Sunrise Wind Farm Project

Appendix I3
Offshore In-Air Acoustic Assessment

Prepared for:

Sunrise Wind | Powered by Ørsted & Eversource

August 23, 2021

Revision 1 – October 28, 2021

Revision 2 – August 19, 2022

Offshore In-Air Acoustic Assessment

Sunrise Wind Farm

July 2022

Prepared for:

Sunrise Wind LLC

Prepared by:

Stantec Consulting Services Inc.

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Abbreviations

BIWF	Block Island Wind Farm
BOEM	Bureau of Ocean Energy Management
CDP	Census-designated place
CMR	Code of Massachusetts Regulations
COP	Construction and Operations Plan
DAQC	Division of Air Quality Control
dB	decibel
dBA	A-weighted decibel
dBL	linear decibel
DC	direct current
EPA	(United States) Environmental Protection Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
Hz	Hertz
IAC	Inter-Array Cables
ISO	International Organization for Standardization
L01, L10, L50, or L90	Statistical Sound Levels
Ldn	Day-night Average Sound Level
Leq	Energy-Average Sound Level
LIPA	Long Island Power Authority
Lmax	Maximum Sound Level
Lp	pressure level
Lw	power level

μPa	micropascals
MA	Massachusetts
MassDEP	Massachusetts Department of Environmental Protection
mi	miles
nm	nautical miles
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
OCS–DC	Offshore Converter Station (DC electrical technology)
OCS	Outer Continental Shelf
OnCS–DC	Onshore Converter Station (DC electrical technology)
Orsted NA	Orsted North America Inc.
O&M	operations and maintenance
RCNM	Roadway Construction Noise Model
RI	Rhode Island
SRWEC	Sunrise Wind Export Cable
SRWF	Sunrise Wind Farm
USFTA	United States Federal Transit Administration
WTG	wind turbine generator

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

Sunrise Wind LLC (Sunrise Wind), a 50/50 joint venture between Orsted North America Inc. (Orsted NA) and Eversource Investment LLC (Eversource), proposes to construct, own, and operate the Sunrise Wind Farm Project (the Project). The Project will be located in federal waters on the Outer Continental Shelf (OCS) in the designated Bureau of Ocean Energy Management (BOEM) Renewable Energy Lease Area OCS-A 0487 (Lease Area)[1] approximately 18.9 statute miles (mi) (16.4 nautical miles [nm], 30.4 kilometers [km]) south of Martha's Vineyard, Massachusetts (MA), approximately 30.5 mi (26.5 nm, 48.1 km) east of Montauk, New York (NY), and 16.7 mi (14.5 mi, 26.8 km) from Block Island, Rhode Island (RI) as measured from the closest Sunrise Wind Farm (SRWF) foundation to any given point of land. Components of the Project will be located in federal waters on the OCS, in state waters of New York, and onshore in Smith Point and the Town of Brookhaven, Long Island, NY. The Sunrise Wind Export Cable (SRWEC) will traverse both federal waters and state territorial waters of New York (SRWEC–OCS; SRWEC–New York State [NYS]), see Figure 1.1-1.

The onshore components of the Project will include an Onshore Converter Station (direct current [DC] electrical technology; OnCS–DC), Onshore Transmission Cable, Onshore Interconnection Cable, and Fiber Optic Cable, which will be located in the Town of Brookhaven, Long Island, NY. The proposed interconnection location is the Holbrook Substation, which is owned and operated by Long Island Power Authority (LIPA). The offshore components of the Project, including the wind turbine generators (WTGs), Offshore Converter Station (DC electrical technology; OCS–DC), and Inter-Array Cables (IACs), will be located in federal waters south of the coast of Rhode Island in the SRWF within the Lease Area.

[1] A portion of Lease Area OCS-A 0500 (Bay State Wind LLC) and the entirety of Lease Area OCS-A 0487 (formerly Deepwater Wind New England LLC) were assigned to Sunrise Wind LLC on September 3, 2020, and the two areas were merged and a revised Lease OCS-A 0487 was issued on March 15, 2021. Thus, in this report, the term "Lease Area" refers to the new merged Lease Area.

Figure 1.1-1
Project Area Location

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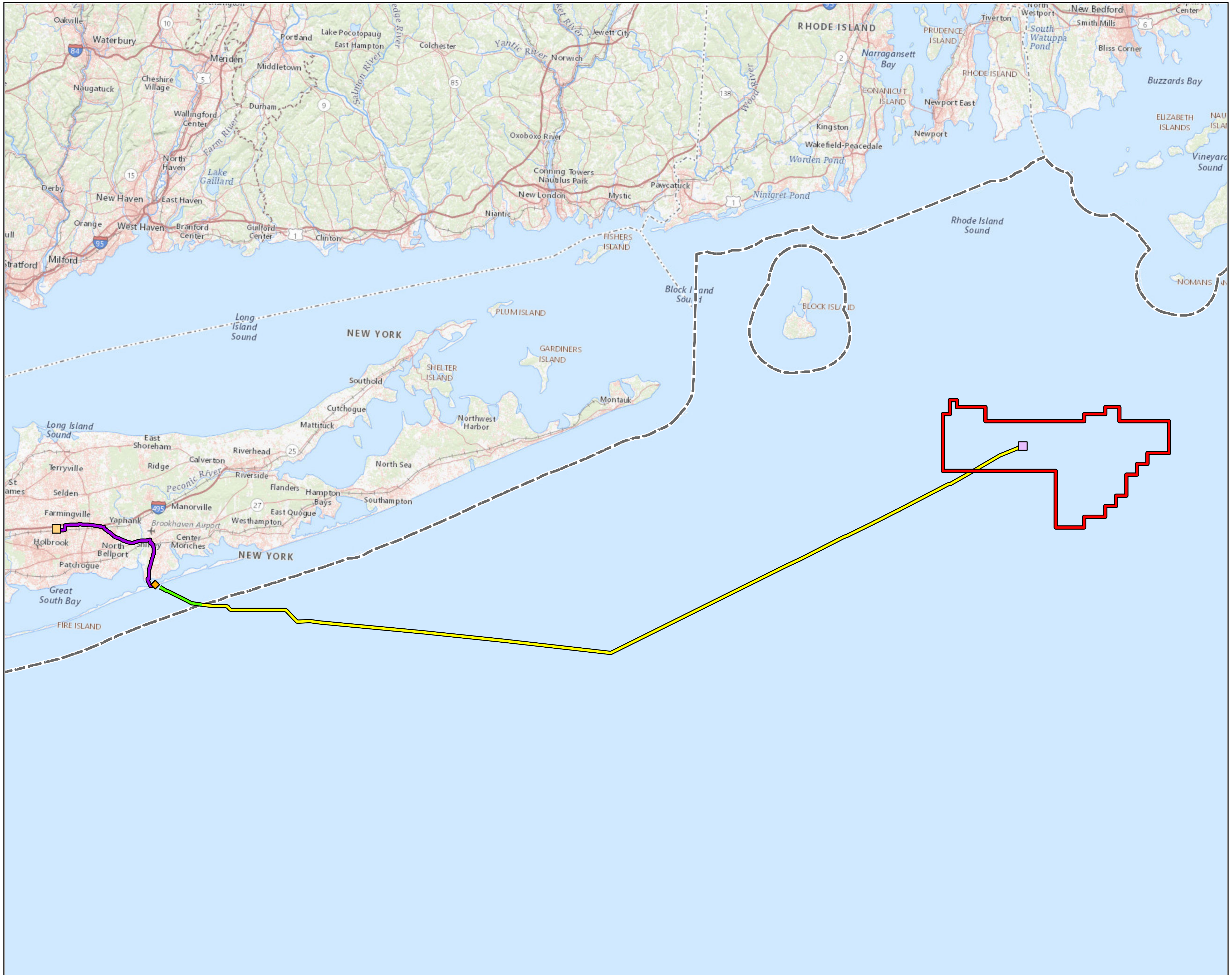


Legend

- Sunrise Wind Farm (SRWF)
- Offshore Converter Station (OCS–DC)
- SRWEC Landfall Location
- Onshore Converter Station (OnCS–DC)
- Sunrise Wind Export Cable (SRWEC–OCS)
- Sunrise Wind Export Cable (SRWEC–NYS)
- Onshore Transmission Cable LIE Service Road Route
- 3-nm State Waters Boundary

Note
Routes are indicative and subject to engineering design changes.

Sources
1. Base map: USGS The National Map

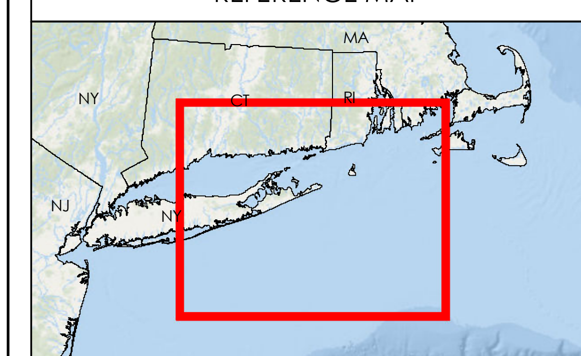
Date	12/18/2020 Revised: 6/1/2021
Project Number	2028113199
Prepared By	GC
Reviewed By	LJ

0 10 miles
0 8 nm
0 16 km

N

Scale at 11x17: 1:676,500
NAD 1983 2011 UTM Zone 19N

REFERENCE MAP



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The Project will specifically include the following offshore components:

- Up to 94 WTGs at 102 potential positions;
- One OCS–DC; and up to 95 foundations (for WTGs and the OCS–DC);
- Up to 180 mi (290 km) of IAC;
- One DC SRWEC located within an up to 104.6 mi (168.4 km)-long corridor.

The following Offshore In-Air Acoustic Assessment includes background information on acoustic concepts and terminology, associated regulatory context, the affected environment, potential impacts to the affected environment, and proposed environmental protection measures. The scope of this analysis includes a qualitative assessment of offshore in-air (or airborne) noise and its potential for causing adverse impacts on wildlife and/or people. A literature review and desktop sound analysis were conducted to define existing offshore in-air sounds around the SRWF and SRWEC; and, to define anticipated in-air noise impacts from the Project construction, and operations and maintenance (O&M) activities in offshore waters. Existing underwater sound and potential impacts of underwater sound produced by the Project are assessed in the COP Appendix I1 – *Underwater Acoustic Assessment.* Sound associated with Onshore Facilities is assessed in the COP Appendix I2 – *Onshore Acoustic Assessment*.

1.2 IN-AIR ACOUSTIC CONCEPTS AND TERMINOLOGY

Sound is the rapid fluctuation of pressure above and below ambient conditions. It can occur within both air and water mediums. In-air (airborne) sound is further described as a rapid fluctuation or oscillation of air pressure above and below the atmospheric pressure, creating a sound wave. The properties of sound waves (including frequency, length, amplitude, and velocity) characterize sound energy. Perception of sound by humans is dependent on several measurable characteristics. The following definitions outline some of the relevant terms used in acoustics:

- **Sound Source.** A sound power level (Lw) which is independent of any external factors.
- **Sound Energy.** Propagates through a medium where it is sensed and then interpreted by a receiver. A measure of sound energy fluctuations at a given receiver location is referred to as a sound pressure level (Lp); these can be obtained via microphone or can be calculated from information about the source power level and the surrounding environment.
- **Broadband Sound.** Includes additive sound energy across the frequency spectrum.
- **Sound Level.** Sound level is based on the amplitude change in pressure and is related to the loudness or intensity of a sound. In-air, sound levels are measured on a logarithmic scale of decibels (dB) relative to 20 micropascals (μPa). Because sound levels are measured in dB, the addition of sound levels is not linear (e.g., adding two equal sound levels will result in a 3 dB increase in the overall level). Sound levels can be further detailed with the following descriptors:
  - **Energy-Average Sound Level (Leq).** A single value representing the same acoustic energy as fluctuating levels that exists over a given period of time. This level takes into account how loud noise events are during a period, how long they last, and how many times they occur. Leq is often used to describe noise and human annoyance.

   - **Day-night Average Sound Level (Ldn).** A single value representing the same acoustic energy as a fluctuating level that exists over a 24-hr period (as opposed to any given period of time for Leq).
   - **Statistical Sound Levels (i.e., L01, L10, L50, or L90).** The different sound level metrics used to present levels exceeded for a particular percentage of time over a given timeframe. For example, L90 is the sound level that is exceeded 90 percent of the time and is therefore representative of background sound levels.
   - **Maximum Sound Level (Lmax).** The level of sound changing over time and taking into account many sound sources (such as mobile and stationary sources).
- **Frequency.** Sounds are comprised of acoustic energy, which is distributed over a range of frequencies, often referred to as "tone" or "pitch" and measured in Hertz (Hz). The human ear generally perceives frequency sound levels of 20 to 20,000 Hz; however, the perception of those frequencies can vary from person-to-person. A concept known as "A-weighting" is often used to evaluate noise levels to compensate for that sound perception factor; these weighted sound levels are then denoted as "dBA." Unweighted sound levels are referred to as linear (dBL) and are used to determine a sound's tonality and to create solutions to control or reduce noise.
- **Pure tone**. A condition where any octave band center frequency sound pressure level exceeds the two adjacent frequency sound pressure levels by 3 dB or more.

Noise is defined as an unwanted sound and becomes an adverse impact when it interferes with normal habits or activities of fish, wildlife, or people. Noise is described based on its loudness, quality, tonality, duration, and intensity. Airborne noise can impact people through effects such as speech or sleep interference, annoyance, and/or physiological effects such as anxiety, tinnitus (i.e., ringing in the ears), pain, or hearing loss.

Common sound levels are provided below in Table 1.1, and common sound levels are outlined in Table 1.2 per the New York City Department of Environmental Protection (NYCDEP 2018).

Table 1.1 Common Outdoor and Indoor Sound Level Ranges

	Sound Pressure (μPa) Range	Sound Pressure Levels (dB) Range
Common Outdoor Noises		
Jet Flyover at 984.3 ft (300 m)	2,000,000–6,324,555	100–110
Gas Lawn Mower at 3.3 ft (1 m)	632,456–2,000,000	90–100
Diesel Truck at 49.2 ft (15 m)	200,000–632,456	80–90
Gas Lawn Mower at 98.4 ft (30 m)	20,000–63,246	60–70
Commercial Area	20,000–63,246	60–70
Quiet Urban Daytime	2,000–6,325	40–50
Quite Urban Nighttime/Quiet Suburban Nighttime	632–2,000	30–40
Quiet Rural Nighttime	200–632	20–30

Table 1.1 Common Outdoor and Indoor Sound Level Ranges

	Sound Pressure (µPa) Range	Sound Pressure Levels (dB) Range
Common Indoor Noises		
Rock Band at 16.4 ft (5 m)	2,000,000–6,324,555	100–110
Inside Subway Train (New York)	632,456–2,000,000	90–100
Food Blender at 3.3 ft (1 m) / Garbage Disposal at 3.3 ft (1 m)	200,000–632,456	80–90
Shouting at 3.3 ft (1 m)	63,246–200,000	70–80
Vacuum Cleaner at 9.8 ft (3 m)	20,000–63,246	60–70
Normal Speech at 3.3 ft (1 m)	20,000–63,246	60–70
Large Business Office	6,325–20,000	50–60
Dishwater Next Room	2,000–6,325	40–50
Small Theater / Large Conference Room Library	632–2,000	30–40
Bedroom at Night / Concert Hall (Background)	200–632	20–30
Broadcast and Recording Studio	63–200	10–20
Threshold of Hearing	20–63	0–10
SOURCE: Federal Highway Administration (FHWA) 2018		

Table 1.2 Common Sound Levels

Common Sounds	Associated Sound Level (dBA)
Whisper	30
Normal Conversation/Laughter	50–65
Vacuum Cleaner at 10 ft (3.0 m)	70
Washing Machine/Dishwasher	78
Midtown Manhattan Traffic Noise	70–85
Motorcycle	88
Lawnmower	85–90
Train	100
Jackhammer/Power Saw	110
Thunderclap	120
Stereo/Boom Box	11–120
Nearby Jet Takeoff	130
SOURCE: NYCDEP 2018	

2.0 REGULATORY CONTEXT

The following sections outline federal, state, and local noise rules and regulations applicable to the Project. A summary of these rules and regulations are provided below in Table 2.1. Local regulations included below are those available from New York, Rhode Island, and Massachusetts coastal counties and townships with the potential to perceive offshore Project noise.

Table 2.1 Summary of Applicable Airborne Noise Standards

Jurisdiction and/or Agency	Standard	Operational Noise Limit (dBA)	Construction Noise Limit (dBA)
Federal			
United States Environmental Protection Agency (EPA)	Information on the Levels of Environmental Noise Requisite to Protected Public Health and Welfare with an Adequate Margin of Safety	55 dBA (Ldn) 48.6 dBA (Continuous Leq)	None
New York State			
NYSDEC	NYSDEC Policy 2001	65 dBA Non-industrial 79 dBA Industrial or commercial policy	None
NYCDEP	New York City Noise Code, §24-243 Ambient Noise Quality and §24-244 Allowable Sound Levels	Daytime (7 AM–10 PM): Low Density Residential 60 dBA (Leq) High Density Residential 65 dBA (Leq) Commercial Zones 70 dBA (Leq) Nighttime (10 PM–7 AM): Low Density Residential 50 dBA (Leq) High Density Residential 55 dBA (Leq) Commercial Zones 70 dBA (Leq)	None
State of New York Vehicle and Traffic Law	New York State Vehicle and Traffic Law §2	Unacceptable noise levels are considered 72 and 90 dB, with >90 dB considered nuisance noise	None

Table 2.1 Summary of Applicable Airborne Noise Standards

Jurisdiction and/or Agency	Standard	Operational Noise Limit (dBA)	Construction Noise Limit (dBA)
Suffolk County	County Code §618-4 Restrictions	Residential: 65 dBA 7 AM–10 PM 50 dBA 10 PM–7 AM Commercial: 65 dBA All Times Industrial: 70 dBA All Times	None
Town of Brookhaven	Town Code Chapter 50	Residential: 65 dBA 7 AM–10 PM 50 dBA 10 PM–7 AM Commercial: 65 dBA All Times Industrial: 75 dBA All Times	None
Rhode Island State			
State of Rhode Island, General Laws	Chapter 11-45.1 Unreasonable Noise Levels	N/A	None
Town of New Shoreham	Town Code Chapter 12-1	Residential: 65 dBA 7 AM–9 PM 55 dBA 9 PM–7 AM	None
Town of Narragansett	Town Code Chapter 22: Noise	Residential: 65 dBA 7 AM–10 PM 55 dBA 10 PM–7 AM	None
Town of Jamestown	Town Code Chapter 22: Noise	Residential: 70 dBA 8 AM–10 PM 60 dBA 10 PM–8 AM	None
City of Newport	City Code Chapter 8: Noise Abatement	Residential: 70 dBA 8 AM–10 PM 60 dBA 10 PM–8 AM	None
Town of Middletown	Town Code Chapter 130.75 Noise	Residential: 65 dBA 7 AM–10 PM 55 dBA 10 PM–7 AM 30 dBA (wind turbine noise)	None
Town of Little Compton	Town Code Chapter III Section 3-1	Residential: 55 dBA 7 AM–9 PM 50 dBA 9 PM–7 AM	None

Table 2.1 Summary of Applicable Airborne Noise Standards

Jurisdiction and/or Agency	Standard	Operational Noise Limit (dBA)	Construction Noise Limit (dBA)
Massachusetts State			
Commonwealth of Massachusetts, DEP	310 CMR 7.10 and DAQC Policy 90 001	Ambient (L90) + 10 dBA (Leq) No Pure Tones	None
Town of Westport	Town Code Article XL, Noise Pollution	All: 60 dBA 9 PM–7 AM	None
Town of Gosnold	Town Noise Bylaw	Residential: “unnecessary, loud, excessive, or unusual noise” 10 PM–6:30 AM	None
Town of Aquinnah	None	None	None
Town of Chilmark	Town Zoning Bylaw, Article 2, Section 5.9	Residential: 10 dBA above ambient sound level as measured at the property line	None
Town of Nantucket	Town Bylaw, §101-2 Noises Prohibited	District A Daytime 68 dBA District A Nighttime 58 dBA District B Daytime 70 dBA District B Nighttime 58 dBA District C Daytime 70 dBA District C Nighttime 70 dBA	None

2.1 FEDERAL

The *Noise Control Act* of 1972 authorized federal agencies to address sources of noise, including motor vehicles, machinery, and other commercial products, that may endanger the health and welfare of the nation’s population. The act authorized the US Environmental Protection Agency (EPA) to issue noise emission regulations for noise sources and the EPA published sound levels of noise that were requisite to protect public health under the act (USEPA 1974). These levels were issued to provide guidelines for state and local governments in setting standards. EPA noise level guidelines are provided below in Table 2.2. However, the primary responsibility of regulating noise has since been delegated to state and local governments, but the *Noise Control Act* of 1972 and the *Quiet Communities Act* of 1978 remain in effect today.

Table 2.2 Noise Levels Identified to Protect Public Health and Welfare per EPA Noise Guidelines

Effect	Sound Level	Description of Area
Outdoor Activity Interference	Ldn [55 dBA]	Outdoors in residential areas and farms, other outdoor areas where people spend widely varying amounts of time, and other places in which quiet is a basis for use
	Leq (24) [55 dBA]	Outdoor areas where people spend limited amounts of time, such as schoolyards, playgrounds, parks, etc.
Indoor Activity Interference and Annoyance	Ldn [45 dBA]	Indoor residential areas
	Leq (24) [45 dBA]	Other areas with human activities, such as schools
SOURCE: EPA 1974		

2.2 STATE

The following sections outline the relevant New York, Rhode Island, and Massachusetts state-level laws, regulations, policies, and guidance applicable to noise generated by the offshore Project components (SRWF and SRWEC) (see also Table 2.1).

2.2.1 New York

Noise standards for New York are managed by the NYSDEC per the New York State Noise Code Section 24. Noise standards are divided into daytime and nighttime hours and by residential and commercial zones. Suffolk County also regulates noise via the County Code §618-4 restrictions, which divide noise threshold allowances by three zones: residential, commercial, and industrial. Furthermore, the coastal townships of East Hampton and South Hampton have residential and commercial noise standard maximum allowances, per Town Codes §185-3 and §235-3.

2.2.2 Rhode Island

Rules and regulations regarding noise in Rhode Island include a noise policy that prohibits unreasonable, excessive, and annoying noise levels from all sources subject to its policy's power (Chapter 11-45.1). There are no state-wide quantitative noise criteria for operations or construction of the Project per the Rhode Island Department of Environmental Management. Alternatively, the state relies on individual communities to establish noise regulations through community by-laws or local ordinances.

2.2.3 Massachusetts

Noise impact criteria have been developed by the Massachusetts Department of Environmental Protection (MassDEP), which evaluates whether or not a facility will generate sound levels resulting in adverse impacts to public health or welfare. The noise regulation policy (310 Code of Massachusetts Regulations [CMR] 7.10 contained within Division of Air Quality Control [DAQC] Policy 90 001) states that a source of sound is violating noise regulations if the source: (1) increases broadband sound levels by more than 10 dBA above ambient sound levels; or, (2) produces a "pure tone" condition.

2.3 LOCAL

Although local municipalities within New York, Rhode Island, and Massachusetts are distant to potential sound generated by construction and O&M of the SRWF and SRWEC, potential noise impacts have been assessed at municipalities along the coastline in regard to their local noise ordinances. Table 2.1 above outlines these municipalities and their rules and regulations for noise.

3.0 AFFECTED ENVIRONMENT

As previously described, the Project is approximately 18.9 mi (16.4 nm, 30.4 km) south of Martha's Vineyard, MA, approximately 30.5 mi (26.5 nm, 48.1 km) east of Montauk, NY, and 16.7 mi (14.5 mi, 26.8 km) from Block Island, RI, measured from the closest SRWF foundation to any given point of land. The offshore components of the Project will be located in federal waters on the OCS and in state waters of New York.

Existing ambient sound levels have been estimated for coastal cities in the vicinity of the proposed offshore construction and O&M activities using methods described by the United States Federal Transit Administration (USFTA 2018), originally adapted from the EPA. These ambient sound level estimates are relatively conservative, leaning towards the underestimation of ambient levels. This methodology is considered conservative because there can be a greater potential for noise effects from new sources of sound in areas that are relatively quieter. Estimated daytime and nighttime ambient sound levels for coastal New York, Rhode Island, and Massachusetts cities are provided below in Table 3.1, using population densities provided in the Socioeconomics Section 4.7.1 of the Construction and Operations Plan (COP) (BOEM 2020). Estimated daytime sound levels range from 35–55 dBA and estimated nighttime sound levels range from 30-45 dBA.

Table 3.1 Estimated Existing Ambient Sound Levels

Location	Population Density (people/square mile)	Existing Ambient Daytime Sound Level (Leq, dBA)	Existing Ambient Nighttime Sound Level (Leq, dBA)
New York			
Suffolk County	1,632	50	40
Town of East Hampton	295	40	30
Montauk census-designated place (CDP)	209	40	30
East Patchogue CDP	2,720	50	40
Fire Island CDP	27	35	25
Mastic Beach CDP	2,532	50	40
North Bellport CDP	2,367	50	40
North Patchogue CDP	3,832	55	45
Shirley CDP	2,502	50	40
Rhode Island			
Washington County	383	45	35
Town of Narragansett	1,122	50	40
Massachusetts			
Bristol County	1,011	50	40
City of New Bedford	4,757	55	45
SOURCES: USFTA 2018; United States Census Bureau 2000, 2018, 2019			

4.0 POTENTIAL IMPACTS

4.1 CONSTRUCTION

4.1.1 Support Vessels and Helicopters

Construction of the SRWF and SRWEC will require the use of support vessels and helicopters. A summary of anticipated construction vessels and helicopters is provided in the COP Description of Proposed Activity, Section 3.3.11. In general, vessels anticipated to be present during construction of the SRWF and SRWEC include construction barges, support tugs, jack-up rigs, supply/crew vessels, and cable-laying vessels. Large work vessels for foundation and WTG installation will generally transit to the work location and remain in the area until installation is complete. These large vessels will be expected to move slowly and over short distances between work locations. Smaller transport vessels will travel between potential ports in New York, Connecticut, Maryland, Massachusetts, New Jersey, Rhode Island, and Virginia, to transport crews.

However, marine vessels are not expected to generate sounds at a level that would harm human health or wellness either onshore or offshore and their presence in any given location will be transient.

During construction, access to the OCS–DC will likely be provided from a boat landing; however, a helicopter could potentially be used as an alternative option, with a helideck located onsite. Additionally, an integrated helicopter hoist platform will be located on the roof of each WTG nacelle to provide access during O&M activities. Helicopters may also be used for crew changes during installation of the SRWF and SRWEC. Helicopter flight paths will generally avoid flying directly over residences; however, the use of helicopters will result in a temporary and transient increase in-air noise at the offshore helipad and along flight paths to and from. While flying offshore, helicopters generally maintain altitudes above 700 ft (213.4 m) but may fly at altitudes of 200- and 500 ft (61- and 152.4 m) when traveling between WTGs (Bastasch 2019). Helicopters at approximately 1,000 ft (304.8 m) are expected to create sound ranging from 62 to 84 dBA, depending on the size of the helicopter (Helicopter Association International 2017). Comparatively, the sound of an automobile ranges from approximately 60 to 90 dBA (Helicopter Association International 2017), and as previously described, estimated daytime ambient sound levels within New York, Rhode Island, and Massachusetts municipalities range from 35 to 55 dBA. Considering the comparative sound levels, and the distances of the SRWF to nearby cities, it is unlikely that helicopter noise will adversely impact onshore or offshore human health and wellness, with the possible exception of personnel located near the helipads used by the Project or those within the helicopters themselves. These personnel will be required to wear ear protection, per general construction best management practices.

4.1.2 Pile Driving Noise

The FHWA created a Roadway Construction Noise Model (RCNM) that evaluates airborne noise associated with various construction activities, and which can be applied to foundation installation during construction of the SRWF (FHWA 2006). The RCNM provides Lmax sound pressure levels at a reference distance of 50 ft (15.2 m) for various equipment, including impact and vibratory pile drivers. The RCMN value for both impact and vibratory pile-driving equipment is 101 dBA, and the acoustical utilization or usage factor of 20 percent is used by the RCNM for both impact and vibratory pile driving types.
The average sound level (Leq) at a receptor is then calculated by accounting for geometric divergence. The predicted sound level from each pile driving type was determined using the following formula for geometric spreading: *Reference Noise Level – 20*log(Distance to Receptor/50) + 10*log (Usage Factor %/100).* Therefore, for vibratory pile driving with a reference noise level of 101 dBA and a usage factor of 20 percent, the contribution of each pile driver is determined by the following formula:
*101 dBA – 20*log(Distance to Receptor/50) + 10*log(20/100).* Table 4.1 summarizes the predicted average airborne sound level from both impact and vibratory pile driving at various distances, considering the usage and distance losses and guidance provided by the RCNM. Additionally, as the sound levels during construction are expected to vary at any given time, Table 4.2 presents suggested sound level adjustments for consideration of the potential number of pile driving sources producing sound at any given time. The total sound level from multiple pile driving sources was determined by dB addition of each individual piece's contribution (using a logarithmic addition).

Table 4.1 Predicted Average Airborne Sound Levels from Pile Driving Activities

Distance (feet)	Sound Level (dBA)
50	94
100	88
200	82
300	78
400	76
500	74
600	72
700	71
800	70
900	69
1,000 ft (=0.19 mi)	68
1,200	66
1,400	65
1,600	64
1,800	63
2,000	62
2,200	61
2,400	60
SOURCE: FHWA 2006	

Table 4.2 Sound Level Adjustment for Number of Pile Driving Sources

Number of Sources	dBA Adjustment
1	0
2	3.0
3	4.8
4	6.0
5	7.0
6	7.8
7	8.5
8	9.0
9	0.5
10	10.0
20	13.0
40	16.0
SOURCE: FHWA 2006	

The Block Island Wind Farm (BIWF), located approximately 3 mi (2.6 nm, 4.8 km) off the state of Rhode Island, consists of five 30 megawatt (MW) WTGs which were installed in 2015 and 2016. During Phase 1 of construction, airborne noise monitoring was conducted to measure sound produced during installation of the WTG foundations. Airborne noise was measured onshore and offshore with several sound level meters, taking sound level recordings during active pile driving and also during a period outside of pile driving (for baseline purposes). Results of this monitoring effort during construction concluded that sound levels detected onshore during pile driving activities ranged from approximately 40 to 65 dB, while sound levels detected offshore ranged from approximately 50 to 80 dB (BOEM 2018). Based on the results of this monitoring program, onshore in-air sound levels during offshore pile driving were comparable to typical conversation levels, as presented in Table 1.2.

The above FHWA and RCNM data, the distance of the SRWF from the shoreline, and the results of the BIWF airborne monitoring suggest that airborne pile driving sounds associated with the Project's proposed offshore construction are not expected to adversely impact perceived sound levels nearshore or on land. Additionally, during sound propagation modeling conducted by Renterghem et al. (2014), airborne sound propagated downwind and over water under a variety of atmospheric and sea conditions was predicted to remain below approximately 40 dBA at a distance of 6.2 mi (5.4 nm, 10 km). Therefore, although receptors on the water near the pile driving activities will hear sound at varying levels, and although background noise levels (such as wind, wave action, boat engines, etc.) may cause some variability, sound levels stemming from pile driving activities are not expected to cause adverse impacts to human health or wellness.

4.2 OPERATIONS AND MAINTENANCE

4.2.1 Support Vessels and Helicopters

The number of support vessels used during O&M of the SRWF and SRWEC will be generally lower than those used during construction. O&M vessels will primarily consist of service vessels and crew transfer vessels, except in the rare event that major maintenance is required, in which case larger jack-up vessels and barges may be used. For typical O&M activities, smaller and faster vessels are likely to be used than those used during construction. A hoist-equipped helicopter and unmanned aircraft system may also be used to support O&M. Helicopters may also be used to provide supplemental means of access when vessel access is not practical or desirable.

O&M support vessels currently being considered are listed in the COP Description of Proposed Activity, Section 3.5.6. However, the type and number of vessels and helicopters will vary over the 25- to 35-year expected operational lifetime of the Project. Support vessel and helicopter traffic associated with O&M is likely to have similar, but relatively less, acoustic impacts to people located offshore or along the coast, than impacts previously described in Section 4.1.1.

4.2.2 Wind Turbine Generator Operational Noise

WTGs produce aerodynamic turbine blade noise and mechanical noise. Sound from operation of the WTGs has been modeled assuming they are all operating continuously and concurrently at the typical maximum rated sound power level of 120 dBA per WTG. These sound levels include mechanical and aerodynamic sources of the WTGs. Since WTGs typically radiate more sound in certain directions, the sound measurement test standard accounts for the maximum directional sound power level. Therefore, the sound emissions are worst-case as they relate to directivity.

The frequency and sound level generated from operating WTGs depends on WTG size, wind speed and rotation, foundation type, water depth, seafloor characteristics, and wave conditions (Cheesman 2016). Collett and Mason (2014) found that noise from operating 6 MW turbines dropped to ambient levels at approximately 328 ft (100 m) from the turbine, a study by Miller and Potty (2017) measured sound pressure levels, root mean square, (SPL_{rms}) of 100 dB re 1 μPa 164 ft (50 m) from a set of five General Electric Haliade 150-6 MW wind turbines, and other studies in Europe estimated SPL_{rms} of operational WTG noise ranging from 125 to 130 dB re 1 μPa across all octave bands (Lindeboom et al. 2011; Tougaard et al. 2009).

Based on International Electrotechnical Commission 61400-11 data from 2012, supplied by the manufacturer, standard acoustical engineering methods were used to estimate airborne sound levels anticipated from operating SRWF WTGs. This modeling is based on a 118 dBA sound power level, and considered sound pressure levels after losses from distance and air absorption. Sound propagation factors were adopted from the International Organization for Standardization (ISO) 9613-2 (1996), where sound prediction algorithms assume every point at which a sound level is calculated is downwind of all noise-emitting equipment, simultaneously. Hard ground conditions (where hard ground represents water, and soft or fully absorptive represents plowed earth), and conditions that favor propagation (10°C and 70 percent relative humidity) were used, per ISO 9613 (1993).

Results are subject to variability, depending on timescale, metrics, and evaluation methods, as long-distance sound propagation over water is complex. However, expected WTG sound levels are not anticipated to exceed 35 dBA at any area surrounding the WTGs. These results represent cumulative sound levels of all WTGs operating simultaneously at their maximum rated sound power level.

After construction of the BIWF was complete, continuous airborne noise monitoring was conducted at an onshore location over a three-month period to record operational WTG sound levels. The sound level meter was placed at the top of the Southeast Lighthouse, located approximately 4 mi (3.5 nm, 1.6 km) from the five offshore operating WTGs. Results showed no airborne noise from operational WTGs detected at any time during the three-month period of monitoring (BOEM 2019). Additionally, airborne noise monitoring was conducted offshore at the BIWF. An offshore sound level meter was installed on a survey vessel located approximately 6.6 ft (2 m) above sea level with the vessel (engine off) drifting past an operating WTG taking continuous measurements. Distance of the vessel from the WTG was approximately 164- to 328 ft (50 to 100 m). Results showed noise levels of 65 dB Equivalent Continuous Sound Pressure Level (LAeq) at the nearest location to the WTG (164 ft [50 m]); however, it was noted that the level of noise appeared to be significantly influenced by natural ambient noise, suggesting the airborne noise from WTG operation would likely be less than 65 dB Leq (BOEM 2019).

Airborne noise modeling was also conducted in April 2012 for the Beatrice Offshore Wind Farm located approximately 8 mi (7.0 nm, 12.9 km) off the coast of Scotland. Modeling results concluded that the predicted noise level at the nearest point on the shoreline from the 7 MW operational offshore WTGs would range from 26 to 27 dBA, dependent on the condition of the water's surface (Beatrice Offshore Wind Farm 2012).

Impacts from operating WTGs are expected to be minimal and highly subjective based on how sound perception varies by person. However, anticipated sound levels per the modeling and monitoring studies described above will be within, or less than, the range of typical New York daytime sound level estimates provided in Section 3.0 (35 to 55 dBA); therefore, human health and wellness is not expected to be impacted by WTG operational noise in either offshore or coastal areas.

4.2.3 Nautical Hazard Prevention Noise

Audible nautical hazard prevention devices (i.e., foghorns) will be installed on select WTGs along the outer perimeter of the SRWF. The foghorns are designed to provide a 2.30-m (2.0-nm) audible range and emit a 134 dB tone at a frequency of 660 Hertz (Hz) at 3 ft (1 m). Regulations in 33 CFR § 67 specify that foghorns are to be installed less than 150 ft (46 m) above mean sea level. The foghorn will be placed atop the transition deck at a maximum of 132 ft (40 m) above mean sea level and will be equipped with fog detection device and allow for remote operation by passing vessel (i.e., non-continuous). Noise from hazard prevention devices is expected to be muted underwater, and although it may be heard from shore, the noise will not be at harmful or nuisance levels.

5.0 ENVIRONMENTAL PROTECTION MEASURES

There are no expected adverse construction, O&M, or decommissioning airborne noises expected from offshore components of the Project, including the SRWF and SRWEC. Therefore, there are no requirements for measures to avoid, minimize, or mitigate offshore airborne noise.

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