides environmentally and economically sustainable solutions for its citizens. The authors of this submission are subject matter experts in terrestrial, coastal and marine conservation issues. Additionally, EAC has retained the services of East Coast Environmental Law and has consulted with experts in other specialties related to the environmental impacts of this proposal. We submit this letter as our response to Northern Pulp Nova Scotia Corporation's (NPNS) Focus Report, which was made public by Nova Scotia Environment on Thursday, October 3, 2019.

OUR POSITION

The Minister must reject the NPNS proposal as outlined in their Environmental Assessment Registration Document (EARD) and expanded upon in their Focus Report for four reasons:

1. There is irrefutable scientific evidence that this mill's proposed operations will have *major adverse effects on marine, coastal and terrestrial ecosystems that cannot be avoided or mitigated, and will cause significant harm to human health in the region*. Dumping inadequately treated toxic effluent in the ocean will cause lasting harm in the vicinity of the pipe and far beyond. Adding the burning of sludge to the current boiler will worsen air emissions from a system that is already regularly exceeding air emission limits. As outlined in the Environment Act, the Minister must reject an undertaking because of the likelihood that it will cause adverse effects or environmental effects that cannot be mitigated.

2. NPNS has *failed to fulfill the requirements of the Focus Report as set out in the Terms of Reference*. Please see the attached letter from East Coast Environmental Law, which outlines many of NPNS's shortcomings in meeting those requirements.

3. Due to errors, omissions and the use of inappropriate environmental protection standards, detection limits and modeling tools throughout the Focus Report, *critical gaps still exist in the information provided which was to enable understanding of the full range of impacts of this project on human and ecological values*. NPNS's incomplete Focus Report consists of studies which are not of adequate quality in several areas, false statements and misleading information, and data which appears to be skewed with frequent use of inappropriate detection limits. NPNS's use of unacceptably low, outdated industry standards and regulations for a project with a potential 50-100 year life span, while touting them as 'environmental protection', puts the long-term ecosystem health of the Northumberland Strait at too great a risk to proceed. Put simply, the Focus Report lacks credibility.

4. Throughout the Focus report, NPNS refers to abstract future monitoring notions and undetermined methodologies for crucial aspects of the ETF design as well as making faint references to possible technology solutions which may or may not be implemented after completion of the replacement ETF project. NPNS had an obligation to have these uncertainties resolved and to commit to defined methodologies for each aspect of the design as well as committing to solutions to reduce effluent toxicity (such as an Oxygen Delignification) before provide submitting this proposal. The Minister does not have the necessary information required in these yet-to-be-determined areas to be able to determine just how much harm the plan will cause to the environment.

For these reasons, NPNS has not met their obligation and the Minister must reject this proposal. At the very least, we believe that this project should be subject to a full environmental assessment report.

As the province embarks upon the complex and extremely expensive remediation of Boat Harbour (A'se'k), which has been devoid of life for more than five decades due to pollution from this pulp mill, the knowledge that similar remediation will be impossible in the fragile marine ecosystem of the Northumberland Strait makes this project unfathomable. In this letter, we will describe our key concerns about the adverse environmental impacts and other considerations, building on our initial submission (see attached) in response to the NPNS EARD. First, we begin by identifying the broader global environmental context which reflects the already compromised ecosystems which will be adversely impacted by this undertaking.

ENVIRONMENTAL CONTEXT

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), ecosystems across most of the globe are now significantly altered by multiple human stressors, with the majority of indicators of biodiversity and ecosystem functioning showing rapid decline[1]. Approximately 25 percent of species in assessed animal and plant groups are threatened and may face extinction if the drivers of biodiversity loss cannot be mitigated[1]. In the marine environment, sixty-six percent of the ocean area is

[1] Díaz, S., Settele, J., Brondízio, E., Ngo, H., & Guèze, M. Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

experiencing increasing cumulative impacts[1]. As recently highlighted by the Intergovernmental Panel on Climate Change (IPCC) Special Report on the Oceans and Cryosphere in a Changing Climate, climate change is the most pervasive stressor in the oceans, with anthropogenic greenhouse gas emissions driving global ocean warming, acidification, de-oxygenation and sea level rise[2]. Human activities such as land- and sea-based pollution, overexploitation of harvested species, and coastal development combine with the effects of climate change, and each other, to further degrade biodiversity and ecosystems[1,2]. In Atlantic Canada, Fisheries and Oceans Canada reports that one quarter of commercial fish stocks are below healthy population levels[3]. At the same time, important coastal habitats like eelgrass meadows[4] and salt marshes[5] have declined or are at risk of decline from stressors such as agricultural run-off, land use changes and invasive species. The Gulf of St. Lawrence, in particular, is heavily stressed due to the combined effects of pollution, species overexploitation, climate change, invasive species and eutrophication[6].

The degraded state of the oceans, both globally and in Atlantic Canada, is the result of many decades of short-sighted decision-making in which we have failed to rigorously evaluate human activities in the broader context of marine environmental health and effectively mitigate adverse effects, particularly long-term cumulative effects. <u>*The best and most current science is telling us loudly and clearly that this approach to doing business is no longer viable*</u>. It is imperative that we prioritize building resilience back into our oceans to support human well-being, including sustainable industries that depend on healthy coastal and marine ecosystems, and mitigate the effects of climate change[2]. As Hans-Otto Pörtner, Co-Chair of IPCC Working Group II, stated: "Reducing other pressures such as pollution will further help marine life deal with changes in their environment, while enabling a more resilient ocean."[7]

KEY CONCERNS

The NPNS EARD and Focus Report raise numerous concerns about the adverse effects on marine, coastal and terrestrial ecosystems and the harm that will be caused to human health. NPNS's registration document solicited an overwhelming number of concerns raised by different government departments, non-governmental organizations and the public. Upon review of the Focus Report, the EAC's concerns include, but are not limited to:

- Composition, toxicity and impacts of effluent on the marine environment
- Increased toxicity and volume of already harmful air emissions by additional burning of sludge in the mill's power boiler

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[2] IPCC, 2019: Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.- O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer (eds.)]. In press.

[3]https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/status-major-fish-stocks.html

[4] Murphy GEP, Wong MC, Lotze HK (2019) A human impact metric for coastal ecosystems with application to seagrass beds in Atlantic Canada. FACETS 4: 210-237.

[5] https://novascotia.ca/nse/wetland/historic-wetland-loss-ns.asp.

[6] Benoît, H. P., Gagné, J. A., Savenkoff, C., Ouellet, P., and Bourassa M.-N. (eds.). 2012. State-of- the-Ocean Report for the Gulf of St. Lawrence Integrated Management (GOSLIM) Area. Can. Manuscr. Rep. Fish. Aquat. Sci. 2986: viii + 73 pp.

[7] https://www.ipcc.ch/2019/09/25/srocc-press-release/

- Inadequate ETF Design to reduce harm
- Impact of the pipe construction on terrestrial and marine environment
- Potential of pipe leaks and risk of contamination of soil, wetlands, Pictou watershed and marine environment
- Indigenous opposition

Effluent

NPNS's proposed effluent characterization will be at least as toxic as the current effluent
Focus Report table 2.4-3 shows Effluent Loading Comparison between 2018 Point C Treated Effluent Loading and Veolia Expected Loading. From the information that NPNS has provided in this table, it is clear that the effluent quality will not be improved by this new ETF design, which is logical as this design does not allow the effluent to cool and experience the 'polishing' effects of the NPNS's current system. The current system enables more of the effluent's toxins and Total Suspended Solids (TSS) to settle into the 'receiving waters' of Boat Harbour.

It is important to note that a toxin is a toxic compound regardless of whether it is below the level of detection used in analysis. NPNS's information, with its varied and inconsistent toxicity detection limits, disregards the cumulative impact of discharging toxins in large volumes of effluent over an extended period of time. Additionally, the information provided in the Effluent Characterization information does not allow for a full determination of actual toxicity to be made. In the Baseline Marine Study, the lab uses a notably lower detection rate for total dioxins and furans than the rate used in the analysis of the effluent. Laboratories with sufficiently sensitive instruments are able to use maximum and minimum detection levels and analyze between that range. Detection limits are not the same as guidelines used to protect human life and marine life. The data reported in this Focus Report appears to be from instruments that are not sufficiently sensitive and are not detecting toxins at appropriate toxicity levels; therefore the information does not enable evidence-based decision making.

NPNS's effluent contains TSS that consist of lignin, cellulose, sodium sulphide and sodium hydroxide. The amount of these solids generated by the mill (anticipated at more than 4,000 kg/day) is problematic for NPNS and has led to the proposal to add to the mill's air emissions by burning sludge in the power boiler in an effort to reduce their volume. Even with the proposed burning of a portion of those solids, a considerable amount will remain and be discharged into the Strait. Discharging this proposed volume of insoluble fibres, with diffusion to a wide area and with limited ability to monitor impact has the potential to cause significant adverse impact by creating anoxia in the underlying sediment and impacting light attenuation. On Page 102 of the Focus Report, NPNS states that TSS are 'largely organic and biodegradable'. This is an absolutely false statement. The cellulose fibres are refractory, meaning that they will not decompose well in seawater, a fact that is mentioned elsewhere in the Focus Report.

NPNS's effluent is toxic to marine life. According to Environment and Climate Change Canada's proposal to modernize pulp and paper effluent regulations (PPER), "studies required by the PPER have shown that effluents from 70% of pulp and paper mills are impacting fish and/or fish habitat, and that the impacts at 55%

of these mills pose a high risk to the environment"[8]. As such, there is clear evidence of adverse pulp and paper effluent impacts on marine life, and the burden of proof should be on the proponent to rigorously demonstrate the lack of impact of their project on fish, fish habitat, and the broader marine environment.

While we appreciate that the PPER are currently being modernized, the 50-year history of the PPER is illustrative of a regulatory model that is fundamentally ineffective at achieving its goal. The enabling statute, the *Fisheries Act*, has two stated purposes:

(a) the proper management and control of fisheries; and
(b) the conservation and protection of fish and fish habitat, including by preventing pollution.[9]

Clearly, the PPER fall within the second purpose of the Act and yet they have repeatedly failed to meet that purpose (see [10] and a summary of the history of PPER as it relates to protection of fish and fish habitat in Canada [attached]). The proposal to modernize the PPER include addition of a few key considerations: COD, nitrogen, phosphorus, temperature and pH. However, the Regulations will not likely be fully implemented for 6 or 7 years. The modernized PPER also will not regulate a host of other harmful substances that may be found in effluent including AOX compounds, phenols, toluene, chloroform, cadmium, PAH, dioxins and furans, as examples. Nor do the modernized PPER give due consideration to cumulative effects or the long-term effects to ecosystem health (see 'Environmental Context'). Finally, the toxicity testing under the 1992 PPER will remain the same. Only the LC-50 test for acute lethality is and will be required. For this test, an effluent is considered acutely lethal if the treated effluent at 100% concentration kills more than 50% of the rainbow trout exposed to it during a 96-hour period.

Given the importance of fisheries (e.g. lobster, herring) to the local economy, livelihoods and cultures on the Northumberland Strait, meeting these modernized minimum standards is not enough. Committing to monitoring these effects through future EEM programs, as is often the tactic throughout the Focus Report, is also not enough. Given the necessary investment and the anticipated 50+ year life of the proposed system, forecasting and exceeding regulatory requirements is the only responsible choice.

NPNS' benthic habitat surveys are woefully inadequate. The benthic habitat surveys described in the Focus Report were extremely basic and the methods (video sampling) were inadequate for robust characterization of benthic communities (e.g. identification of marine algae). More intensive grab sampling or SCUBA surveys should have been conducted. Furthermore, it is extremely concerning that NPNS only conducted video surveys in the immediate vicinity of the proposed pipeline route and diffuser area. They did not conduct surveys in areas where the effluent is likely to flow. How can NPNS possibly conclude that "effluent sediment will not have a significant impact on the marine benthic environment" (Focus Report p. 102) when they haven't investigated the areas where sediment will eventually settle? TSS will indeed eventually settle out on

[8]https://www.canada.ca/en/environment-climate-change/services/managing-pollution/effluent-regulations-fisheries-act/consultation-modernization-pulp-paper-effluent-regulations/detailed-proposal-consultation-may-2019.html

[9] An Act to Amend the Fisheries Act, Statutes of Canada 2019, Chapter 14 (assented to 21 June 2019), s. 2.1.

[10] Environment Canada, Environmental Effects Monitoring Program, 6th National Assessment of Environmental Effects Monitoring Data from Pulp and Paper Mills Subject to the Pulp and Paper Effluent Regulations (April 2014). Accessed on-line at: http://publications.gc.ca/collections/collection_2014/ec/En14-84-2014-eng.pdf.

the bottom and could affect foundational plant life and sessile invertebrates in particular. In addition, TSS increase turbidity in the water column and, along with the dark colour of the effluent, reduce light availability to the sea bottom. This is a major potential impact on benthic habitats due to the sensitivity of many foundational marine plants to light limitation. Yet, this has not been considered.

Dumping effluent into the Northumberland Strait may exacerbate eutrophication and de-oxygenation. The volume of nutrients that will be pumped into the Strait by NPNS is significant. In particular, at a time when the Gulf of St. Lawrence is rapidly losing oxygen[6,11] and many estuaries around Prince Edward Island are experiencing anoxic events on a near annual basis[12], adding more nitrogen to the region's waters will exacerbate an already severe problem. Business as usual cannot continue.

The temperature of the effluent dumped into the Northumberland Strait will disrupt local marine life. The average water temperatures of the Northumberland Strait are 1°C in winter and 16.8°C in summer. Temperature is among the most significant environmental factors affecting the emergence of marine life, metabolic processes, and patterns of movement. For this reason, appropriate measures are needed to minimize changes in sea temperature caused by effluent. For example, the average maximum temperature limit for emissions in Maine is 29.4°C, and the average maximum temperature limit for U.S. states setting the emission limit is 29.5°C. According to NPNS, the temperature of the effluent released into the Northumberland Strait will reach between 25°C and 37°C, and may exceed modernized PPER limits during summer. We note that the Focus Report includes modeling that suggests that the temperature difference between the effluent and ambient water will be minimal at 2 m from the diffuser. Unfortunately, we do not have the capacity to evaluate this conclusion given the short comment period. However, we do have concerns about the influence of the temperature difference on the marine community around the diffuser area.

Dumping effluent into a protected area in the Northumberland Strait will directly undermine its conservation objectives. Given the degraded state of the Gulf of St. Lawrence[6], efforts have been made to set aside some areas for protection in order to rebuild ecosystem resilience. This includes the Scallop Buffer Zone within Scallop Fishing Area 24. This Marine Refuge, established under the *Fisheries Act*, was designated to protect juvenile American lobster and their habitat from physical disturbance of the seabed associated with scallop dragging. The proposed pipeline would dump directly into this protected area and is in direct conflict with its conservation objectives. Through potential impacts on benthic plants and sea-bottom habitats, this could put the local lobster fishery at risk while also negatively affecting other benthic species like winter flounder, which has experienced stock declines due to high natural mortality[13]. It simply makes no sense to do this.

Environmental remediation of the ocean is not possible

[11] Claret M, Galbraith ED, Palter JB, Bianchi D, Fennel K, Gilbert D, Dunne JP (2018) Rapid coastal deoxygenation due to ocean circulation shift in the northwest Atlantic. Nat Clim Chang 8: 868-872.

[12] Bugden, G., Jiang, Y., van den Heuvel, M.R., Vandermeulen, H., MacQuarrie, K.T.B., Crane, C.J. and B.G. Raymond. 2014. Nitrogen Loading Criteria for Estuaries in Prince Edward Island. Can. Tech. Rep. Fish. Aquat. Sci. 3066: vii + 43 p.

[13] Surette, T., and Rolland, N. 2019. Assessment of the Winter Flounder (Pseudopleuronectes americanus) stock of the southern Gulf of St. Lawrence (NAFO Div. 4T) to 2016 and advice for the May 2017 to May 2022 fisheries. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/026. x+94p.

In addition to the six concerns outlined above about the adverse effects of discharging a massive volume of toxic effluent into the Northumberland Strait, EAC is also deeply concerned because there cannot be a clean-up effort to undo or repair the damage once this effluent is discharged into the marine environment. The diffuser will ensure that adverse effects will be far-reaching and NPNS's plan to determine changes by monitoring will not allow a proactive response to mitigate these devastating impacts.

Air Emissions

NPNS's toxic air emissions will cause harm. In EAC's previous submission, concerns were raised about the chemicals and particulate matter to be released by the mill. The added impact of burning chemically laden toxic sludge in the mill's power boiler on top of the mill's already harmful emissions present a significant health risk. EAC's previously raised concerns have not been adequately addressed. Additionally, NPNS has failed to provide adequate information for the Minister to make an informed decision about the mill's air emissions. In this case, NPNS's consultant did not choose the appropriate air emissions modeling software for its computerized (theoretical) air pollution displacement modelling. The consultant used AERMOD which should not be used where a) there are nearby human populations in close proximity and b) there are large water bodies nearby. AERMOD ignores or underestimates these parameters, predicting a very high elevation and distant dispersion and settlement pattern for the emissions coming from the mill. AERMOD does not adequately take into account the atmospheric effects of the nearby large water bodies - Pictou Harbour and the Northumberland Strait. Water acts to condense and bring down the pollution plumes emitting from the seven smokestacks and vents at the mill. This is why the Town of Pictou, directly across the harbour, is frequently bathed in the pollution plume. The modelling software which the consultants should have used for this proposal is called CALPUFF as this software takes into account both proximity to population centres and the effects of nearby large water bodies. Without analysis using the proper modelling software, NPNS has not met this requirement of the Terms of Reference.

ETF Design

NPNS's ETF Design is in no way a 'state-of-the-art wastewater treatment facility'

The mill at Abercrombie Point is a very old, highly polluting (both air emissions and effluent) and has never been substantially upgraded by any of its five different owners in over five decades of continuous use. It is one of the most polluting mills in North America. The mills' current owner, Northern Pulp Nova Scotia Corporation, claims on page xxxix of the Focus Report that the proposal is for a 'state-of-the-art wastewater treatment facility' and suggests throughout the Focus Report that analysis predicts non-detectable amounts of environmental pollutants but this claim is neither credible nor possible. Modern mills of similar type and older mills which have had substantial upgrades both produce far less pollution than NPNS's Pictou County mill. The mill had been permitted to operate with non-functioning emissions controls on their recovery boiler for many years, and the mill continues to do so with the power boiler, lime kiln, smelt recovery stack and high level vent. Despite commissioning a report regarding Oxygen Delignification in 2017, NPNS has not made any commitment to add this effective pollution mitigation system to its operations and continues to defer on such a commitment in the Focus Report, despite the fact that the system would significantly improve the effluent composition. Additional brief exploration suggestions that installation of centrifugal hydrocyclones could dramatically reduce the amount of Total Suspended Solids discharged into the marine environment, but NPNS does not appear to have considered that option.

To meaningfully reduce the organic and chemical pollution from a pulp mill, it is not adequate to 'clean' the effluent at the very end of the chemical pulping process. The mill needs to modernize and optimize the internal process during the production phase (i.e. in the recovery boiler) before sending it to a secondary effluent treatment system like the one proposed by NPNS. Optimization options such as brown stock washing and screening, reverse osmosis systems, chlorine-free bleaching systems and fail-safe systems have not been included in this proposal. Attached to this submission is a promotional brochure from the Irving Mill in Saint John which provides direct comparison to a mill which has done many of these internal process upgrades.

NPNS cannot credibly state that this proposal is for a 'state-of-the-art wastewater treatment facility' using the ETF Design they have provided.

Impact of the Pipe

<u>*Construction, maintenance and operation of the pipe will damage sensitive marine habitats like seagrass meadows and algae beds*</u>. Seagrasses like Nova Scotia's eelgrass are foundation species that generate valuable ecosystem services. They support coastal food webs and commercial fisheries (i.e. through creation of nursery habitat for species like lobster), buffer shorelines from storm surge and erosion, improve water quality, and capture and store carbon. However, seagrasses are facing a global crisis and are being lost at an accelerating rate around the world[14,15]. The NPNS registration document states that "there is evidence that eelgrass beds play an important role in the spawning and rearing of white hake in the Northumberland Strait area (AMEC 2007). Eelgrass beds have been in decline over the past several years in the Northumberland Strait, and Atlantic Canada in general (Hanson 2004). An eelgrass bed in Caribou was sampled and losses of 8.7% and 23.6% were recorded in 2001 and 2002, respectively (AMEC 2007)." In addition, "The Northumberland Strait Ecosystem Overview Report Technical Workshop on Biota (2006) identified the following key issues with respect to marine plants in the Northumberland Strait: (1) excessive growth of some species (i.e., *Furcellaria*); (2) disappearance of kelp beds in some areas; (3) disappearance of Irish moss; (4) declining health and range of eelgrass beds; and (5) presence of anoxic areas."

As the Focus Report (section 7.0) states: "Changes in the sediment quality from dredging activities may cause increased TSS and increase sedimentation in other areas which can impact life stages of all marine life in the area." Construction of the proposed NPNS pipeline may therefore damage eelgrass meadows and other sensitive benthic habitats in shallow coastal areas outside the immediate vicinity of the pipe, and leaks and spills during operation could also have serious detrimental impacts. While it may be argued that the footprint of this individual project will be small, this kind of narrow thinking is exactly what has led to degraded coastal ecosystems around the world and why the oceans are currently experiencing death by a thousand cuts.

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[14] Orth RJ, Carruthers TJB, Dennison WC, Duarte CM, Fourqurean JW, Heck Jr. KL, Hughes AR, Kendrick GA, Kenworthy WJ, Olyarnik S, Short FT, Waycott M, Williams SL (2006) A global crisis for seagrass ecosystems. BioSciece 56: 987-996.
[15] Waycott M, Duarte CM, Carruthers TJB, Orth RJ, Dennison WC, Olyarnik S, Calladine A, Fourqurean JW, Heck Jr. KL, Hughes AR, Kendrick GA, Kenworthy WJ, Short FT, Williams SL (2009) Accelerating loss of seagrass across the globe threatens coastal ecosystems. Proc Nat Acad Sci 106: 12377-12381.

Construction, maintenance and operation of the pipe will damage coastal/tidal wetlands.
On Page 100 of the Focus Report, NPNS admits that there will be adverse impacts on wetlands: "It is expected that the vast majority of the land-based portion of the effluent pipeline, including the short section on NPNS property, will utilize trench and bury methodology for effluent line installation. It is anticipated that both wetland compensation and watercourse alteration permits will be required for construction." Yet NPNS provides no information about the scope of the impact and the methodology for the pipeline installation is left undetermined. The Wetland Baseline Study also does not meet the required quality to provide a sufficient baseline of information, with limited field studies for the 19 impacted wetland sites.

Coastal wetlands such as salt marshes (and sub-tidal vegetated habitats like seagrass meadows and kelp forests) play an important role in fighting climate change by sequestering carbon and enhancing ecosystem resilience[16]. The international scientific community is clear in its support for protecting these 'natural carbon sinks' as an effective component of climate change mitigation strategies[2,14]. However, the NPNS Focus Report makes no mention of climate change and does not consider the impact of its proposal on these sensitive 'blue carbon' habitats in the Northumberland Strait. Again, this type of narrow, short-term thinking reflects a business-as-usual approach that is no longer viable.

This region of Nova Scotia does not have abundant coastal wetlands, placing greater importance on the vibrant coastal wetlands being considered for this pipe's pathway. As described on the NS Environment Wetlands website, 'wetlands perform many important functions and services in our landscape such as, improving water quality, controlling floods, recharging groundwater, protecting coastal infrastructure and providing critical habitat for rare and endangered species. Wetlands are also among the most productive and diverse of all the ecosystems on earth, so the loss of wetlands can mean the loss of species or local populations of fish, wildlife and plants that depend on them for habitat or food. Because many of Nova Scotia's wetlands have already been lost due to various human activities (e.g. over half of all original salt marsh habitat has been converted to other uses), wetlands that remain take on a heightened level of importance.'

Due to the crucial nature of these tidal wetlands and the missing information about the scope of adverse impacts, the methodology for pipeline installation and the inadequate quality of the wetland baseline study, the Minister does not have sufficient information to make a decision about adverse impacts to wetlands.

Potential Leaks and Contamination

NPNS provides extremely limited information about a proposed leak detection system which is stated to be effective in detecting leaks as small as 60 L/hr and which is not included in the marine portion of the pipe. The marine portion of the pipe requires a leak detection system as this section of pipe may be even more subject to potential leaks from the impact of ice scour then the terrestrial section of pipe. With the proposed leak detection system, chronic small leaks will not be detected and could go on for extended periods. The localized

[16] Mcleod E, Chmura GL, Bouillon S, Salm R, Björk M, Duarte CM, Lovelock CE, Schlesinger WH, Silliman BR (2011) A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO_2. Front Ecol Environ 9: 552-560.

impacts of such leaks on the Pictou water supply, the important wetland areas, the marine environment and the soil will have significant adverse environmental impacts.

Indigenous Opposition

The EAC supports Chief Andrea Paul of Pictou Landing First Nation in her unequivocal opposition to NPNS's proposal to discharge effluent into the Northumberland Strait. Pictou Landing First Nation deserves to have clean land, water and air. NPNS states that this proposal will allow 'community healing and rebuilding' but that is not possible when the community is in opposition with NPNS's plan. Nova Scotia's government must keep their promise to Pictou Landing First Nation by honouring the Boat Harbour Act and saying no to a plan which will cause new and greater damage.

The EAC supports the Mi'kmaq.

CONCLUSION

Northern Pulp Nova Scotia Corporation has proven over the past several years that they are prepared to operate the mill in a manner that has attributed to two known effluent leaks and repeated air emission violations. Throughout their proposal, NPNS uses unacceptably low, outdated industry standards and regulations for a project with a potential 50-100 year life span, while touting them as 'environmental protection'. Putting this proposal forward as a 'state-of-the-art effluent treatment facility' is a grievous insult to the Minister of Environment, the taxpaying citizens of Nova Scotia and especially to the Pictou Landing First Nation and the community members of Pictou County.

The Ecology Action Centre requests that the Minister of Environment reject the NPNS proposal as outlined in their Environmental Assessment Registration Document (EARD) and expanded upon in their Focus Report. NPNS's proposal will have major adverse effects on marine, coastal and terrestrial ecosystems that cannot be avoided or mitigated, and will cause significant harm to human health in the region. NPNS has failed to fulfill the requirements of the Focus Report as set out in the Terms of Reference, as outlined in the attached letter from East Coast Environmental Law. The information provided in the Focus report contains errors, inconsistencies, misleading information and undetermined methodologies and as such, NPNS has not successfully provided the necessary information to enable the Minister to understand the full range of impacts on human and ecological values.

Respectfully submitted,

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08 November 2019

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Re: Northern Pulp Replacement Effluent Facility Environmental Assessment Focus Repot

The following represents the East Coast Environmental Law Association's review on behalf of the Ecology Action Centre of the Northern Pulp Nova Scotia Corporation's Focus Report for its proposed Replacement Effluent Facility Project.

The purpose of this review is to determine whether the Focus Report meets the requirements of the Terms of Reference ("TOR") and will meet the criteria set out in the *Environment Act* and its regulations regarding the environmental assessment.

1. Overview

On 07 February 2019, the Northern Pulp Nova Scotia Corporation ("Northern Pulp" or "NPNS") registered its proposed Replacement Effluent Treatment Facility Project ("Effluent Facility") with Nova Scotia Environment ("NSE") for an environmental assessment ("EA") under the Nova Scotia *Environment Act* and its *Environmental Assessment Regulations*.

On 29 March 2019, the Nova Scotia Minister of Environment (the "Minister"), informed Northern Pulp that a review of its Registration Document for its proposed Effluent Facility had been completed. The Minister determined that, pursuant to section 13(1)(c) of the *Environmental Assessment Regulations*, a focus report was required to better understand the potential for adverse effects or significant environmental effects of the project.

During the review period for Northern Pulp's project registration document, a large number of public comments were submitted to the Minister. A number of concerns related to adverse effects or significant environmental effects from the project were raised in these comments, including (but not limited to) impacts to fish and fish habitat, concerns about the facility's design, concerns about the use of, and impact to, water resources, impacts from air emissions and noise, impacts on flora, fauna and human health, impacts on local archaeological sites, and the impacts on Mi'kmaq land uses and rights.

Then Minister Margaret Miller identified an initial list of key information gaps, which she outlined in her letter to Northern Pulp. These identified gaps in information were further expanded on by the EA Administrator in a Terms of Reference (the "TOR") for the Focus Report. Northern Pulp was given up to one year to submit its Focus Report.

Northern Pulp submitted its Focus Report to NSE on 02 October 2019 and it was released for a public comment period. The public was provided until 08 November 2019 to comment on the Focus Report. Once the comment period ends, the Administrator has 25 days to summarize public comments received and provide these along with a recommendation respecting the approval or rejection of the project to the Minister. The Minister then has 14 days to make a final decision. The Minister's options include:

1. Approval of the project subject to terms and conditions and other approvals;
2. Requiring an Environmental Assessment Report;
3. Referring all or part of the assessment to alternative dispute resolution; or
4. Rejecting the proposed project.

2. Summary of Findings

The Terms of Reference sets out what must be included in Northern Pulp's Focus Report. All impact assessment, mitigation and impact conclusions that are outlined in the initial Environmental Assessment Registration Document must be updated to reflect the requirements in the TOR. The TOR identified 11 key categories where more information was necessary for the Minister to make a decision, as follows:

1. Public, Mi'kmaq and Government Engagement
2. Project Description
3. Facility Design, Construction & Operation, and Maintenance
4. Marine Water and Marine Sediment
5. Fresh Water Resources
6. Air Quality
7. Fish and Fish Habitat
8. Flora and Fauna
9. Human Health
10. Archaeology
11. Indigenous People's Use of Land and Resources

We conclude that Northern Pulp has failed to fulfil multiple requirements of the TOR. The Minister must reject the project or require an environmental assessment report. It is our finding that Northern Pulp failed to fulfil 15/35 of the TOR requirements. We were unable to determine whether Northern Pulp adequately fulfilled 9/35 of the TOR requirements.

The table that follows is a summary of our findings:

Table 1: Summary of whether Focus Report met requirements of Terms of Reference

Category	Requirement	Requirement Met (Y/N)	Notes
1.Public, Mi'kmaq and Government Engagement	1.1 Provide a response (via a concordance table) to questions and comments raised by the public, Mi'kmaq and government departments, and incorporate these comments in the Focus Report where applicable. Comments may be summarized prior to providing the response.	**NO**	Northern Pulp did not provide responses to comments other than to reference the Focus Report.
	1.2 Provide a plan to share future reports and/or studies relevant to this Project with the public and the Mi'kmaq such as the Pictou Landing First Nation, including but not limited to the future Environmental Effects Monitoring results for the new effluent treatment facility.	**NO**	Northern Pulp did not create a plan, only an engagement strategy for the initial environmental assessment. Its strategy did not include Environmental Effects Monitoring.
2. Project Description	2.1 Provide the following information regarding the on-land portion of the effluent pipeline: • a re-alignment route for the effluent pipeline, given Department of Transportation and Infrastructure Renewal does not permit the pipeline to be placed in the shoulder of Highway 106; • maps and/or drawings of the new pipeline location; • a list of properties (ie., Premises Identification number or PID) that will intersect with the new pipeline alignment.	**NO**	The realigned route remains on the ROW of Highway 106. Maps and drawings of the new pipeline route were included (Figure 2.1-1). A list of properties was provided (Table 2.1-1).
	2.2 Conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must determine the potential impacts of ice scour on the pipeline.	**NO**	While geotechnical survey was completed, viability was not confirmed.

	2.3 Submit data regarding the complete physical and chemical characterization of NPNS' raw wastewater (ie., influent at Point A for the Project), to support the assessment of the appropriateness of the proposed treatment technology. The influent characterization results must be compared against the proposed treatment technology specifications.	**NO**	While characterization of physical and chemical composition of raw wastewater is provided, the characterization does not appear to be complete; nor does it provide information on how wastewater will meet regulations found in CEPA.
	2.4 Submit a complete physical and chemical characterization of NPNS's expected effluent following treatment by the proposed technology. To assess the efficacy of the proposed treatment technology, the following must be included: • Data from laboratory trials on NPNS's raw wastewater that were conducted at Veolia/AnoxKaldnes in Lund, Sweden in May 2018; • Modelling results using the raw wastewater parameters and quality; • A comparison of the effluent characterization results from the laboratory trials and modelling work, against appropriate regulations and/or guidelines.	**NO**	Data from laboratory trials was included (Appendix 2.4). Modeling results data was included (Appendix 2.4). Effluent characterization was not compared against appropriate (relevant) CEPA regulations for pulp and paper effluent (*Pulp and Paper Mill Defoamer and Wood Chip Regulations* and *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations*)
	2.5 Provide any proposed changes to the pipeline construction methodology and other associated pipeline construction work, related to the potential changes to the marine portion of the pipeline route (e.g., infilling, trenching, temporary access roads,	**YES**	Changes to construction will result in larger volumes of soil being excavated and an anticipated 7-fold increase

	excavation, blasting, disposal at sea, and others where applicable).		in the scheduled timeline from original timelines for excavation. This will result in greater impacts on the marine environment.
3. Facility Design, Construction & Operation, and Maintenance	3.1 Submit treatment technology specifications (e.g., optimal performance range of the technology) and an assessment of the efficacy of the proposed treatment technology for use at the NPNS facility, to the satisfaction of NSE. For example, peak effluent temperature is proposed to be above the generally accepted range of temperatures to achieve optimal biological treatment. Explain how the proposed higher than optimal treatment temperature would affect the treatment performance.	**NO**	Northern Pulp has not indicated how proposed temperature levels would meet proposed changes (additions) in the *Pulp and Paper Effluent Regulations*.
	3.2 Provide effluent flow data to support the proposed peak treatment capacity of 85,000 m3 maximum flow of effluent per day. At a minimum, data from 2017 and 2018 is required. Provide flow data for Point A, clarify source of the effluent flow volumes given in the EARD, and provide other relevant data and information to support the proposed treatment system design. If the 85,000 m3 cannot be justified based on historical data, identify water reduction projects, or re-evaluate the treatment system design and update the receiving water study accordingly.	**NO**	Flow data from Point A is not provided.
	3.3 Effluent discharge parameters must be updated (where necessary) based upon the results of the effluent characterization in Section 2.4 and relevant additional studies. Refer also to Addendum item 2.0	**YES**	Updates were provided.
	3.4 Provide the following information regarding the spill basin: • Submit information to assess the sizing and appropriateness of the design of the spill basin. The EARD indicates a retention time of 10-13 hours at a design	**YES**	The information was provided.

	capacity of 35,000 m3. The basis of this design has not been provided. If flows exceed 85,000m3 per day on a consistent basis (e.g., during summer months), confirm that there will be sufficient recovery time in the treatment system to empty the basin before the additional volume is required; • Explain where the overflow will be directed in the event of unforeseen scenarios (e.g., power outage).		
	3.5 Provide the following information regarding the effluent pipeline: • Provide viable options including the selected option for leak detection technologies and inspection methodologies, with specific consideration to any portion of the pipeline located in the Town of Pictou's water supply protection area; • Provide viable options including the selected option for the enhanced pipeline protection, such as trench lining and justify how the chosen option is an adequate option for secondary containment. Be sure to address any potential changes in flow regimes, especially within the Town of Pictou's water supply protection area, due to the installation of the pipeline and secondary containment. If different options are provided for different areas of the proposed re-aligned pipeline route, the locations for each option must be identified.	**NO**	Northern Pulp does not provide options for the marine component of the pipeline.
	3.6 Clarify where the potential releases of waste dangerous goods at the Project site will be directed for treatment and/or disposal. It is important to note that the new treatment facility is not proposed to treat waste dangerous goods based on the information provided in the EARD and requirements of NSE.	**YES**	Information included.

4. Marine Water and Sediment	4.1 Conduct baseline studies for the marine environment (such as marine water quality and marine sediment) in the vicinity of proposed marine outfall location.	**YES**	Baseline study included.
	4.2 Update the receiving water study to model for all potential contaminants of concern in the receiving environment (based on the results of the effluent characterization and/or other relevant studies such as Human Health Risk Assessment). Baseline water quality data for Caribou harbour must be applied to this study. Refer also to Addendum 3.0.	**YES**	The Receiving water study was updated.
	4.3 Provide results of sediment transport modelling work to understand the impacts of potential accumulation of sediment within near field and far field model areas. This should include chemical and physical characterization of the solids proposed to be discharged by NPNS as well as a discussion of how these solids will interact with the marine sediments and what the potential impact will be on the marine environment as a result.	**YES**	Results were provided. However; see above for comments on characterization.
5. Fresh water resources	5.1 Complete a wetland baseline survey along the proposed re-aligned effluent pipeline route (if wetlands are expected to be altered).	**NOT CLEAR**	The wetland survey was done; however, see above on comments on re-aligned effluent pipeline. This requirement is contingent on another component of the TOR, which is not completed. Note that in the Dillion Report (Appendix 5.1, p. 1) it states that "only a small fraction [of the wetlands] was available for 'on-the-

			ground- assessment due to property access restrictions”.
	5.2 Provide monitoring methodologies for areas with significant risk of pipeline leaks or spills (e.g., two areas where the pipeline crosses the Source Water Protection Delineated Boundary for the Town of Pictou wellfields; below water table; important wetlands; watercourse crossings; etc.).	**NO**	A number of monitoring methodologies are not complete, including monitoring for the example areas.
6. Air Quality	6.1 Provide a revised inventory of all potential air contaminants to be emitted from the proposed project, including but not limited to, speciated volatile organic compounds, semi-volatile organic compounds, reduced Sulphur compounds, polyaromatic hydrocarbons and metals.	**NO**	Despite providing a revised inventory, it appears that not “all” potential air contaminants were included. It is also recommended that the applicability of sections 67 and 68 of the Nova Scotia *Environment Act* be considered.
	6.2 Update the air dispersion modelling for the pulp mill facility for all potential air contaminants of concern related to the Project.	**NOT CLEAR**	See above in comments addressing 6.1.
	6.3 Complete an updated ambient air monitoring plan for the Project site based on the air dispersion modelling results. This plan must include the potential air contaminants to be monitored and proposed air monitoring location(s).	**YES**	An updated ambient air monitoring plan was submitted.
7. Fish and Fish Habitat	7.1 Conduct fish and fish habitat baseline surveys for the freshwater environment, to the satisfaction of Fisheries and Oceans Canada.	**NOT CLEAR**	The fish and fish habitat baseline surveys for the freshwater environment were provided.

			Neither the Focus Report nor Appendix 7.1 offers insight into what will satisfy Fisheries and Oceans Canada, or whether these criteria were pre-determined.
	7.2 Conduct fish habitat baseline surveys for the marine environment, to the satisfaction of Fisheries and Oceans Canada.	**NOT CLEAR**	The fish and fish habitat baseline surveys for the marine environment were provided. Neither the Focus Report nor Appendix 7.2 offers insight into what will satisfy Fisheries and Oceans Canada, or whether these criteria were pre-determined.
	7.3 Conduct additional impact assessment of treated effluent on representative key marine fish species important for commercial, recreational and Aboriginal fisheries. This must be based upon updated information, additional studies and/or an understanding of expected movement of contaminants. Assessment methodology must first be agreed upon by NSE in consultation with relevant federal departments.	**NOT CLEAR**	Note that there is no indication that the assessment methodology used for this impact assessment corresponds or meets the requirements of NSE. This is a gap in information. Without a clear indication to that effect, it is impossible to determine

			whether this TOR requirement was met.
	7.4 Submit an updated Environmental Effects Monitoring (EEM) program based on the results of various relevant baseline studies and an updated receiving water study. Refer also to Addendum item 4.0	**NO**	Northern Pulp did not submit an updated EEM.
	7.5 Clarify what contingency measures will be in place to mitigate potential impacts (e.g., thermal shock to fish) due to potential large and rapid fluctuations in water temperature in the winter at the diffuser location during low production or maintenance shut down periods.	**YES**	Contingency measures were discussed.
8. Flora and Fauna	8.1 Complete a plant baseline survey along the proposed re-aligned effluent pipeline route.	**NOT CLEAR**	Revised plant baseline survey was completed; however, the proposed pipeline route remains essentially unchanged and runs along the Highway 106 TIR Right-of-way.
	8.2 Complete a migratory bird survey along the re-aligned pipeline route.	**NOT CLEAR**	Revised migratory bird survey was completed; however, the proposed pipeline route remains essentially unchanged and runs along the Highway 106 TIR Right-of-way.
	8.3 Complete a bird baseline survey for common nighthawk (Chordeiles minor), double crested cormorants (Phalacrocorax auratus), owls, and raptors and raptor nests, for the entire project area which includes the re-aligned pipeline route.	**NOT CLEAR**	Requested bird baseline surveys were completed; however, the proposed pipeline route remains essentially unchanged and

			runs along the Highway 106 TIR Right-of-way.
	8.4 Complete a herptile survey for the Project area which includes the re-aligned pipeline route.	**NOT CLEAR**	Herptile survey was completed; however, the proposed pipeline route remains essentially unchanged and runs along the Highway 106 TIR Right-of-way. It is recommended that a precautionary approach be taken in this respect; further analysis and study is required to determine Northern Pulp's ability to comply with statutory requirements with respect to two identified species at risk potentially within pipeline route or area.
9. Human Health	9.1 Complete baseline studies for fish and shellfish tissue (via chemical analysis) of representative key marine species important for commercial, recreational and Aboriginal fisheries in the vicinity of the proposed effluent pipeline and diffuser location.	**NO**	Data collection for studies is on-going.
	9.2 Commence a Human Health Risk Assessment (HHRA) to assess potential project-related impacts on human health. The risk assessment must consider human consumption of fish and other seafood, consumption of potentially contaminated drinking	**NO**	The HHRA was not completed and is not anticipated to be completed until spring 2020.

	water, exposure to recreational water and sediment, outdoor air inhalation, and any other potential exposure pathways. The analysis must inform the identification of contaminants of concern and updating of the receiving water study.		
10. Archeology	10.1 Complete an Archaeological Resource Impact Assessment for the marine environment related to the Project.	**YES**	An Archaeological Resource Impact Assessment was completed.
	10.2 Complete shovel testing for areas in the terrestrial environment that are identified to have elevated or medium potential of archaeological resources, to confirm the presence or absence of these resources.	**YES**	The shovel testing was completed.
11. Mi'kmaq Ecological Knowledge Study	11.1 Complete a Mi'kmaq Ecological Knowledge Study (MEKS) for the Project.	**NO**	The process of producing a MEKS includes a review by the Kwilmu'kw Maw-klusuaqn Negotiation Office ("KMKNO") to ensure consistency with its EKS Protocol. While Northern Pulp indicated the completion of this process, the KMKNO had not yet completed its review.

3. Discussion of the Terms of Reference

3.1 Public, Mi'kmaq and Government Engagement

Northern Pulp was required to provide a response to questions and comments raised by the public, Mi'kmaq and government departments ("public comments") and to incorporate these comments into the Focus Report. Northern Pulp created a Concordance Table for public comments it received and attached it as Appendix 1.1 to the Focus Report. The Concordance Table has four columns: comments grouped into issues related to Valued Environmental Components ("VECs"), summaries of concerns, the source of concerns, and response comments.

A summary review of the concordance table reveals that the majority of Northern Pulps responses are in the form of references to the Focus Report. In fact, in the concordance table, the phrase "refer to section X" occurs a total of 809 times as Northern Pulp's response. In other parts of the concordance table, Northern Pulp states that a particular concern will be addressed in the future; for example, on page 3 of 40 of the government comments, it responds to multiple concerns surrounding the atmospheric environment by stating that the concerns "will be addressed in the IA and with discussion with NSE".

Many of the responses from Northern Pulp are not adequate responses for the purposes of the *Environment Act,* the *Environmental Assessment Regulations* and the environmental assessment process. The public expects, and Northern Pulp is obligated to provide, actual responses to their concerns, detailing how adverse effects or environmental effects would be prevented or mitigated by Northern Pulp.

The objectives of public participation in an environmental assessment are rooted in fair process and the democratic process. Legislatures across Canada, both provincially and federally, have incorporated public participation into their environmental assessment processes because public engagement is an important part of living and participating in a democratic society. Imbedded in the environmental assessment process is the recognition that the larger and longer lasting the impacts of a project, the more capacity must be provided to the public to have their concerns heard AND addressed. This recognition of fair process in administrative decision-making, such as the environmental assessment process, has been acknowledged and protected by the courts.

Section 2 of the Nova Scotia *Environment Act* sets out the purposes of the Act, and includes (emphasis added):

> *(h) providing access to information and facilitating effective public participation in the formulation of decisions affecting the environment, including opportunities to participate in the review of legislation, regulations and policies and the provision of access to information affecting the environment;*

Effective public participation requires more than soliciting public comments; it requires engagement and response. The public has highlighted concerns and asked Northern Pulp how their concerns will be addressed. Northern Pulp must provide an adequate answer. Providing blanket statements (809 times) to the numerous concerns expressed by the public is not effective public participation and does not provide access to information relevant to mitigation efforts for the adverse effects or environmental effects of the proposed effluent treatment facility that were identified by Mi'kmaq, the general public and government.

Northern Pulp was also required to provide a plan to share future reports or relevant studies with the Public and Mi'kmaq, including future Environmental Effects Monitoring results.

Northern Pulp developed a "Stakeholder Engagement Plan" ("SEP") which is found in Appendix 1.2; there, it is described as an engagement guide. The Focus Report states that "[a]s key reports are prepared for each phase of the project, they will be provided to the appropriate stakeholders and rights holders". This statement does not meet the criteria of the TOR, which requires a plan to share future reports or relevant studies with the Public and Mi'kmaq.

Table 1.2- 1, found in the Focus Report, is a summary of the documents that Northern Pulp has shared and with whom. There are three categories of "stakeholders" or "rights holders" – Pictou Landing First Nation, Federal Government and NSE. There is no category for "public". The Focus Report states that "moving forward, reports will be similarly shared with stakeholders and rights holders".[1] The purpose of Northern Pulp's engagement guide is described in section 1.1:

> *"This SEP serves as a guide to engagement during the environmental assessment stage. This version of the SEP is an initial guide to engagement and will need to be revised following project approval to inform ongoing stakeholder engagement through the various stages of the ETF project development, construction, operation and closure/rehabilitation"*

Section 3.0 of the SEP identifies all the stakeholders, divided into three groups: internal/external, government, and civic, business leaders and others. The general public, including members of Pictou county, communities, etc. are not identified as stakeholders. Indigenous communities other than PLFN are also not identified. Despite the TOR requiring the inclusion of a plan to share Environmental Effects Monitoring ("EEM") results, EEM is not mentioned at all in the SEP.

Northern Pulp failed to fulfil both requirements for public engagement as set out in the TOR. It failed to respond to public comments and did not prepare an engagement plan as required.

3.2 Project Description

Northern Pulp was required to provide the following information regarding the on-land portion of the effluent pipeline:

[1] Focus Report, p. 11.

- a re-alignment route for the effluent pipeline, given Department of Transportation and Infrastructure Renewal does not permit the pipeline to be placed in the shoulder of Highway 106;
- maps and/or drawings of the new pipeline location;
- a list of properties (ie., Premises Identification number or PID) that will intersect with the new pipeline alignment.

Despite the explicit and clear statement that the Nova Scotia Department of Transportation and Infrastructure Renewal ("TIR") does not permit the pipeline to be placed in the shoulder of Highway 106, Northern Pulp states the following in its Focus Report (emphasis added):

- "Approximately 8.7km of the on-land proposed pipeline is proposed to be installed in the TIR ROW (right of way) between Pictou and Caribou"
- "Land-based installation outside of NPNS property will occur predominantly within the existing NSTIR's ROW adjacent to and paralleling provincial Highway 106"
- "The on-land pipeline will be placed at the eastern most edge of the Highway 106 ROW for the majority of the route".[2]

The description of the effluent pipe route in Northern Pulp's registration document closely mirrors the descriptions of its new route found in the Focus Report (see table 2 below).

Table 2 – Comparison of Focus Report with Registration Document for Pipeline Route

Focus Report [section 2.2 – page 13-14]	**Registration Document [section 5.2.3.1 – page 47-48]**
The pipeline begins at the ETF pump station at the NPNS facility. The pipeline will run on NPNS property until it meets and enters Pictou Harbour. The pipeline is submerged across Pictou Harbour, aligned immediately to the east of the Pictou Causeway until it meets the north bank of Pictou Harbour. On the north side of Pictou Harbour, it enters NSTIR's Highway 106 (Trans-Canada Highway, also known as Jubilee Highway) ROW and follows Highway 106 north to Caribou, NS, mostly on the eastern side of the Highway 106 ROW. The pipeline will be installed generally parallel to Highway 106, along the outermost eastern portion of the NSTIR ROW. It will be situated	The pipeline will begin on land at a pump station where treated effluent from the secondary clarifiers at the ETF is pumped into the pipeline. Pumping will be required to overcome static pressure exerted on the pipeline to achieve proper dispersion of the treated effluent at the outfall. Pumping will also be required to overcome forces of gravity in order for treated effluent to reach the outfall. This facility will operate in a similar manner to municipal pumping stations. The land-based pipeline portion extending from NPNS property to the edge of shore at Caribou Harbour, will be approximately 11.4 km in length. The pipeline will be buried for

[2] Focus Report, p 13.14.

predominantly on the east side until it reaches Caribou. At this point, the pipeline will cross under Highway 106 to the west side and enter the marine environment at Caribou Harbour to the north, and to the west of the Northumberland Ferries marine terminal building and parking area. The exact location where the pipeline will enter the marine environment will be determined in consultation with the marine designer, the land-based designer, the construction contractor, and Northumberland Ferries Limited in an effort to reduce impact on ferry operations. Construction of the on-land portion of the treated effluent pipeline will require an approximate working area width of 10 m. Along Highway 106, the pipe will be generally installed in undeveloped and unmaintained areas. The pipe will be located outside the existing road shoulder but within the ROW, and specific details of the location will be determined in agreement with NSTIR.	the majority of the route. Based on the proposed design there will be one area where the pipeline will be exposed to cross the spillway of the Pictou Causeway, where it will be suspended and attached to the exterior of the bridge due to limited roadway width. The exposed area will be protected from damage by existing guide rails. For approximately the first kilometer of the pipeline, the pipe will be located on NPNS property. The pipeline then moves across NPNS property and enters NSTIR's Highway 106 (Trans-Canada Highway, also known as Jubilee Highway) ROW at the northwest corner of NPNS property. The pipeline then follows Highway 106 north to Caribou. The pipeline will be installed generally parallel to Highway 106, within the outer portion of the developed road shoulder. It will be situated on the south side until it reaches the Pictou roundabout. Utilizing horizontal directional drilling (HDD) or other boring method to avoid traffic and roadway disturbance, it will be constructed under the roundabout crossing to the north side of the road and continuing there for the remaining extent of the land-based portion. HDD or other boring methods, or open cut crossing methods will be used for pipeline crossings of local public roads and driveways as required. The pipeline will stay within disturbed portions of NSTIR's road right-of-way (Highway 106) until it reaches Caribou Harbour and enters the marine environment, immediately to the west of the Northumberland Ferries marine terminal building and parking areas.

Northern Pulp has not identified an alternative route as required by the TOR, with respect to the primary issue – that TIR will not allow the pipe to be built along the right-of-way along Highway 106.

Northern Pulp has indicated in the Focus Report that "conversations between NPNS and TIR regarding installation of the pipeline within the right-of-way (ROW) are ongoing". A letter from TIR is attached as Appendix 2.1.[3] It is noteworthy to highlight that the letter from TIR, while indicating that discussions with regard to the pipeline route are on-going, does not indicate that these discussions are with respect to the right-of-way. Considering that construction of any pipeline is within TIR jurisdiction, this is misleading.

Northern Pulp has included a single map of the proposed altered pipeline route and included information about all properties along the proposed route. Considering the misleading information and failure to meet the previous terms of the TOR, we cannot comment on whether all the properties have been identified.

Northern Pulp was also required to conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must also determine the potential impacts of ice scour on the pipeline.

The purpose of the geotechnical surveys required by this TOR is to confirm viability of the marine portion of the pipeline route – that is, the physical pipeline itself must actually be a viable construction project, and this must be confirmed by the surveys. While a geotechnical survey was completed, the Focus Report does not positively or explicitly confirm the viability of the proposed pipeline, nor does it offer any statement of an expert's opinion to that effect.

Furthermore, the Focus Report identifies two possible complications: 1) "there were some restrictions in portions of the survey near the shorelines due to the shallow water in these areas" and 2) "the depth to bedrock is not known and may be encountered during the pipeline installation".[4] This may lead to areas in which dredging is limited due to the sub-bottom geology. These issues are not dealt with in the Focus Report.

The geotechnical survey report ("GSR") summary also highlighted these issues. The GSR discussed the difficulty with mapping nearshore sections of the route and interpreting the sub-bottom geology.[5] Additionally, the GSR identified three main areas along the proposed Caribou Harbour pipeline route where dredging activities might be constrained – dredging being the method used to reach the planned trench depth of 3 meters.[6]

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[3] Focus Report, p. 13.
[4] Focus Report, p. 20 and 21.
[5] Geotechnical Survey Report, Appendix 2.2 of Focus Report, p. 120.
[6] Geotechnical Survey Report, Appendix 2.2 of Focus Report, p. 121.

Finally, the GSR made a number of recommendations for work to be considered in further supporting the engineering, design and installation of the proposed pipeline that indicate more work is required before viability can be confirmed.[7]

As part of this aspect of the TOR, Northern Pulp was also required to submit data regarding the complete physical and chemical characterization of the raw wastewater to support its assessment of the appropriateness of the proposed treatment technology.

Northern Pulp notes in its Focus Report that the bleaching process used to remove residual lignin from the pulp, in a step generally referred to as "delignification", used chlorine dioxide (ClO_2) as the bleaching chemical in a process known as Elemental Chlorine Free ("ECF") bleaching.[8] The Focus Report notes that "several studies" have reported that replacement of older systems with the ECF process has resulted in the virtual elimination of detectable amounts of dioxins and furans.

The proposed replacement effluent facility will use an Activated Sludge Treatment ("AST") process involving aeration and recirculation of bacterial population back into the intake of the system. The Focus Report suggests that this process results in effluent that meets the *Pulp and Paper Effluent Regulations* under the *Fisheries Act*, which set out limits on amounts of TSS and BOD that can be released from mills and prohibit the release of effluents that cause harm to fish.[9]

However, under the *Canadian Environmental Protection Act* ("CEPA"), the *Paper Mill Effluent Chlorinated Dioxins and Furans Regulations* (SOR/92-267) require that all pulp and paper mills produce effluent in which there are no measurable quantities of dioxins and furans. Table 2.3-1 of the Focus Report provides a summary of the NPNS's current sampling of untreated effluent (Point A) and indicates that no sampling of dioxins or furans occurred.[10] Table 2.3-3 of the Focus Report provides the laboratory analytical results summary, and does not include any indication of the level of dioxins or furans at Point A (the untreated effluent).[11]

Furthermore, the KSH Consulting Report used to facilitate the Focus Report summary findings found that results for dioxins and furans, indicated in the form of total toxic equivalency ("TEQ") at Point C are in line with TEQ of raw water or Caribou Harbour samples. It concludes that the results demonstrate effectiveness of the PPERs in achieving virtual elimination of dioxins and furans in the effluent.[12] However, there is no indication of how the levels present compare to regulatory requirements under CEPA, using the approved (required) methods for testing for measurable amounts found in those regulations. In fact, Table 1-11 of that KSH report shows

[7] Geotechnical Survey Report, Appendix 2.2 of Focus Report, p. 123.
[8] Focus Report, p. 25.
[9] Focus Report, p. 46.
[10] Focus Report, p. 27.
[11] Focus Report, p. 30.
[12] Appendix 2.3 – KSH Consulting Report, p. 32.

detected levels at Point A and Point C of some forms of dioxins and furans.[13] The KSH report then provides its conclusion that:

> *The analysis shows that because of their potential impact on the receiving waters and despite no direct indication that these effects have been observed in the environment, some compounds should be considered for further scrutiny, either as part of future testing or as part of more long-term investigations, such as the Environmental Effects Monitoring (EEM) program or Human Health Risk Assessment (HHRA)"*.

The components of effluent that warrant further study include dioxins and furans.[14]

Therefore, considering the legal requirements under CEPA and the regulations, the non-inclusion of the levels of dioxins and furans at Point A (the current untreated effluent) leads to the conclusion that the physical and chemical characterization of the raw wastewater (at Point A for the Project) is not complete. Additionally, there are indications that the proposed effluent treatment process is not appropriate, given the identified need for additional studies related to dioxins and furans and indications that regulatory requirements would not be met.

Finally, Appendix 2.3 has a full Raw and Treated Effluent Characterization report conducted for this Focus Report that supposedly provides the complete physical and chemical characterization of expected effluent following treatment. Its objective is to answer the question: *What are the expected list of contaminants that may be generated specifically by the new NPNS Effluent Treatment Facility*? It appears to us that the appropriateness of the proposed treatment technology was not part of the work done.

Northern Pulp was also required to submit a complete physical and chemical characterization of NSPN's expected effluent following treatment by the proposed technology, including:

- Data from laboratory trials on NPNS's raw wastewater that were conducted at Veolia/AnoxKaldnes in Lund, Sweden in May 2018; ·
- Modelling results using the raw wastewater parameters and quality; ·
- A comparison of the effluent characterization results from the laboratory trials and modelling work, against appropriate regulations and/or guidelines.

In undertaking this component of the TOR, Northern Pulp states that a comparison of the untreated (Point A) and treated (Point C) effluent components against published effluent composition data from other Canadian jurisdictions indicates that the mill's effluent is similar to effluent from other bleached kraft mills using similar technology. Northern Pulp notes that the proposed replacement ETF will provide performance comparable to other mills, and furthermore, that the current and proposed ETF will have comparable performance. It concludes

[13] KSH Consulting Report, p. 31.
[14] KSH Consulting Report, p. 33-34.

that the data collected from Point C can be used to accurately represent what effluent from the replacement ETF will resemble.[15]

The comparison of effluent characterization results from both laboratory trials and modelling work against appropriate regulations or guidelines was incomplete. Table 2.4-2 of the Focus Report sets out the comparison.[16] The characterization data used was BOD and TSS from the Veolia expected performance data against the PPER (1992 – current) and the First Draft of the Modernization of the PPER, released in May 2019, as well as provincial limits on BOD and TSS. There is no comparison against other appropriate regulations, including against those created under CEPA (see: *Pulp and Paper Mill Defoamer and Wood Chip Regulations* and *Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations*). Furthermore, while there are regulatory daily maximums for both BOD and TSS in regulations provided, the data provided for the comparison did not include daily maximums, and instead, looked only at monthly averages. No comparison with any guidelines was provided.

Northern Pulp was required to provide any proposed changes to the pipeline construction methodology and other associated pipeline construction work, related to the potential changes to the marine portion of the pipeline route.

Note that Table 2.5-1 shows a summary of the changes to construction; this includes many changes that were made as a result of the marine geotechnical survey. This includes an estimated increase of 6,500 cubic meters of soil per kilometer in excavated volume of soil from dredging.[17] There is also an anticipated change in the excavation rate of 300-500 cubic meters per hour and 3-4 day per kilometer timeline to a rate of 60-120 cubic meters per hour and a timeline of at least 21 days per kilometer. These are large increases (it is a 7-times increases in the time taken) and will have an impact on the length of time required for excavation. This will have an impact on the marine environment that is much greater than originally anticipated and highlights the need for further evaluation.

3.3 Facility Design, Construction & Operation and Maintenance

Northern Pulp was required to submit treatment technology specifications and an assessment of the efficacy of the proposed treatment technology for use at the NPNS facility, to the satisfaction of NSE. The TOR provides, as an example of the type of assessment required, that the peak effluent temperature is proposed to be above generally accepted range of temperatures to achieve optimal biological treatment; it asks Northern Pulp to explain how the proposed higher temperatures would affect the temperature performance.

[15] Focus Report, p. 32-33.
[16] Focus Report, p. 37.
[17] Table begins at p. 40 of the Focus Report.

This TOR requirement likely came about as a result of comments from the NSE Inspection, Compliance and Enforcement Division and Industrial management Unit, which had a concern that temperatures would be above 25-35 degrees Celsius; more specifically, NSE was concerned about the ability of the ETF to meet and not exceed effluent limits.[18]

Neither the Focus Report, nor the KSH Consulting Report found in Appendix 3.1, discuss in any manner the reason that peak effluent temperatures are above generally accepted range of temperatures. In fact, there is no discussion whatsoever of the generally accepted range of temperatures of effluent. Likewise, there is no discussion of the "optimum treatability" temperatures of the proposed effluent technology.[19] Northern Pulp has also failed to indicate how it plans to comply with changes in the PPER, since ECCC has proposed to limit temperature of effluent to 35 degrees C daily and 40 degrees C monthly.

Finally, it is not clear that an explanation of how the proposed higher temperatures would affect treatment performance. In the Focus Report, Northern Pulp acknowledges that the rate of biological reaction will increase with temperature to a maximum value of around 35.5 degrees Celsius for most aerobic effluent systems, and that temperatures above 39 degrees will result in a decreased oxidation rate for mesophilic organisms.[20] Since oxidation is the process used to remove organic material from the wastewater, the reduced oxidation rates found at the higher than normal temperatures seem counterintuitive to the purposes of the process. This is not reconciled within the Focus Report. Northern Pulps statement that "with increasing effluent temperature, bacterial activity increases" is misleading because the bacterial activity appears to level off at a certain temperature and then decline.[21]

As part of the TOR for facility design, Northern Pulp was also required to provide effluent flow data to support proposed peak treatment capacity of 85,000 m3 maximum flow of effluent per day, with a minimum of 2017 and 2018 data required.

Part of this TOR requirement is the provision of flow data from Point A of the current effluent plant; however, the Focus Report states that there is an "absence of accurate Point A data".[22] The Report in Appendix 3.2 confirms that "flow is not measured at Point A".[23] Northern Pulp's statement that "A design of 85,000 m3/day is appropriate and well supported by the operating data of the last three years" is not accurate; no operating data for Point A is provided and so all calculations for flowrate are approximations of the actual flowrate at Point A. No reason is provided for not providing data for Point A, other than in the Report as follows:

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[18] Focus Report, Appendix 1.1, Concordance Table p. 9/40 – Government comments.
[19] Refer to government submissions in Registration Documentation, p. 255.
[20] Focus Report, p. 46.
[21] Focus Report, p. 47.
[22] Focus Report, p. 49.
[23] Focus Report, Appendix 3.2, p. 3.

Flow is measured using a doppler-type system at the effluent feed pumps at the mill, but this measurement is for indication purposes only, as its accuracy is not sufficient for either data analysis or regulatory purposes.[24]

The Report also notes that: "Effluent flow exceeded 85,000 m3/day one day in 2016 and not at all in both 2017 and 2018"; yet, the Table showing historic flowrates (in monthly averages and expressed in m3/day) indicate two separate instances where flowrate was above: in July 2017 and in August 2017. Furthermore, there are two instances where the flow rate is above 84,000 m3/day, including in July and August 2018.[25] Considering that flowrates are expressed as monthly averages, it is difficult to reconcile the fact that averages consist of figures both below and above that average. It is likely that flowrate went above the 85,000 m3/day more than once.

Northern Pulp is required to provide the following information regarding the effluent pipeline:

- Viable options for leak detection technologies and inspection methodologies, with specific consideration of the Pictou water supply protection area
- Viable options for the enhanced pipeline projection, including justification for how the chosen option is an adequate option for secondary containment

Northern Pulp identifies several possible leak detection technologies it might use; however, the Focus Report does not provide for any leak detection technology to be deployed for the marine component of the effluent pipeline.[26] The Focus Report also does not provide specific consideration of the Pictou water supply protection area with respect to leak detection technologies and inspection.

3.4 Marine Water and Marine Sediment

Northern Pulp is required to update the receiving water study to model for all potential contaminants of concern in the receiving environment.

In the Receiving Water Study ("RWS"), the Focus Report states that for near-field modeling, a three-dimensional software model was used to assess "regulatory mixing zones" resulting from continuous source discharges. The "mixing zone" for the purposes of this study was defined as per the Canadian Council of Ministers of the Environment (CCME, 2003) as "an area contiguous with a point source (effluent) where the effluent mixes with ambient water and where concentrations of some substances may not comply with Water Quality Guidelines or objectives".[27] The objective of the modelling was to confirm ambient water quality

[24] Focus Report, Appendix 3.2, p. 3.
[25] Focus Report, Appendix 3.2, p.4.
[26] Focus Report, p. 62: pipeline [see specifically, p. 62, PDF 102 – re "leak detection system…will be installed…in the overland portion…of the route between Pictou and Caribou…"; and: "Automated leak detection will not be installed in the rest of the fused HDPE pipeline outside of this land-based section".[26]
[27] Focus Report, p. 85.

concentrations or established water quality guidelines were met at the edge of the mixing zone (100m).

There are several issues with this approach. First, the CCME is a forum of federal and provincial Ministers to discuss common issues related to environmental issues of national and international concern. The guidelines created within this forum are only that – guidelines; they do not form part of the legal framework that would ultimately guide the proposed effluent discharge. Second, there is no "mixing zone" or "regulatory mixing zone" created under provincial or federal legislation for the purposes of the proposed effluent pipeline and outlet.

Under the *Fisheries Act* and the *Canadian Environmental Protection Act* and their regulations, the release of substances into the marine environment (the "receiving environment" in this case) occurs at the point where the substance is released, not the edge of a 100m mixing zone. Therefore, the effluent released from the proposed pipeline must meet all regulatory requirements at the moment that the effluent exits the pipe at the diffuser.

3.5 Fresh Water Resources

Northern Pulp was required to provide monitoring methodologies for areas with significant risk of pipeline leaks or spills.

Appendix 5.2 of the Focus Report is left intentionally blank and refers to the corresponding section of the Focus Report. The TOR identifies several issues to be addressed, including: the two areas where the pipeline crosses Source Water Protection Delineated Boundaries for Town of Pictou wellfields, below water table, wetlands, water crossings. It leaves open the possibility of others.

The Focus Report is vague on the methodologies it will use to monitor impacts from the pipeline. A surface water monitoring program will be "developed".[28] A Construction Monitoring Program will be "developed".[29] The current NPNS monitoring program will continue to be used to monitor groundwater and it will "develop a surface water monitoring program".[30]

With respect to wetlands, the Focus Report identifies that future monitoring will be conducted to assess success of wetland compensation that it anticipates. It also states that the degree of disturbance in wetlands adjacent to the proposed project will be "assessed" prior to and subsequent to construction activities. It proposed to assess disturbed portions of wetlands with undisturbed portions of the same wetland – this assumes that impacts on part of a wetland do not affect other parts of that same wetland. Assessment criteria are included.

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[28] Focus Report, p. 106.
[29] Focus Report, p. 106.
[30] Focus Report, p 106-07.

This TOR requirement is not fulfilled. The two pages of "methodologies", with no attached appendix. Other than the limited description of wetlands monitoring, within the narrow scope of compensation, no other methodologies are provided. The Focus Report simply identifies that future monitoring will be developed. This is not a methodology.

Considering the ordinary or common meaning of the word "methodology", a statement to the effect that a study will be "developed" is not sufficient to meet that definition. Methodology means the body or system of practices, rules, principles that will be used to develop and undertake the study. For example, the Collins English Dictionary (online) defines methodology as "a system of methods and principles for doing something, for example for teaching or for carrying out research".[31]

The Focus Report states that "leak detection technologies and inspection methodologies are addressed in other sections of this report";[32] however, relevant sections of the report (assuming section 3.5 – Leak Detection Technologies) does not provide methodologies. That section also does not address specific areas with significant risk of pipeline leaks or spills, such as the identified areas explicitly set out in section 5.2 of the TOR.

Finally, it is important to note that there are other areas that will be faced with "significant risk of pipeline leaks or spills", not least the marine components of the pipeline. While the TOR provides specific examples of areas facing these significant risks, the requirement relates to all areas that face significant risk.

3.6 Air Quality

Northern Pulp was required to provide a revised inventory of all potential air contaminants to be emitted from the proposed project, including but not limited to, speciated volatile organic compounds, semi-volatile organic compounds, reduced Sulphur compounds, polyaromatic hydrocarbons and metals. Furthermore, Northern Pulp is required to update the air dispersion modelling for the pulp mill facility for all potential contaminants of concern related to the Project.

Northern Pulp creates its inventory based on the selection of contaminants as indicated in section 6.1 of the TOR; it appears then, that the inventory (found in Appendix 6.2) is not of all potential contaminants. The Focus Report states that:

> *The <u>air contaminants considered in the development of the revised inventory</u> for the project included CACs, metals, PAHs, VOCs, reduced Sulphur compounds, dioxins and furans and terpenes, <u>as per Section 6.1 of the Terms of Reference</u> for the Focus Report and <u>through further communication with NSE</u>.*[33]

[31] See: https://www.collinsdictionary.com/dictionary/english/methodology
[32] Focus Report, p. 106.
[33] Focus Report, p. 109.

It should be noted that section 6.1 of the TOR explicitly lists the substances to be included in the inventory but does not limit Northern Pulp to those substances for the purposes of the TOR requirement. There is no indication of the substance of communications with NSE; however, the NSE Air Quality Unit had provided comments, provided in the concordance table, that Northern Pulp "should have identified the full air emissions inventory for the facility and modeled all potential air contaminants of concern, as a result of the proposed project".[34]

Moreover, the following is a more detailed description of the process to develop the inventory, as found in Appendix 6.1 of the Focus Report (emphasis added):

> *The air contaminants considered in the development of the revised inventory for the Project included criteria air contaminants (CACs), metals, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), reduced Sulphur compounds, dioxins and furans and terpenes, as per Section 6.1 of the Terms of Reference (NSE 2019b) and further communication with NSE (S. Vervaet, personal communication, July 12, 2019). The <u>considered list was refined</u> using published literature focused on the pulp and paper industry, including the National Council for Air Stream Improvement Inc.'s (NCASI) Handbook of Substance-Specific Information for National Pollutant Release Inventory Reporting (NPRI) for Pulp and Paper Mills (NCASI 2007) and those presented as being released from pulp and paper mills in Ontario's Technical Standards to Manage Air Pollution (Appendix 4-A) (MECP 2018a). <u>Of the refined contaminant list, those included in the revised emission inventory</u>, and therefore assessed through modelling, were identified based on site-specific data, data obtained from Kraft mills with similar operations (e.g. AST ETF and co-combustion of biosludge and biomass – mills included Howe Sound and Crofton), and published literature specific to the Project operations, <u>as per the following considerations</u>[…].*[35]

Therefore, the inventory of contaminants was refined twice. First, the full list of identified contaminants was refined using publishing literature; second, this refined list was further refined using additional criteria or "considerations". It should be noted that this does not meet the requirement that "all potential contaminants" be included in the inventory. In fact, an inventory is generally considered a complete list. For example, the Collins English Dictionary (online) defines inventory as "a written list of all the objectives in a particular place".[36]

It is noted in the Focus Report that the contaminants that are part of the updated and expanded air dispersion modelling are not currently regulated under the *Air Quality Regulations* created under the *Environment Act*. However, section 67 of the *Environment Act* is explicit that (emphasis added):

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[34] Focus Report, Appendix 1.1, Concordance Table, p. 2.
[35] Focus Report, Appendix 6.1, Stantec, "Expanded Air Dispersion Modelling Study", p. *v*.
[36] See: https://www.collinsdictionary.com/dictionary/english/inventory

(1) No person shall knowingly release or permit the release into the environment of a substance in an amount, concentration or level or at a rate of release that causes or may cause an adverse effect, unless authorized by an approval or the regulations.

(2) No person shall release or permit the release into the environment of a substance in an amount, concentration or level or at a rate of release that causes or may cause an adverse effect, unless authorized by an approval or the regulations.

Substances within this context include any solid, liquid or gas. Therefore, although some contaminants are explicitly regulated in the *Air Quality Regulations*, any potential substance released from the proposed effluent facility that causes or may cause an adverse effect will be the focus of provisions under the law and should have been included in the inventory.

3.7 Fish and Fish Habitat

Northern Pulp is required to submit an updated Environmental Effects Monitoring ("EEM") program based on the results of various relevant baseline studies and an updated receiving water study. As part of this TOR requirement, Northern Pulp must also refer to Addendum 4.0, which states that several field studies and monitoring are "likely to be required as part of an EEM program regulated under the PPER for the project if it is approved". This includes biological monitoring studies covering a benthic invertebrate community study, fish population study, and dioxin and furan levels in fish.

Northern Pulp did not submit an updated EEM program. The accompanying Appendix 7.4 is Schedule IV.1 of the *Pulp and Paper Effluent Regulations*. It is noted in the Focus Report that:

The proposed EEM investigations related to the NPNS Caribou Harbour outfall relocation was provided by EcoMetrix Incorporated as part of the original EARD (Appendix G of the EARD)(EcoMetrix, 2018a) and remains relatively unchanged based on the various baseline studies and the updated RWS.[37]

While the FR suggests that the EEM is "relatively unchanged", it does not provide further details on what parts were changed, or how so. An EEM proposed program was submitted in the EARD (Appendix G).

The requirement for an EEM is set out in the *Pulp and Paper Effluent Regulations* created under the *Fisheries Act*, as follows:

28 (1) The owner or operator of a mill shall conduct environmental effects monitoring studies of the potential effects of effluent on the fish population, on fish tissue and on the benthic invertebrate community.

[37] Focus Report p. 148.

(2) Environmental effects monitoring studies consist of the sublethal toxicity testing referred to in section 29 and the biological monitoring studies referred to in section 30.

(3) The studies shall be performed and their results recorded, interpreted and reported in accordance with generally accepted standards of good scientific practice at the time that the studies are performed.

The Focus Report states that there are provisions in the PPER that removes the requirements for specific study components of the EEM program based on the dilution of effluent, as follows:

- If the effluent concentration is less than 1% at a distance of 250m, no fish community study is required; and
- If the effluent concentration is less than 1% at a distance of 100 from the discharge, no benthic invertebrate community study is required.[38]

Northern Pulp refers to the 3D modeling in the local study area and suggests because it indicates that dilution of the effluent will occur to less than 1% at approximately 20m from the discharge location, neither a fish community nor benthic community study is required.[39] Northern Pulp goes on to state that predictions of effluent dilution will need to be confirmed as part of the first EEM study. Finally, the Focus Report states that some fish and benthic studies are still warranted as part of the EA follow-up and monitoring program and that "it is intended that they will be completed by a third party consultant for the current project".[40]

The requirements for biological monitoring studies are set out in more detail in Schedule IV.1 of the PPER:

3 Biological monitoring studies consist of

(a) a study respecting the fish population, if the concentration of effluent in the exposure area is greater than 1% in the area located within 250 m of a point of deposit of the effluent in water;

(b) a study respecting fish tissue if:

(i) since the submission of the most recent interpretive report, the effluent contained a measurable concentration of 2,3,7,8-TCDD or of 2,3,7,8-TCDF, within the meaning of the Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations, or

[38] Focus Report, p. 150.
[39] Focus Report, p. 150.
[40] Focus Report, p. 150.

(ii) an effect on fish tissue was reported in the most re- cent interpretive report; and

(c) a study respecting the benthic invertebrate community, if the concentration of effluent in the exposure area is greater than 1% in the area located within 100 m of a point of deposit of the effluent in water.

As noted in Addendum 4.0, Northern Pulp is likely to be required as part of an EEM program regulated under the PPER for the project if it is approved to include a benthic invertebrate community study and fish population study. This likely refers to the PPER modernization efforts currently under way by Environment and Climate Change Canada ("ECCC"). As part of that modernization, ECCC is considering adding critical effect sizes (CES) as criteria for determining when investigation studies are required. CES are based on the size of effects on fish or fish habitat.[41]

3.8 Flora and Fauna

Northern Pulp is required to complete a number of baseline surveys along the proposed re-aligned effluent pipeline route, including:

- Plant baseline survey;
- Migratory bird survey;
- Bird baseline surveys for the Common Nighthawk, Double-crested Cormorants, owls, and raptors and raptor nests for the entire project area; and
- Herptile survey

Note that potential turtle habitat was identified; there may be species at risk under the provincial *Endangered Species Act*. The ETF was identified as being within range of two species identified in the Herptile Survey as being species at risk or endangered species: wood turtle and snapping turtle.[42] It is recommended that further analysis and study is required to determine Northern Pulp's ability to comply with statutory requirements with respect to these species.

3.9 Human Health

Northern Pulp was required to complete baseline studies for fish and shellfish tissue of representative key marine species important for commercial, recreational and Aboriginal fisheries in the vicinity of the proposed effluent pipeline and diffuser location.

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[41] See: Environment and Climate Change Canada, "Proposed Modernization of the Pulp and Paper Effluent Regulations – Consultation Document" (September 2017), p. 3-4.
[42] See Focus Report, Appendix 8.4, Herptile Study, p. 1.

Additionally, Northern Pulp was required to commence a Human Health Risk Assessment ("HHRA") to assess potential project related impacts on human health. The HHRA must include human consumption of fish and other seafood, consumption of potentially contaminated drinking water, exposure to recreational water and sediment, outdoor air inhalation, and any other potential exposure pathways. The analysis must inform the identification of contaminants of concern and updating of the RWS.

Northern Pulp has not completed the HHRA; it is ongoing and is not anticipated for completion until the spring of 2020.[43] Furthermore, Northern Pulp appears not to have finished collecting data on key representative species, since it has plans to conduct additional rounds of tissue collection prior to construction targeting additional shellfish (scallop, blue mussel and oyster), and locally relevant fish (such as Atlantic striped bass, Atlantic mackerel and Atlantic herring).[44]

3.10 Archeology

Northern Pulp was required to complete an Archaeological Resource Impact Assessment ("ARIA") for the marine environment related to the project. While it appears that the ARIA was meant to be included in Appendix 10.1, that appendix only has a letter from the Nova Scotia Department of Communities, Culture and Heritage indicated the ARIA was completed. It is our recommendation that the ARIA be provided for public comment.

3.11 Indigenous Peoples' use of land and resources

Northern Pulp was required to complete a Mi'kmaq Ecological Knowledge Study (MKES) for the project.

The process of producing a MEKS includes a review by the Kwilmu'kw Maw-klusuaqn Negotiation Office ("KMKNO") to ensure consistency with its EKS Protocol. While Northern Pulp indicated the completion of this process, the KMKNO had not yet completed its review.

Similar to the lack of completion of the HHRA, this requirement is started but not completed. Given that Northern Pulp has a statutorily granted period of one year to complete its Focus Report and given that it may also be granted an extension of that period by the Minister, it is not clear why these components were not completed prior to submission. No explanation is offered.

Sincerely,

[43] Focus Report, p. 165.
[44] Focus Report, p. 165-66.

East Coast Environmental Law

The Role of the Pulp and Paper Effluent Regulations in the long-term protection of fish and fish habitat.

1.0 Introduction

The Pulp and Paper Effluent Regulations (PPER) allow pulp and paper companies to release deleterious substances into water frequented by fish. Such a release would otherwise violate subsection 36(3) of the *Fisheries Act.*

> **36(3)** Subject to subsection (4), no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water.

However, subsection 36(4) of the Fisheries Act permits certain deposits if they are in accordance with regulations.

> **36(4)** No person contravenes subsection (3) by depositing or permitting the deposit in any water or place of **(b)** a deleterious substance of a class and under conditions — which may include conditions with respect to quantity or concentration — authorized under regulations made under subsection (5) applicable to that water or place or to any work or undertaking or class of works or undertakings;

The authority to make these regulations sits with the Governor in Council (Cabinet), the details of which can be found in subsection 36(5) of the Act.

2.0 Brief History of the PPER

The first Pulp and Paper Effluent Regulations were passed in 1971. The Regulations were created in response to evidence that pulp and paper effluent was causing dissolved oxygen depletion in marine environments and releasing substances that were toxic to fish. The 1971 Regulations set limits on total suspended solids (TSS), biological oxygen demanding (BOD) matter and effluent that was acutely toxic to fish. Owing to the high cost of installing effluent treatment systems, the 1971 PPER applied only to new mills and in some instances mills that were expanded or altered.[1]

By the late 1980s, Environment Canada had determined that the 1971 Regulations had not yielded all of the desired effluent quality improvements that were initially sought through the Regulations. [2]

> "In 1985, about 25% of mills were meeting the requirement for effluents to be non-acutely lethal to Rainbow Trout."[3]

The Government amended the PPER in 1992. The changes in 1992 included application of the Regulations to all mills and off-site treatment facilities and a requirement that all effluent not be acutely toxic to rainbow trout. Older mills required upgrades to meet the 1992 Regulations so existing mills were given until 1996 to come into compliance with the Regulations.[4] By 1996, the Regulations had been in place for 14 years and the regulator had clear knowledge that the 1971 Regulations were not effective for 11 years.

Following the full implementation of the 1992 Regulations, the rate of compliance improved and discharges of TSS and BOD improved significantly. Between 1987 and 1996, total discharges of TSS and BOD matter to water decreased by approximately 60% and 90%, respectively. Most of these improvements took place because the Regulations applied to all mills and many mills added secondary biological treatment systems.[5]

3.0 The Impact of Environmental Effects Monitoring

The 1992 Regulations also added requirements for Environmental Effects Monitoring (EEM). During the period 1992 to 2010, the Regulations were amended to enhance requirements for EEM.

Environmental Effects Monitoring Protocol Evolution

Cycle	Years	Requirements
1	1992 – 1996	EEM study results used as initial data but not used to assess effects.
2	1996 – 2000	EEM studies to assess effects.
3	2000 – 2004	EEM studies to assess and confirm effects, and assess magnitude and extent of effects.
4	2004 – 2007	EEM studies to assess and confirm effects, and assess magnitude and extent of effects. Investigation of Cause (IOC) studies
5	2007 – 2010	EEM studies to assess and confirm effects, and assess magnitude and extent of effects. IOC and Investigation of Solution (IOS) studies.
6	2010-2013	Requirement to conduct a fish test was removed by the 2008 PPER amendments.

As a result of the evolution of the EEM, the data revealed that despite the increase in compliance with the Regulations post-1992 and the reduction in TSS and BOD, effluent was continuing to cause unacceptable environmental harm.

3.1 Sublethal Toxicity

As part of the EEM protocol each mill had to measure the sublethal toxicity of its final effluent discharge 2 x each year (summer and winter). Analysis of this data showed that mill effluent toxicity decreased between 1992 and 1996 (the year the 1992 Regulations were fully applied) and then generally remained constant. Between 1996 and 2010, 50% of the tests showed sublethal toxicity.[6] In cycle 6 of the EEM testing (2010-2013) showed an increase in sublethal toxicity to 63% of all effluent tests.[7]

3.2 Biological Monitoring

Analysis of EEM biological monitoring studies over the same period revealed mill effluents were causing effects on fish (increase liver size, decrease gonad size) and fish habitat (benthic invertebrate communities) and in rare instances causing elevated levels of dioxins and furans in fish tissue.[8] In Cycle 2, ten mills were required to analyze fish tissue for dioxins and furans and 6 of those had levels of dioxins and furans in fish tissue that exceeded Health Canada guidelines for fish consumption.[9]

In cycle 6 of the EEM testing 11 mills conducted 9 biological monitoring studies for different purposes. In 7 of the 9 studies effects on fish or fish habitat were observed or confirmed.[10]

The results of the 6 EEM study cycles have shown that approximately 70% of the mills confirmed an effect for at least one of the effect indicators, with approximately 45% of mills confirming effects relating to eutrophication and 20% confirming a reduced gonad size effect.

4. Modernizing the PPER

It took 20 years for the EEM protocol to evolve to a point where the regulator (ECCC) could deem that the 1992 Regulations were not effective at preventing harm to fish and fish habitat.

In 2017, 4 years after the results for cycle 6 of the EEM and 5 years after the 2012 Status Report that clearly identified regulatory failure, engagement on the modernization of the 1992 PPER began. Two years later, in May 2019, Environment and Climate Change Canada released the Modernization of the *Pulp and Paper Effluent Regulations* – Detailed Proposal.

The proposal to amend the PPER includes increasing the effluent intensity factors for biochemical oxygen demand (BOD), suspended solids (SS), and adding an intensity factor for chemical oxygen demand (COD). The proposal will also add effluent concentration limits for nitrogen and phosphorus and limits for temperature and pH.[11] The final version of the revised PPER is planned for 2021.[12]

Graphic evidence provided by ECCC indicates that operating mills have, for the most part, been meeting the 1992 PPER requirements for BOD and TSS.[13] However, despite general compliance and nearly 50 years of regulation, pulp and paper effluent continues to cause dissolved oxygen depletion in marine environments and continues to release substances that are toxic to fish. Presuming the modernized regulations come into force in 2021,one can anticipate that there will be a transition period of 4 years for operating mills, meaning full compliance could be expected by approximately 2025.

[1] Environment Canada, Environmental Stewardship Branch, Status Report on the Pulp and Paper Effluent Regulations (June 2012) at page 2, on-line at: http://publications.gc.ca/collections/collection_2012/ec/En14-66-2012-eng.pdf
[2] *Ibid.*
[3] *Ibid* at 4.
[4] *Ibid* at 5.
[5] *Ibid* at 11.
[6] *Ibid* at 18.
[7] Environment Canada, Environmental Effects Monitoring Program, 6th National Assessment of Environmental Effects Monitoring Data from Pulp and Paper Mills Subject to the Pulp and Paper Effluent Regulations (April 2014) at page 5, on-line at: http://publications.gc.ca/collections/collection_2014/ec/En14-84-2014-eng.pdf
[8] Supra Note 1 at 18.
[9] SHERRY L. WALKER,* KATHLEEN HEDLEY AND EDWARD PORTER, Pulp and Paper Environmental Effects Monitoring in Canada: An Overview, *Water Qual. Res. J. Canada, 2002 Volume 37, No. 1, 7–19* at page 14, on-line at https://www.cawq.ca/journal/temp/article/151.pdf
[10] Supra Note 7 at 9.
[11] Environment and Climate Change Canada, Modernization of the Pulp and Paper Effluent Regulations, Details Proposal (May 2019).
[12] Environment and Climate Change Canada, Forest Products and Fisheries Act Division, Presentation on the Modernization of the Pulp and Paper Effluent Regulations, Detailed Proposals, August 15, 2019 on-line at https://drive.google.com/drive/folders/1tpZlB4bv_8T0UeQUwp3olh91qEVIxn7x
[13] Environment and Climate Change Canada, Forest Products and Fisheries Act Division, PPER Modernization Graphs, on-line at https://drive.google.com/drive/folders/1R3DOdRQPcvriSrZ5I8yz9oH1S1ZzBFbE

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March 9, 2019

Environmental Assessment Branch
Nova Scotia Environment
P.O. Box 442
Halifax, NS, B3J 2P8

Re: Northern Pulp Nova Scotia Corporation's Replacement Effluent Treatment Facility Project

This letter is submitted on behalf of the Ecology Action Centre (EAC), an environmental charity working since 1971 at the local, provincial, national and international level to build a healthier and more sustainable world. Our vision is 'a society in Nova Scotia that respects and protects nature and provides environmentally and economically sustainable solutions for its citizens'. The EAC works to catalyze change through policy advocacy, community development and awareness building. And, when required, we serve as a watchdog for our environment.

In that capacity, we respectfully request that the Minister reject Northern Pulp Nova Scotia Corporation (NPNS)'s proposal as outlined in their registration document under Section 34(1)(f) of the Environment Act "because of the likelihood that it will cause adverse effects or environmental effects that cannot be mitigated". We also cite that there are a number of areas in the registration document where crucial information is lacking or unknown, triggering Section 34(1)(a-c) requiring additional information and focus reports. We also cite Section 2(b)(ii) "the precautionary principle will be used in decision-making so that where there are threats of serious or irreversible damage, the lack of full scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation."

Despite its impressive volume, NPNS's registration document is very poor and fails to provide necessary information about key elements of their plan, including and importantly - the content of the substances they wish to pump in large volumes into the Northumberland Strait and the potential impacts that it undoubtedly will have on marine life and air quality. The registration document seems designed to obfuscate essential details, downplay them or intentionally omit them altogether. It essentially says there will be no impact of any kind. This is simply not credible. In Table E.1.1-1: Summary of the Significance of Project-Related Residual Environmental Effects Predicted. Every row and column of the table contains 'NS' which represents 'No Significant Residual Environmental Effects Predicted', including water quality, fish and fish habitat, surface and groundwater and the entire 'Accidents, Malfunctions and Unplanned Events' column. It is inconceivable that after NPNS's lengthy history of leaks, ruptures, over-limit emissions and other unplanned events that these predictions could be put forward credibly in a registration document for environmental assessment of this proposed effluent treatment facility.

NPNS has not done its due diligence to fully determine the potential impacts of their proposed project. It is the duty of Nova Scotia Environment to apply a rigorous standard of environmental protection when assessing risk and we do not feel that NPNS has provided sufficient information within their registration document to enable the province to complete the assessment. In light of this, the only acceptable decision is to reject the proponent's proposal for this effluent treatment facility. The potential for damage to our land, water and air from this proposed effluent treatment system is far too great for the province to grant approval.

The EAC's concerns about this proposed effluent treatment facility are numerous. Despite the very limited time available under this 'Class 1 undertaking' environmental assessment process (30 days) to review the proponent's registration document (1,586 pages spread over 17 documents), this letter outlines our primary concerns, which are:

- Use of an insufficient standard for effluent;
- The potential impact on the marine environment from the massive volume of effluent with its undetermined chemical and physical composition;
- Cumulative impacts and the fragility of the ecosystem of the Northumberland Strait;
- The risks associated with the effluent pipe and its pathway;
- Air pollution from burning waste sludge;
- Socio-economic impacts on fisheries and other sectors; and
- Indigenous opposition
- Lack of serious consideration of alternatives

Insufficient Standard for Effluent

NPNS had a responsibility to develop a solution that enables their operations to continue in Nova Scotia while preventing harm to the environment and the wider community. Rather than identifying an innovative solution which does these things, it is clear that NPNS's objective is simply to meet the minimum Pulp and Paper Effluent Regulations (PPER). The federal regulations are very old and are currently undergoing a major overhaul. NPNS will be required to comply with the updated PPER once the new standards are complete and accordingly, it is irresponsible for their effluent goals to just meet the existing standard. And this statement assumes that their effluent would meet the current standard, something that NPNS cannot guarantee since they cannot say what will be in their effluent until the new system is operational.

A key reasoning behind the proposed modifications to current PPER has been the ongoing degradation of fish habitat by most mills, even when in regulatory compliance. The PPER are primarily designed to prevent effluents that cause acute lethality to fish from entering nearby waterways (pg. 357) and do not deal with long-term cumulative effects or ecosystem impacts. Furthermore, according to Caroline Blais, the Director of the Forest Product and *Fisheries Act* Division at Environment and Climate Change Canada (ECCC), 70% of pulp and paper mills abiding by today's PPER have still shown deleterious impact on fish or fish habitat. A 2016 EcoMetrix study also found enlarged gonads and livers in fish tested near the current Boat Harbour effluent treatment facility's outfall location, despite the fact that Northern Pulp has routinely passed the acute lethality testing. Director Blais, in presentation for the Prince Edward Island Standing Committee on Agriculture and Fisheries in February 2019, described widening the scope of deleterious substances that may call for regulation and "reviewing the regulatory limits for existing and new substances," as central to the government's PPER modification effort. This process will also seek to develop new regulations to treat nutrient inputs, which to date have not been addressed in PPER legislation. NPNS's proposal has not adequately addressed how the company intends to meet new and more stringent effluent regulations that the federal government is working towards.

Simply meeting the PPER is a tremendously low bar to set in environmental protection and is no guarantee that harm to the environment and ecosystem will not occur, only that outdated regulatory maximums of permissible harm might be reached. This is unacceptable, particularly since NPNS cannot even identify what will be in the effluent - a major red flag that this undertaking carries unacceptable levels of risk of impact to the environment and the legitimate interests of other stakeholders. Nova Scotia Environment clearly stated to NPNS that their EA must go beyond the parameters in the Federal PPER. Their proposal as outlined in the registration document does not do that. Aiming to achieve the lowest possible standard after decades of causing significant environmental damage to the natural world and communities surrounding the mill is simply not enough.

Effluent Content and Potential Impacts on the Marine Environment

The volume and toxicity of the liquid waste produced at the NPNS mill is significant. Boat Harbour provides incontrovertible evidence of the impact of the effluent to the current "receiving waters" - the area is devoid of life. Redirecting the effluent into the Northumberland Strait and the lower Gulf of St. Lawrence will certainly be detrimental to the health and productivity of the new "receiving waters". But unlike Boat Harbour, where most of the damage to date has been contained (and will cost taxpayers hundreds of millions to clean up), the potential damage to the Northumberland Strait will not be easily contained and will be impossible to clean up.

The Northumberland Strait is a relatively shallow area with slow moving currents far from the open sea. This makes it a very low "flushing" system. It takes approximately a year for the water to fully exchange. Northern Pulp's own reports say that on top of 60 to 80 million liters of liquid effluent they also anticipate releasing up to four tons of suspended solids in their waste water each day. In addition to that it is important to note that every drain, toilet and sink inside the mill is attached to the effluent disposal system meaning that in addition to human waste every oil or chemical spill inside the plant ends up in their effluent system. Test results in the current receiving waters (Boat Harbour) show the presence of dioxins, furans, chlorinated compounds, halogenated organic compounds and traces of heavy metals. These substances are known to have serious negative impacts to aquatic and other life. In addition to the chemicals and solids produced in the pulping process the new effluent treatment system "will require several chemical inputs, including urea, phosphorus, sodium hydroxide, sulfuric acid and an anti-foam agent to support its process." (pg. 46). So these too would be sent out into the Northumberland Strait. With so many deleterious inputs it's no wonder NPNS doesn't know what will be in their own effluent stream.

Dioxins and Furans

Research from other pulp and paper mills can provide insight on the potential risks to the marine environment associated with some of the products referenced in NPNS's project proposal. In British Columbia's Howe Sound, the Port Mellon and Woodfibre bleach kraft pulp mills contaminated the local waters so badly that several fisheries had to be shut down in the 1980s. This was due in large part to the dioxins and furans released as a byproduct of the chlorine bleaching process, the same process used by NPNS. Dioxins and furans are toxic, carcinogenic and bioaccumulative pollutants, posing a significant threat to marine species and human health via ingested seafood or otherwise. These compounds have been linked to cancer and diabetes, among other serious conditions.

In 1992, national Pulp and Paper Effluent Regulations (PPER) were put in place to mitigate harmful impacts to fish habitat, and the marine life at Howe Sound slowly began to recover. But while the dioxin and furan content in the Sound's commercial fish and crab species have been reduced by 95% or more since that time, in three of eight Dungeness crab samples collected near the Port Mellon mill in 2012, the dioxin and furan content still exceeded Health Canada's safe-consumption criteria. Federal advisories to limit crab consumption remain in effect in the area to this day. The same results also held for testing done on Dungeness crab near the Woodfibre mill, despite the fact that Woodfibre was in a relatively good "flushing" position at the mouth of the Squamish River, up until the facility's closure in 2006.

NPNS's registration document, in Section 1-7, states that "Dioxins and furans in [Northern Pulp's] effluent have virtually been eliminated since the conversion to chlorine dioxide bleaching in 1998. NPNS has never exceeded the limits as per the Pulp and Paper Mill Effluent Chlorinated Dioxins and Furans Regulations." But we know that during NPNS's 2014 spill, on sacred burial grounds at the Pictou First Nation (PFN), proved that at least five distinct dioxin or furan compounds were indeed still present in the mill's effluent, sixteen years after that conversion to chlorine dioxide bleaching. One of the dioxins was detected more than a kilometre down the beach from the spill site. ECCC regulations stipulate that dioxin and furan content must be non-detectable in pulp mill effluent. In addition, NPNS was found exceeding the daily release allowance for suspended solids by almost double the legal limit. Ultimately, the mill was fined $225,000 for the incident. Today, NPNS refuses to release the full suite of information on the components of the effluent they would see released into Northumberland Strait under their new proposal, and claims that the risk of contamination to marine habitat is "Not Significant". This is simply not credible.

In an attempt to explain this lack of transparency, the NPNS registration document states, "At this time, effluent chemistry characteristics (including the specific substances present in treated effluent and their anticipated concentrations) will not be known with certainty **until the project is operational**" (pg. 489). An expectation that NS Environment would grant approval to this project without provision of full details of the content of this effluent to be discharged into the Northumberland Strait should be extremely suspect, particularly given the company's track record of non-compliance. This includes not only the regulatory disregard displayed during the 2014 PFN spill, but also another spill by the Mackenzie Pulp Mill Corporation, owned by Paper Excellence (NPNS's parent company). In this case, Mackenzie Pulp was fined $900,000 and added to the Canadian Environmental Offenders Registry for violating the *Fisheries Act* by neglecting to properly treat the effluent spilled into British Columbia's Williston Lake on two occasions in 2014 and 2016. Paper Excellence has proven in spill scenarios in both Nova Scotia and British Columbia that their standard of care is simply not high enough for Maritime citizens to entrust this company to operate within the bounds of legality, let alone safety, in the Northumberland Strait.

Additionally, it is important to consider the cumulative effects of adding the toxins from NPNS's effluent into the proposed discharge area. In 2002, a study conducted on Nova Scotia's North Shore tested mussels for leukemia. At a site just 500 metres from the current Boat Harbour Treatment Facility outfall location, 30% of the tested mussels were infected. At a distance of one kilometre, 23% of the tested mussels showed signs of leukemia. In contrast, 56% of tested mussels in Pictou Harbour showed leukemia - a higher rate because of the dumping of untreated sewage at the time. Conversely, mussels tested in Merigomish Harbour did not show any effects of leukemia. In the end, the scientific team pinned the results on both municipal and industrial waste products. With the proposed level of effluent expected to be released into the Strait under NPNS's new plan, we may risk a future in which continued inputs render the local area entirely unusable for shellfish aquaculture or shellfish harvest altogether.

Total Suspended Solids (TSS) and Cellulose Fibers

NPNS public relations messaging from NPNS says that the new effluent treatment facility will be better than the existing one at Boat Harbour. However, this is not credible because Boat Harbour currently allows all the solids and the worst toxic elements to settle out and for the fluid to cool, often called "polishing off", as it is held for approximately a month before its release into the Northumberland Strait. The new effluent system will attempt to "treat" and cool the effluent in a matter of hours before it is released directly into the marine environment. In private documents and in recent media interviews, NPNS executives have admitted that the effluent is likely to be no better - and could potentially be worse - than what now flows into the Boat Harbour basin (Point C).

Total Suspended Solids (TSS) largely consists of cellulose fibers. Although the document states that 85 to 95% of the lignin, cellulose, sodium sulphide and sodium hydroxide will be removed from the sludge via biological activity in treatment, there is no information provided about the 5-15% which survives treatment - the cellulose. Cellulose fibers are refractory, meaning that they don't degrade quickly or decompose well in water, especially seawater. The registration document provides, in section 5.2.2.9 on Effluent Quality, that the effluent annual average flow will have an anticipated TSS concentration of 48 mg/l of effluent which equates to a total 3053 kg of TSS per day, i.e., a full dump truck load each day in equivalent tonnage. These fibers have the potential to settle into a deep hole or depression, smothering the bottom and causing anoxia in the underlying sediment. The document hints at this on page 347: “The discharge of effluent containing elevated levels of TSS could also cause a change in sediment quality near the diffuser due to the settlement of suspended sediment, which could cause a change in sediment characteristics such as sand and silt size fractions and/or a change in chemical composition of sediments”. The TSS could very likely spread beyond the area near the diffuser due to the buoyant nature of effluent and the likelihood that the effluent plume will reach the surface of the marine water column. This is the very same TSS, known to be harmful to marine life, that NPNS was found to be pumping at a rate of double the daily legal limit into Boat Harbour during the company’s 2014 spill on First Nations land.

The insoluble nature of these fibers, the proposed volume of TSS discharge, the potentially wide area of impact and the inability to observe and monitor the effluent stream make this incredibly risky and appear to guarantee a significant impact on the marine environment.

Cumulative Effects: Long Term risk in a Fragile Ecosystem

The Gulf of St. Lawrence is already one of the most highly-stressed marine ecosystems on earth. In a recent study published in the journal Nature Climate Change indicates that the Gulf of St. Lawrence is showing a dramatic decline in oxygen.

A separate study done by DFO and University du Quebec entitled “Man-Made Environmental Changes in the Southern Gulf of St. Lawrence, and their Possible Impact on Inshore Fisheries” states: “Major sources of stress on the Gulf of St. Lawrence ecosystem include climatic changes on one hand and human-induced interferences such as physical modification, pollution and harvesting on the other hand. There are indications that these changes have significant impact on the oceanography, ecology and fisheries of the Gulf. The potential danger to the fishery includes physical, biological and chemical contamination.”

This is research that should be covered in effective cumulative effects assessment processes examining marine environments. Northern Pulp’s Cumulative Effects research presents a marine “Regional Assessment Area” between Pictou Harbour and Charlottetown to the north, spanning approximately 60 kilometres in an east-west direction. The proponents claim that the majority of the disruption to ocean habitat is likely to take place during the project’s construction phase, when the seafloor is to be dredged and laid with a rocky substrate to lay the pipeline and keep it place over the long-term. As for the operations phase, during which the pipe will dump its tens of million litres of treated effluent into the Strait, the report suggest that all concerns related to the quality of the water will dissipate within five metres of the discharge location.

The report claims that “given the likely lack of spatial overlap at this location, significant cumulative residual environmental effects to water quality or sediment quality as a result of treated effluent discharge are not likely.” But several studies, as well as ECCC expert testimony before the Prince Edward Island Standing Committee on Agriculture and Fisheries referenced above, tell us that pulp and paper effluent *is* known to be harmful to fish and fish habitat in the majority of tested circumstances. In essence, the substance that Northern Pulp would inject into the Northumberland Strait *would*, undoubtedly, pose a threat to aquatic life - and the assessment document says as much - *but suggests that*, because of dilutive power of the ocean, no great harm should occur in this instance. This simply is not true and this type of outdated Industrial Age thinking, suggesting that, because the ocean is big, it should be able to absorb our waste forever, is the same thinking that now sees the entire planet awash with plastic waste.

In a Northumberland Strait context, the cumulative impacts of over 25 billion liters of toxic effluent flowing into the water every year in perpetuity are potentially catastrophic. The NPNS registration document clearly shows that there will be very little, if any, positive change in wastewater quality with the proposed effluent treatment system and information revealed through the FOIPOP requested showed NPNS suggesting that the effluent could in fact be worse. With a myriad of chemical and nutrient inputs from municipal wastewater systems, industrial operations and agricultural runoff, among others, this is no time to augment present threats to marine life by adding a continuous, high volume stream of toxic pollution into a shallow, low flowing section of the ecosystem. We need our governments and our commercial industries to work together to reduce the inputs already entering into the Strait, and we need to put plans in place to start restoring this natural Maritime treasure, as has been called for by federal studies. If we don't, we are at significant risk of creating contaminated marine habitats and unfishable dead zones in the future.

Pipeline Pathway

The effluent pipeline will go over Pictou Harbour, attached to the causeway across Highway 106 and then in a trench through the Town of Pictou's water supply area, putting both at risk in the event of a pipeline breach or spill. Similarly, the potential for pipeline failure at Caribou Harbour is considerable. These are unacceptable risks.

Air Pollution

In the plan outlined in NPNS's registration document, toxic sludge will be collected early in the effluent treatment process and will then be burned in the NPNS power boiler. Chemicals from this process, including Polycyclic Aromatic Hydrocarbons, Volatile Organic Compounds, sulphur and chlorinated compounds, benzine, cadmium, as well as fine particulate matter will be released. The NPNS registration document speaks virtuously about displacing unspecified amounts of fossil fuels by collecting and burning chemically-laden sludge from the pulping process. It states the sludge will have a 40% moisture content. This will provide no fuel (heat) value and will likely require as much or more fossil fuel to burn. Much worse is the fact that it will actually make the mill's already terrible air emissions problems even worse by burning this toxic sludge in the mill's power boiler which has no precipitator and reportedly malfunctioning/non-functioning scrubbers to "clean" the Sulphur, VOCs and other chemical compounds, and carcinogenic fine particulate matter (PM10 and PM 2.5). The NPNS registration document indicates incineration of up to 20 tonnes of chemically laden sludge per day in the power boiler. The power boiler is very old and has repeatedly failed stack emissions tests. This is a significant public health risk and yet another compelling reason to reject this proposal. Although the provincial Class 1 Environmental Assessment does not specifically require the proponent to conduct a human health risk assessment (HHRA) study, such a study should be ordered by the minister under Environment Act Section 34(1)c or b.

The NPNS registration document acknowledges that there will be additional pollutants released by burning the sludge in the power boiler and that these airborne pollutants will land on nearby "receptors" (e.g. people, animals, land, water, etc.):

"Emissions of combustion gases, particulate matter, and possibly odour from the replacement ETF during operation and maintenance could result in air contaminants that could disperse in the atmosphere to off-site receptors. Additionally, since the project will include the combustion of sludge generated in the replacement ETF for energy recovery and odour control, emissions from the combustion of such sludge in the power boiler during operation and maintenance could disperse from mill stacks to off-site receptors." (Pg. 142)

Air quality testing has been incredibly lax in and around the NPNS mill. A new, robust independent air quality monitoring program should be required of NPNS by the Minister. This should include continuous stack emissions monitoring and multiple remote sensors. This data should be made available to the public in a continuous, real-time feed over the internet.

A sample of some of NPNS's recent air pollution violations:

- In 2014 the mill reported the release of 1,290 tonnes of fine particulate matter — the equivalent of 13 Irving St. John pulp mills in one location.
- Air emissions exceeded limits 4 times in a two year span - March and September 2015, June and December 2016.
- NSE investigation in 2017 as mill exceeded air contaminant emissions limits by nearly 50 per cent in June.
- The mill exceeded emissions 3 years in a row (2015, 2016 and 2017) despite the purchase and instillation of a new electrostatic precipitator on the recovery boiler stack.

Socio-Economic Impacts

Risk to Fisheries and Aquaculture

Despite NPNS's claim that the project proposal's impact on marine life will not be significant, the company's Receiving Waters Study, prepared by Stantec in August of 2017, states, "Among the four potential outfall locations … the [chosen] outfall location provides the *smallest potential long-term cumulative effects* on the fishery and socio-economic environments, and therefore is considered the better outfall location for the discharge of the treated wastewater from the mill." (Conclusion 2.4) Here we see suggestion that NPNS is well aware that the fishery will be adversely impacted in the long term, despite public claims to the contrary. The potential impacts to fish, bivalves, crustaceans, fish habitat and critical spawning areas are outlined above. While the deleterious short term impacts of NPNS's proposed effluent treatment facility on fisheries may be limited to a relatively small area, the long-term effects could still be significant. The Lobster Fishing Area 26A, stretching east-west from Pugwash to Port Hastings and north of Souris, PEI, supports more than 700 licenses at 300 traps per license. This is a marine area worth upwards of $40 million on fisheries alone. The Northumberland Fishermen's Association notes in a position letter that the Strait is one of the "most lucrative habitat and spawning grounds for lobster, crab, scallop, herring, mackerel and groundfish" in the Gulf. Each haul is significant to the fishermen that live and work there and, as such, the long term effects on the larger fishery should be more carefully considered.

Northern Pulp has demonstrated a clear unwillingness to do the work necessary to address these concerns in their environmental assessment registration document; particularly those concerns of the lobster fishermen in the region. NPNS's consultants at Dillon Consulting even went so far as to prompt Northern Pulp via letter in February of 2018, noting the importance of further research on lobster at all of the animal's life developmental stages: "… Conducting research on lobster larvae, and potential alternative to pipe discharge into the Strait needs to be completed to demonstrate to regulators that these were properly considered and stakeholder concerns are being addressed as much as reasonably possible."

In spite of this recommendation, NPNS did not conduct any studies or provide any information on potential impacts over the various life stages of the most important commercial marine species in the Canadian Atlantic, simply dismissing the issue by saying, "It was the conclusion that it is highly unlikely that there will be serious impact on lobster or lobster larvae given the limited area of potential impact." The assessment goes on to admit that marine studies "have been hampered by both seasonal constraints and by physical opposition and obstruction... The existing environmental conditions and associated potential environmental effects of the project therefore have been defined based on existing available information." Again, we see a standard of care set far too low, in the face of significant risks and potential consequences.

Maritimers and Maritime fishermen have told NS Environment and NPNS loud and clear that this is a risk they are not willing to have foisted upon them; that the social and economic value of the region's fisheries are simply too great. Fishing unions and associations alike have since called, for a federal environmental assessment. At a broader scale, the economic value of Atlantic Canadian seafood production is immense. Fisheries and aquaculture products account for upwards of $3 billion to the Atlantic economy, with more than 15,000 licensed fishing boats and more than 500 aquaculture outfits. The Northumberland Strait is major component of that system, and the Southern Gulf of St. Lawrence has been one of the most productive lobster regions in the country. Today, there are some 700 fishing licenses. The legitimate concerns of the Northumberland Strait fishermen, and Canadian fishermen more broadly, need to accepted and respected.

Reputational Risk to Nova Scotia Seafood Brand

Nova Scotia has an international reputation for producing high-quality seafood from "cold, clean and pristine northern waters". This is particularly true for our shellfish - lobster, scallops and oysters. The reputational risk to the industry if any harvested species becomes contaminated with pollutants is significant - particularly in emerging markets in China and southeast Asia where demand from an expanding middle class is dependent on the "clean and pristine" brand. In this regard it is instructive to recall that the discovery of a single reported case of BSE or mad cow disease in 2003 led to an immediate worldwide ban on all Canadian beef imports which lasted for years and cost the industry billions of dollars in lost sales. Imagine what one contaminated lobster could do the Canadian lobster industry's access to foreign markets. Even the idea of seafood produced in polluted waters could be enough to shut down or seriously curtail demand in sensitive markets like China. This is a serious financial risk that Nova Scotia cannot afford to take.

EAC supports the fishermen.

Tourism Industry

The tourism industry in Nova Scotia is worth $2.7 Billion and growing, creating 40,000 jobs and producing $300 million in taxes. At a regional level, tourism revenue in the Northumberland Shore Region of Nova Scotia is 7.8% of the total tourism revenues translating to $210.6 Million and over 3,200 jobs, generating about $24M in tax revenues. This sector of the economy could be much greater but is hampered by the presence of the NPNS mill.

Tourism operators have reported the length of stay in the Town of Pictou has declined from 2010, an average of 3.3 days to 2017 at 2.5 days. Tourism Operators explain the decline in visitor stays is a direct result of the air and water pollution emanating from the NPNS mill. Allowing the mill to release its effluent into the Northumberland Strait and to increase its harmful air emissions by burning large quantities of toxic sludge will only make things worse for this industry. Tourism operators in western Cape Breton (Inverness County), along the south coast of PEI and the New Brunswick coastline of the Northumberland Strait are all at risk of impacts from the proposed discharge of large volumes of effluent into the marine environment.

EAC supports the tourism operators.

Indigenous opposition

It is important to note that all of the Mi'kmaq Chiefs in the three Maritime Provinces are opposed to piping the NPNS mill's effluent into the Northumberland Strait. Chief Terry Paul identified the mill's proposal for a new effluent treatment plant as the top issue raised by Mi'kmaq leaders in their annual meeting with Provincial Cabinet in December 2017. "The first consideration is the environment" he said. "We want to ensure that whatever is done to mitigate the effluent there isn't detrimental to the fishery". He stated clearly that the chiefs cannot support the NPNS effluent pipe plan. Chief Andrea Paul of Pictou Landing First Nation has been unequivocal in stating her communities firm opposition to the proposed new effluent treatment system. "The effluent discharge is in the Northumberland Strait and for that we are opposing it" she said in July 2018. "We do not want this pipe in our waters. We need to protect our resources. All of us have an inherent duty to do that".

EAC supports the Mi'kmaq.

Unwillingness to Explore Alternatives

The pulp mill in Pictou County has a long history of putting Nova Scotia's environment and citizens at risk. Despite five years to find a suitable alternative to the Boat Harbour treatment facility and taking the opportunity to improve their environmental performance, NPNS simply offers one single option: to pollute a different area, this time spreading the potential impact much further. The registration document has been carefully tailored to reach the NPNS's preferred outcome of pumping the effluent into the sea. In preparing the document the consultants, appear to have relied almost exclusively on information provided by NPNS. There is no evidence of serious independent analysis of the options, assumptions or conclusions in the report. The Ecology Action Centre strongly disagrees and believes that NPNS could do much to 1) reduce the toxicity of their effluent by improving internal process inside the mill and 2) negate the need to dispose of their effluent into the environment at all by modifying their production process (i.e. eliminate chemical bleaching) and installing a closed-loop system.

It is clear from NPNS's registration document that the scope of exploration of alternative options was deliberately narrow and entirely restricted to finding an alternative dumping site for the effluent. All other options to reduce or eliminate the mills liquid pollution output are summarily dismissed early in the registration document, abandoning any further consideration or research for better options. On its project website, NPNS confirms this: "At the onset of the design phase a closed loop (zero effluent) treatment alternative was immediately ruled out as it is not an option for Northern Pulp. A closed loop system does not exist anywhere in the world for an elemental chlorine free (ECF) bleached kraft pulp mill. The concept is not technically or economically achievable." This is consistent with NPNS's long-held public position that only a pipeline into the Northumberland Strait will work. NPNS says the technology does not exist to close their loop. They are lying by omission.

NPNS could install and run a closed-loop system if it simply changed its production process and stopped bleaching their semi-finished kraft pulp product prior to shipping it to their Asian parent company. The result would be a light brown fiber product rather than a bright-white one. If the parent company wished to bleach some or all of the kraft pulp during its subsequent product production processes (making tissue, napkins, diapers, etc.) they could easily do so at their end. Another workable alternative would be to retool the NPNS mill to use peroxide and ozone instead of chlorine dioxide to whiten their kraft pulp and thus become a Totally Chlorine Free (TCF) mill.

The truth is NPNS could change its process and install a closed loop system but they have chosen not to. They admit as much in their registration document (Project Alternative 3: Change the NPNS Mill Type and Make a

Closed Loop System, Pgs. 25-26), stating the reason for not doing so is that it is "market prohibitive", not that it is technically impossible. Their justification for not doing so is cost: "NPNS would not remain competitive due to high wood and electricity costs" and that "NPNS must continue to operate by producing NBSK to be economically viable". They admitted that "Production of a different type of pulp can allow operation using closed loop systems." But that "NPNS would not be economically viable with a different product". Although NPNS says changing their product process is "not economically viable", they provide no proof for these claim.

Notwithstanding their refusal to seriously consider altering their process and implementing a closed loop system, before the NPNS mill starts pumping their effluent anywhere they should first be required to improve the inside performance of their very old mill in order to significantly improve the quality of the effluent before it is sent for secondary treatment. In industry parlance this is called "tightening up the loops" inside the mill prior to the effluent treatment process. The mill employs very old (1960s era) technology. There are three specific areas that need to be modernized before sending effluent into a secondary treatment system, regardless of where the effluent is subsequently dumped. They are: #1 Optimize brown stock washing, #2 Install an oxygen delignification system in the bleaching plant and #3 Implement fail-safe systems to ensure against process upsets into the effluent treatment system. Process upsets can come from overflows of brown stock, bleach and/or black liquor.

It's important to point out that with regard to #2, NPNS has previously said they would be installing an oxygen delignification system which would result in a 30 to 40% reduction in chlorine dioxide bleaching chemicals and thus much "cleaner" effluent. That oxygen delignification system is now missing from NPNS's registration document.

It's also important to highlight why NPNS should be required to build in effective fail-safe systems to minimize and contain process upsets whereby the system becomes overloaded with pulping chemicals and shuts down the biological activated sludge (BAS) treatment process. In brief: NPNS has a history of frequent process upsets with its current effluent treatment system in Boat Harbour. When this happens the biological agents (bacteria, fungi and protozoa) that are used to consume organic pollution from the effluent prior to release are killed and the process stops working. In the Boat Harbour lagoon, the untreated effluent can be contained at an early stage while the system is re-inoculated with replacement biological agents so treatment can be resumed. This can take several days. In the event of black liquor or other chemical spills into the proposed new effluent treatment system, the biological agents will be killed and the system will stop functioning as it's supposed to. In the registration document, NPNS says it plans to build a 35 million liter raw effluent spill basin that, assuming optimum conditions, will be sufficient to contain 10 to 13 hours of effluent diversion in the event of process upsets (pg. 42). That means only half a day's worth of effluent can be contained while they try to fix the problem. But process upsets often take much longer to fix than half a day. Therefore the risk of potentially large volumes of untreated effluent by-passing the new effluent treatment system and flowing directly out into the marine environment is very high as their proposed spill basin will be too small to contain effluent volumes greater than half a day's output while NPNS works to restore the biological agents to sufficient levels to function again.

NPNS has repeatedly minimized serious concerns about their effluent treatment plan. Vague assurances through the registration document with phrases such as 'no significant residual environmental effect predicted' are simply not credible, particularly in light of the vast evidence of ecosystem destruction committed at Boat Harbour. With an effluent leak only months ago in October 2018, which was discovered by a citizen walking in the vicinity of the mill, and another in June 2014 that released 47 million litres before detection, public trust is at an all-time low. Attribution of pollution in the Northumberland Strait will be challenging, ensuring that the province of Nova Scotia will have a very difficult time seeking remediation for damages. Fastidious monitoring will be required to intervene as quickly as possible and ideally this monitoring would be administered by an independent body to ensure compliance.

Conclusion

The Ecology Action Centre strongly recommends that the Minister of Environment reject NPNS's effluent treatment facility proposal as outlined in their registration document. The document fails to provide the Province with the required information to assure itself and all Nova Scotians that their proposed effluent treatment facility would be safe for the community or the environment. All evidence points to the fact that this effluent treatment facility will cause at least as much pollution as the levels at Boat Harbour, if not more, and this time the pollution will be spread over a far greater area with even less ability to contain and repair that damage in the future. It is also clear that the burning of large amounts of toxic sludge in the power boiler will make the mill's already terrible air emissions even worse. The claims by NPNS that there will be no impact of any kind is not credible and they have failed to provide evidence that this even possible. It is unconscionable of NPNS to ask, nay, demand that Nova Scotian's accept all the risks and harms so an ancient, highly-polluting pulp mill can continue operating for a few more years.

NPNS has shown a consistent sense of entitlement, often operating outside of the rules and boundaries which exist to protect our environment. NPNS even made a request to begin building elements of its proposed new effluent treatment system in mid-2018, well before submitting its proposal for environmental assessment. The sheer audacity of this request demonstrates a corporation that fully expects Nova Scotia to continue to bend to their wishes, regardless of the impacts. Now that we are within a year of the January 31, 2020 shut down date for the Boat Harbour effluent treatment system, the corporation has requested an extension to continue polluting Boat Harbour, citing a lack of time to get an alternative in place. Complying with this request would require repealing that legislation and would be an unforgivable violation of the faith of the Pictou Landing First Nations community and to every other Nova Scotian who is counting down the days until January 31, 2020.

It is time for this province to stop operating with a methodology of privatizing our shared natural resources for private profit while socializing the enormous risks and costs. Nova Scotian taxpayers will long be paying for the damage that has already been done by the pulp mill at Abercrombie Point in Pictou County. The investment to create the new pipe, a piece of infrastructure which will cost an enormous amount and likely to be charged again to the taxpayer, is making a commitment to allow this mill to continue discharging toxic effluent into our environment for many years to come. That is unacceptable. The Minister should reject this project outright. Failing that the Minister must, at the very least, order focus reports in a number of areas where information is lacking, including the composition of the effluent, baseline studies on lobsters and other marine species, baseline benthic surveys of the bottom of Caribou Bay, plans for air pollution controls and monitoring, etc. The minister should also order the mill to upgrade its internal processes and equipment to reduce its already substantial air and water pollution levels regardless of if or where they might send their effluent. But at the end of the day the Minister must not make a bad situation worse by allowing another place to be fouled and one that can never be cleaned up.

In closing we cite Premier Stephen McNeil's wise words at the annual meeting of Nova Scotia Cabinet and Mi'kmaq Chiefs on December 14th, 2017 in Millbrook: "*It has never been our government's intention and never will be our government's intention to clean up one environmental problem and move it somewhere else*."

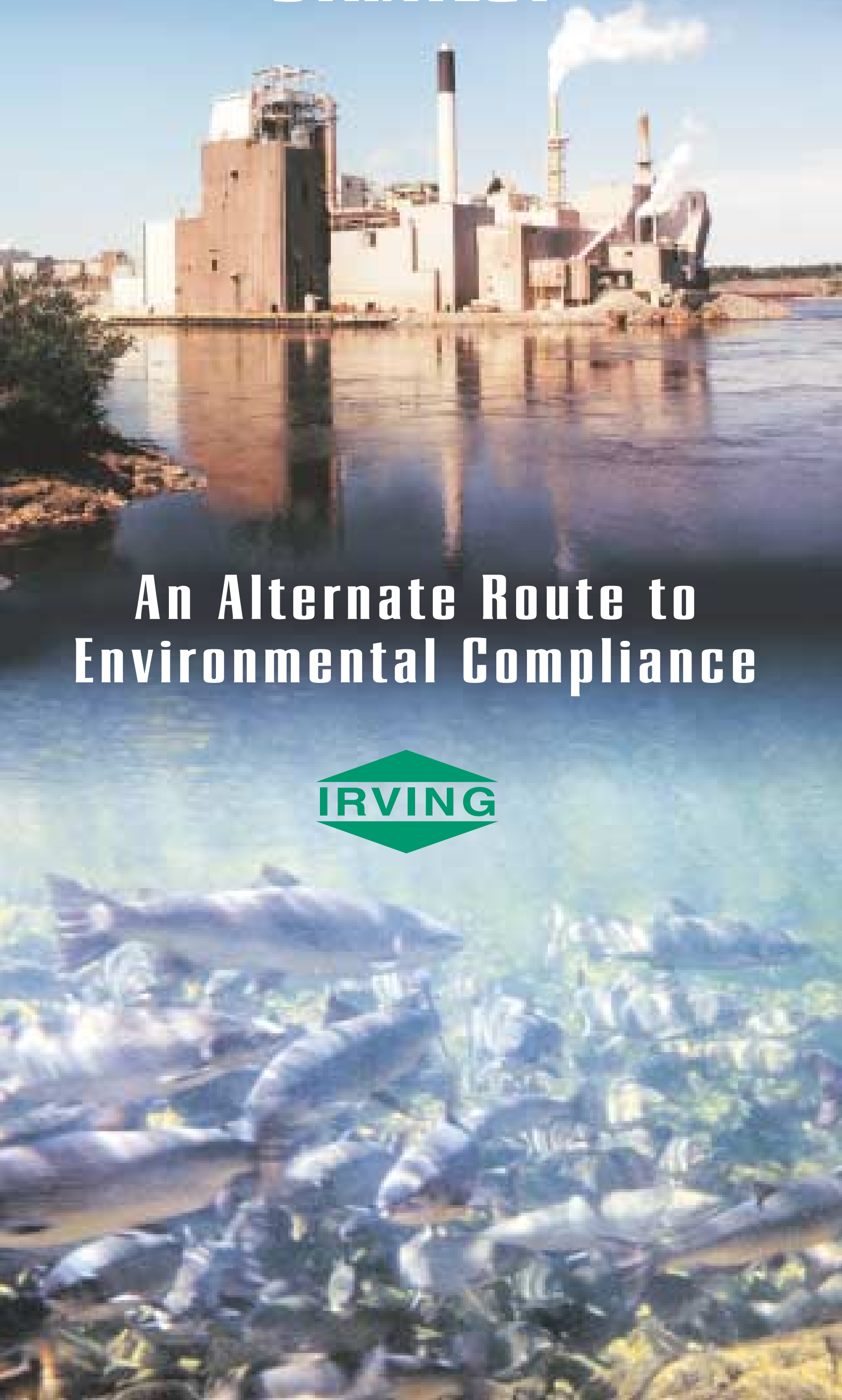
And that is the right answer. No pipe.

Respectfully submitted,

Wilderness Coordinator
Coastal Coordinator
Marine Conservation Officer

IRVING PULP & PAPER'S

POLLUTION PREVENTION STRATEGY



An Alternate Route to Environmental Compliance

IRVING

THE CHALLENGE

Pollution Prevention is the use of processes, practices, materials, products and energy that avoid or minimize the creation of pollutants and waste and reduce the overall risk to human health or the environment. ***— Environment Canada Mission Statement, 1995***

New Options For Environmental Compliance

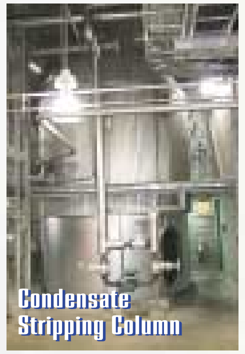
To meet government regulations most mills went with a conventional secondary treatment lagoon. Treating pollution after it has exited the mill pipe has been the standard technology enabling mills to meet regulations with limited costs. Faced with local opposition to a lagoon, Irving Pulp & Paper underwent a complete Environmental Impact Assessment. Following this assessment and after researching other options, the mill decided to go in an unprecedented direction. Irving Pulp & Paper launched a pollution *prevention* strategy that would see them meet regulations by recovering, reducing and reusing pulp-making materials. Irving Pulp & Paper would break new ground in the industry by preventing pollution at the source, inside the mill, before it exited the pipe. This approach was complementary to the Environment Canada initiative for Pollution Prevention.

The Strategy

Irving Pulp & Paper planned their pollution prevention strategy around the best available technologies of the day. At the time of design there were not enough known technologies to take them all the way to environmental compliance, but they believed that with the rate of technological advancement and the ongoing research, new technology would evolve by the time the known technologies were in place.

1. Objectives Of The Strategy

- Remove, reuse and recycle chemicals and other pulp-making materials.
- Modernize technology to improve efficiency, cost-competitiveness and environmental performance.
- Address community concerns against a conventional secondary treatment lagoon.
- Minimize mill outflow.



Condensate Stripping Column

2. Implementing Best Available Technologies - Highlights

- Improved Brown Stock Washing - Recovers more used chemicals and unusable wood components.
- Closed Brown Stock Screening – Decreases outflow volume from the mill by recovering dirty process wash water that contains used chemicals and unusable wood components.
- Elemental Chlorine Free Bleaching – Replaces former process with more environmentally responsible bleaching agents.
- Condensate Stripping Column – Removes wood alcohol for incineration allowing the cleaned water to be reused.

Elemental Chlorine Free Bleaching

Improved Brown Stock Washing

PIONEERING CHANGE

Oxygen Delignification

3. Oxygen Delignification

- Decreases amount of chemicals needed in bleaching process by removing unusable wood products.
- Unusable wood products are incinerated and generate heat for the mill.

Reverse Osmosis

4. Reverse Osmosis

- Filters products from water by using specialized membranes under high pressure. This allows increased recycling and reuse of filtered water.
- Awarded patent for unique application of well-known technology.
- Removes compounds largely responsible for endocrine disruption in fish.

A WORLD 1ST

210 specialized membranes on 5' x 10" spools remove 10 - 15 gallons of concentrated filtrate per minute.

Reverse Osmosis

5. Moving Bed Bioreactor

- Consumes wood alcohols from the largest contributor to the mill's outflow.
- A unique application for the biological system. It had never been used before in the kraft pulping industry in this application.
- This system was the final technology needed to bring the mill into environmental compliance with all the federal regulations.

Moving Bed Bioreactor
3.5 million plastic carriers house bacteria that consume wood alcohol from the largest contributor to the mill's outflow.

6. Environmental Performance Review

- Pioneered advances in pollution prevention technologies in our industry.
- Non-traditional approach to meeting environmental regulations and community concerns.
- Irving Pulp & Paper has discovered new technological application that eliminates their potential for endocrine disruption at Reversing Falls. The University of New Brunswick in Saint John is working in cooperation with Environment Canada to research some of the compounds responsible for endocrine disruption that are removed by Irving Pulp & Paper's reverse osmosis system. Endocrine disruption is an emerging global issue with implications for both humans and wildlife.
- Involved mill employees and experts in the industry to reach significant environmental and scientific milestone.
- Patented applications of new technologies for export potential to pulp mills around the world.

THE NEXT CHAPTER

1. Seek out additional opportunities to further improve our environmental performance.
2. Continue publicizing our progress and results within the industry and academic community.
3. Communicate with the public and interested stakeholders on new industry advances and ongoing progress.

REFLECTIONS

"Implementing this pollution prevention program was an important and innovative step. Many of the technologies are new in their application to the pulp and paper industry, providing greater options to the industry in how they deal with their wastes. The reduction in endocrine disrupters was an unexpected and positive environmental benefit."

- John Clarke, Head of Pollution Control with Environment Canada, Atlantic Region

"Pollution Prevention is a new option the industry has that they didn't have five years ago. This is a technology the company can export."

- Wally Vrooman, President Vrooman Environmental Inc.

"Irving Pulp & Paper is further ahead on the endocrine disrupter issue than probably every other mill in Canada."

- Dr. Deborah MacLatchy, University of New Brunswick Saint John Campus

"When you look at the chemistry of the effluent produced in the pulp making process and what you have to get rid of, you know there's a way either by recycling, reusing or removing elements. We just had to find it."

- Wayne Sprague, Irving Pulp & Paper employee

"Throughout this project there was an excitement and a pride — amongst all of the employees — that we were pioneering new applications of new technologies for export potential to pulp mills around the world."

- Jim Brewster, Production Manager, Irving Pulp & Paper

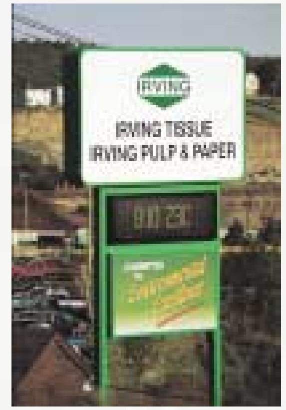
"This environmental achievement is a tremendous tribute to the teamwork, determination and skills of the men and women at Irving Pulp & Paper. No other mill in the world has done what they have accomplished."

- Jim Irving, President, J.D. Irving, Limited

"In addressing community concerns, a real scientific advancement has been achieved for the industry."

– Willa Mavis, Innkeeper, Inn on the Cove, Saint John, NB

CONTACT US



For more information on Irving Pulp & Paper's innovative approach to pollution prevention, please contact:

Environmental Coordinator

Phone:
(506) 633 - 6925

E-mail:
environmental@irvingpulp.com

Tours are available for individuals and groups.

Please contact Irving Pulp & Paper's Human Resources Department for more information or to set up a tour.
Phone: (506) 635 – 7735

IRVING

IRVING PULP & PAPER

MacIsaac
Clarke &
Duffy
Barristers
and Solicitors

November 6th, 2019

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N.S. ENVIRONMENT
ENVIRONMENT ASSESSMENT BRANCH
NOV 08 2019
RECEIVED

Re: Environmental Assessment - Northern Pulp Nova Scotia Corporation Replacement Effluent Treatment Facility Project, Pictou County, Nova Scotia

Dear Sir or Madam and Minister Wilson:

Please be advised we continue to represent the Harbour Authority of Caribou (hereafter "the Authority"), Pictou County, Nova Scotia.

Located at the mouth of Caribou Harbour, the Authority operates the busiest fishing port in Northern Nova Scotia. It is a hub of fishing activity from April to early December. It is accessed via the 106 branch of the Trans-Canada Highway and is adjacent to the Northumberland Ferries terminal. The facility managed by the Authority is the 'heart' of the commercial fishing industry in northern mainland Nova Scotia. It is also the site of Northern Pulp Nova Scotia's (NPNS) proposed marine effluent pipeline and effluent outfall.

The Authority has again retained our firm to express its continuing concerns regarding Northern Pulp's Focus Report for the Replacement Effluent Treatment Facility Project.

The Authority's position continues to be that Northern Pulp's proposal fails to adequately address critical issues which could result in catastrophic damage to the rich fishing grounds of Caribou Harbour and beyond. On this basis, as detailed below, my client is calling on Minister Wilson to reject Northern Pulp's proposed replacement effluent treatment facility.

This submission will address the following issues of concern to the Authority and its patrons:

1. No leak detection for marine portions of effluent pipe
2. Leak repair to the marine pipe in Caribou Harbour would be virtually impossible in winter months
3. Risk of ice damage to marine pipe
4. Navigation issues
5. No confirmed marine pipe route in Caribou Harbour
6. No definitive plan for marine pipeline construction
7. Risk of siltation in the harbour during construction causing significant harm to marine life and to current users of the harbour
8. Timing of marine pipe trenching and installation conflicts with existing uses of the harbour
9. Effluent will enter Caribou Harbour with significant harmful effects
10. Errors of fact relating to fisheries and presence of fish.

1. There is an absence of leak detection on the marine portions of the effluent pipe.

TOR 3.5 requires Northern Pulp to "Provide viable options including the selected option for leak detection technologies and inspection methodologies …" Northern Pulp has provided no plan for leak detection on the marine portions of the effluent pipeline. The leak detection systems outlined in Section 3.5 apply only to the on-land portion of the pipeline.

> "A leak detection system as described below will be installed with the effluent pipeline **to monitor for potential leaks in the overland portion of the route between Pictou and Caribou** …" (FR, Section 3.5, p. 62) (emphasis ours).

In response to questions submitted about potential damage and leaks to the marine pipe, the public is directed to "Refer to section 3.5 for comments concerning pipeline leak detection and enhanced pipeline protection options." (Appendix 1.1, pp. 10 and 18) However, there is absolutely no mention of any leak detection system for the marine portion of the pipe in section 3.5. The marine pipe is explicitly excluded. There is similarly no mention of leak detection in other sections, e.g. section 2.5, Changes to Pipeline, and Appendix 2.5, which address marine pipeline construction.

The absence of attention to leak detection in the marine pipe is a critical omission. Risk of leakage in the marine pipe has been and remains a significant public concern. A leak anywhere along the route of the marine pipe inside Caribou Harbour would result in build-up of effluent in the harbour, with the likely result being catastrophic damage to the marine environment, including juvenile lobster in the Marine Refuge Scallop Buffer Zone 24 and a highly productive rock crab nursery, both of which are critical to the regional fisheries of the Northumberland Strait.

Recommendation #1: Northern Pulp has not fulfilled the requirement of TOR 3.5 in relation to the marine portion of the pipeline. The Minister cannot approve this project without evidence that the project provides the highest level of effluent leak prevention, detection and timely repair to prevent significant and irreparable harm to the marine environment.

2. **Leak repair to the marine pipe in winter months would be virtually impossible.**

Even if effective leak detection technology was planned, in the event a leak developed during the 3- 4 month period when the harbour is ice-covered (with from 1- 5 metres of ice) repair would be nearly impossible. Ice conditions in Caribou Harbour and the Northumberland Strait are so severe that the PEI ferry does not run in the winter, and all fishing boats are taken out of Caribou Harbour.

The question of whether and how timely a repair could be carried out if a leak in the marine pipe occurred during winter months was raised repeatedly in public submissions. Northern Pulp has not addressed this issue, except by saying that burying the pipe will provide sufficient protection from ice scour. Ignoring and failing to address a possible occurrence on the basis that in Northern Pulp's view the event will not occur is not acceptable.

Recommendation #2: The Minister cannot approve this project without evidence that the project provides the highest level of effluent leak prevention, detection and timely repair to prevent significant and irreparable harm to the marine environment. The absence of attention to an acknowledged risk with such severe consequences greatly increases the likelihood of significant and irreversible harm at some point in the project life.

3. **Risk of ice damage to the marine portion of the pipe**

Ice damage to a marine pipe is an acknowledged risk in the Focus Report and accompanying documents, and in earlier reports from Stantec. TOR 2.2 requires Northern Pulp to "Conduct geotechnical surveys and provide the survey results to confirm viability of the marine portion of the pipeline route. The surveys must determine the potential impacts of ice scour on the pipeline."

Makai Engineering states that depth of burial for a marine pipe should be determined by survey information and historical data. Historical data has not been provided in the

Focus Report. NP has provided only one year of data on ice scour. Survey information from CSR shows that Caribou Harbour is an area with many ice scour events. One hundred and thirty-three (133) were noted in the survey, which CSR believes were from 2018-2019 alone. The company also notes that scours begin to fill in immediately, (Appendix 2.2, Section 5.5, p. 95) so that the measured scours do not indicate the deepest scour that would have taken place.

The general consensus among local fishermen and divers who have observed ice in the area for decades is that there is high risk of damage to the marine pipe and diffusers from ice even if the pipe is covered by 2-metres of soil. These same individuals note that shifting bottoms could uncover areas of pipe, making it more vulnerable to damage.

The Stantec Preliminary Receiving Water Study prepared for Northern Pulp in August 11, 2017, p. 4.80-4.81 contains this information:

> *It was reported (in ENSR, 1999) that Maritime Telephone and Telegraph (MT&T) performed an ice evaluation in support of an optical communication cable deployment across the Northumberland Strait. Based on MT&T's review, the estimated potential for damage to the cable from ice scour extended to water depths of 12 to 14 m. In 1991 their cable was trenched and buried to a selected depth (depth is unknown) and left on the surface of the sea bottom at greater depths. Unfortunately, the winter of 1991/1992 was severe and the cable was severed by ice keels at a water depth greater than 18 m towards the Woods Island, PEI side of the Northumberland Strait.*

This indicates that ice scour can take place a much greater depths than expected. This is crucial information that should be considered by the Minister in determining likelihood of harm.

Ice scour is not the only source of risk to the marine pipe. There are also risks to the pipe's integrity from structural stresses, as explained in the submission of Colton Cameron, PEng. to the EARD. Cameron writes: "Due to the cyclical nature of the tidal forces and wave action these induced stresses combined with ice loads over time could present fatigue stress issues."

These risks have not been addressed by Northern Pulp and must be fully examined before this project can be approved.

Finally, the Authority notes that there has been no attention given to protection of the marine pipe from ice or storm damage at the point where the proposed pipe would enter Caribou Harbour, before it is buried. This is another serious omission. This is a point where the marine pipe is vulnerable to moving ice as well as strong storm and wave action. Damage at this point could have the same catastrophic results as outlined above.

Recommendation #3: Northern Pulp has not fully addressed the issues to confirm the viability of the marine route in relation to ice or other stresses. They have not established that ice scour and other conditions do not present significant risks to the marine pipeline. Northern Pulp has not considered or responded to information submitted by local diver Rob MacKay based on his direct experience, nor to the issues of potential structural damage from ice pressure raised by professional engineer Colton Cameron in his submission. They have not considered historical information on ice scour in the area.

Damage to the marine portion of the pipe would result in significant and irreversible harm to the entire Caribou Harbour ecosystem. A break or leak in the marine effluent pipe in an iced-over marine environment with minimal flushing capacity could continue for an extended period before detection – at the rate of 62 million litres per day.

We ask the Minister to reject this proposal. Northern Pulp has not provided sufficient information to conclude that a marine effluent pipe installed as described will not be at risk.

4. Navigation issues

NPNS completely fails to address the navigational concerns raised in our earlier submission. The Authority is very concerned that its patrons, both commercial and recreational, will have their navigational abilities under the *Navigational Protection Act* restricted. NPNS has responded only that "Impact to navigation is not anticipated. A Navigational waters review will be required before construction begins, at this time adjustments will be made as necessary."

In our submission this is not an adequate response.

The Authority's earlier submission pointed out that the patrons of the Authority, in particular seventy plus (70+) commercial fishermen, navigate directly across the path of the proposed pipe route in Caribou Harbour, on a daily basis, during regular fishing seasons of lobster, crab, herring and scallop, from April through November.

Any interference with existing navigation routes could cost individual fishermen hundreds of miles of additional travel every season for the lifetime of the project, with corresponding costs in time and fuel, and increased emissions to the environment.

My client also has serious concerns about interference with navigation during the proposed construction timeline of 84+ days, detailed below.

Recommendation #4: The Authority's position is that all navigation concerns must be addressed satisfactorily prior to any approval. The minister, in making his decision, must consider how the proposed project will impact existing uses of the area. Northern Pulp has not provided sufficient information to ensure that the proposal will not substantially interfere with existing navigational uses of the area during construction and in the long-term.

5. **There is no confirmed marine pipe route in Caribou Harbour.**

NPNS has not presented a confirmed marine pipe route for Caribou Harbour. The only specific information provided about the route are the co-ordinates for the entry point of the marine pipe and the outfall location. This is in notable contrast to the detailed drawings and plans presented for the on-land portion of the pipe. Marine survey information was gathered from a corridor 200 metres wide, within which NPNS presumable plans to locate the marine pipe.

Recommendation #5: This project cannot be approved before a specific pipe route is presented for evaluation and input from the public and government departments. The minister cannot accurately evaluate whether there will be significant and irreversible harm in the absence of a detailed marine pipe route.

6. **There is no definitive plan for marine pipeline construction.**

Northern Pulp is required by TOR 2.5 to "Provide any proposed changes to the pipeline construction methodology and other associated pipeline construction work, related to the potential changes to the marine portion of the pipeline route (e.g., infilling, trenching, temporary access roads, excavation, blasting, disposal at sea, and others where applicable).

Northern Pulp has not fulfilled TOR 2.5. They have not provided a detailed plan for marine pipeline construction. The Focus Report states, "Appendix 2.5 provides the details of the current proposed construction." (Section 2.5, p. 39). This is not accurate. Appendix 2.5 **does not provide this information**. Makai Ocean Engineering Inc. which prepared the report for Appendix 2.5 writes, "This report provides an opinion of the likely construction methods and design features of the pipeline, based on the available data and standard practices for marine pipelines." They also state, "The exact method used for dredging will be determined by the selected marine contractor based on schedules, costs, and available equipment resources." (Executive Summary, p. 1)

Makai states clearly that, "While Makai has extensive experience with HDPE pipeline installations and has taken considerable efforts to consider the site specifics and likely approaches for this project, **the actual means and methods and construction processes will remain the responsibility of the Marine Contractor, and may vary from this approach."** (Introduction) (*emphasis ours*)

We note some, but not all, of the issues relating to TOR 2.5 where no concrete plan has been presented:

- **No plan for how excavated material will be dealt with during construction**: Neither the Focus Report Section 2.5 and Table 2.5-1, p.18 nor Appendix 2.5

provide a definitive plan for how excavated material will be dealt with during the construction process, (sidecast, removed to barge or other.) Options are presented, but no definitive plan is presented.

- **No plan for spoils disposal:** The question of potential disposal at sea is raised explicitly in TOR 2.5. NPNS downplays the issue of spoils and their disposal. The Focus Report states, "It is anticipated that spoils from the excavation will be repurposed as fill to cover over the trenched pipeline once placed. Excess spoils may be (sic) require disposal and will be subject to regulatory approval and permitting." (Section 2.5, p. 43)
  NPNS has provided no explanation of how spoils will be disposed of. They have not addressed the question of they will be looking at disposal at sea.
  The Harbour Authority notes that it appears physically impossible that there will not be a significant amounts of spoils requiring disposal in some way, given that 6" of gravel and a 36" diameter pipe will replace excavated soil for the 4 km distance of the trench.
- **Some of the excavated soil may exceed contaminant guidelines**. Contaminant levels beyond guidelines in some soils are identified in the Focus Report documentation. NPNS has not addressed this issue except to say that it will be dealt with at a later time.
- **There is no clear plan for how the trench will be finished.** "Once the trench is covered in soil, it could either be graded down using a towed grader bar, or left to the elements if local currents and sediment transport is agreeable." (Appendix 2.5, p.18) The possible use of armour stone in some places is mentioned. There has been insufficient attention given to the strong tides and currents that could expose the pipe to ice damage.
- **Blasting very unlikely**. In response to TOR 2.5, NPNS says only that blasting is "very unlikely." The Authority is very concerned with leaving this issue unresolved. My client's position is that sufficient information should have been gathered and provided in the Focus Report to determine whether blasting is proposed as part of this project or not, in order that this issue can be fully considered in terms of assessing potential impacts. Use of blasting could have significant consequences.
- **Siltation during construction**. See point 7 below regarding potential impacts of siltation during the 84+ day proposed construction period.

Recommendation #6: The Harbour Authority of Caribou believes that Northern Pulp has not provided sufficient information to fulfill the requirements of TOR 2.5. NPNS has presented a number of possible scenarios, but no plan that can be evaluated for potential impacts. The missing information is not available in earlier documentation, i.e. the EARD or in Appendix F to the EARD.

The Harbour Authority is very concerned that, *"The exact method used for dredging will be determined by the selected marine contractor based on schedules, costs, and available equipment resources."* (Appendix 2.5, p. 1) Decisions based on schedules, costs and available equipment do not prioritize prevention of environmental harm to the

Harbour or impacts on present users of Caribou Harbour and do not ensure protection of the delicate harbour environment.

My client asks the Minister not to approve this project without a detailed construction plan subject to scrutiny and input from the public, including our patrons, who have detailed knowledge of the actual conditions of the area and the potential for harm. NPNS has not provided the Minister with the information needed to determine whether construction of the marine pipeline can be done without causing irreparable, long-term harm to Caribou Harbour and the nearby Northumberland Strait, including the marine life within it, both plant and animal, and current users.

7. **Siltation in the harbour during construction may cause significant harm to marine life and current users of the harbour.**

The Authority and our patrons have great concern about the impact of siltation on the Harbour and surrounding waters during construction and for an unknown period afterwards. No attention has been given to the potential effect of excavation of over 80,000 cubic metres of silty bottom over a period of 84+ days, (Focus Report, Table 2.5-1) in a shallow, tidal area. Caribou Harbour experiences tidal changes of up to 5 feet, twice daily. During a construction period of this length, storm conditions are almost inevitable. Storm surges can raise waters by 6 feet over normal conditions, with high winds and crashing waves. Northern Pulp has only addressed this issue by saying that silt curtains and isolating work areas will be used to reduce turbidity. This is completely insufficient for an issue which could have significant impacts on all life in the harbour.

Is it viable to isolate up to 4 km of trench and up to 80,000 cubic metres of sidecast soil effectively, without interfering with navigation and existing uses of the harbour? What amount of silt would be contained by these methods, what would be released? Conditions inside Caribou Harbour, with depths of between 0 and 8 metres, are significantly different than in many open ocean areas, where dispersion of silt would take place more effectively. What would be the impact of siltation under both normal and storm conditions on eel grass beds, on plankton, on juvenile lobster and crab and other forms of marine life, on the seabed itself? This issue must be fully examined based on the actual conditions in Caribou Harbour prior to approval being given for the project.

There are 70+ fishers, buyers and a nearby fish plant employing 140 people, that all need clean water for multiple purposes. During the months of May and June in Caribou Harbour at our wharf and at North Nova Seafood's, there is a minimum of 100,000 to 150,000 thousand pounds of live lobster, 'floating' every day. This means the lobsters are submerged in containment pens or 'cars' in seawater, in 100-pound crates. The lobsters are reliant on clean, oxygenated water. So are the oysters in the 4 oyster leases in the harbour, and the juvenile rock crab, lobster and other species. Fishers use seawater to spray down their catches as they fish, to keep them cool. They use seawater to wash down their boats and traps. That water must be clean.

Over 84+ days construction, with unpredictable weather, the Harbour Authority has serious doubts about whether installation of 4km of marine pipe can be carried out without significant, long-term harm. Certainly, Northern Pulp has not provided sufficient information to show that it can be done without such harm.

Recommendation #7: The Minister cannot approve this proposal until the potential impacts of siltation in the Harbour during the 84+ day proposed construction period is fully evaluated.

8. Timing of proposed marine pipe trenching and installation and existing uses of the harbour

The Authority's position is that there is no 84+ day construction window that would not severely interfere with existing activities. There is ice in the harbour from late December until April. Lobster season and the related storage/navigation/fishing from end of April to end of June. Major recreational activities occur throughout July, August and September, with rock crab season running from early August to November. Include the herring fishery in the Northumberland Strait from early September until later October, of which Caribou Harbour is the epicenter. Tuna fishing in August, September and October, then scallop fishing from early November to mid- December. Complicate that with the beginning of fall storms and high winds. Ice can close in by early December. Then add in the Northumberland Ferries running from May 1st until mid- December in a narrow channel only slightly larger than the vessels themselves.

Recommendation #8: Caribou Harbour is used for activities central to the economy of the area for all months of the year when it is ice-free. There is need for a full evaluation of the potential impacts of proposed pipeline construction on existing uses prior to any approval of the project.

9. Effluent will enter Caribou Harbour

Northern Pulp's proposal relies on a receiving water study (RWS) prepared by Stantec. This study indicates that there will be minimal flow of effluent discharged into Caribou Harbour. The Authority reasserts its position that this conclusion is erroneous, and does not reflect what its fishers know from working the waters of Caribou Harbour year-round for many decades.

a) The receiving water study does not take into account conditions familiar to fishers in the area, including storm surges/surge tides or sustained, heavy onshore winds from the northeast or northwest that can last for several days and 'hold' the tide in.
b) There is a bottleneck effect at the mouth of the Harbour between Munroe's Island and Caribou Island caused by the deeper water, (the proposed location for the outfall and diffusers), meeting the shallow water adjacent to the sandbar at the mouth of the harbour. This is the actual narrow, marked

channel the Prince Edward Island and Northumberland Ferry navigates to exit Caribou Harbour, which averages a depth of 25 feet. (This channel needs to be dredged every so often to maintain a safe depth for the ferry to navigate in and out of the harbour.) A rising tide basically, especially with onshore winds, funnels in from the proposed diffuser location.

c) Under storm conditions, the water level in Caribou Harbour sometimes rises in excess of 2 meters. There is nowhere for this excess to come from but the mouth of the harbour, where the effluent outfall is proposed to be.

d) A local knowledge submission containing detailed information about the tides, currents and winds in the Caribou Harbour area was submitted as a response to the EARD by Caribou fishers . It contains important information that does not appear to have been considered in the revised RWS.

e) We draw your attention to the expert opinion of Dr. Oliver Fringer of Stanford University, an oceanographer with expertise in numerical modelling of coastal dynamics. Dr. Fringer reviewed the Stantec RWS in the EARD and concluded that errors of modeling lead,

> "to the incorrect conclusion that the environmental impacts will be negligible because the effluent concentrations are predicted to be unphysically low. **Instead, correct implementation of the models with more conservative and physically realistic scenarios would show that effluent concentrations in the region could be much larger and that effluent accumulation in Pictou and Caribou Harbours is likely.** (emphasis added) (Fringer, p. 1, Appendix 1, Ecojustice Response to EARD)

Dr. Fringer also states that Stantec's use of the two-dimensional Mike 21 model is inappropriate as it fails to take into account local dynamics caused by wind, river inflows, offshore currents, ice, waves and storm surge. (p. 7)

Recommendation #9: We are aware that Dr. Fringer is preparing an updated submission on the revised RWS. We ask the Minister, and government departments reviewing the NPNS proposal, to give Dr. Fringer's past and updated submissions their full attention, and to give attention and respect to the local knowledge of fishers submitted previously and to this review.

The RWS is a key element of NPNS's conclusion that no harm will be done by the release of an average of 62 million litres of treated effluent daily into the Northumberland Strait at the mouth of Caribou Harbour. If the information on which the RWS modeling is based is not correct or complete, the results will not be correct. Likewise, if the methodology is not correct. The RWS is not an area where mistakes can be allowed; there is too much at stake.

The Harbour Authority and its patrons are not experts in modelling. Dr. Fringer is an independent expert, and we note that his conclusions were consistent with our fishers' local knowledge. We note that there are many errors of fact in NPNS' focus report in relation to fisheries and the presence of fish. We have listed some of these errors in point 10 below. Fisheries and fish are subjects on which the fishers of the Authority do consider themselves experts. The multiple errors on these subjects (see point 10 below) in the Focus Report and attached documents do not give us confidence that NPNS has provided accurate information in other areas.

10. Errors of fact relating to fisheries and the presence of fish.

Due to limitations of time for public comments, my client is unable to fully respond to errors of fact relating to fish and fisheries that may exist in Northern Pulp's documents. However, we would like to point out some which are apparent to the Harbour Authority and its patrons.

a) Appendix 7.3, p. 68, erroneously states that rock crab are not found at depths greater than 10 m. To give an idea as to how inaccurate this is, you simply need to understand that most fishermen have 35 to 60 meters of buoy line to fish rock crab. Rock crab are fished as deep as 35 to 50 m in the Strait. Depending on the time of year they congregate at different depths.
b) Appendix 7.3, p. 68 also states that rock crab are not fished near the proposed outfall. This is false. The area is extensively fished for rock crab. The vast majority, if not all, fishers in Caribou who participate in the rock crab fishery have fished rock crab in the direct vicinity of the diffuser location.
c) Figure 7.3-3, p. 130 of the Focus Report, titled Northumberland Strait Lobster Buoy Locations, gives a highly inaccurate picture of the presence and amount of lobster fishing directly in the vicinity of the diffusers. The entire harbour and channel area including the vicinity of the proposed diffuser is fished for lobster. Lobster fishing effort and locations change sometimes on a daily basis. They are dependent on many factors, including water temperatures, molt cycles, and annual migration inland to molt, spawn and feed.
(In fact, Northern Pulp's own information contradicts itself. Figure 7.3-4 Lobster Distribution and Harvest Area indicates that lobster fishing takes place much closer to the proposed diffuser than the representation in Figure 7.3-3)
d) Figure 3-12 (Appendix 7.3, p.66) suggests Atlantic Herring resources in the LAA are limited to the outer Caribou Harbour / Northumberland Strait where depths approach 10 m and greater. This is false and completely in error. The adjacent Pictou Banks, (middle ground), Caribou Point and northwest to Pictou Island, all are basically less than 10 meters depth and extensively fished for Atlantic Herring.
Atlantic Herring converge in the exact location of the channel and proposed diffuser to spawn there and in the adjacent banks. Northern Pulp says herring are generally located outside the zone of discharge (Appendix 7.3, Section 4.1.3.6, p. 4.2) and pass through this area on their way to spawning grounds. (Appendix 7.3, Appendix D, last page, no page #) This is incorrect. This entire area including the area of the diffuser is the spawning ground for Atlantic Herring.

e) Mackerel is fished extensively in the exact location of the channel and proposed diffuser location. Mackerel feed on juvenile herring and herring spawn and basically are in abundance when the herring come to this area to spawn. The greater depth of the channel allows for more line in the water, which enables more hooks to fish mackerel effectively at the exact diffuser location and all along the channel.

f) Northern Pulp states that the proposed marine pipe intersects the scallop buffer zone and that the diffuser is not within the scallop buffer zone. (Appendix 2.5, p. 8) This is incorrect. The entire 4 km proposed pipe including outfall location is within a Scallop Buffer Zone, SFA 24. The buffer zone is measured 1 nautical mile (1.1 miles) from any land.
These zones are part of a marine refuge for American Lobster and are part of Canada's Marine Refuge program, which contributes to Canada's marine conservation targets. Consider that part of the considerations given for the marine refuge is that 'no human activities that are incompatible with the conservation of the ecological components may occur or be foreseeable within the area'. This entire proposed pipe and associated effluent is not compatible with the intent of a Marine Refuge. Marine refuges contribute to Canada's marine conservation targets.

The Harbour Authority submits for your attention Appendix 1, consisting of signed documentation from 65 fishers who fish lobster, rock crab and/or herring in the vicinity of the diffusers. This information is submitted to correct inaccurate information in Appendix 7.3 of Northern Pulp's Focus Report, which represents the area around the proposed outfall as free from fishing.
Sixty-five (65) fishermen and women indicated that they fish for either lobster, rock crab or herring in the vicinity of the proposed outfall. Thirty-eight (38) state that they fish one or more of these species within 300 metres of the proposed effluent outfall. Forty-three (43) state that they fish one or more of these species within 1 km of the proposed outfall.
This information was gathered in Pictou, Nova Scotia, on November 1 and November 4, 2019. Due to time constraints, this information represents some, but not all, of the fishers who fish in the vicinity of the proposed effluent outfall. It does not include information from fishers who fish other species in the immediate vicinity of the outfall.

Recommendation #10:

My client is disturbed by the many errors of fact regarding the presence of fish and fisheries in the area of the proposed outfall, including continued misrepresentation of the relationship of the 4 km pipeline and outfall to marine refuge SFA 24. Fishermen have presented information about the presence of fish and fisheries to Northern Pulp from the very first meeting almost two years ago. Northern Pulp has not reflected this information in their Focus Report. As noted, the short time for public input limits our ability to fully review the documents for errors in these areas. We ask the Minister to take into consideration the repeated errors of fact, which raise significant questions about potential inaccuracies in other information, and must limit confidence in the conclusions drawn by NPNS that the project will cause no significant, residual harm.

11. Conclusion and Final Recommendation:

The Authority's position is that the Minister must reject Northern Pulp's proposed new ETF. Northern Pulp's Focus Report response contains errors of fact and lacks information on critical issues. It lacks key protective measures. Northern Pulp has failed to address the Terms of Reference adequately and they have failed to address realistic and legitimate concerns raised by ourselves and other members of the public. Critical scientific studies have not been done, including lobster larvae studies recommended by NPNS's own consultants. Northern Pulp has drawn the conclusion that this project will cause no significant, irreversible harm without providing the science to back up this conclusion.

There is credible evidence of significant, long-term of risks to the marine environment presented by ourselves and others. There is also evidence of the devastation caused by pulp effluent to Boat Harbour. The Authority does not want to see this repeated in Caribou Harbour.

Because of these errors and omissions, and because of credible evidence of risk, we believe the Minister cannot approve this project. The Minister does not have a basis to conclude that the project can be undertaken without likelihood of serious consequences and irreparable harm to Caribou Harbour and the marine ecosystem that the Authority and its patrons rely on to earn a decent and moderate living. We ask that this proposal be outright denied based on these very realistic and legitimate concerns.

Yours truly,
MACISAAC CLARKE & DUFFY

cc Client
Minister of Environment and Climate Change
Minister of Fisheries Oceans and the Canadian Coast Guard
Canadian Environmental Assessment Agency NS Regional Office

Appendix 1

Submission of Caribou Harbour Authority

November 6^{th}, 2019

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓		✓	
	✓	SCALLOPS	✓	
	✓		✓	
	✓		✓	
		✓	✓	
	✓	✓	✓	
	✓		✓	

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	✓		✓	
			✓	
	✓	✓	✓	
	✓		✓	
			✓	
	✓		✓	

The proposed effluent outfall is at: 14307.6
29812.2
Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	✓	✓	✓	
	✓	—	—	
	✓		✓	
	✓	✓	✓	
	✓	✓	✓	
	✓		✓	

The proposed effluent outfall is at: 14307.6
29812.2
ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	✓	✓	✓	
	✓	—	—	
	✓		✓	
	—	—	—	
	✓	✓	✓	
	✓		✓	

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
			✓	
		✓	✓	
	✓	✓	✓	
			✓	
	✓	✓	✓	
		✓	✓	

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	Less than 100 ✓	Less than 100 ✓	✓	
			✓	
			✓	
			✓	
	✓	✓	✓	
	✓			

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	✓	✓	✓	
	✓	✓	✓	
	groundfish			
	✓		✓	
	✓	✓		
			✓	

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
		✓	✓	
	✓	✓	✓	
	✓	✓	✓	
	✓		✓	
	✓	✓		
			✓	

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓		✓	
			✓	
	✓			

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
	✓		✓	
			✓	
	✓	✓	✓	
		✓	✓	

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓		✓	
	✓		✓	
			✓	
	✓		✓	
			✓	
			✓	
			✓	

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
	✓			

The proposed effluent outfall is at: 14307.6
29812.2

Check the boxes for any species that you have fished within 1 km of the proposed outfall.

Name - print	Lobster	Rock Crab	Herring	Signature
	✓	✓	✓	
	✓	✓	✓	
	✓			
	✓	✓	✓	
	✓	✓	✓	
			✓	
			✓	

The proposed effluent outfall is at: 14307.6
29812.2

ALSO: Check the boxes for any species that you have fished within 300 metres of the proposed

Name - Print	Lobster	Rock Crab	Herring	Signature
		✓	✓	
	✓	✓	✓	
			✓	
	✓	✓	✓	
	✓	✓	✓	
	✓	✓		
	✓		✓	