MEMORANDUM

To: File

From: Kevin J. Ostrowski, Senior Meteorologist, Maine DEP

Date: December 18, 2019

Re: Nordic Aquafarms, Inc., Belfast and Northport

Chapter 115 Minor Source Air Emission License Application # A-1146-71-A-N

Background

Nordic Aquafarms, Inc. (Nordic) applied to the Maine Department of Environmental Protection (DEP or Department) for Site Location of Development Act (Site Law), Natural Resources Protection Act (NRPA), Maine Pollutant Discharge Elimination System (MEPDES)/Waste Discharge License (WDL) and Chapter 115 Minor Source Air Emissions licenses to construct and operate a Recirculating Aquaculture System (RAS) facility in Belfast and Northport, Maine for the rearing and processing of Atlantic salmon. DEP accepted Nordic's applications as complete for processing on June 13, 2019, and the Board assumed licensing jurisdiction over the applications and voted to hold a hearing on the applications at its June 20, 2019 meeting.

Nordic's proposed project would be located on an approximately 54-acre site in Belfast, with pipelines extending into neighboring Northport. The proposed project would raise and process up to approximately 33,000 metric tons per year of Atlantic salmon. As part of its proposed project, Nordic has applied for a Chapter 115 Minor Source Air Emission License for the installation of eight distillate fuel-fired generators, the specifications of which are listed below. Following review of comments submitted by Intervenor Upstream Watch/Northport Village Corporation, DEP staff recommended, and the Board voted on November 7, 2019, to include the air emissions application among the issues to be examined at the hearing. Additionally, although the emissions as quantified by the applicant would not normally require an air dispersion modeling analysis pursuant to Chapter 115 § 7 of the DEP's rules, staff decided to conduct dispersion modeling to estimate ambient air concentrations from the operation of the proposed stationary fuel-burning equipment as part of its evaluation of Nordic's license application and provide that information to the Board and the parties.

The inputs and results of the staff's dispersion modeling are set forth below.

1.0 INTRODUCTION

The dispersion modeling analysis was performed to assist the DEP in determining whether emissions from the operation of Nordic's fuel-burning equipment would cause or contribute to violations of National Ambient Air Quality Standards (NAAQS) for SO_2, PM_{10}, $PM_{2.5}$, NO_2 or CO or to Class II increment standards for SO_2, PM_{10}, $PM_{2.5}$ or NO_2.

All modeling was performed in accordance with all applicable requirements of DEP Bureau of Air Quality (DEP-BAQ) and the United States Environmental Protection Agency (USEPA).

The following is a summary of the assumptions, methodologies and results of the analysis:

2.0 MODEL AND OPTION SELECTION

The AERMOD refined dispersion model with its associated pre-processors was used to predict ambient air concentrations in the modeling domain surrounding the proposed Nordic facility.

The following versions were used:

- AERMOD (version 19191)
- AERMET (version 19191)
- AERMAP (version 18081)
- AERSURFACE (version 13016)

The AERMOD analysis accounted for the potential of building wake and cavity effects on emissions from all modeled stacks.

Due to the terrain variations over the modeling domain, the 'elevated terrain' setting was chosen.

Since the proposed Nordic facility is not located near any significant population center, the 'rural' dispersion option was chosen.

2.1 PHYSICAL STACK AND EMISSIONS DATA

All AERMOD data inputs for Nordic were developed by DEP-BAQ from information derived from Nordic's license applications and, from Nordic's responses to subsequent requests for information by DEP staff, including data submitted by Elizabeth Ransom to Jane Gilbert (DEP-BAQ) via e-mail dated November 19, 2019.

Nordic's air license application states: "Nordic Aquafarms is planning to install eight 2-MegaWatt (MW) diesel engine sets. The power plant will be designed to generate 14 MWs of electricity using seven of the eight engines. The eighth engine will be designed as a back-up." The AERMOD analysis was set up to estimate impacts associated with the simultaneous operation of seven engines.

The seven engines were conservatively modeled at their maximum design heat input rate for 8,760 hours per year.

AERMOD point-source parameters for Nordic can be found in Tables 1 & 2:

TABLE 1: PHYSICAL STACK DATA

Stacks	Stack Base Elevation (m)	Stack Height (m)	GEP Stack Height (m)	Stack Diameter (m)	UTM Easting NAD83 (m)	UTM Northing NAD83 (m)
Engine Stack 1	18.28	20.57	32.77	0.41	500542	4915990
Engine Stack 2	18.28	20.57	32.77	0.41	500541	4915990
Engine Stack 3	18.28	20.57	32.77	0.41	500545	4915990
Engine Stack 4	18.28	20.57	32.77	0.41	500545	4915991
Engine Stack 5	18.28	20.57	32.77	0.41	500548	4915992
Engine Stack 6	18.28	20.57	32.77	0.41	500548	4915993
Engine Stack 7	18.28	20.57	32.77	0.41	500551	4915993
Engine Stack 8	18.28	20.57	32.77	0.41	500551	4915994

TABLE 2: STACK EMISSION DATA

Stacks	Averaging Periods	SO_2 (g/s)	PM_{10} (g/s)	$PM_{2.5}$ (g/s)	NO_x (g/s)	CO (g/s)	Stack Temp (K)	Stack Velocity (m/s)
Engine Stacks 1 - 8	All	0.53	0.0038	0.0038	0.004	2.03	463.71	60.64

2.3 MODELING DOMAIN AND RECEPTOR GRID

As illustrated in Figures 1 and 2, a two-tiered nested 10 x 10-kilometer Cartesian receptor grid was utilized in the AERMOD analysis. The receptor grid contained a total of approximately 7,700 receptors and was centered near the location of Nordic's proposed stacks, comprised of the following receptor spacings:

- 20-meter spacing out to 750 meters
- 200-meter spacing out to 5000 metes

All receptors within Nordic's property line were removed from the analysis as they are not considered ambient air.

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FIGURE 1: EXTENT OF 200 METER RECEPTOR GRID

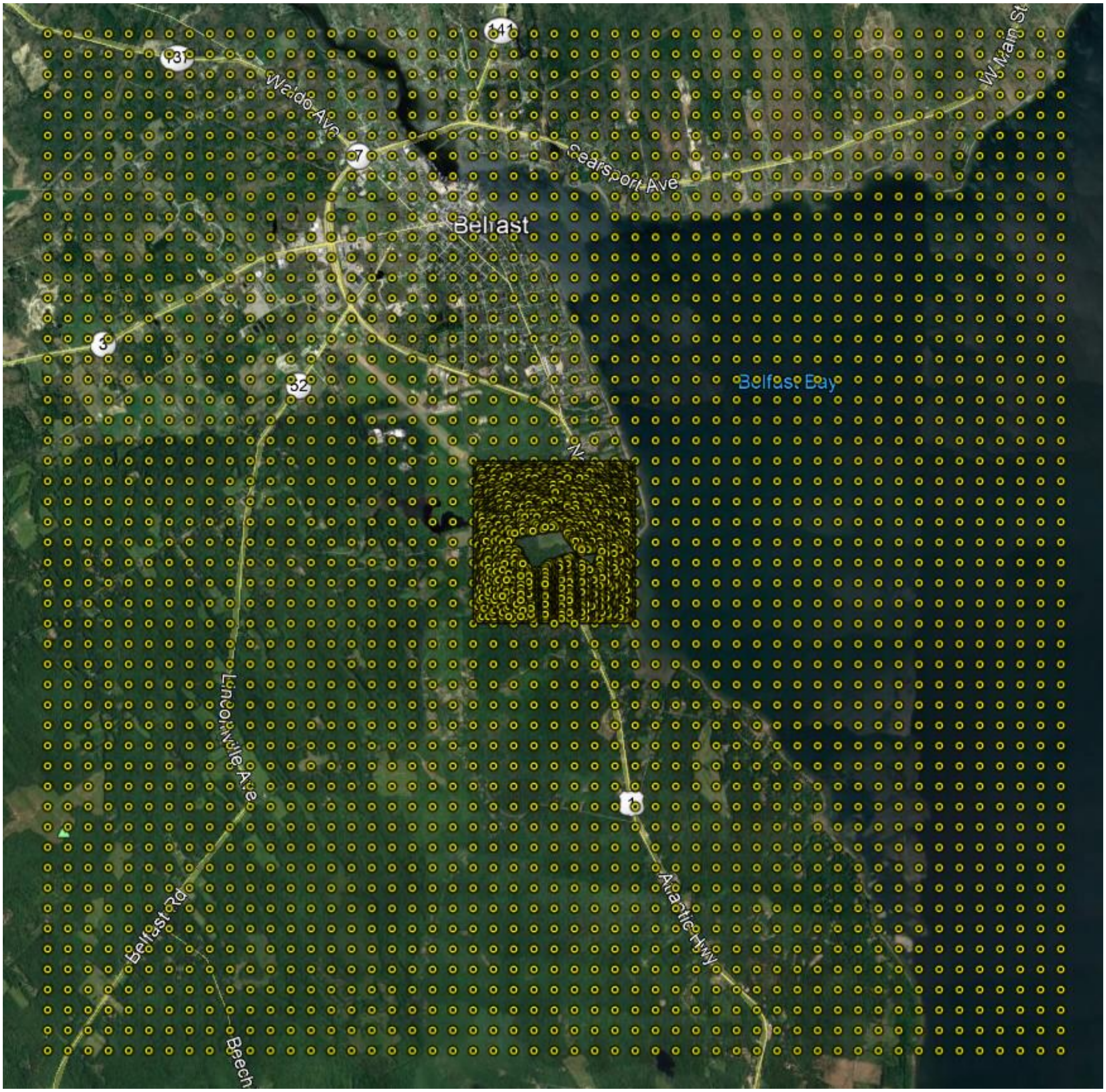


FIGURE 2: EXTENT OF 20 METER RECEPTOR GRID

2.4 TERRAIN DATA

Receptor elevations and corresponding receptor height scales (h_c) were generated by the AERMAP terrain pre-processor using terrain data acquired from the United States Geological Survey's (USGS) National Elevation Dataset (NED).

2.5 METEOROLOGICAL DATA

A valid five-year hourly meteorological database was used in the AERMOD modeling analysis. The monitored parameters and their associated heights, as found in Table 3, were collected at the Verso Bucksport meteorological multi-level monitoring site during the five-year period January 1, 1988 to December 31, 1992.

TABLE 3: METEOROLOGICAL DATA PARAMETERS

Parameter	Sensor Heights
Wind Speed	10 & 100 meters
Wind Direction	10 & 100 meters
Standard Deviation of Horizontal Wind Direction (Sigma Θ)	10 & 100 meters
Standard Deviation of Vertical Wind Direction (Sigma W)	10 & 100 meters
Temperature	10 & 100 meters

Surface data collected at the Bangor National Weather Service (NWS) site were substituted for any missing data in the primary surface dataset. All other missing data were interpolated or coded as missing, per USEPA guidance. In addition, hourly Bangor NWS data, from the same time period, were also used to supplement the primary surface dataset for the required variables that were not explicitly collected at the Verso Bucksport monitoring site.

The surface data was combined with concurrent hourly cloud cover and upper-air data obtained from the Portland NWS. Missing cloud cover and/or upper-air data values were interpolated or coded as missing, per USEPA guidance.

Both the surface and upper-air meteorological data were concurrently processed using the AERMET meteorological pre-processor.

AERMET also requires that site-specific surface characteristics around the meteorological and application sites be evaluated. Accordingly, the site surface characteristics values for albedo (r), surface roughness (z_o) and Bowen Ratio (B_o) were calculated using USEPA's AERSURFACE program for each of the twelve 30-degree sectors.

Per USEPA guidance, the surface roughness values were calculated within a one-kilometer radius of the monitoring site, while values of albedo and Bowen ratio were developed over a 10 x 10 kilometer region, centered over the monitoring site.

The seasonal categories for AERSURFACE were assigned in accordance with DEP modeling guidance.

2.6 BUILDING RELATED DATA

Buildings at the proposed Nordic facility, as illustrated in Figure 3, were input into USEPA's Building Profile Input Program with Plume Rise Model Enhancement (BPIP-PRIME) to determine any downwash effects from these structures. The dimensional building data was developed and input into BPIP-PRIME from plot plans and other site drawings on file at DEP-BAQ.

FIGURE 3: NORDIC BUILDINGS

2.7 POLLUTANT CONVERSION METHODS / OTHER ASSUMPTIONS

For the purpose of determining maximum predicted NO_2 and PM_{10}/$PM_{2.5}$ impacts, the following assumptions were used:

- NO_X emissions were assumed to convert to NO_2 using USEPA's Tier II Ambient Ratio Method (ARM2) minimum and maximum ratios of 0.5 and 0.9, respectively;

- $PM_{2.5}$ emissions were conservatively modeled as being equivalent to PM_{10} emissions.

2.8 AMBIENT BACKGROUND CONCENTRATIONS

Background concentrations, as found in Table 4, used in the analysis were derived from representative rural background data for use in the Midcoast Maine region.

TABLE 4: AMBIENT BACKGROUND CONCENTRATIONS

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$)	Monitoring Site, Year(s)
SO_2	1-hour	15	Kennebec County, 2016-2018
	3-hour	2	Acadia National Park, 2018
PM_{10}/$PM_{2.5}$	24-hour	15	Kennebec County, 2016-2018
	Annual	6	
NO_2	1-hour	39	Presque Isle, 2016/2017
	Annual	4	
CO	1-hour	460	Hancock County, 2018
	8-hour	460	

3.0 MAXIMUM PREDICTED IMPACTS

The maximum predicted AERMOD impacts, which were explicitly normalized to the form of their respective NAAQS, were added with the conservative rural background values to obtain a final maximum concentration to compare against the NAAQS, as shown in Table 5.

TABLE 5: MAXIMUM PREDICTED IMPACTS (NAAQS COMPARISON)

Pollutant	Averaging Period	Max Impact ($\mu g/m^3$)	Receptor UTM E (m)	Receptor UTM N (m)	Receptor Elevation (m)	Back-Ground ($\mu g/m^3$)	Total Impact ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
SO_2	1-hour	1.81	500570	4915810	14.71	15	16.81	196
	3-hour	1.63	500450	4915790	16.02	2	3.63	1,300
PM_{10}	24-hour	6.19	500470	4916150	21.26	15	21.19	150
	Annual	1.47	500490	4916150	21.22	6	7.47	50
$PM_{2.5}$	24-hour	6.19	500470	4916150	21.26	15	21.19	35
	Annual	1.47	500490	4916150	21.22	6	7.47	12
NO_2	1-hour	123.34	500550	4915810	13.84	39	162.34	188
	Annual	16.95	500490	4916150	21.22	4	20.95	100
CO	1-hour	1135.74	500570	4915810	14.71	460	1595.74	40,000
	8-hour	574.62	500490	4916150	21.22	460	1034.62	10,000

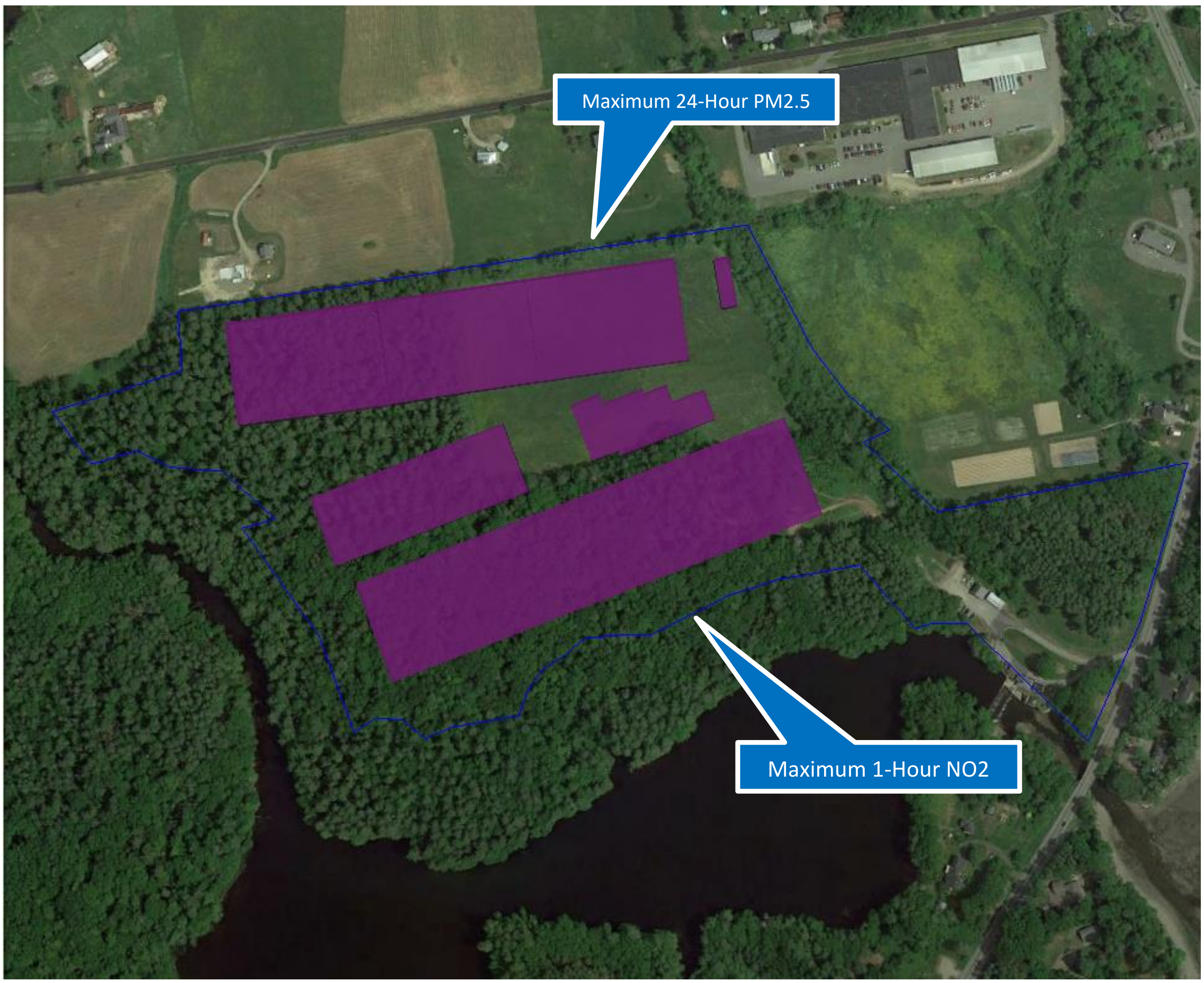
The maximum predicted AERMOD impacts, which were explicitly normalized to the form of their respective Class II increment standard, are shown in Table 6.

TABLE 6: MAXIMUM PREDICTED CLASS II IMPACTS (INCREMENT COMPARISON)

Pollutant	Averaging Period	Max Impact ($\mu g/m^3$)	Receptor UTM E (km)	Receptor UTM N (km)	Receptor Elevation (m)	Class II Increment ($\mu g/m^3$)
SO_2	3-hour	1.63	500450	4915790	16.02	512
	24-hour	0.88	500490	4916150	21.22	91
	Annual	0.15	500490	4916150	21.22	20
PM_{10}	24-hour	6.19	500470	4916150	21.26	30
	Annual	1.47	500490	4916150	21.22	17
$PM_{2.5}$	24-hour	8.34	500490	4916150	21.22	9
	Annual	1.47	500490	4916150	21.22	4
NO_2	Annual	16.95	500490	4916150	21.22	25

For the two pollutants/averaging periods whose modeled impacts were closest to their respective NAAQS and Class II increment standards, Figure 4 shows the locations of the maximum NO_2 (1-Hour averaging period) and $PM_{2.5}$ (24-Hour averaging period) predicted concentrations.

FIGURE 4: LOCATION OF MAXIMUM 1 HOUR NO2 IMPACT



All data, site drawings and other information used in developing the AERMOD input and output modeling files can be made available for review to interested parties at the DEP-BAQ offices located in Augusta.