

## **Acentech Report No. 0480r3**

Acentech Project No. 631096

### **Nordic Aquafarms Salmon Facility Belfast, Maine**

### **Construction, Operation, and Maintenance Noise Impact Assessment**



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## **1. Introduction**

Nordic Aquafarms proposes to design, build, and operate a land-based salmon farm on a 54-acre site located in the City of Belfast, Maine. Phase 1 will have an annual capacity of about 13,000 metric tons of Atlantic Salmon. With Phase 2 in operation, the annual capacity will increase to about 33,000 metric tons

This report describes noise regulations applicable to the Project followed by an assessment of the sound expected during construction, operation, and maintenance of the Project. Appendix A describes sound in lay terms for the convenience of the reader.

## **2. Site Description**

The proposed land-based salmon farm is to be located on an undeveloped 54-acre site to the southwest of the intersection of Route 1 and Perkins Road, about two miles south of the center of the City of Belfast. The Project site and nearby adjacent areas are shown on the Figure 1 aerial photograph and the Project site layout plan is presented on Figure 2.

The Project site is located in the Route One South Business Park Zoning District of the City of Belfast. The site abuts other properties in the Route One South Business Park Zoning District and in the Residential II Zoning District.

Nearby property to the west of the Project site is undeveloped woodlands beyond which are homes along Herrick and Woods Roads. A large area of undeveloped woodlands and Belfast Reservoir Number One are to the south of the Project site. Property to the east of the Project site is mostly open fields followed by Route 1 (Northport Avenue) and residential areas. To the north of the Project site is the Matthews Brothers business operation as well as nearby open areas with several homes located along Perkins Road. Belfast Municipal Airport is located somewhat more than a mile to the northwest.

## **3. Noise Regulation Requirements**

### **Federal**

No federal noise regulations are applicable to the off-site environmental noise associated with the construction, operation, or maintenance of the proposed salmon farm facility. Federal regulations do limit the noise produced by over-the-road trucks and portable air compressors.

## State of Maine

Chapter 375.10 of Maine's Site Location of Development Law Regulations includes the following noise standards applicable to the off-site sound produced during routine operation of regulated equipment at the proposed Project.

- Hourly equivalent operating sound level limits of 60 dBA during daytime hours from 7 a.m. to 7 p.m. and 50 dBA during nighttime hours from 7 p.m. to 7 a.m. at protected locations in areas where the zoning is not predominantly commercial or industrial.
- Hourly equivalent operating sound level limits of 55 dBA during daytime hours from 7 a.m. to 7 p.m. and 45 dBA during nighttime hours from 7 p.m. to 7 a.m. at particularly quiet protected locations where the pre-development ambient hourly sound level is equal to or less than 45 dBA during daytime hours and/or equal to or less than 35 dBA during nighttime hours.
- Hourly equivalent operating sound level limits of 70 dBA during daytime hours from 7 a.m. to 7 p.m. and 60 dBA during nighttime hours from 7 p.m. to 7 a.m. at protected locations in areas where the zoning is predominantly commercial or industrial.
- Hourly equivalent operating sound level limit of 75 dBA at the Facility property boundary.

Sources of sound exempt from the above limits include safety and protective devices and warning signals, construction operations during daytime or daylight hours, and registered and inspected motor vehicles that enter the site to make a delivery or pickup, but not when parked at the facility with the engine running for more than 60 minutes.

## City of Belfast

(extracted from the City website)

- The City of Belfast Code of Ordinances includes the following Article IX quantified noise performance standard for certain properties located within the City:

Noise may be equal to but not exceed, during any consecutive eight-hour period, an average of 75 dBA (re 20 microneutons/m<sup>2</sup>) measured at any boundary line. During the peak activity of 60 minutes in a twenty-four-hour period a noise may not exceed 115 dBA when measured at the source.

- The below quantified noise performance standard applies to properties in certain districts in the City of Belfast that are used for nonresidential uses:
  - (a) Excessive noise at unreasonable hours shall be required to be muffled so as not to be objectionable due to intermittence, beat, frequency, shrillness or volume (refer to table below). The maximum permissible sound pressure level of any continuous, regular or frequent source of sound produced by any commercial or industrial activity regulated by this division shall be established by the time period and type of land

use listed below. Sound pressure levels shall be measured on a sound level meter at all major lot lines of the proposed site, at a height of at least four feet above the ground surface.

### Sound Pressure Level Limit

	7:00 a.m.—9:00 p.m.	9:00 p.m.—7:00 a.m.
Commercial activities	60 dBA	55 dBA
Industrial activities	70 dBA	55 dBA

The levels specified above may be exceeded by 10 dBA for a single period, not longer than 15 minutes, in any one day.

Noise shall be measured with a sound level meter meeting the standards of the American National Standards Institute (ANSI S1 4-1961) "American Standard Specification for General Purpose Sound Level Meters". The instrument shall be set to A-weighted response scale and at the meter to the slow response. Measures shall be conducted in accordance with ANSI S1 2-1962 "American Standard Method for the Physical Measurements of Sound", or such standard as may be amended from time to time. The City code enforcement officer, however, may use a portable sound meter available to the City to establish potential noise levels. If the code enforcement officer registers a noise level that is either near to or greater than the above standards, the officer may use these results to require the property owner to conduct a sound level analysis from a licensed engineer that fully complies with the above standards and to present these results to the code enforcement officer for analysis. Further, the planning board may require a noise level study for any use which requests a permit from the City.

(b) No person shall engage in, cause, or permit any person to be engaged in very loud construction activities on a site (active construction area) located within 750 feet of any residential use between the hours of 8:00 p.m. of one day and 7:00 a.m. of the following day. Construction activities shall be subject to the maximum permissible sound level specified for industrial districts for the periods within which construction is to be completed pursuant to any applicable building permit. The following uses and activities shall be exempt from the sound pressure level regulations:

- (1) Noises created by construction and maintenance between 7:00 a.m. and 8:00 p.m.
- (2) The noises of safety signals, warning devices and emergency pressure relief valves and any other emergency activity.
- (3) Traffic noise on existing public streets, railways or airports.

No other regulations are applicable to the off-site environmental noise associated with the construction, operation, or maintenance of the Project.

#### **4. Project Construction Sound**

Construction of Phase 1 is expected to start within a few months after receiving all necessary approvals and to continue for about two years. Phase 2 will include additional smolt and grow out tanks. Total construction time for both phases is expected to be about six years.

Initial activities will include site clearing, earth moving, excavation, infrastructure connections, and foundations. This will be followed by concrete pouring and steel erection and then by installation of machinery and piping inside and outside of the new buildings. Later stages of construction will include siding installation, completion of interior systems, paving, finishing, testing and commissioning of systems, and final grading. A majority of the exterior construction activities will occur during daytime hours from 7:00 a.m. to 7:00 p.m. or during daylight hours, whichever is longer.

Typical on-site equipment used during construction will include trucks, dozers, excavators, loaders, graders, backhoes, cranes, compressors, pumps, generators, welders, and rollers. Representative equivalent noise levels associated with construction equipment during the workday are listed in Table 1. The noise levels shown in Table 1 are based on the results of extensive previous acoustical studies of engine-powered construction equipment.

Construction equipment noise levels are presented here for informational purposes. Maine's Site Location of Development Law Regulations and the City Ordinances do not regulate noise levels generated by daytime construction activities. However, all equipment used in these activities will comply with any applicable federal noise regulations, and will include noise control devices in proper working condition and maintained as originally provided by the equipment manufacturer.

#### **5. Project Operation and Maintenance Sounds**

Sound associated with routine operation of the proposed Project will be produced by electric motors, water pumps, fans, filters, water flow, boilers, chillers, and engine-driven electric generators with all to be located inside industrial-grade Project buildings. Sounds associated with routine operation of exterior equipment will be produced by ventilation intakes and exhausts, cooling towers, and registered over-the-road trucks coming to and from the Project site. The Project will be available to operate 24-hours per day and seven days per week.

The expected hourly equivalent A-weighted sound levels from future operation of regulated equipment operating at the proposed Project have been calculated for nearby protected locations surrounding the site. Calculations were performed with the professional CadnaA computer sound model, which is used to conduct detailed

modeling of sounds from future industrial facilities. The model is based on ISO Standard 9613 that includes downwind atmospheric conditions that are favorable for outdoor sound propagation (i.e., allow for a higher level of anticipated noise so as to conduct a conservative study).

Table 2 lists six protected residential locations near the Project site to the north, south, west, and east together with A-weighted hourly equivalent Leq sound levels that will not be exceeded from regulated Project equipment during future operations of Phases 1 and 2.

Presented in Figure 3 are contours of the A-weighted hourly equivalent Leq sound levels that will not be exceeded from regulated equipment during future operation of Project Phases 1 and 2. The buildings and individual equipment are shown in blue on this figure. Sound levels without Phase 2 and at greater distances from the Project will be lower.

The Project will be designed and operated such that the routine hourly equivalent operating sound levels from regulated equipment will comply with noise limits that are applicable to the Project.

Maintenance of the Project will include operations such as snow removal, machinery inspections, and machinery maintenance. Maintenance activities are not expected to require operations that produce significant off-site sounds that will be intrusive to residential neighbors.

## **6. Noise Abatement**

Measures being adopted to mitigate potential noise impacts associated with construction, operation, and maintenance of the proposed Project include the following:

- Effective exhaust mufflers in proper working condition will be installed on all engine-powered construction equipment at the site. Mufflers found to be defective will be replaced promptly.
- Construction contractors will be required to ensure that their employee and delivery vehicles are driven slowly on site (e.g., 10mph limit with no Jake Brakes) and responsibly when entering and leaving the site.
- A majority of all exterior construction activities will occur during daytime hours from 7:00 a.m. to 7:00 p.m. or during daylight hours, whichever is longer.
- Most facility machinery will be enclosed within facility buildings. The facility buildings will be constructed with industrial-grade sidewalls and roofs specified with the necessary sound transmission loss (STL) to contain noise and will include thermal/acoustic insulation to reduce the buildup of interior noise.

- Sound level specifications will be included in the bidding and purchase documents for the portions of noise producing machinery that are exposed to the outdoors including cooling towers, ventilation systems, and generators.
- The necessary dynamic insertion loss (DIL) will be specified in purchase documents for the mufflers to be installed at building ventilation inlets and exhausts.
- The diesel-engine driven electric generators will be fully enclosed within an industrial-grade insulated building together with mufflers specified to provide the necessary noise attenuation for the engine exhausts and cooling air inlets and exhausts.
- Employees and drivers bringing trucks to and from the site will be required to drive slowly on site (e.g., 10mph limit with no Jake Brakes) and responsibly when entering and leaving the site.

## **7. Noise Impact Assessment**

Most construction activities associated with the proposed Project will be located hundreds of feet and further from protected residential locations. Also, routine outdoor construction activities will be conducted during daytime hours. Construction sounds will vary from hour-to-hour and from day-to-day, depending on the equipment in use and the operations being performed at the site. The temporary sound associated with construction of the Project will be similar to the sound produced during construction activities at many other similar building projects. Equipment used in these activities will comply with applicable federal noise regulations.

The Project will operate seven days per week, 24 hours per day. It is expected that regulated equipment during routine operation will produce sound levels that are equal to or lower than the applicable noise level limits contained in Chapter 375.10 of Maine's Site Location of Development Law Regulations. See Sections 3 and 5 of this report for a more detailed discussion.

Neighbors may at times hear sounds associated with construction, operation, or maintenance of the Project, but the sound levels from the facility will be modest and in compliance with DEP and local noise level requirements.





Figure 1. Project Site and Surrounding Area

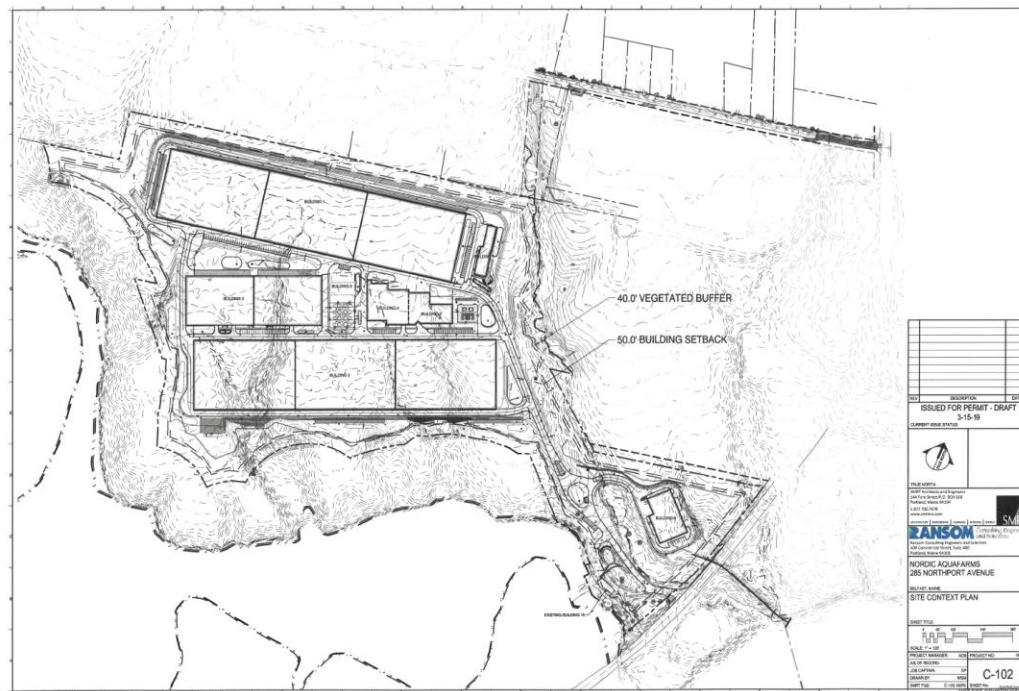
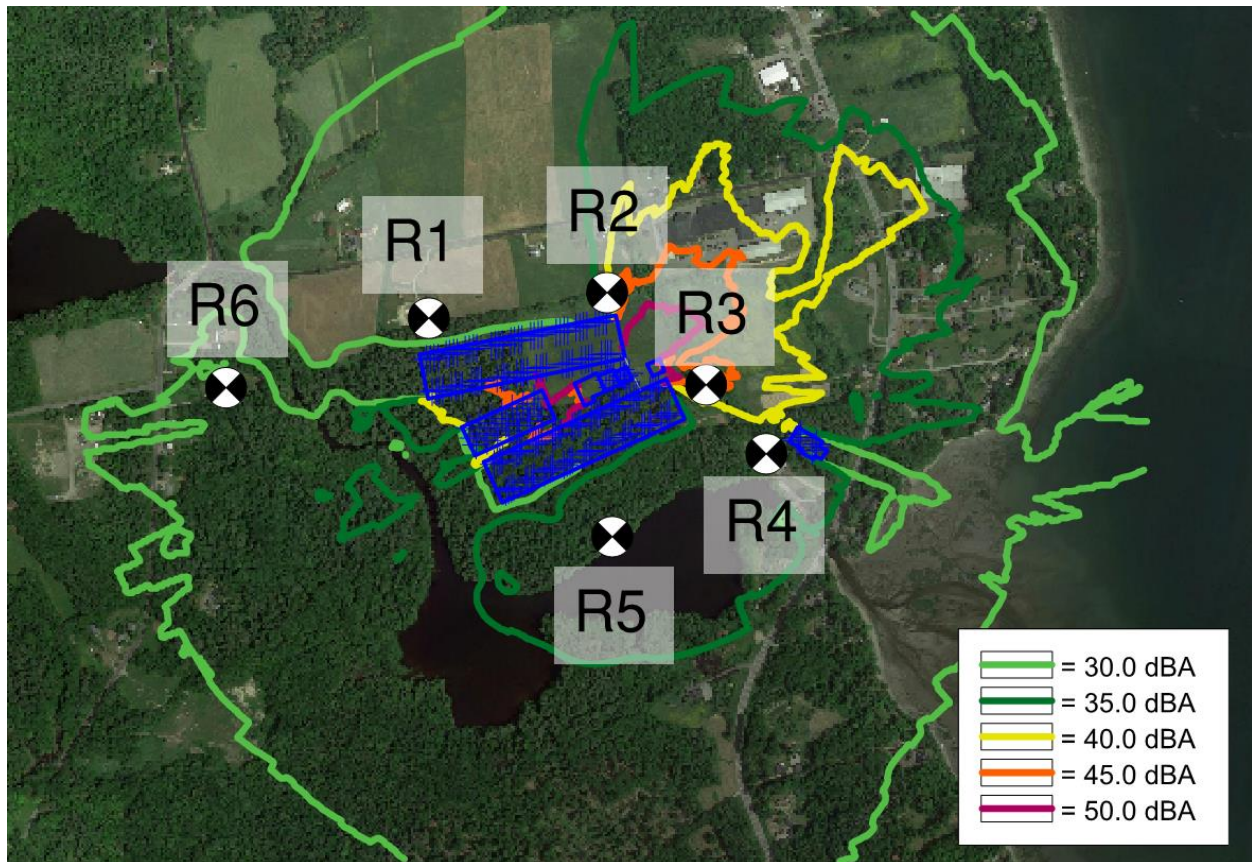


Figure 2. Project Site Layout Plan



**Figure 3. A-weighted Hourly Equivalent Leq Sound Level Contours from Regulated Equipment during Future Routine Operation of both Project Phase 1 and Phase 2**

**Table 1. Representative Construction Equipment Workday Equivalent Sound Levels**

Equipment	Sound Level in dBA at 500 ft
Truck	54
Dozer	58
Excavator	60
Loader	59
Grader	58
Backhoe	60
Crane	47
Compressor	57
Pump	50
Generator	52
Welder	46
Roller	55

**Table 2. Project Sound Levels That Will Not be Exceeded during Routine Operation of Both Phase 1 and Phase 2**

Nearby Protected Locations and Distance From Project Center	Project Sound Levels Not to be Exceeded	
	Daytime	Nighttime
1 Northwest 975 ft.	< 55 dBA	< 45 dBA
2 North 585 ft.	< 55 dBA	< 45 dBA
3 Southeast 790 ft.	< 55 dBA	< 45 dBA
4 Southeast 1,230 ft.	< 55 dBA	< 45 dBA
5 South 950 ft.	< 55 dBA	< 45 dBA
6 West 2,115 ft.	< 55 dBA	< 45 dBA

## Appendix A. Sound in Lay Terms

Sounds we hear come from small pressure oscillations, or sound waves, that travel through the air and actuate our hearing mechanism. These airborne pressure oscillations cause the eardrum and small bones of the middle ear to vibrate. These vibrations are transmitted to the fluid-filled cochlea of the inner ear's sensory organ. Sensory hair cells then transduce these vibrations into nerve impulses that are transmitted to the brain where they are perceived and interpreted.

Noise is often defined as unwanted sound and the degree of disturbance or annoyance of an intruding noise depends on various factors including the magnitude and nature of the intruding noise, the magnitude of the background or pre-development ambient sound present without the intruding noise, and the nature of the activity of people in the area where the noise is heard. For example, people relaxing at home generally prefer a quiet environment, while factory employees may be accustomed to relatively high noise levels when at work.

The magnitude, or loudness, of sound waves (pressure oscillations) is described quantitatively by the terms sound pressure level, sound level, or simply noise level. The magnitude of a sound is measured in decibels, abbreviated dB. Decibels are used to quantify sound pressure levels just as degrees are used to quantify temperature and inches are used to quantify distance. The faintest sound level that can be heard by a young healthy ear is about 0 dB, a moderate sound level is about 50 dB, and a loud sound level is about 100 dB.

Sound level meters are usually equipped with electronic filters or weighting circuits, as specified in ANSI S1.4 – 1983 (and more recent versions), for the purpose of simulating the frequency response characteristics of the human ear. The A-weighting filter included with essentially all sound level meters is most commonly employed for this purpose because the measured sound level data correlate well with subjective response to sounds. Sound levels measured using the A-weighting network are designated by dBA.

Sound energy spreads as it travels away from its source causing the sound level to diminish. Other factors that reduce sound levels include absorption in the atmosphere, diffraction and refraction in the atmosphere, terrain, and forests.

The frequency of a sound is analogous to its tonal quality or pitch. The unit for frequency is hertz, abbreviated Hz (formerly cycles per second or cps). Thus, if a sound wave oscillates 500 times per second, its frequency is 500 Hz. The fundamental frequency of Middle C on a piano keyboard, for example, is 262 Hz. However, most sounds include a composite of many frequencies and are characterized as broadband or random. The normal frequency range of human hearing extends from a low frequency of about 20 to 50 Hz (a rumbling sound) up to a high frequency of about 10,000 to 15,000 Hz (a hissing sound) or even higher for some people. People have

different hearing sensitivity to different frequencies and generally hear best in the mid-frequency region that is common to human speech, about 500 to 4000 Hz.

The background or ambient acoustical environment in most communities varies from place to place and varies with time at any given location due to the composite of many nearby and distant sound sources. The ambient environment includes high sound level single-events such as the passby of an airplane or nearby car, the barking of a dog, thunder, or a siren. The ambient acoustical environment also includes relatively steady residual or background sounds caused by sources such as distant traffic and ventilation equipment. The quantity of the single-event sounds and the amplitude of the background sounds are usually least during the late night hours from about midnight to 5:00 am. Indeed, the pre-development ambient sound level at a location is related to the amount of human activity in its vicinity. The amplitude statistics of this rather complex acoustical environment include the presence of a relatively-steady lower-level background and diurnal and seasonal variations.

At any location, a complete physical description of the ambient acoustical environment might include its sound level at various frequencies, as a function of time. As a first step towards simplifying this multi-dimensional description, it has become common practice to eliminate the frequency variable by measuring the A-weighted sound level (dBA), as observed on a standard sound level meter. The A-weighting filter emphasizes the mid-frequency components of sounds to approximate the frequency response of the human ear. A-weighted sound levels correlate well with our perception of most sounds.

An increase or decrease of the outdoor ambient sound level in a community by 1 or 2 dB is generally not noticeable. Whereas a change of the ambient sound level by 5 or 6 dB is generally noticeable and an increase or decrease of the ambient sound level by 10 dB is generally considered to represent a doubling or halving of the perceived sound.

To evaluate noise impacts and report time-varying ambient sound levels it is common practice, using the A-weighted scale, to measure the equivalent sound level and the day-night sound level. The equivalent sound level is the level of a steady-state sound that has the same total (equivalent) energy as the time-varying sound of interest, taken over a specified time period. Thus, the equivalent sound level is a single-valued level that expresses the time-averaged total energy of the entire ambient sound energy. It includes both the high sound level single-event ambient sounds and the relatively steady background sounds. The day-night sound level is simply the average equivalent sound for 24-hours after 10 dBA has been added to the nighttime sound levels from 10 pm to 7 am. Adding 10 dBA to the nighttime sound levels accounts for people's expectation that nighttime be a quiet period.

Both the equivalent sound level and the day-night sound level have been selected by the U.S. Environmental Protection Agency as the best descriptors to use for the purpose of identifying and evaluating levels of environmental noise.

The hourly equivalent sound level has been selected by the State of Maine DEP and identified in Chapter 375.10 of Maine's Site Location of Development Law Regulations as the descriptor to be used in the regulation and measurement of noise from regulated equipment proposed for new facilities near protected locations. Protected locations (areas) generally include residences, houses of worship, academic schools and colleges, libraries, hospitals and nursing homes, and certain parks and recreation areas. A complete definition of protected locations is provided in Chapter 375.10 of Maine's Site Location of Development Law.