March 7, 2019

Honorable Minister Margret Miller
Environmental Assessment Branch,
Nova Scotia Environment
P.O. Box 442, Halifax, Nova Scotia
B3J 2P8

RE: Northern Pulp Nova Scotia - Environmental Assessment Registration Document-Replacement Effluent Treatment Facility

Please see the following document in response to the Environmental Assessment of Northern Pulp's Effluent Replacement Project. The following document will focus on some major concerns of the underwater portion of the proposed pipe and the site-specific characteristics of the seafloor along the proposed route. I am a commercial fisher and harvest lobster, rock crab, and herring from the waters directly surrounding the proposed pipe route and outfall location. I also have a background in structural engineering and have worked on various projects throughout the Maritimes assisting in both the structural design and geotechnical investigation of various structures. This submission will include a combination of site-specific observations and the effects it will have on the structural integrity of the pipe.

Sincerely,

Colton Cameron

1.0 SEAFLOOR CHARACTERISTICS OF PROPOSED ROUTE

1.1 Effluent Effects Rock Crab Population

Inside Caribou harbour consists mainly of shallow soft sand and mud bottom with portions of broken hard bottom. Such seafloor characteristics create a favourable environment for the rock crab population to flourish. While harvesting rock crab throughout LFA 26A fishers have observed that this inlet presents optimal conditions for juvenile and female rock crabs. If you place traps within the harbour (south/southwest of Munros Island or directly east of the ferry terminal) the majority of the harvested catch appears to consist of small juvenile crab including a high percentage of females. As you move out of the harbour along the proposed pipe route and along the shore east and west the percentage of harvestable rock crab (a rock crab of legal size) within the catch appears to significantly increase. Traps placed further offshore in deeper waters tend to have a catch rate with the majority of the catch consisting of large harvestable crabs with very few undersized crabs. Over the years all of the above has remained consistent and local fishers have concluded that the Caribou harbour acts as a breeding ground and an optimal environment for juvenile rock crab to mature before moving to deeper waters. This raises the major concern of what effect will this effluent have on these juvenile rock crab and the rock crab population as a whole? Not to mention the chain reaction that would occur throughout other species including lobster whose diet consists of a large percentage of rock crab (Fisheries & Oceans Canada, 2013).

1.2 Effects of Site Specifics on Structural Integrity of the Pipe

The marine portion of Northern Pulps pipeline design consists of approximately 4 kilometers of 36" high density polyethylene (HDPE) pipe that will be weighted with concrete ballast and placed in a 3 m trench (providing approximately 2 m of cover to the top of pipe) and will be backfilled with armour stone (Appendix F, Northern Pulp, 2019).

The pipeline location proposed by Northern Pulp presents various challenges that must be addressed to ensure the structural integrity of the pipe. As previously stated, the bottom has been observed by fishers to consist of soft sand and mud bottom with small pockets of hard bottom. With no geotechnical investigation carried out by any of Northern Pulps consultants it is unknown how deep the soft bottom continues. This raises the concern of non-uniform settlement of the soil that will be supporting the pipe. Due to the pipe being placed in a pre-dug trench during the construction phase it is likely that the pipe will experience increased installation deflections due to the trench quickly being filled in with sand due to wave and tidal action, thus creating discrepancies between design pipe elevations and as built pipe elevations. The pipe is also likely to experience increased in-service deflections over time due to the pockets of hard bottom creating a point of solid support while large portions of soft bottom allow for settlement and pipe sag. These deflections will induce increased compressive and tensile bending stresses within the pipe wall resulting in bending strains. The design code aims to limit these strains and the geometric stability of the pipe by setting ring deflection limits of 7.5%. As deflections increase beyond this point geometric stability is eventually lost and the crown of the pipe will begin to flatten and eventually reverse leading to reverse curvature collapse of the pipe Figure 1 shows observed pipe deformation patterns that lead to failure due to increased pipe deflections (Plastic Pipe Institute, 2014).

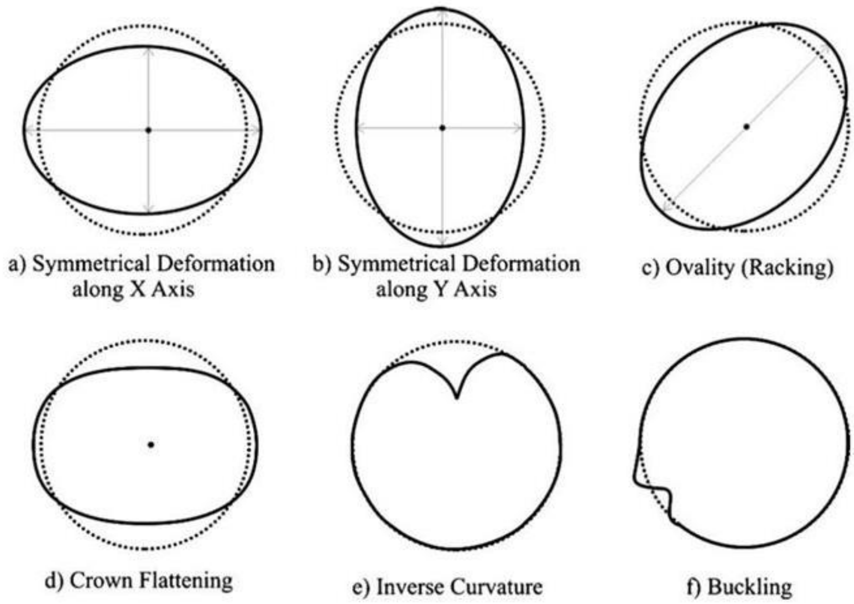

Figure 1: Observed deformations of installed HDPE pipelines (Motahari & Abolmaali, 2010)

Figure 1 is from a study published in the Journal of Transportation Engineers of the American Society of Civil Engineers (ASCE). The study included structural monitoring with video and laser surveillance of over 15,000ft (96 pipelines) of buried HDPE pipe across the USA. It was concluded that the majority of pipelines had actual deformations in excess of design code limits (Motahari & Abolmaali, 2010). This study gives great insight into the possible repercussions of not accurately modeling induced strains in buried HDPE pipes.

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. Although HDPE pipes are extremely flexible making them well suited to bend and adhere to the seafloor, cyclical loading has the potential to cause failure if the site-specific loadings on the pipe are not properly addressed. “One of the causes for failures of HDPE pipes is fatigue which is the result of pipes being subjected to cyclic loading, such as internal pressure, weight loads or external loadings on buried pipes, which generate stress in different directions: circumferential, longitudinal and radial.” (P. 600, Djebli et al., 2014). To accurately determine these site-specific loads, various data is required including accurate geotechnical site investigation with borehole results, hydrographic site surveys including bottom type/depths, potential ice scours, and site observations of ice conditions. It should be noted that none of these are present in Northern Pulp’s submission.

Of all the loads the pipe will experience, ice loads present that largest risk to the structural integrity of the pipe. Potential failure of the pipe due to ice could occur from one of two mechanisms: 1) Direct impact causing a ductile failure (high amount of stress over a relatively short time), 2) Cyclical loading causing a brittle failure (stress levels lower than the mechanical strength of the material induced repeatitly over a relatively long time) (Zhang, 2005). Brittle failure due to ice impact could occur if any of the following project tasks are neglected: complete a site survey of ice conditions, complete a hydrographic survey depicting any potential ice scours, burry pipe at an adequate distance to account for extreme ice event. Although Northern Pulp shows a pipe buried with cover of approximately 2 meters, they have not completed any of the pre-design field work required to ensure that the pipe is not at risk of failure. When determining extreme ice scouring events, it is also recommended that ice scour surveys be carried out more than once, spaced out over time to gain an accurate depiction of the ice and seafloor interaction (C-Core, 2004). Grounding models such as the one created for a tunnel project crossing the Strait of Belle Isle, Newfoundland can also be carried out to gain insight into ice activity in a given region (C-Core, 2004). The soft soil and shallow design depth of the pipe (approximately 2 meters) also poses concerns for ice and seafloor interaction. If large ice accumulation was present and gouged the seafloor to the unknown depths of the soft bottom there would be no evidence of such gouges once the ice had melted as the sand would infill the gouges within a couple tide cycles. Figure 2 and Figure 3 are a photo's taken March 4th, 2019 from the Caribou light house, the PEI ferry can be seen docked in the background.

Figure 2: Ice southeast of Caribou lighthouse along proposed pipe route (March 4th, 2019)

This photo shows extensive ice directly over the proposed pipe route. Locations where water depths are as shallow as 1 meter have ice piles of 3-4-meter heights above sea level. It is not unlikely to conclude from these photos alone that potential for ice impact at a depth of 2m below seafloor bottom in a soft bottom is a very real possibility that could lead to a ductile failure resulting in the catastrophic event of premature released effluent into the Caribou harbour. Figure 3 shows more ice further north along proposed pipe route.

Figure 3: Ice east of Caribou lighthouse along proposed pipe route (March 4th, 2019)

Alex Falconer, now retired, fished the waters surrounding the proposed pipe location for 55 years. Along with other species Alex fished lobsters along the shores of Caribou Island. He recalls one winter when ice conditions were at their peak, one of his most lucrative lobster spots was completely wiped out by the ice. North of Black Point the bottom consisted of dense hard bottom with drastic elevation changes in the bottom including a large trench where lobsters could always be found. The following spring the rock bottom had been completely changed and the trench had been filled in.

Barry Sutherland, a long-time fishermen and Rob Mackay a commercial diver in the area for 25 years have also seen the power of the ice in the area. One spring Barry could not seem to get his traps boarded as they were tangled on something on the bottom. When Rob dove to retrieve them a navigational marker buoy from PEI was found drove into the rock bottom by the ice.

3.0 RECIEVEING WATER STUDY

Events that would be catastrophic to the marine ecosystems include: 1) Structural failure of the pipe causing effluent to be released prematurely of the discharge location. 2) Errors in the receiving water study including tides, water flow, mixing characteristics at discharge location, lack of consideration for climate change effects will have on mixing characteristics.

The shallow soft bottom that extends south of the Caribou lighthouse combined with Munroe's Island extruding westward creates a bottleneck effect for the water currents. This bottleneck effect is also accelerated by the water moving in from deep waters to shallow waters on a rising tide.

These physical characteristics create accelerated tides and wave action, across the proposed location. These conditions combined with a prevailing north wind can cause water to swell into the harbour and hold waters in the harbour longer on a rising tide this gives the harbour very poor flushing characteristics. If there were a failure in the pipe at a location prior to the diffusers there would be no chance of meeting the dilution standards. The same could be said about the diffuser location if there is any variability in the water/mixing properties that were used in the receiving water study. Although computer modelling can give great insight into complex problems performing thousands of iterations and time steps in the matter of seconds, the results are only as good as the variables that were entered into the model. When dealing with a project with environmental consequences as catastrophic as this, each variable of tidal data, water depths, salinity, mixing characteristics etc. must be observed and calculated in a timely manner to ensure the level of confidence of the model is extremely high.

In near field portion of the receiving water study Stantec states "No historical water quality data are available for Northumberland Strait around the CH-B location. Data from the neighbouring Pictou Road (Stantec, 2017) located about 6 km southeast were used." (Stantec, 2018). While in the far field portion of the study they simply extended the boundaries of the previous model created for the previous outfall location in the original study that was completed for Pictou Harbour (Stantec, 2017). I will not attempt to touch on the technical data within the receiving waters study as I do not have the educational background to do so. I will however pose the following questions: Has adequate field investigations been carried out to ensure the results of these models are correct? Is stating there was no historical data thus we used data from our previously studied location sufficient? Should actual water sampling have been carried out at the actual location? Is this project being fast tracked? The study concludes that "The effluent discharged at the CH-B location is predicted to be dispersed and transported predominantly with offshore currents in the northwest and southeast directions. The effluent intrusion into Caribou Harbour is predicted to be minimum." (P.27 Stantec 2018). With what level of confidence can they make this statement while some data was simply pulled from the original location of Pictou Harbour? Have they modelled the bottleneck effect that all fishermen are aware of?

4.0 CONCLUSIONS & RECOMMMENDATIONS

Due to the lack of detail presented concerning site-specific data of various elements of the project, the minister must request an environmental assessment report. The report should include a geotechnical investigation, hydrographic survey and further investigations detailing ice presence. Pipe deformation issues should be addressed and a study must be conducted to ensure that direct ice impact will not occur. A detailed tidal study should be carried out to ensure that the effluent will not intrude into Caribou harbour severely effecting the marine ecosystem.

References

Cameron, G. (2019, February 21). Ice effects on the seafloor around Caribou harbor observed over years of fishing [Personal interview].

C-Core. “Iceberg Scour Risk in the Strait of Belle Isle.” *SGE Acres Ltd.*, R-04-004-101, 2004, www.gov.nl.ca/publicat/fixedlink/pdf/AppendixB.pdf.

Chehab, A. G. (2008). TIME DEPENDENT RESPONSE OF PULLED-IN-PLACE HDPE PIPES. *Queens University Thesis*. Retrieved March 6, 2019

Collins, J. (2019, February 21). Ice effects on the seafloor around Caribou harbor observed over years of fishing [Personal interview].

Djebli , A. et al. (2014) “Uniaxial Fatigue of HDPE-100 Pipe Experimental Analysis.” *Engineering, Technology & Applied Science Research*, vol. 4, no. 2, ser. 600-604, 2014. *600-604*.

Falconer, A. (2019, March 6). Ice effects on the seafloor around Caribou harbor observed over years of fishing [Personal interview].

Fisheries & Oceans Canada. “ASSESSMENT OF THE ROCK CRAB (CANCER IRRORATUS) FISHERY IN THE SOUTHERN GULF OF ST. LAWRENCE FOR 2006 TO 2011.” *Canadian Science Advisory Secretariat Science Advisory Report,* 2013

MacCarthy, D. (2019, March 5). Ice effects on the seafloor around Caribou harbor observed over years of fishing [Personal interview].

MacKay, R. (2019, February 24). Ice effects on the seafloor around Caribou harbor observed over years of commercial diving [Personal interview].

MacKeil, C. (2019, March 5). Ice effects on the seafloor around Caribou harbor observed over years of fishing [Personal interview].

Motahari, A., & Abolmaali, A. (2010). Structural Deformation Characteristics of Installed HDPE Circular Pipelines. *Journal of Transportation Engineering, 136*(4), 298-303. doi:10.1061/(asce)te.1943-5436.0000091

Northen Pulp. (2019). Northern Pulp's Effluent Replacement Project. *Nova Scotia*. Retrieved February, 2019, from https://novascotia.ca/nse/ea/Replacement_Effluent_Treatment_Facility_Project/.

Phillip, J. et al. *Marine Wastewater Outfalls and Treatment Systems*. IWA Publishing, 2010.

Plastic Pipe Institute. *Second Edition Handbook of PE Pipe*. 2014. https://plasticpipe.org/publications/pe-handbook.html

Sutherland, B. (2019, March 1). Ice effects on the seafloor around Caribou harbor observed over years of fishing [Personal interview].

Wood Group Kenny. “Ice Scour and Gouging Effects with Respect to Pipeline and Wellhead .” *BSEE*, vol. 100100.01.PL.REP.004, 2015.

Zhang, Jingyu. “Experimental Study of Stress Cracking in High Density Polyethylene Pipes .” *Drexel University Thesis*, 2005, Accessed 1AD.