

To: Environmental Assessment Branch
Nova Scotia Environment
P.O. Box 442
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Fax: (902) 424-6925

Re: Northern Pulp Nova Scotia Effluent Treatment Project Proposal

Submitted by: Linda Irving, MPH

Tatamagouche, NS

Dear Sir or Madam,

I respectfully submit the following comments on the Northern Pulp proposal for the replacement effluent treatment project (NP Proposal), as registered at your office on February 7, 2019. The proposal document is too voluminous to possibly comment on all of the sections that could be included here. Therefore, I have selected several issues that I feel I am able to reasonably comprehend and make valid comments on.

I hold a Bachelor of Science from Mount St. Vincent University, and a Master of Public Health from the University of Massachusetts, Amherst. In my academic work at both the undergraduate and graduate levels, I have had to read many research papers in various disciplines in order to fulfill coursework, including writing my own graduate thesis. Understanding the underlying challenges of collecting and analyzing data using statistical methodology, and the importance of appropriately communicating conclusions of studies has informed my comments below.

My responses to the NP Proposal document include the following issues:

- Lack of scientific and statistical basis for many conclusions
- Use of ecological models without validation via observed data
- Lack of current and accurate baseline data
- Vague descriptions of the final effluent composition and impacts of solids content of effluent
- Omission of thermal pollution and global warming issues from effluent
- Irrelevance of Section 9 regarding human health impacts

The first general comment that I wish to make about the NP Proposal is its lack of what is commonly referred to as '**scientific method**'. There is a burden of work that must be completed in scientific endeavor. The best description that I could readily find on the internet (my underscores):

1. Make an observation or observations.
2. Ask questions about the observations and gather information.
3. Form a hypothesis — a tentative description of what's been observed, and make predictions based on that hypothesis.
4. Test the hypothesis and predictions in an experiment that can be reproduced.
5. Analyze the data and draw conclusions; accept or reject the hypothesis or modify the hypothesis if necessary.
6. Reproduce the experiment until there are no discrepancies between observations and theory. "Replication of methods and results is my favorite step in the scientific method," Moshe Pritsker, a former post-doctoral researcher at Harvard Medical School and CEO of JoVE, told Live Science. "The reproducibility of published

experiments is the foundation of science. No reproducibility – no science."

<https://www.livescience.com/20896-science-scientific-method.html>

In the instant NP Proposal, data is derived from models created and operated in controlled environments. In the natural world, the number of variables that affect the validity of the data are either too numerous to list, or are simply unknown. Statistical confidence intervals of conclusions in this proposal are not stated, nor are any statistical analyses mentioned (See #5 above). All scientific and technical data must withstand statistical scrutiny. This is meant to address the probability that the data is replicable and applicable in the natural environment or larger population.

There is no mention in the NP Proposal of how the models utilized by Stantec were validated, yet numerous assumptions/conclusions regarding the performance parameters of the proposed project are presented. Studies have been published about the validity of utilizing **models in ecological studies**:

“Because there are no generally agreed validation criteria for ecological models, the best that can be done at present is for the modeller to state explicitly what the validation criteria are and leave it to the user to judge if the criteria are adequate. The most common criteria at present are the “see how well the simulated data matches the observed data”...

Rykiel, E.J., Jr. “Testing ecological models: the meaning of validation.” *Ecological Modelling* 90 (1996) 229-244.

Validation criteria are not mentioned in the NP Proposal, based on my own reading. Stantec has included simulated data on many effluent and pipe parameters. However, observed data is not included. For instance, with respect to the receiving environment – the baseline (current) water quality data is *assumed* to be the same at the outfall location as a previously considered location. This is articulated in the following disclaimer found in Appendix E - Receiving Water Study p. 16:

“No historical water quality data are available for Northumberland Strait around the CH-B location. Data from neighboring Pictou Road (Stantec 2017) located about 6 km southeast were used.”

Two year old data from a location “about” 6 km southeast was utilized, and characterized as “...expected to be worse than off Caribou Point at CH-B...” **This is a significant flaw in the validity of conclusions about the risks inherent in this project. Scientific conclusions cannot be drawn from the modelling data, only hypotheses.**

This deficiency should be considered pursuant to Section 12 (da) of the Environmental Assessment Regulations.

Section 5.6.1 Replacement Effluent ETF Effluent Discharge

The NP Proposal provides projected *estimated* composition of effluent leaving the diffusers at Table 5.5-1. It is then purported that this effluent “...will meet ambient water quality (current background) at the edge of a standard mixing zone.” This critical section of the proposal is lacking in detail and does not explain where the extraordinary volume of effluent matter that will be continually exiting the diffusers will go. A fundamental scientific law states:

“**The law of conservation of matter** or principle of matter conservation states that the mass of an object or collection of objects never changes over time, no matter how the constituent parts rearrange themselves. The mass can neither be created nor destroyed.”

There is one variation in the law of conservation of matter, which is the production of energy in radioactive materials. The basic law of conservation of mass/matter is well known and applies in the fields of chemistry, physics, fluid dynamics etc.

The NP Proposal does not adequately address where the effluent mass being delivered at the diffusers will end up once it enters the Northumberland Strait. Every molecule of effluent will remain in the strait/ocean waters unless vaporized into the atmosphere.

Table 5.6-1 Anticipated Daily Maximum Effluent Water Quality (Reprinted from Stantec 2018, Table 3.2)

1. The **total suspended solids** in the effluent are *estimated* to be 48 mg/L. Using the conservative approach, the mill will be sending 85,000,000 Liters of effluent to the Northumberland Strait every day. This is the equivalent of 4,080 kg/day, or 1,489,200 kg/year of “suspended solids” being dumped into the strait. It is further noted that these suspended solids will be comprised of an unknown proportion of floc – biological organic solids, including microbes. Whether floc, sediment, chemical or any other substance, this is an enormous volume of organic and inorganic solid mass entering the Northumberland Strait.

If the solids become diluted within an arbitrary “mixing zone”, then the massive amount of solid organic and inorganic material will simply be present in a more dilute concentration.

Given that each year there will be 1,489,200 kg of suspended solids released, the consequences should be addressed by the proponent. This is a serious deficiency in the proposal.

This deficiency should be considered pursuant to Sections 12 (c), (d) and (e) of the Environmental Assessment Regulations.

2. The temperature of the effluent leaving the diffusers is *estimated* to be 25° C in the winter and 37° C in the summer. At Appendix E - Table 3.1 Background Water Quality (from Stantec 2017) at the location “about 6 km southeast”, the average winter temperature is denoted as 0° C and average summer temperature as 17.6° C. Thus, the average **effluent to ambient temperature differences would be 25° C in the winter and 19.4° C in the summer.**

Thermal pollution is perhaps the most concerning aspect of this proposed project, in its **deleterious effects on organisms** and contribution to **global warming**. A short primer on thermal pollution:

- Cold water contains more oxygen than hot water so increases in temperature also decrease the oxygen-carrying capacity of water. In addition, raising the water temperature increases the decomposition rate of organic matter in water, which also depletes dissolved oxygen. These decreases in the oxygen content of the water occur at the same time that the metabolic rates of the aquatic organisms, which are dependent on a sufficient oxygen supply, are rising because of the increasing temperature.
- Ocean invertebrates, fish and marine reptiles are obligate poikilotherms - their body temperatures depend entirely on the surrounding water. Each species is adapted to a single range of temperatures and many pass through several different life stages, each with an individual range of tolerance. The ocean's vast populations of microbes, fungi and sea plants also rely on narrow temperature ranges for optimal growth.

- Thermal pollution often temporarily increases aquatic plant populations. Other life forms, including microbes and animals, move into these regions to exploit the higher oxygen levels, but when photosynthesis stops at night or upon the death of plants, dissolved oxygen levels plummet, leading to massive animal die-offs. Excess heat can also cause unnaturally large microbial blooms, which kill animals by depleting local oxygen or producing toxins.
- Unnatural warmth and cold can also delay and redirect migration, influence when and whether breeding occurs, and decrease survival of young in marine mammal, reptile and bird populations. Heat pollution that leads to an overabundance of organisms in a region can draw in excessive numbers of creatures that feed on them, while depletion of prey populations by heat stress forces their predators to encroach on regions outside their normal range. Both situations lead to unnatural competition between and within species.
- A sudden thermal shock can result in mass killings of fish, insects, plants or amphibians. Hotter water may prove favorable for some species while it could be lethal for other species. Small water temperature increases the level of activity while higher temperature decreases the level of activity. Many aquatic species are sensitive to small temperature changes such as one degree Celsius that can cause significant changes in organism metabolism and other adverse cellular biology effects.

<https://www.slideshare.net/meghamajoe/effect-of-thermal-pollution-on-marine-life>

This aspect of the proposal should be considered pursuant to Sections 12 (c), (d) and (e) of the Environmental Assessment Regulations.

It is unclear whether this EA will consider the effluent contribution to **global warming**. The gradual warming of the receiving waters within and beyond the arbitrary “mixing zone” from hot/warm effluent is not discussed in the NP Proposal. There is a document on the Nova Scotia Environment website at the Environmental Assessment pages titled: “Guide to considering climate change in environmental assessments in Nova Scotia”. According to this document, Global Warming considerations in the EA include:

“Operational processes and activities can include the project’s energy sources and operational boundaries (Guide to Considering Climate Change in Project Development in Nova Scotia Section 2.2, Steps 1–A and 2–A);

- Anticipated emissions can include information on the processes contributing to GHGs (Section 2.2, Steps 1–A,2–B) and estimated GHG emissions (Section 2.2, Step 2–C);
- General layout and size can describe the loss of carbon sinks through extent of forest removal (Section 2.2, Step 1–B); and
- The project’s location or setting can be used in relation to a project’s climate change vulnerability.”

<https://novascotia.ca/nse/ea/docs/EA.Climate.Change.Guide.pdf>

Table 2-1 Criteria for Assessing Significance of Impacts from Project Activities

Operational processes and boundaries include the piping of hot effluent into the marine environment. Thermal pollution and its contribution to global warming are not discussed in the NP Proposal. The contribution to global warming should NOT be glossed over in this assessment. The 1967 mill should not be pushed forward into our collective future without considering the timely and relevant issue of global warming vis-a-vis the thermal pollution that will result from the proposed project. **Thermal pollution from the effluent will cause a significant adverse residual environmental effect in its contribution to global warming.**

Section 8.1.3.1. Potential Environmental Effects

The following paragraph in its entirety is vague and without any scientific basis. This paragraph should be rewritten to provide clear and detailed information about potential harm from the emissions after the project:

“Without mitigation, the project *could* interact with the atmospheric environment in the following ways...emissions from the combustion of such sludge in the power boiler during operation and maintenance *could* disperse from mill stacks to off-site receptors.” (Registration Document at page 142)

The use of “estimates” of current emissions at Table 8.1-5 is inadequate. The use of “estimates” at Table 8.1-6 is therefore, also unacceptable. Note that the “estimated” values are then utilized as baseline in the modeling noted at page 146: “Ground-level concentrations (GLC’s) of air contaminants were predicted for two modeling scenarios...”.

The models utilize baseline “estimates” to inform the conclusions seen in **Table 8.1-7 Summary of residual environmental effects related to the atmospheric environment VEC** (page 147). Ultimately, the findings under Significance of Residual Effect are all deemed “not significant”. The conclusions based upon estimates are not valid or scientific. The conclusions are based on conjecture.

Breathhtaking in their brevity, and vague, sweeping conclusions, Sections 8.1.3.1 through 8.1.4 should be rewritten to include a scientific basis. The conclusions are based on hypothetical outcomes derived from models. There is simply no rigorous scientific study noted in the proposal to support the assumptions in Sections 8.1.3.1 – 8.1.4.

This deficiency should be considered pursuant to Sections 12 (c), (d) and (e) of the Environmental Assessment Regulations.

Section 9 Human Health Evaluation

As a public health professional, it is impossible to understand why a project of this magnitude and nature would not require a human health risk assessment (HHRA) in an EA.

Anecdotally, there have been long suffering health effects in the population in geographic proximity to the Abercrombie pulp mill. The mill emissions are copious and unpredictable as they flow in response to wind velocity and direction. The waters of Boat Harbour are toxic and therefore, the effluent leaving Boat Harbour and going into the Northumberland Strait cannot be innocuous to marine or human life.

Morbidity and mortality can be measured and analyzed in a healthcare system such as Nova Scotia’s. Reportable disease is recorded and some data is published. However, rates of disease such as cancer in Nova Scotia are published at “zone level”, which makes it impossible to discern an elevation of disease rates in small geographical locales, or clusters.

<https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6208a1.htm>

My public health practice has been outside of Nova Scotia and so I cannot speak to the reason why the province has failed to study disease rates in Pictou County. I find it unusual that over the long history of the mill’s presence, this has not been undertaken. This work is the domain of epidemiologists who utilize data (such as from the Nova Scotia Cancer Registry) and determine if disease rates appear to be elevated and, whether high rates of disease might be associated with the mill emissions and effluent. To the best of my knowledge, this has never been undertaken.

In the absence of epidemiological studies, it is not possible to dismiss the effects of the mill on human health. Nor is it possible to confirm the effects without delving into epidemiological studies. Unfortunately, this EA is currently proceeding without requirement to review the project's potential future effects on human health. This follows the paucity of attention to health effects from mill emissions and effluent over the last 51 years. This is an unjust burden upon the people of Pictou County. In any case, the information in Section 9 has no application in this EA in the absence of any historical epidemiological data. Any future epidemiological study would obviously take many months or years.

If human health were deemed relevant to this undertaking, the matter should be considered pursuant to The Environment Act, Section 34 (1) (b).