Public Comment regarding Nordic Aquafarms Permit
TO: The Department of Environmental Protection and the Board of Environmental Protection
Att: Cynthia S. Bertocci
Executive Analyst, Board of Environmental Protection
17 State House Station, Augusta, Maine 04333-0017

FROM: Jim Merkel
97 Patterson Hill Rd
Belfast, Maine 04915
(207)323-1474
jimimerkel@gmail.com

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I am writing to urge you to deny permits to Nordic Aquafarms for their concentrated fish feeding operation. As an engineer and who teaches sustainability at the University level, I know of no large monocultures that are sustained without chemistry. Because an operation of this scale has never been built, skepticism, track record and science from similar projects will be useful, but not definitive.

Maine has collapsed fishery after fishery. The net pen was promoted as a solution, yet after many unintended consequences, land-based systems are now thought to be the new solution. Net pens benefited from sun and regular flushing of tides. Land-based systems are more extreme monocultures, which often breed resistant strains of disease. Many mass die-offs have already occurred.

Nordic made several serious errors is selecting it's site.

1. The land is a beloved mature forests whose existing use provides a wildlife habitat, city green belt, an ecological connecting corridor from the sea to the woodlands. It also purifies water and sequesters and stores carbon. The DEP should forbid the destruction of this important habitat which provides multiple ecosystem services.
2. Nordic has not demonstrated they have Title Right or Interest for the land crossed by their pipelines.
3. The soils are unstable and require massive removal and import of material. Nordic would completely obliterate the site. The DEP should demand they use a Brownfield, a retired gravel pit or quarry.
4. Nordic's outflow pipe has nitrogen content of 1483 pounds/day or approximately 11 times that of the Belfast City Sewer (108-147 pounds/day).[i] This effluent should exit into deep ocean currents not deep into one of the most productive estuaries on the eastern seaboard. Nordic's outflow threatens any recovery in the delicate estuaries of Belfast Bay. The DEP should not allow Nordic to dump any wastewater into Belfast Bay, especially while there are shellfish closures, red tides, linked to already high nitrogen levels. The DEP should demand Nordic use

a closed system or relocate the pipe to deep ocean currents of 200-foot depths or more with flushing currents.

5. Nordic would be a massive emitter of carbon, equal to adding 150,000 cars to Maine's roads. The DEP should not allow large new sources while state law (Chapter 3A of Title 38, statute §576-A.) call to reduce to 45 % below 1990 levels by 2030. Nordic should be required to demonstrate carbon neutrality in both construction and operation.

The context for evaluating this proposal recognizes the historical and recent status of the Penobscot Bay as Maine's largest and most productive fishery and estuary system. It is also noted as one of the most significant estuaries on the eastern seaboard. It can produce high quantities of wild fish, but has been severely mismanaged -- a tragedy to the regional ecosystem, the economy and culture. The waters and rivers have been cleaned considerably since the days of chicken processing and many industrial polluters have gone out of business, left the area or reduced their outflow.

However, many dams remain, blocking the path for salmon and other species such as alewives and herring to migrate and spawn. Where fish ladders have been built, such as on the Darmariscotta and Bagaduce rivers, massive alewife runs totaling over a million fish per year have returned. This great comeback" is threatened by both net pen, and now this land-based proposal.

Belfast has yet to correct its blocked rivers where it has non-vital historic dams or blockages on the Passagassawakeag River, the Little River, the Goose River and the Wescot Stream. Restored runs on these rivers could total over a million fish per year, given the quantity, quality and size of the watersheds, lakes and ponds. According to "Maine Rivers," Alewives bring an enormous influx of marine-derived nutrients to freshwater ecosystems. They are a forage fish for many predators and they are the only known host for the freshwater mussel Anodonta implicata, the alewife floater." Scientist link cod's disappearance to alewife demise.

A recovery of the historic abundance of a variety of fish species in Belfast Bay are linked to alewife recovery. Nordic Aquafarms' high nitrogen effluent, pheromones, medications and vaccinations added to these fragile, collapsed, yet clean and ready to be restored waters, would be a major obstacle to recovery of a wild fishery. A proposal of the scale of Nordic Aquafarms should only be considered after serious restoration of the wild marine ecosystem is completed.

Large RAS systems have limited performance records and few scientific studies by unbiased researchers, however, there is a history of disease being a major problem the aquaculture industry has faced. On March 1, 2018, CBC news reported "Virus at 2 Nova Scotia land-based fish facilities results in 600,000 salmon being killed… Aquaculture Minister Keith Colwell said Thursday the two facilities are located close to each other, but wouldn't name them."

Land-based tanks were developed to raise young salmon and as a solution to the numerous problems such as diseases, genetic contamination of wild salmon and sea lice plaguing sea-based pens. Washington state recently banned Atlantic Salmon sea pens. Extensive antibiotics and coloring agents have caused health warnings to consumers of farmed fish. Nordic Aquafarms claims land-based pens solve sea-pen woes, however, they have yet to prove this at a scale close to what is being proposed.

The massive flows of inputs and outputs hold untold vectors for spread of disease. All these vectors can be managed and reduced; however, it is impossible to prove viruses and diseases can be contained. Think coronavirus. Think of a hospital. The cleaner you make it, the more powerful and resistant the strains become. Nature is humbling. Extreme monocultures such as land-based RAS pens are the precise breading grounds for resistant forms of diseases. Although Nordic claims they will not use antibiotics, yet their permit includes pages of medications and chemicals. What guarantee do we have, that faced with a new owner of the facility or an outbreak of disease threatening millions of fish, that toxic treatment will not be given. What guarantee do we have that genetically modified fish will not be raised?

Studies conducted by the aquaculture industry and researchers have come to understand that salmon pheromones, kairomones and “fish smell” attract sea lice. Although the land-based salmon might be safe from sea lice, the outflow pipe with its smell, will attract sea lice. How will this effect other species in the bay and the returning wild salmon that are listed as endangered species who might be attracted to this pipe? Might this make salmon recovery more difficult?

According to Dr. Stephen Ellis, about 10% of caged salmon are sent to market early because they are diseased with infectious salmon anemia (ISA) virus infections. Aquaculture industry has developed markets for the smaller, yet diseased fish, unbeknownst to the consumer. The sold fish, the cartons, or the destroyed fish all can spread viruses and diseases.

UV light is not effective in killing viruses. Also, the fish food is a vector for the spread of disease, especially as Nordic is stating that their feed mix will likely include smaller fish from abroad.

Journalist Mark Hume reported in the Globe and Mail, updated May 11, 2018, “The action, filed with the Federal Court by Ecojustice on behalf of Alexandra Morton, alleges the Minister of Fisheries and Oceans (DFO) acted "unlawfully" by issuing a license to Marine Harvest Canada Inc. to allow the farm to transfer fish carrying piscine reovirus (PRV).” The virus is deadly and causes heart and skeletal muscle inflammation in fish. “She said she first detected PRV last year when she tested samples of farmed salmon bought at Vancouver supermarkets. The Cohen Commission of Inquiry, which examined the collapse of sockeye stocks in the Fraser, warned that fish farms could be passing diseases to wild salmon. Ms. Morton said PRV could be to blame for the collapse of Fraser stocks.” The Piscine reovirus began in Norway, home to massive aquaculture

facilities. If diseases were to break out in Nordic's facility, what guarantee is there that they would not withhold this information from the public?

This project is being sold as a way to solve the world's food shortages with low impact "sustainable" food. These claims fall short of reality. A sustainable diet would be to eat wild fish from Maine or Canada or a vegetarian diet.

Nordic has not said what it's salmon would eat, but the fish food expert Nordic invited to an information session at the Hutchinson Center, explained that feed typically contains chicken slaughterhouse byproducts, pig blood, GMO corn and soy, along with edible forage fish.

If the small fish that that are caught and ground into fish meal to comprise around 20 % of the diet came from Maine, what impact does this have on marine ecosystem that are is crisis? CEO Eric Heim states that they will likely source these fish outside Maine. If the small fish churned into fishmeal are coming from South America, what impact does this have on their ecosystem and people who eat these smaller fish.

Many cultures eat these base-of-the-food-chain fish, which is more sustainable and healthier for local populations of people and fisheries than feeding these fish to higher trophic level fish such as salmon to become a high-priced meal for those with high incomes. Of the 14 species typically churned into fishmeal, 13 are used for human food and the 14th is used for fish oil.

NAF's claims to capture a high percentage of phosphorus and assumes it would be filtered out with solids. But depending upon the diet fed to fish in containment, their excrement's phosphorus can both change in level and amount that is dissolved into the water. Can the dissolved phosphorous be removed by Nordic's filters? Dissolved Phosphorous levels can increase by four times simply by feeding fish a fishmeal-free diet that contains mixed nut meal, poultry meal, wheat flour, and corn protein concentrate.

Could a diet change at a future date cause 4 times the phosphorous to enter the bay? A quote from the study in Aquaculture Engineering: "Total phosphorous (most of which was dissolved) was 4 times greater in the culture water of RAS that received the FMF (Fishmeal-free) diet, e.g., 4.3 ± 0.1 mg/L v. 0.9 ± 0.0 mg/L for the FM (Fishmeal) Diet. This was the first research attempt to formulate a fishmeal-free diet for Atlantic salmon with this ingredient profile and one of few studies to demonstrate uncompromised Atlantic salmon performance when feeding a diet without fishmeal.[ii]"

Most salmon feed mixes include corn and/or soy which is primarily GMO and grown with herbicides, pesticides and chemical fertilizers. Will these residues dissolve in the water and be impossible to filter?

NAF plans to discharge effluent 0.62 miles from shore, where the water depth is just 35 to 40 feet. Contrary to NAF's predictions, the current flows in complex circular paths, at various depths, around the islands, rather than flushing nearly 20 miles downstream into

the deep ocean currents. With an incoming tide and a wind from the South, which is very common, the effluent plume will likely move past the City Park, the boathouse and into Belfast Harbor on an incoming tide, and past Bayside's beaches on an outgoing tide. The discharge pipe is not into deep ocean currents as claimed by Eric Heim at informational meetings.

Warmer brackish water increase the risk of algae blooms. How will this affect local mussel and kelp farms? How will other fisheries, such as lobster, be affected?

An 11-year study in Port Mouton Bay, Atlantic Canada was released June 28, 2018 in the journal "Marine Ecology," that measured the impacts to lobsters in proximity to net pen salmon aquaculture. Inka Milewski, a marine biologist who managed the study over the last four years stated, "What we found was during periods when the fish farm was actively raising fish, market catch across all regions, dropped by 42 per cent." She said "the egg bearing lobster counts also dropped by an average of 52 per cent when the farm was active. Milewski believes an odor plume from the farm may be affecting the lobsters ability to detect food and therefore they're not finding their way into the traps." [iii] What effect would Nordic's odor plume have on Penobscot Bay lobsters?

The study reported:

- Lobster "sniff" the odour seascape with their antennules and chemoreceptors found on their legs.
- Odours are used to locate food, find mates, detect predators and avoid environmental stresses.
- Sulphides and ammonium have toxic and behavioural effects on adults and other lobster life stages.
  – In laboratory studies, 50% of lobsters die within 3.3 days in low oxygen, low sulphides (5.5 μM) and ammonium (17 μM) conditions (Draxler et al. 2005)
  • Berried lobster are very sensitive to odours and temperature.
  • Berried lobster show retreat behaviour at 50 μM sulphide (Butterworth et al. 2004); at 500 μM and regular oxygen conditions, 50% of lobster died in 22.5 hr.

  Further, the study sited the effects of nitrogen pollution include:
  •Decrease in water quality.
  •Increase in epiphyte growth on eelgrass.
  •Increase in benthic algae •Increase in nuisance or "slime" algae.

I could not find a study of an RAS system with 11 years of data. This study's findings should be compared to the characteristics of Nordic's best- and worst-case outflow dynamics. The quantities of sulfides, pheromones and fish smell in Nordic's effluent could affect lobster in proximity to the outflow.

The details of how Nordic handles backflushing of filters and disposal of sludge needs careful consideration. Its sludge is problematic to dispose of because it is salty and could be a vector for spreading disease to wild fish. If it is dehydrated, it takes considerable

energy and concentrates the salts. NAF says this dried sludge will be a valuable fertilizer. But can the salt be removed and what farmer wants to add all this salt to their fields. For how many years can this be done? Can the soils be made unfertile?

If the sludge is not dried, where will it be spread? In wintertime, with frozen soil and snow on the ground, spreading is impossible, as spring runoff would send the nitrogen-rich sludge into streams causing massive problems. How far south will the sludge be sent in winter? What are the impacts of run-off in these sacrifice zones? Will the neighbors object to the smell? Will Nordic need a settling pond for the sludge, and what would happen during a hurricane or intense rains? How will it be kept from streams?

Questions regarding Nordic's proposal:

1. Can Nordic demonstrate with scientific evidence that their outflow will have no negative impacts on the Bay and its recovery?
2. The proposed outflow pipe is in habitat for young cod and eel grass. Can Nordic provide scientific data to demonstrate that the outflow will not negatively impact these habitats?
3. If the Nordic facility is found to be affecting recovery efforts, what recourse are regulators prepared to take? Will claims of financial hardships outweigh impacts to Belfast Bay?
4. In what ways would Nordic's outflow change the chemistry of the bay?
5. If Nordic has a disease outbreak, will it be required by law to disclose the location to the public?
6. What plan does Nordic have to halt circulation into the bay should a virus or disease outbreak in their tanks? Will the diseased tank water be released into the bay? Where would the diseased fish go?
7. Would Nordic be permitted to sell diseased fish into the market.
8. Can Nordic provide scientific studies that prove their outflow pipe will unequivocally not spread diseases, viruses or sea lice to other sea life, who then become carriers.
9. Can Nordic provide scientific studies that prove UV light is effective in killing viruses and diseases.
10. What protocols will be used to test for viruses and disease in the fish food.
11. Will Nordic be permitted to increase its discharge levels of phosphorus, should they change fish food composition?
12. Will Nordic feed their fish any of the following: Pig blood or byproducts, chicken slaughterhouse waste, GMO corn, GMO soy?
13. What diseases will Nordic be required to regularly monitor for?
14. Erik Heim has said that no antibiotics or chemicals will be used in the tanks. What penalties and enforcement can citizens rely on?
15. If Nordic sells its facility to another company, what contractual guarantee will be in place to ensure the effluent standards are met?
16. What systems will be required to prevent any black water from the tanks from being syphoned or inadvertently injected into wells or surface water.
17. What physical systems will contain spills from a ruptured pipe or tank?

18. What systems are in place should there be an ice storm or other event causing loss of power for several weeks?
19. Can Nordic prove the outflow will not add to red tide closures or make the existing problems worse?
20. What quantities of sulphides and ammonium per day would be in the wastewater?
21. Can Nordic provide scientific data to prove that the outflow odor plume will not effect berried lobsters.
22. Can Nordic provide recent measurements regarding the water currents at low depth, mid depth and surface depth on both incoming and outgoing tides as well as under various wind directions and various density profiles of seawater as related to seasonal variations in fresh water run-off.
23. Can Nordic's plume move past the beaches including Belfast Park, the boat house and Belfast Bay on an incoming tide, with winds from the south?
24. Can Nordic prove that the wastewater plume will not flow past the beaches of Bayside and Kelly's Cove on an outgoing tide with winds from the north?
25. Can Nordic provide scientific data that proves that the beaches will not experience unhealthy or undesirable conditions for swimming or for marine life?
26. How will Nordic salmon get their color? Will these chemicals be in the outflow pipe?
27. What are the cumulative impacts on the bay from the combined Belfast and Bucksport facilities?
28. Is Nordic willing to contractually agree to not use genetically modified salmon?

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[i] Summer 2015 Belfast study, relayed by Jon Carmen, Belfast's sewer operator.

[ii] Aquacultural Engineering Volume 74, September 2016, Pages 38-51, Effects of feeding a fishmeal-free versus a fishmeal-based diet on post-smolt Atlantic salmon *Salmo salar* performance, water quality, and waste production in recirculation aquaculture systems. **JohnDavidson[a]Frederic T.Barrows[b]P. BrettKenney[c]ChristopherGood[a]KarenSchrover[a]Steven T.Summerfelt[a]**

[iii] Milewski I, Loucks RH, Fisher B, Smith RE, McCain JSP, Lotze HK (2018) Sea-cage aquaculture impacts market and berried lobster (*Homarus americanus*) catches. Mar Ecol Prog Ser 598:85-97. https://doi.org/10.3354/meps12623