STATE OF MAINE

DEPARTMENT OF ENVIRONMENTAL PROTECTION

BOARD OF ENVIRONMENTAL PROTECTION

	IN THE MATTER OF
NORDIC AQUAFARMS, INC.	:APPLICATIONS FOR AIR EMISSION,
Belfast and Northport	:SITE LOCATION OF DEVELOPMENT,
Waldo County, Maine	:NATURAL RESOURCES PROTECTION
	ACT, and MAIN POLLUTANT
	DISCHARGE ELIMINATION SYSTEM
	MEPDES)/WASTE DISCHARGE
A-1146-71-A-N	:LICENSE
L-28319-26-A-N	:
L-28319-TG-B-N	:
L-28319-4E-C-N	:
L-28319-L6-D-N	:
L-28319-TW-E-N	:
W-009200-6F-A-N	:
ME0002771	

TESTIMONY/EXHIBIT: **NVC/UPSTREAM 4**

TESTIMONY OF: **Dr. Kyle Aveni-Deforge**

Date: **December 13, 2019**

Introduction

I am a practicing environmental scientist and work primarily in the marine environment. I have a PhD in Ecology and Evolutionary Biology from the University of South Carolina (Columbia, SC; 2007). That work focused on rocky intertidal ecology and biomechanics including barnacle and mussel disturbance ecology and environmental stress. In my post-doctoral fellowship (University of Hawaii, Hawaii Institute of Marine Biology 2007-2011), I worked on projects that studied biological and ecological responses to environmental fluctuation. We looked at how hydrodynamic environment affect rates of nutrient uptake in submerged sea-grass beds, how algal canopies affect the redox potential of sediments and how short term fluctuations of physical environmental parameters affect biology. Current professional projects are in support of permit work for beach nourishment projects in the Hawaiian Islands. In this capacity, I conduct benthic habitat surveys and water quality analysis to establish baseline environmental conditions. Frequently this work is in support of National Environmental Policy Act (NEPA) requirements, such as Environmental Assessments (EA) or Environmental Impact Statements (EIS), or its parallel state-level program, the Hawaii Environmental Policy Act. I grew up in Belfast and return regularly to visit family.

As an environmental scientist and consultant, I am not an activist. I take a pragmatic approach to coastal development, where good science and best management practices are used to make rational decisions about project scope and project permitting. Fortunately the EA and EIS process within NEPA encourages open and clear communication about environmental consequences of proposed actions. One of my favorite components of this process is the development of alternatives to the desired action, which, when executed in good faith, helps to consider scale and scope of a project in the context of their environmental outcomes.

I typically work in a different Army Corps of Engineers District (Pacific) and different EPA District (9), with perhaps different emphasis on water quality. My expectation that the proposed action would enter the NEPA process through federal regulation of the MPDES/NPDES permitting process via the Coastal Zone Management Act, Essential Fish Habitat Provisions (of the Magnuson-Stevens Act; also see Table 1) or an Army Corp of Engineering dredge permit for pipe placement have not been met. Even so, the preparation of environmental assessments for concentrate aquatic animal production (CAAP) and aquaculture projects is not uncommon for projects like this (USEPA 2006; USEPA 2019).

Table 1: Federal laws applicable to NPDES permits, per EPA NPDES permit writer's manual (USEPA 2010)

Federal law	Year	Federal agency	Legislative citations	Implementing regulations
Endangered Species Act (ESA)	1973	FWS, NMFS	16 U.S.C. 1531 et seq.	50 CFR Part 402
National Environmental Policy Act (NEPA)	1969	CEQ	42 U.S.C. 4321 et seq.	40 CFR Part 6
National Historic Preservation Act (NHPA)	1992	ACHP	16 U.S.C. 470 et seq.	36 CFR Part 800
Coastal Zone Management Act (CZMA)	1972	NOAA	16 U.S.C. 1451 et seq.	15 CFR Part 930
Wild and Scenic Rivers Act	1968	Various	16 U.S.C. 1271 et seq.	36 CFR Part 297
Fish and Wildlife Coordination Act (FWCA)	1934	FWS	16 U.S.C. 661 et seq.	--
Essential Fish Habitat Provisions (EFH)	1996	NOAA	16 U.S.C. 1855(b)(2)	50 CFR Part 600

Abbreviations

NEPA National environmental policy act
CEQ Council on environmental quality
EIS Environmental Impact Statement
EA Environmental Assessment
EPA Environmental Protection Agency
NAF Nordic Aqua Farms
NOAA National Oceanographic and Atmospheric Administration
FFAMP The finfish aquaculture monitoring program implements a tiered monitoring program for facilities that are already in production

TESTIMONY

The proposed project site, like many coastal areas has many intersecting interests, including recreation on the water and at the shoreline (recreational boating in Belfast and Bayside harbors, including sailboats, fishing boats and small craft, like stand-up paddle boards, ocean kayaks and row-boats and water-front parks in Belfast and Bayside), commercial interests (including lobster and shellfish harvest), conservation interests (including eelgrass and habitat areas of particular concern for coastal fisheries) and municipal (including water treatment facility discharges at Belfast and Bayside). Permitting the proposed facility depends on demonstrating that the waste discharged to the nearshore waters of Belfast and Northport is not disruptive to the current uses. To date the data collected to support the application do not appear to be sufficient to demonstrate that there will be no significant impact on the local environment and its stakeholders.

A central component of rationally evaluating potential environmental impacts at the proposed site is the release of nutrients into the water column and their dispersal and dilution thereafter. Three important factors exist for evaluating the discharge into the local environment: local physical oceanographic conditions, local background water quality and waste-water composition. Based on my understanding of the currently available data, these parameters have not been well enough described to make a confident risk assessment for water quality near the project site. Because the proposed project will operate continuously throughout the year and possibly for decades, collecting a thorough data set that describes the background environmental and ecological conditions is important.

The FFAMP proposes a tiered system of guidelines for monitoring aquaculture projects, and NAF has proposed monitoring programs for their facility once it is operational. My testimony asserts that existing knowledge of site water quality and physical oceanography is insufficient to have confidence in our understanding of baseline environmental conditions or how the process waste-water will interact with the environment. Consequently a rational, evidence based decision on the impacts of the proposed action cannot be made. Similarly, the future monitoring program proposed by NAF would not have enough baseline data of the pre-project environment at and near the project site to evaluate environmental impacts.

BACKGROUND WATER QUALITY:

The baseline conditions at the project site were characterized by SONDE casts and water collection on two trips, one in September and the other in October of 2018 (Normandeau 2018). These data are the right type of information to be collecting (temperature, salinity, dissolved oxygen, turbidity, as well as nutrient content). However, these data are not sufficient to describe the receiving water during the proposed action. As NAF will conduct operations throughout the year, the baseline conditions at the proposed outfall should describe a full year's range of variability in water quality parameters. There are many changes that occur in the coastal ocean across seasons, including the strength of stratification, depth of thermocline, available light, available nutrient concentrations and phytoplankton abundance. A suitable monitoring plan would include a minimum of seasonal/quarterly casts and nutrient analysis, accompanied a higher sampling frequency during the period of the year when proposed discharge would likely have its greatest environmental impact[1]. Considering that one

[1] The argument for this specific period of time is likely to balance ocean temperature, photosynthetically active radiation and other environmental sources of pollution that could exacerbate the likely impacts of the proposed outfall; site knowledge would be important in making this decision.

possible outcome of nutrient accumulation in the nearshore waters is algal/dinoflagellate bloom, it may be advantageous to begin documenting phytoplankton as a part of baseline monitoring.

Physical Oceanographic and Meteorological Conditions

The local water currents and residence time in this section of the bay also of high importance to how the proposed discharge is distributed in the water column and advected from the project site. The dispersal models prepared by Ransom were prepared with the best available data and using generally appropriate models. However, without local data for tidal currents, wind forcing and wave structure it is hard to have confidence that these results are representative of the dynamics of real discharge from the proposed site. In fact, there is very little contemporary quantitative data available for local currents and meteorological conditions at or near the project site. A drogue study from the 1990's (Bergund 1995) references work for Normandeau in the mid 1970's (Normandeau 1975; Normandeau 1978). These data sets seem to indicate that there is residual clockwise flow around Islesboro Island, based on the use of Lagrangian drifters and numerical modelling. This is old data, but contradicts the expected plume path, as modeled by NAF.

The numerous islands of Penobscot Bay shield Belfast Harbor and the Little River estuary site from open ocean conditions. The closest buoy that measures oceanographic parameters such as wave period, wave direction,

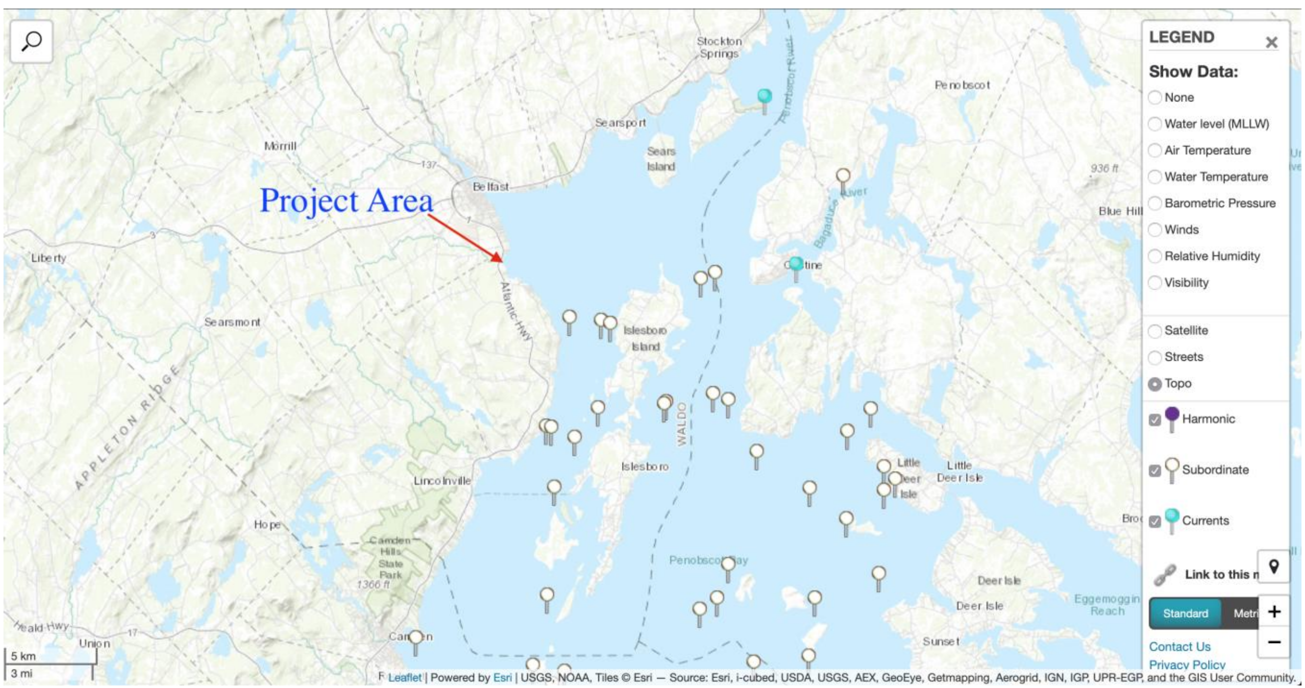

Figure 1: Location of NOAA tidal current prediction sites near the project site

wave, height, wind speed and wind direction is to the south, between Owl's Head and Vanalhaven. With the exception of a pure-south swell, this station is unlikely to provide data that are well correlated physical oceanographic conditions near the project site. Similarly, tidal current data are forecast for a number of stations around Islesboro (Figure 1) and provide bulk flow estimates that are based on tidal change, not measured flow rates. None of them are particularly close to the project site, nor are they anchored by nearby current measurement, or an active tidal monitoring station (the nearest tidal station is NOAA station 8413320 in Bar Harbor).

Given the lack of site-specific information on currents and wave structure, I would expect that seasonal/quarterly current profiles, using an acoustic-doppler current profiler, would be conducted at or near the proposed discharge site. As with background water quality sampling, frequency of measurement would be increased during the period of time when the possible environmental impacts of the outfall would be most likely to occur. These data should be used to parameterize appropriate models to evaluate whether 1.) the plume will reach the sea surface, and if so, under what conditions 2.) the plume will be quickly diluted and 3.) the plume will be carried away from the project site and not be retained near the project site.

PROPOSED NUTRIENT LOAD IN WASTE-WATER

The applicant's discharge calculations are projected as average daily load and average concentration. The timing and fluctuation of the discharge is a potential factor in how the outfall is temporally and spatially distributed in the water column. Average nitrogen in the discharge water is proposed to be more than 45 times the measured background levels. Mean phosphorous discharge is 8 to 16 times the background level. Mean TSS is close to or below background, and mean BOD is about 2 times background levels (Table 2). Given these levels, it is important that the modeling of the plume dispersal is accurate.

Table 2: Proposed discharge and background water quality levels of key pollutants near the discharge site

	Proposed Discharge		Background Levels	
	Daily Total [kg]	Mean Concentration [mg/l]	Min [mg/l]	Max [mg/l]
Total N	673	23	0.17	0.48
P	5.8	0.2	0.012	0.024
BOD	162	2		5.55
TSS	185	6.33	6.9	11

If conditions exist where the plume can reach the surface, the surface is poorly mixed, the plume is cohesive, or local currents to not draw it away as expected by the bulk flow parameters that match the tide unintended and unanticipated environmental consequences may result. The worst case scenario would be a poorly diluted plume that reaches the surface that is then forced onshore by surface winds or tidal currents. No evidence suggests that this is a likely outcome of the proposed outfall.

Another important aspect of nutrient release from the facility is whether it is constant, or pulsatile. While the time-averaged release of nutrients gives a daily mean concentration of nutrient discharge, if the nature of the discharge is not uniform, but sporadic, reflecting process-based activities, such as filter flushing, or periodic maintenance, the instantaneous release of a nutrient may be much higher. A risk analysis of the facility should also include maximum possible discharge levels, the conditions that might trigger un-treated discharge, and the maximum duration of such an accident.

Modeling of the NAF discharge that incorporates actual on-site hydrodynamics with process-relevant discharge scenarios will provide the level of consideration that should allow managers to make reasonable decisions about project related effects on water quality in the receiving water.

RISKS TO LOCAL ENVIRONMENT

The applicant is relying on the present dispersal model to forecast good dilution of the proposed discharge and evaluate environmental risk. Because the dispersal model is not strongly driven by on-site measurements, the applicant may be underestimating the risk of discharge to the local environment. In fact the only data I have been able to find for the peri-Islesboro currents indicates that net flow, in the 1970's through 1990s, had a residual clockwise flow. The risks associated with underestimating the dilution and dispersal of the outfall could have consequences to a variety of ecosystem functions and services, affecting the stability of local ecosystems as well as how humans can take advantage of the environment.

Nutrient enrichment of a body of water that leads to excessive algal or bacterial growth is called eutrophication Typically, fixed nitrogen is considered to be the limiting factor for primary production in the coastal ocean (e.g. Howarth and Marino, 2006), and increases in nitrogen availability in the water column can promote growth of numerous varieties of phytoplankton and algae. Such growth can lead to general habitat degradation (via reduced water clarity, increased biological oxygen demand leading, in some cases to hypoxia) and harmful algal blooms (e.g. Huisman et al 2005), including red tides and brown tides (see Anderson et al 2008), although tight coupling between red and brown tides and coastal eutrophication is not proven. HABs often result in closure of recreational and commercial fisheries but can also cause closure of beaches and nearshore waters to recreational use. Shellfisheries are documented throughout the soft sediment of the Maine coastline, and are present near the project site (**Figures 2 and 3**).

Eutrophication can also promote the growth of ephemeral filamentous green algae, such as *Ulva spp.*, as well as epiphytes that occupy the leaves of submerged aquatic vegetation, such as eelgrass. Floating mats of green algae, dubbed green tides, have become increasingly common throughout eutrophic coastal waters (e.g. Ye et al. 2011). Blooms of phytoplankton have the short-term effects of reducing water clarity and can rob benthic algae and submerged aquatic vegetation (SAV; such as eelgrass) of light. Coupled with accelerating growth of epiphytes and epibionts, coastal eutrophication can have negative effects on SAV, even leading to loss of beds. There are existing SAV beds of eelgrass near the project site (**Figure 4**).

The proposed action will increase the amount of nutrients in the nearshore. The dilution and removal of those nutrients from the project area is important, yet without local hydrodynamic and meteorological data, accurate predictions of possible plume paths cannot be made.

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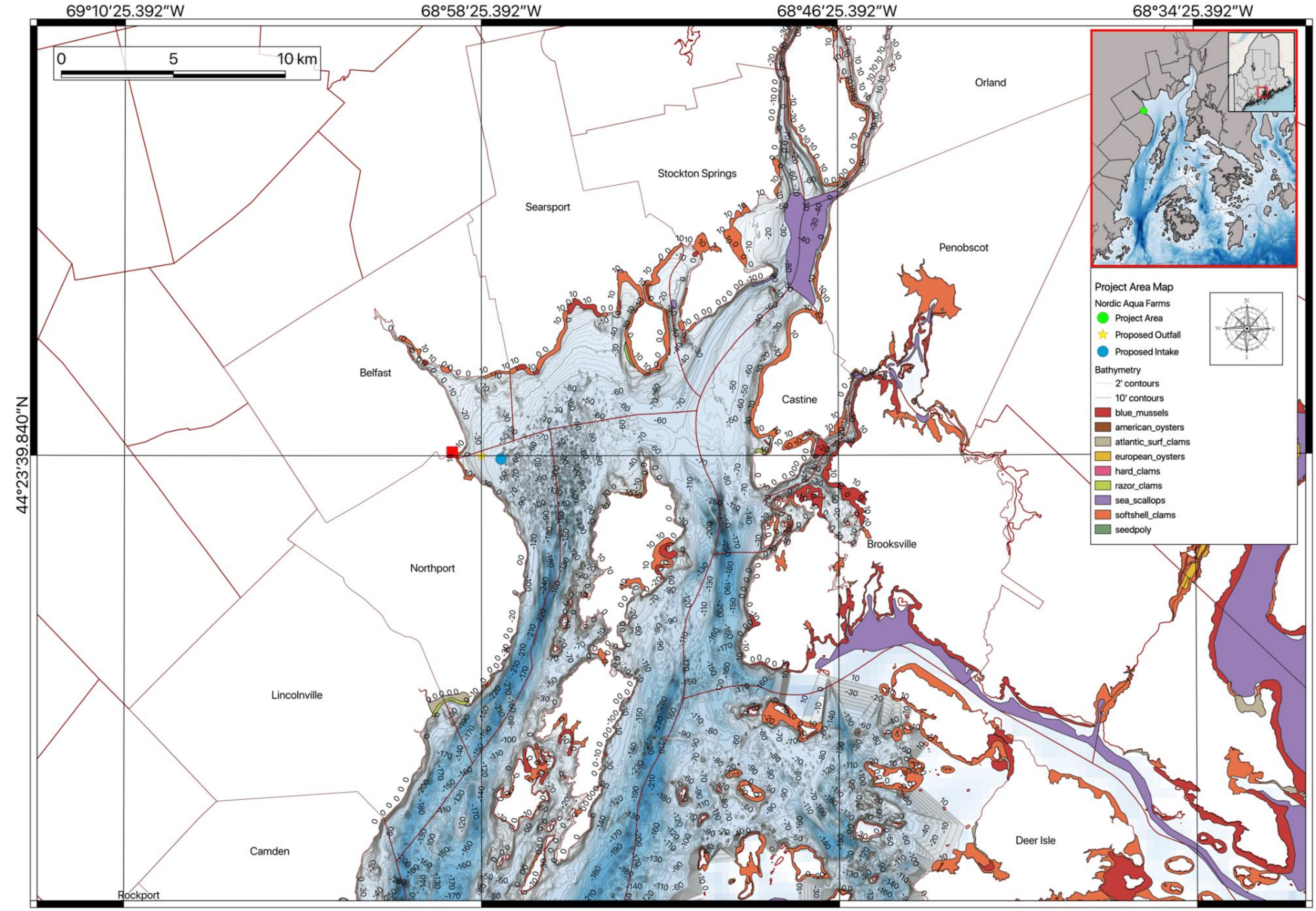

Figure 2: Distribution of shellfisheries within Penobscot Bay

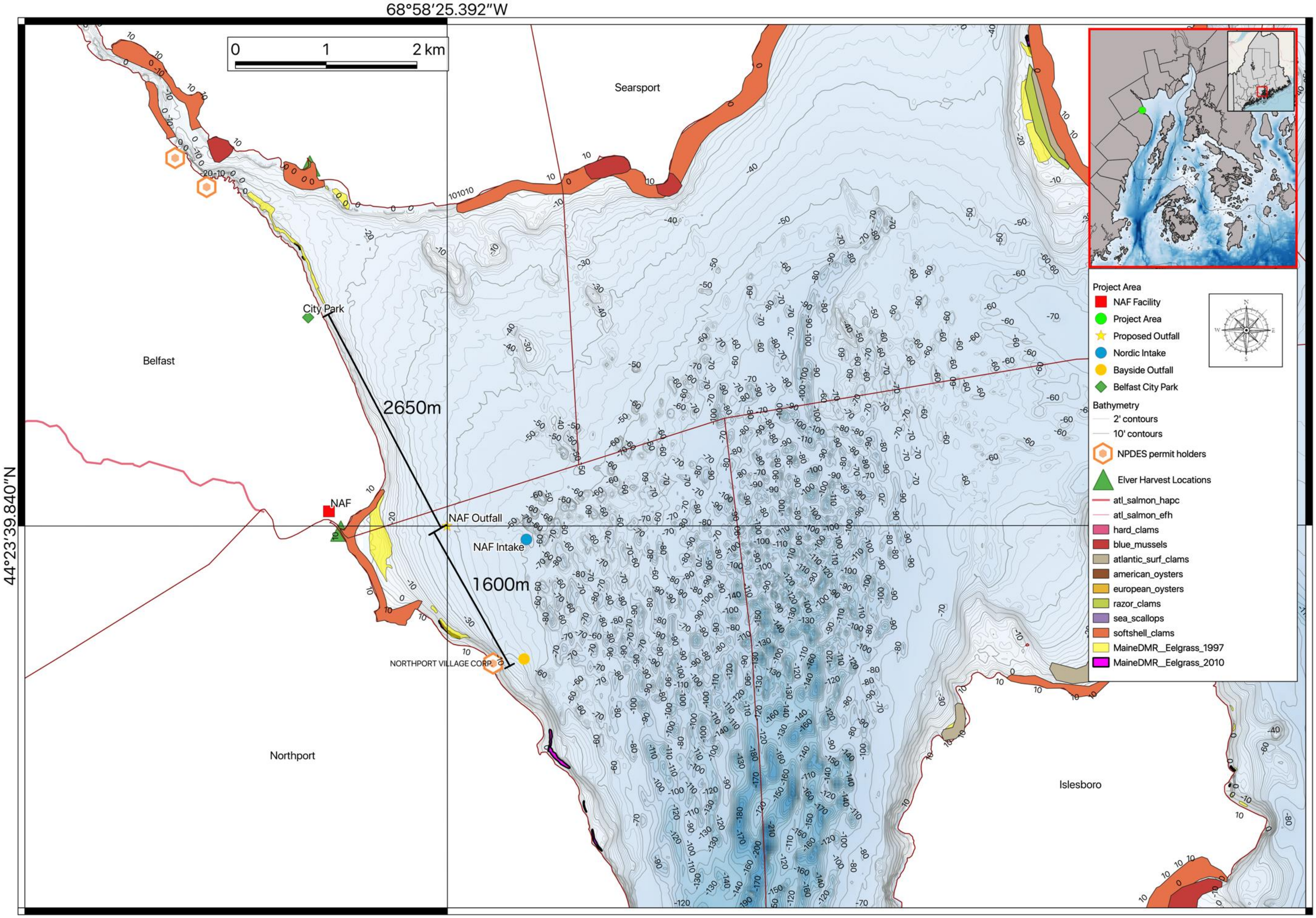

Figure 3: Distribution of shellfisheries in Penobscot Bay near the project site

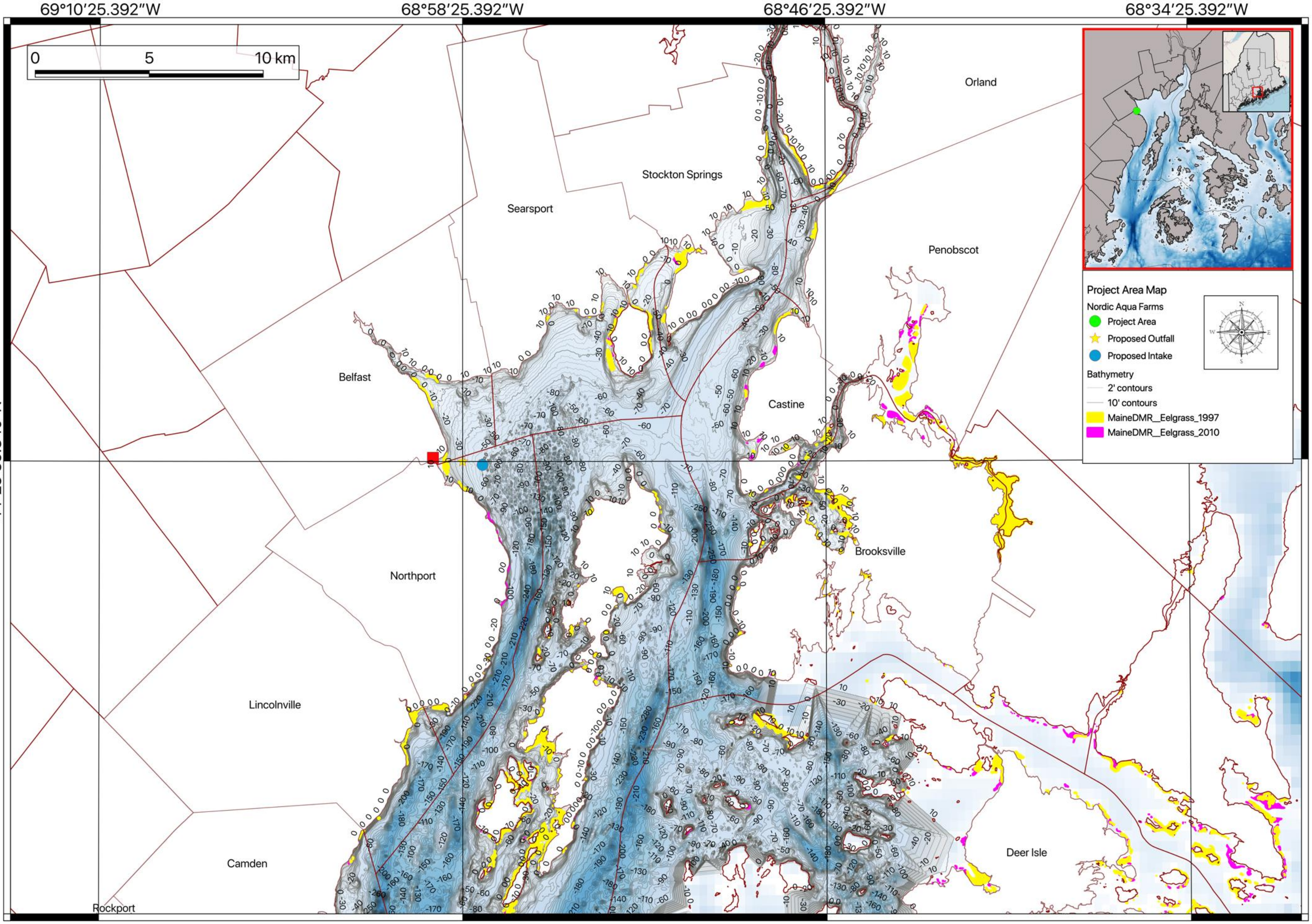

Figure 4: Location of eelgrass beds in Penobscot Bay

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Environmental Scientist

I am a broadly trained scientist, with research and educational experience that links physical, biological and chemical components of an environment to its ecology. I have more than 15 years of experience working at all stages of project development and execution; more than nine years of that experience includes work in the Hawaiian and other Pacific Islands. My recent work has focused on the analysis of coastal erosion, monitoring of water quality characteristics, analysis of marine ecological communities, sampling and analysis of benthic sediments and documentation of environmental compliance for HEPA and NEPA.

Extremely Relevant Professional Experience

Chief Scientist *Ecological Monitoring and Analysis LLC* 2015-*present*

Sand Field Analysis: Managed sand surveys for Royal Kahana Condominiums, Maui County Kahana Bay Regional Sediment Survey, Kahana Bay Environmental Impact Statement and Napili Bay beach restoration projects. Used sub-bottom profiling, jet-probe and coring to quantify available sand and test suitability of grain size distribution, meeting state and federal guidelines for beach restoration. Collaborated with Rising Tide Engineering, Moffatt & Nichol, and Golder.

Benthic Habitat Analysis: Designed benthic habitat evaluation for Royal Kahana Condominiums and Napili Bay restoration projects, participated in development and analysis of Stable Road Beach restoration benthic habitat analysis. Used photographic survey techniques to quantify composition of sensitive benthic communities in support of federal and state permits for beach restoration work.

Water Quality Analysis: Planned and initiated water quality monitoring program to document existing water quality conditions for Royal Kahana Condominiums.

Videographic Coastal Erosion Monitoring and Modeling: Designed and implemented long term photographic/videographic monitoring of nearshore and beach sand volume to build a model that links erosion with observed and forecast physical oceanographic conditions, including long-term sea-level changes, short term sea-level changes (meso-scale eddies), tides and sea-state (wave height, period and direction).

Lead Environmental Scientist *Stable Rd. Beach Restoration Foundation* 2009 – 2015

Lead monitoring and analysis of water quality and benthic habitat in support of permitting and environmental compliance at all stages of the project. This included developing environmental standards for the nearshore project site, offshore sand borrow-site and off-site water quality controls. Worked with other consultants and the Foundation to conduct sand field analysis, dredge monitoring, dredge pipeline routing and stabilization. Coordinated with contractors, oversight agencies (county, state, and federal) and stake holders.

Environmental Scientist *Oceanit Labs, Honolulu, HI* 2012 - 2014

Worked with Guam/CNMI government to provide expert commentary on technical analyses of biological, ecological, environmental and hydrological consequences of a proposed CVN expansion of Aprah Harbor. Conducted analysis of competing coral growth models for mitigation related planning. Conducted HAPC and EFH analysis for harbor dredge projects. Other work included document review, summary and reporting, proposal writing and habitat equivalency analysis.

Post-Doctoral Fellow *Hawaii Institute of Marine Biology, Kaneohe, HI* 2007-2010

NSF funded study to evaluate nutrient uptake dynamics in submerged aquatic vegetation in Florida and Hawaii. Used acoustic Doppler velocimetry (ADV/ADCP) to measure hydrodynamic parameters. Studied shallow water light field dynamics on Hawaiian benthic communities. Other activities may have included time series analysis, marine algae ecology, fish pond dynamics, report writing, professional meetings/hobnobbing, peer review, grant writing, public outreach

Education

Ph.D. Ecology and Evolutionary Biology University of South Carolina, Columbia, SC 2007

A Biomechanical Investigation of the Advantages to Aggregation in Rocky Intertidal Mussel Beds

Advisor: David S. Wethey

BA Biology Swarthmore College, Swarthmore, PA 1999

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

______________________________ Date: 12-11-2019

Printed Name: Kyle Aveni-Deforge

Title:

Parties Assisting:

Name: Address: Signature:__________

Name: Address: Signature:__________