Leading Light Wind

Attachments to Section 10

Attachment 10.1
Environmental Protection Plan

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Acronyms and abbreviations

Acronym/ abbreviation	Meaning
BOEM	Bureau of Ocean Energy Management
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO_2	Carbon dioxide
COP	Construction and Operations Plan
EEIOA	Environmentally Extended Input-Output Analysis
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FPP	Fisheries Protection Plan
FTE	Full-time equivalent
GW	Gigawatt
HAPCs	Habitat Areas of Particular Concern
HRG	High-resolution geophysical
IPAC	Information for Planning and Consultation
IPFs	Impact producing factors
ISO-NE	Independent System Operator New England
Lidar	Light detection and ranging

Acronym/ abbreviation	Meaning
MAAC	Mid-Atlantic Area Council
MMPA	Marine Mammal Protection Act
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industrial Classification System
NGTC	National Guard Training Center
NJ	New Jersey
N.JA.C.	New Jersey Administrative Code
NJBPU	New Jersey Board of Public Utilities
NJDEP	New Jersey Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NYSERDA	New York State Energy Research and Development Authority
NYISO	New York Independent System Operator
O&M	Operations and maintenance
O_3	Ozone

Acronym/ abbreviation	Meaning
OBCs	Overburdened communities
OCS	Outer Continental Shelf
OFCS	Offshore converter station
ONCS	Onshore converter station
OREC	Offshore renewable energy credit
PAM	Passive acoustic monitoring
Pb	Lead
PEIS	Programmatic Environmental Impact Statement
$PM_{2.5}$	Particulate matter 2.5
PM_{10}	Particulate matter 10
PSOs	Protected species observers
PJM	PJM Interconnection, LLC
RMI	Regional Monitoring Initiative
ROW	Right-of-way
SEIA	Solar Energy Industries Association
SAV	Submerged aquatic vegetation
SO_2	Sulfur dioxide
USACE	US Army Corps of Engineers
USCG	US Coast Guard
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
UXO	Unexploded ordnance
WTG	Wind turbine generator

01 Introduction

Invenergy Wind Offshore LLC (Leading Light Wind) is developing an offshore wind facility, Leading Light Wind (the project), within Lease Area OCS-A 0542 in the New York Bight that will interconnect into the regional power grid. Leading Light Wind has prepared this Environmental Protection Plan as a requisite component of Leading Light Wind's response to the New Jersey Board of Public Utilities (NJBPU) New Jersey Offshore Wind Third Solicitation.

The project is located offshore of New Jersey, approximately 48 miles (77 kilometers) east of Atlantic City and 57 miles (92 kilometers) from the National Guard Training Center (NGTC) at Sea Girt. [redacted] The project is adjacent, to the east, of the Atlantic Shores Offshore Wind lease area (OCS-A 0541).

For the purpose of this assessment, the Leading Light Wind project area refers to the area in which project infrastructure will be built and is split into the onshore and offshore project areas. The offshore project area refers to the lease area and submarine export cable routes, while the onshore project area refers to the NGTC landfall in Sea Girt, NJ, terrestrial export cable routes, and the parcel of land that will house the ONCS and Larrabee Collector Station (LCS) POI.

1.1 Purpose

The purpose of this Environmental Protection Plan (the Plan) is to describe how Leading Light Wind intends to avoid adverse impacts to biota and sensitive habitats within the Project area. The Plan contains an emissions assessment of the project (Section 2.3). A full cost-benefit analysis of emissions impacts can be found in Section 17 of the Application Narrative, Cost-Benefit Analysis. Where impacts cannot be avoided, this Plan describes how impacts can be minimized, and if necessary, mitigated. This Plan includes an explanation of how Leading Light Wind will implement environmental protection measures (EPMs) to address any identified environmental impacts. In addition, this plan describes Leading Light Wind's approach to engaging with environmental stakeholders and commitments to environmental research and innovation throughout the region, and includes a discussion of cumulative impacts from regional offshore wind development and a comparison of the project to other Class 1 renewable energy sources.

1.2 Environmental Protection Plan approach

This Plan includes an assessment of anticipated environmental benefits and environmental impacts of the project (per New Jersey Administrative Code [N.J.A.C.] 14:8-6.5(a)(11)(xiv)), including the impacts of routine activities associated with pre-construction, construction, operations, and decommissioning phases. This plan assumes a full build-out scenario for the project footprint, using a reasonably foreseeable scenario of impact-producing factors (IPFs) that could be conducted in support of pre-construction, construction, operations, and decommissioning activities. This scenario includes:

- **Direct effects**, which are caused by the activity and occur at the same time and place.
- **Ecological effects** (such as the effects on natural resources and the components, structures, and functioning of affected ecosystems), aesthetic, historic, or cultural, whether direct, indirect, or cumulative. Effects may include those resulting from actions which may have beneficial and/or detrimental effects.

This Plan includes a scientifically rigorous desktop assessment of associated benefits and impacts from pre-construction, construction, operations, and decommissioning activities to physical, biological, cultural, and visual resources within the project area. [redacted] Data is being collected and managed per the Data Management and Availability Plan (Attachment 10.2).

Potential project benefits

Environmental benefits

As a clean renewable source of energy, the project will improve regional air quality through the net reduction of regional air pollution over the life of the project. [redacted]

The ocean is the world's largest natural carbon sink due to absorbing excess heat and energy released from rising greenhouse gas emissions trapped in the Earth's system. CO_2 is a primary greenhouse gas. Reductions in its emissions and other greenhouse gases will contribute to improved ocean health by reducing the rate of absorption of excess heat and energy, thus reducing ice-melting, sea-level rise, marine heatwaves, and ocean acidification.

Additionally, the project is expected to create artificial reefs through the placement of wind turbine generator (WTG) and OFCS foundations with enhanced scour protection, which will create hard substrate habitats for new and more diverse communities of marine life. As described in Section 3 of the Infrastructure Monitoring Plan (Attachment 10.3), project infrastructure and other deployed assets offshore may be leveraged for research and monitoring of protected species and environmental conditions, furthering science and conservation in the region. [redacted]

Socioeconomic benefits

The project is intended to be operational by 2032 to contribute to meeting New Jersey's goal of procuring 11,000 MW of offshore wind energy by 2040. If selected by NJBPU, the project will generate $XX million of economic activity in New Jersey, including investments in supply chain, workforce development, research and innovation, and community initiatives, especially for overburdened communities (OBCs) (see Section 8 of the Application Narrative, Economic Development Plan). [redacted]

As described in Section 11 of the Application Narrative, Fisheries Protection Plan, Leading Light Wind is working with fishermen and research institutions to develop monitoring activities to better understand the ecological and socioeconomic impacts of offshore wind. Increased biomass and biodiversity resulting from the artificial reefs created by the WTG and OFCS foundations are expected to increase sport fishing enjoyment and tourism revenue for recreational fishermen.

$XX million of economic activity generated by the Leading Light Wind project

Potential impact-producing activities by project phase

Pre-construction phase

Offshore site assessment and site characterization activities will occur during the pre-construction phase of the project. Site characterization activities include geophysical, geotechnical, and biological surveys. Leading Light Wind is collecting information to determine site conditions for siting, routing, and impact assessment in advance of the Construction and Operations Plan (COP) for Bureau of Ocean Energy Management's (BOEM) review.

Leading Light Wind will conduct high-resolution geophysical (HRG) surveys to collect data on shallow hazards, archaeological, bathymetric charting, and benthic habitat. [redacted] Leading Light Wind will conduct geotechnical/sub-bottom sampling to collect data on geological resources. T[redacted]

Construction phase

During the construction phase of the project, seafloor preparation (including unexploded ordinances (UXO) removal, boulder removal, and sandwave

[redacted]

clearance, as needed), installation of foundations and scour protection, assembly of WTGs, cable laying, and anchoring of vessels will occur.

[redacted]

WTGs will be installed by loading components onto barges and installation vessels. The barge or installation vessel will transport the components to the lease area where a crane will lift the components onto the pre-installed monopile foundation. An OFCS will be installed in two phases, beginning with the substructure. The prefabricated topside structure will then be installed on top of the substructure.

Figure 10.1-2. Wind turbine installation vessel. Courtesy of Van Oord.

Operations phase

During the operations phase of the project, facility maintenance, inspections, and repairs of non-routine events will occur, along with regularly scheduled preventive maintenance based on regulatory requirements, original equipment manufacturers' guidelines, and industry best practices. Additionally, Leading Light Wind will inspect WTGs, the OFCS, foundations, the submarine export cables, inter-array cables, terrestrial export cables, ONCS, and other parts of the project using methods appropriate for the location and component. HRG surveys will be required for the life of the project as part of facility maintenance.

Decommissioning phase

Under 30 Code of Federal Regulations (CFR) 585 and commercial Renewable Energy Lease OCS-A 0542, Leading Light Wind is required to remove or decommission all facilities, cables, pipelines, and obstructions and clear the seafloor of all obstructions created by the proposed project. All facilities would be removed 15 feet (4.6 meters) below the mudline [30 CFR 585.910(a)] unless granted permission from BOEM to remain. Decommissioning will be complete within two years of termination of the lease, and all removed materials will either be reused, recycled, or responsibly disposed of. Leading Light Wind will apply a reverse installation process to decommission project infrastructure. Turbine components and the OFCS topside structure will be removed prior to foundation removal.

02 Potential project impacts assessment

2.1 Physical resources

This section describes the physical resources found within the project area, and the environmental impacts associated with development through decommissioning as required by N.J.A.C. 14:8-6.5(a)(16).

The following section assesses potential project benefits and impacts to land use, geological resources, air quality, and water quality. More detailed, site-specific studies are under development. As data becomes available, Leading Light Wind will assess impacts as part of the COP process.

Land and marine uses

Existing conditions

Land use. The landfall will be situated on federal property at the NGTC within Sea Girt Borough, abutting Manasquan Borough. The area surrounding the NGTC is primarily comprised of dense residential and commercial development. The NGTC is adjacent to a stretch of public beaches to the east, including Sea Girt Beach, Seawatch Beach, and Manasquan Beach, and is just north of Stockton Beach Park, which hosts baseball fields, a skatepark, and other recreational amenities.

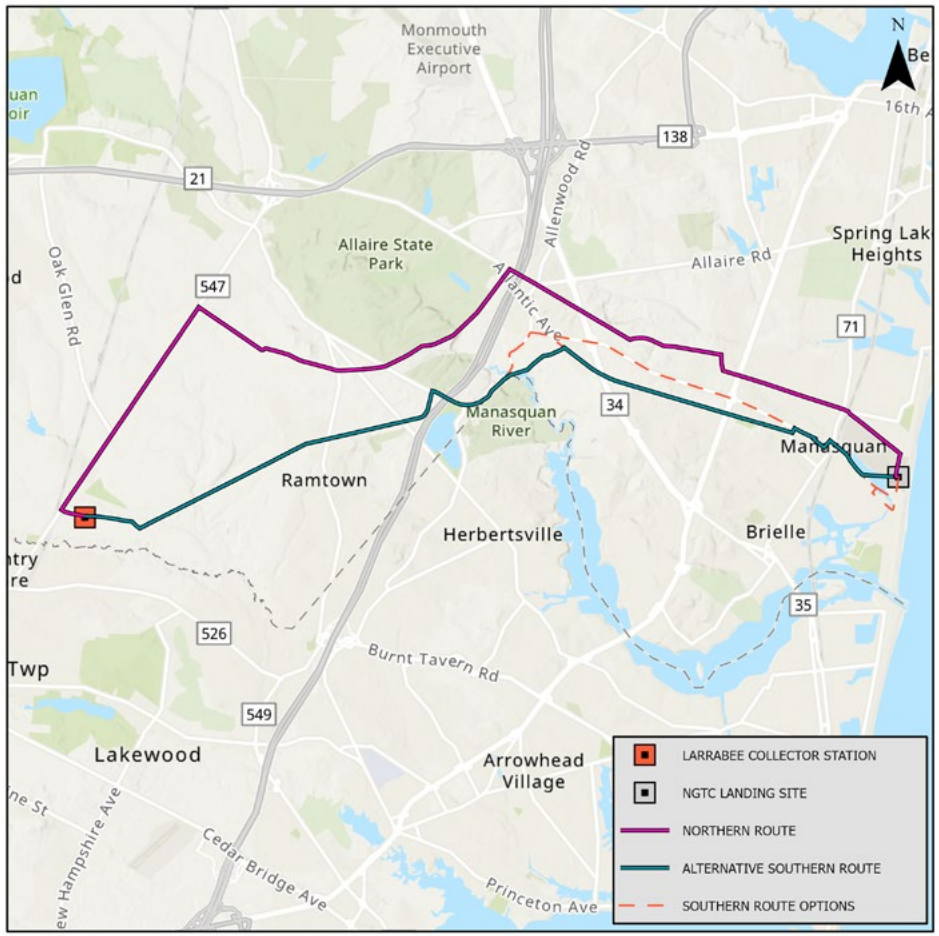

Figure 10.1-3. Proposed prebuild infrastructure terrestrial cable routes for four HVDC cables.

Recreation and tourism. The New Jersey Shore offers many opportunities for recreation and tourism, including swimming, wildlife viewing, surfing, boating, sunbathing, and recreational fishing.[1] In addition to nature-based and sporting activities, boardwalks in many of New Jersey's beach towns host a diversity of activities such as shopping, restaurants and bars, and music venues. In Sea Girt and Manasquan Boroughs, the beachfront adjacent to the NGTC landfall is primarily residential with no commercial boardwalk; however, there are other recreational amenities nearby such as Stockton Lake (popular for fishing and paddling), the Manasquan Skatepark and Stockton Beach Park just south of NGTC, and Crescent Park, north of NGTC.

[redacted]

Offshore recreation and tourism activities in New Jersey include recreational boating, fishing, scuba diving, whale watching, and sailing (MARCO 2022). In Monmouth County, 94.6% of all ocean-related jobs are related to tourism (NOAA 2012). Scuba diving is popular in the area on the many shipwrecks that dot the New Jersey coast, and there are several dive shops in Monmouth and Ocean Counties, particularly in the Manasquan River vicinity. As described in the Fisheries Protection Plan (Section 11 of the Application Narrative), recreational fishing mostly occurs from shore, and roughly a third of anglers report fishing from a private boat. Recreational fishing activity tends to peak in the warmer summer months and decrease throughout the winter. Minimal recreational fishing effort was reported in the lease area itself, and no party/charter revenue was reported over the available data years between 2008-2017.

Impacts assessment

During construction, potential IPFs affecting land and marine uses within the project area include land disturbance, noise, onshore and offshore traffic, and visible structures/lighting. Use of public open spaces, including beaches and parks, could be impacted by these IPFs. [redacted] Localized and temporary land disturbance may occur onshore during the construction and decommissioning phases of the project from the movement of construction vehicles, equipment placement, and trenching activities. Public access to the beach adjacent to the NGTC landfall may be limited during construction, and the enjoyment of nearby beaches may be impacted by noise and the presence and lighting of construction equipment. During construction there may be increased vessel traffic from the staging

[1] ICF Incorporated, LLC. 2012. "Atlantic Region Wind Energy Development: Recreation and Tourism Economic Baseline Development." Herndon, VA: U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. www.espis.boem.gov.

area to the offshore project area and disturbances to the seabed from cable burial which may disrupt recreational fishing activities.

[redacted] There may be increased noise from trench excavation and visual impacts from temporary construction equipment and the lighting of construction areas, all of which may deter tourists from visiting recreational sites. However, these impacts will be temporary and localized. Because the landfall and cable infrastructure will be installed underground, and areas would be restored to original or better conditions following construction, no permanent impacts to land use or recreation and tourism onshore are anticipated. If onshore project infrastructure is removed during decommissioning, impacts are anticipated to be equal to or less than those during the construction phase.

During the operations phase, potential IPFs affecting land and marine uses will be reduced but may include noise and visible structures/lighting. The new construction and lighting of onshore electrical components, such as an ONCS, may have direct and long-term impacts on surrounding land uses due to increased lighting at night. [redacted] There may be imperceptible increases in both vehicle and vessel traffic to perform maintenance on both onshore and offshore project infrastructure during the operations phase; however, these changes will be in line with existing traffic patterns and are not expected to impact land and marine uses. Additionally, the Leading Light Wind lease area is situated far enough offshore that it will not be visible from land. As such, no visual impacts are anticipated to land uses or onshore recreation and tourism activities.

Construction activities will cause an increase in vessel traffic in the project area and may involve the use of a variety of marine, air, and land vehicles. Construction activity and vessel traffic to the offshore project area may cause increased noise and navigational hazards. Leading Light Wind will conduct a Navigational Safety Risk Assessment to determine potential impacts to navigation. During operations, obstructions from project infrastructure may impact traditional vessel navigation. Evaluations of spacing and layout of the WTGs in coordination with the US Coast Guard (USCG) will inform layout to ensure sufficient sea room for safe vessel navigation and USCG maneuvers. Additionally, helicopters may be used during project phases. Leading Light Wind will comply with Federal Aviation Administration (FAA) requirements and coordinate with the Department of Defense to minimize impacts to military operations should they be within the affected project area.

Figure 10.1-4. The offshore components of Leading Light Wind are not expected to be visible to onshore communities.

Environmental protection measures

Leading Light Wind has conducted a terrestrial cable routing analysis to identify the least-disruptive routing options from the landfall to the LCS. To minimize land disturbance, [redacted] Where necessary, Leading Light Wind will secure crossing agreements with utility owners. [redacted]

Leading Light Wind will minimize impacts to wetlands by maintaining buffers around wetlands, implementing best management practices from erosion and sediment control, and maintaining natural surface drainage patterns (see Wetlands in Section 2.2 below). Through consultation with regulatory agencies such as the US Army Corps of Engineers (USACE), the project will implement any required mitigation measures.

All onshore construction and operations activities will comply with New Jersey Department of Environmental Protection (NJDEP) noise regulations (N.J.A.C. 7:29) and any relevant local ordinances. [redacted]

To minimize traffic impacts, Leading Light Wind will follow best management practices, create, and maintain a Traffic Management Plan, coordinate with local agencies and authorities, and ensure construction work areas allow one lane of traffic to pass whenever feasible. All necessary permits and crossing agreements will be obtained prior to the start of construction activities.

Additionally, Leading Light Wind will notify relevant federal, Native American Tribes and Tribal Nations, state, and local authorities, and stakeholders including local businesses and fishermen, when construction and maintenance activities are scheduled to occur. Leading Light Wind will distribute Local Notices to Mariners and publish vessel traffic corridors ahead of planned offshore survey and construction activities.

Geological resources

Existing conditions

The offshore project area is situated on a broad continental shelf with a width generally greater than 75 miles (120 kilometers). The water depth at the lease area ranges from approximately 120-300 feet (36- 91 meters). The seabed is covered by a mantle of sand approximately 65 feet (20 meters) deep. Linear sand ridges are also characteristic of the continental shelf in this region. The continental slope in the region contains the Hudson Canyon. Sediments on the slope are highly variable but consist mainly of sandy silts on the upper slope and silts and clays on the lower slope (McGregor 1983).

Just south of the project there is a deep sedimentary basin under the continental margin, the Baltimore Canyon Trough. The mineral particles in the northeast-trending basins are characterized by extensional tectonic features (horst and graben) related to the rifting between North America and Africa during the Triassic Period approximately 200 million years ago. Both basins thicken seaward and have no physiographic expression. The Baltimore Canyon Trough is the deepest basin along the US Atlantic margin, with a thickness of up to 11 miles (18 kilometers) (McGregor 1983; Mattick and Hennessy 1980; Schlee and Klitgord 1988; Grow et al. 1988).

The onshore project area is situated on the Coastal Plain which is the largest physiographic province in New Jersey (NJ DEP 2006). The unconsolidated deposits of the Coastal Plain age from the upper Lower Cretaceous to the Miocene. At Sea Girt, the rocky soil type is sand and pebble gravel up to 50 feet thick but generally less than 20 feet thick. The terrestrial export cable routes will traverse through a combination of sand, pebble gravel, minor silt, clay, peat, and cobble gravel. The soil combination can extend up to 200 feet thick on the Cape May peninsula, but generally less than 50 feet thick elsewhere. Further onshore the soil is made up of a combination of exposed sand and clay of Coastal Plain bedrock formations. It includes thin, patchy alluvium and colluvium, and pebbles left from erosion of surficial deposits.

Impacts assessment

Potential impacts on geological resources from the development, construction, operations, and decommissioning phases of the project include physical seabed and land disturbance and sediment suspension. Temporary IPFs include cable burial and seafloor preparation, which may include boulder removal and sandwave clearance. Permanent impacts would result from placement of facilities/structures or associated scour and cable protection on the seabed or soils.

[redacted] Temporary impacts to geologic resources would result from sediment and soil removal or displacement and re-suspension.

Environmental protection measures

Leading Light Wind will conduct seafloor surveys to ensure that the project is sited appropriately to avoid or minimize potential impacts associated with seafloor instability or other hazards; and to identify and characterize topographic features. During cable installation, Leading Light Wind will take all reasonable actions to minimize seabed disturbance and sediment dispersion. [redacted] All measures proposed would be subject to regulatory review and approval.

After cable installation, Leading Light Wind will conduct routine surveys or inspections of sub-sea cables as well as inspections following hurricane or other major events causing disturbance to the seabed as part of the maintenance of the facility during the operations phase. If the surveys or inspections reveal cable damage or exposure, then Leading Light Wind will mitigate the issue and restore cable burial to acceptable standards. Underwater cables will have the appropriate shielding to control the intensity of electromagnetic fields. Per N.J.A.C. 7:7 9.13, cable installation and cable maintenance and repair buffer areas will avoid shipwreck and artificial reef habitats, as well as other culturally or archaeologically sensitive areas. [redacted]

Air quality

Existing conditions

Onshore air quality is characterized by comparing the ambient air concentrations of criteria pollutants to the National Ambient Air Quality Standards (NAAQS), which have been established by the US Environmental Protection Agency (EPA) to be protective of human health and welfare. The NAAQS have been established in 40 CFR Part 50 for each of the six criteria pollutants: sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$, particulate matter with a diameter less than or equal to 10 and 2.5 micrometers [µm], respectively), and lead (Pb). Ozone forms in the atmosphere from precursor pollutants such as nitrogen oxides (NOx) and volatile organic compounds.

When the monitored pollutant levels in an area exceed the NAAQS for any [redacted]

Section 162(a) of the Clean Air Act (CAA) establishes air quality protections for designated Federal Class I areas such as national parks, national wilderness areas, and national monuments. Class I Areas are defined in Sections 101(b)(1), 169A(a)(2), and 301(a) of the CAA, as amended (42 USC 7401(b), 7410, 7491(a)(2), and 7601(a)). In these areas, very little air quality degradation is allowed and air quality-related values including visibility are protected. There is one Class I area in New Jersey, the Brigantine Wilderness Area, in southern New Jersey approximately 11 miles north of Atlantic City. Class I areas have stringent incremental limits for NO_2, SO_2 and PM_{10}. The Brigantine Wilderness Area is 53 miles from the NGTC at Sea Girt; therefore, no impacts from onshore or offshore activities are expected.

Impacts assessment

Direct pollutant emissions associated with the pre-construction, construction, operations, and decommissioning of the project would impact air quality in the lease area, along cable routes, at the landfall, and onshore at the site of the LCS and ONCS. Most potential impacts to air quality from these direct emissions are temporary. Pollutant concentrations due to emissions from the project during the construction and decommissioning phases could lead to violations of the NAAQS in the short-term and would therefore require mitigation in accordance with the EPA Region 2 and the New Jersey State Implementation Plan. In the long-term, the project will have beneficial impacts to air quality as it is a clean source of renewable energy that would result in a long-term net reduction of regional air pollution over the life of the project through displacement of fossil fuel-generated power plants. For detailed information regarding the direct and avoided emissions of the project, see the emissions assessment in Section 2.4, Environmental Benefits and Emissions Impacts.

Environmental protection measures:

Once operational, the project itself is an air quality impact avoidance measure since it will result in a net reduction of regional air pollution over the life of the project. During pre-construction surveys and construction, when increased pollutant emissions are possible, Leading Light Wind will take steps to avoid and minimize impacts to air quality. The International Maritime Organization recommends very low sulphur fuel oil and marine gas oil; additionally, vessels can limit their air pollutants by installing exhaust gas cleaning systems, known as “scrubbers”. To the extent practicable, Leading Light Wind will use appropriate installation technology and vessels, helicopters, and automobiles that meet modern EPA standards to minimize exhaust and pollutant emissions. This includes the use of low sulfur fuels (15 parts per million [ppm] per 40 CFR §80.510 as applicable); select engines designed to reduce air pollution to the extent practicable (such as EPA Tier 3 or 4 certified); limit engine idling time, comply with international standards regarding air emissions from marine vessels, and implement dust control plans onshore. By employing these measures during the manufacture, transportation, installation, and maintenance phases of the project, Leading Light Wind will minimize the release of embodied carbon.

According to the EPA’s *Final Rule for Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards*, there is a 60% reduction of sulfur in fuel and older cars would run cleaner, cutting an estimated 260,000 tons of NOx in a single year. With these changes, by 2030, EPA projects an annual prevention of up to 2,000 premature deaths, 50,000 respiratory illnesses in children, and 2,200 asthma attacks.

Leading Light Wind is committed to reducing air pollution throughout the development of the project, particularly in environmental justice and overburdened communities.

[redacted]

Water quality

Existing conditions

The offshore project area sits 40 miles off the coast of New Jersey in the highly stratified continental shelf waters of the North Atlantic. The benthic environment of the project area is predominantly sandy (NJDEP, 2010). Offshore benthic habitat varies significantly by season and proximity to the coast. Inshore, coastal areas have the highest production area due to nutrient upwelling coming from coastal inlets.

[redacted] Currently, there are no downstream water quality monitoring efforts in these areas (USGS, 2023).

Impacts assessment

The IPFs affecting water quality include physical seabed disturbance, sediment suspension, discharges, releases, and water withdrawals from vessels. Seabed disturbance for offshore construction activities will result in localized and temporary increases of suspended sediment. Seabed disturbance from submarine cable inspections and repairs during the operations phase will result in temporary increases of suspended sediment. Potential water contamination may occur from accidental spills and of the hazardous materials. An accidental spill or release of hazardous materials could be caused by vessel collisions with other vessels or allisions with project infrastructure. Collisions and allisions occur infrequently out in the ocean but could occur due to unexpected severe weather and decreased visibility. Most vessels have marine vessel radar or automatic identification system (AIS) transponders to detect activity in the ocean. Transponders are required for many commercial vessels and for passenger ships. All project infrastructure will be clearly lighted and marked as required by the USCG, and will include an AIS marking schema. Infrastructure will also be labelled on NOAA nautical charts, thereby reducing the risk of an event.

The largest volumes of oils/fuels as part of an offshore wind facility are located on buoy generators. It is estimated that the average buoy generator could contain 240 gallons of diesel fuel (Fishermen's Energy of New Jersey, LLC 2011). In the unlikely event that an accidental release of oil or hazardous materials occurs, no long-term impacts to water quality are anticipated since potentially impactful activities are temporary and localized. In addition, water resources should recover completely after decommissioning because there will no longer be any routine seabed disturbing or sediment suspension-causing activities taking place. Impacts to water quality are expected to be localized and temporary with the application of environmental protection measures.

Environmental protection measures

Leading Light Wind will implement turbidity reduction measures to minimize impacts to water quality from pre-construction surveys and sampling, construction, and decommissioning activities to the extent practicable, as documented in the project's sediment sampling and analysis plans prepared for geotechnical surveys and construction activities. Potential discharges will be in conformance with required federal, state, and local approvals. All vessels will be certified to conform to vessel O&M protocols designed to minimize the risk of fuel spills and leaks. Additionally, Leading Light Wind will prepare all applicable waste management and hazardous materials plans, including a Spill Prevention, Control, and Countermeasures Plan (which includes an Oil Spill Response Plan), and a Stormwater Pollution Prevention Plan, as required by federal, state, and local law.

If needed, Leading Light Wind will obtain a National Pollutant Discharge Elimination System (NPDES) 316(b) permit for the cooling system associated with the OFCS. The Clean Water Act prohibits any discharge of pollutants through a point source into a "water of the United States" without an NPDES permit. The permit will contain limits on what Leading Light Wind can discharge, monitoring and reporting requirements, and other provisions to ensure that the discharge does not degrade water quality.

An environmental monitoring program will be implemented for the project area, including offshore, and will monitor for environmental changes and necessary impact mitigation. The environmental monitoring program may include regularly scheduled inspections, especially after severe weather events, and the installation of thermometers and acoustic doppler current profilers (ADCPs) to detect changes in the water.

2.2 Biological resources

This section describes the biological resources found within the project area, and the environmental impacts or benefits associated with development through decommissioning as required by N.J.A.C. 14:8-6.5(a)(16). The following assessment represents the best data publicly available from desktop analyses. More detailed site-specific and resource-specific studies are under development. As data becomes available, Leading Light Wind will assess impacts as part of the COP process and ongoing project surveys.

Figure 10.1-5. The piping plover and silver-haired bat are species that can be found in the onshore project area.

Avian and bat

Existing conditions

The offshore project area is not within many avian species' seasonal habitats; rather, there are a significant number of migratory seabirds that use the general area during seasonal migrations. Seabirds use offshore waters to forage for fish and marine invertebrates. Using US Fish and Wildlife Service (USFWS) Information for Planning and Consultation tool (IPAC), 11 species of birds protected under the Migratory Bird Treaty Act (16 U.S.C. 703-712) were identified as using the offshore project area.[2] These species include the following:

- Atlantic puffin (*Fratercula arctica*)
- Common loon (*Gavia immer*)
- Common murre (*Uria aalge*)
- Cory's shearwater (*Calonectris borealis*)
- Dovekie (*Alle alle*)
- Great shearwater (*Ardenna gravis*)
- Manx shearwater (*Puffinus puffinus*)
- Pomarine jaeger (*Stercorarius pomarinus*)
- Razorbill (*Alca torda*)
- Red necked phalarope (*Phalaropus lobatus*)
- Wilson's storm petrel (*Oceanites oceanicus*)

The onshore project area covers habitat potentially used by USFWS and state threatened and endangered species, including piping plover (*Charadrius melodus*), least tern (*Sternula antillarum*), red knot (*Calidris canutus rufa*), osprey (*Pandion haliaetus*), and bald eagle (*Haliaeetus leucocephalus*).[2] Shorebirds such as piping plover may use beach and dune habitat near the NGTC landfall for nesting.

There are several bat species that can be found in New Jersey year-round and seasonally. Northern long-eared bat (*Myotis septentrionalis*), tricolored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis lucifugus*), eastern small-footed bat (*Myotis leibii*), hoary bat (*Lasiurus cinereus*), eastern red bat (*Lasiurus borealis*), and silver-haired bat (*Lasionycterus noctivagans*) can all be found in New Jersey at various times of the year, but most common are the big brown bat, little brown bat, tricolor bat and northern long-eared bat. The tricolor and northern long-eared bat species are federally listed as endangered.[2] These bat species tend to hibernate in caves or manmade structures. The hoary, eastern red, and silver-haired bats are all migratory, spending winters in subtropical or tropical regions. These migratory species tend to roost in trees or crevices rather than manmade structures.

[2] US Fish and Wildlife Service. Information for Planning and Consultation (IPAC). www.ipac.ecosphere.fws.gov. Accessed April 27, 2023.

Impacts assessment

Temporary, onshore habitat disruption may occur due to increased traffic, noise, and construction activities. During pre-construction surveys and construction, impacts may include temporary avian and bat habitat avoidance and displacement from increased traffic, noise, and lighting from construction activities. Construction debris may also cause avian and bat species to temporarily avoid habitat. During decommissioning, impacts are expected to be similar or less than those during construction. Visual impacts from construction and infrastructure are discussed in Section 2.3 and in the Visibility and Viewshed Impacts Assessment (Appendix A).

Offshore temporary habitat disruption may occur due to increased vessel traffic, noise, and construction in the lease area and along submarine cable routes. During pre-construction vessel surveys and construction, there may be habitat avoidance and displacement by avian and bat species migrating and foraging in the offshore project area. Impacts during operations are reduced, as compared to construction impacts, and may include habitat avoidance and migration pattern alteration due to the presence of the WTGs and OFCS. During decommissioning, habitat disruption is expected due to increased vessel traffic, increased noise, and construction. Lighting impacts from all project phases are expected from infrastructure, vessels, and construction equipment.

Environmental protection measures

Protection measures for avian and bat species will be incorporated through site and infrastructure design, such as using low intensity strobe lights to deter avian and bat species from structures, coupled with additional deterrents to reduce and avoid turbine collision. Leading Light Wind will ensure offshore project area lighting during construction, operations, and decommissioning meets BOEM, FAA, and USCG requirements (Form CG-2554).[3] Leading Light Wind will follow all voluntary marking and lighting rules to increase the conspicuity of structures where appropriate.

Using varied monitoring techniques to understand usage of the offshore project area during migration will inform future mitigation efforts.[4] [redacted]

[redacted]

During construction, slow starts can be used to provide ample opportunity for wildlife to vacate areas prior to pile driving or other high-noise construction activities, and boom structures can be used surrounding construction areas to reduce spread of waste and debris. Leading Light Wind will prepare all applicable waste management and hazardous materials plans, including a Spill Prevention, Control, and Countermeasures Plan (which includes an Oil Spill Response Plan), as required by federal, state, and local law.

Onshore vegetation

Existing conditions

[redacted]Tree species are likely made of varying North American species, including maple (*Acer*) and oak (*Quercus*) species.

Sea Girt NGTC, while heavily developed, does have beach habitat. Vegetation in the sandy beach and dune area is made up of grasses including, bitter panicgrass (*Panicum amarum*), coastal panicgrass (*Panicum amarum var. amarulum*), switchgrass (*Panicum virgatum*), saltmeadow cordgrass (*Spartina patens*), beach pea (*Lathyrus maritima*) along with other dune plant species. The beach is heavily used by tourists and recreation during the summer months but may have potential habitat for the federally threatened seabeach amaranth (*Amaranthus pumilus*).

Impacts assessment

[redacted]Temporary impacts may include vegetation removal and increased probability of erosion. Cable burial during the construction phase may temporarily disturb beach habitat near landfall at the Sea Girt NGTC.

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[3] Bureau of Ocean Energy Management. (2022). *Appendix D: Typical environmental protection mitigation measures and best management practices*. www.boem.gov.

[4] O'Connell, A., C. S. Spiegel, and S. Johnson. (2011). *Compendium of Avian Occurrence Information for the Continental Shelf Waters along the Atlantic Coast of the United States, Final Report (Database Section - Shorebirds)*. Prepared by the U.S. Fish and Wildlife Service, Hadley, MD for the USGS Patuxent Wildlife Research Center, Beltsville, MD. U.S. Department of the Interior, Geological Survey, and Bureau of Ocean Energy Management Headquarters, OCS Study BOEM 2012-076.

Environmental protection measures

[redacted] During construction, Leading Light Wind will prepare all applicable waste management and hazardous materials plans, including a Spill Prevention, Control, and Countermeasures Plan (which includes an Oil Spill Response Plan) and a Stormwater Pollution Prevention Plan. An environmental monitoring program will be implemented in the project area to monitor changes and implement any necessary impact mitigation. If protected vegetation species are found, such as seabeach amaranth, Leading Light Wind will work with NJDEP to provide appropriate protection and mitigation.

Commercial finfish and shellfish

Existing conditions

Finfish and shellfish within the project area are covered in detail in Section 11 of the Application Narrative, Fisheries Protection Plan.

The project area covers a variety of habitats for over 50 fish species, some of which are commercially-fished finfish and shellfish in both state and federal waters. The top 10 species of historical commercial importance in the lease area include sea scallops, surfclam, ocean quahog, *Loligo* (longfin) squid, summer flounder, black sea bass, *Illex* (shortfin) squid, monkfish, and scup. In the broader project area, menhaden, American lobster, bigeye tuna, and golden tilefish are also economically important. Dredge and trawl methods are most frequently used for commercial fish harvesting in the offshore project area. Along the export cable routes, dredges, trawls, and pot/trap gear are most frequently used, with some gillnetting activity off of Sea Girt, NJ. These fishing methods can impact sandy and muddy-bottomed areas. In addition, there are several designated prime fishing and aquaculture areas within the project area. The Fisheries Protection Plan provides further detail and maps of these areas.

The cable routing from the lease area to shore passes through Essential Fish Habitat (EFH) for several highly migratory fish species.[5] NOAA Fisheries has designated the coast of New Jersey as habitat areas of particular concern (HAPCs) for summer flounder populations in submerged aquatic vegetation. Summer flounder HAPCs are designated for any EFH area containing macroalgae, seagrasses, or freshwater or tidal macrophytes in either loose aggregations or beds. Based on available data, five Endangered Species Act (ESA)-listed fish species could occur in the project area: the Atlantic salmon (*Salmo salar*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), shortnose sturgeon (*Acipenser bervirostrum*), giant manta ray (*Manta birostris*), and oceanic whitetip shark (*Carcharhinus logimanus*). The federally endangered Atlantic sturgeon has designated critical habitat in the Hudson and Delaware Rivers. While these two critical habitats are outside of the project area, the endangered species may be found transiting the project area. More detailed information regarding fish, endangered species, and fisheries maps can be found in Section 11 of the Application Narrative, Fisheries Protection Plan.

Impacts assessment

A detailed list of potential impacts to fish and fisheries over all stages of project development are included in Section 11 of the Application Narrative, Fisheries Protection Plan.

During pre-construction, temporary impacts from seabed and oceanographic surveys may cause seabed and sediment disturbances. Similarly, temporary impacts during construction may include sediment disruption from cable burial and seafloor preparation activities such as boulder removal or sandwave clearance, and increased turbidity and sediment redistribution during construction of offshore project infrastructure. Other impacts include individual fish mortality due to construction activities. Permanent impacts include installation of WTG and OFCS foundations and scour and cable protection. These impacts could disrupt fishing operation patterns and harvest in the offshore project area. There is also the chance that fishing gear may become entangled in project infrastructure, resulting in loss of gear.

Activities during the operations phase would likely have temporary impacts including increased vessel traffic and noise from regular maintenance inspections. During decommissioning, there may be loss of the artificial reef habitat created by WTG and OFCS foundations. Decommissioning of the infrastructure would have similar environmental impacts as the construction phase, regarding sediment disruption and noise.

Environmental protection measures

Proposed mitigation measures to potential fish and fisheries impacts are described in Section 11 of the Application Narrative, Fisheries Protection Plan.

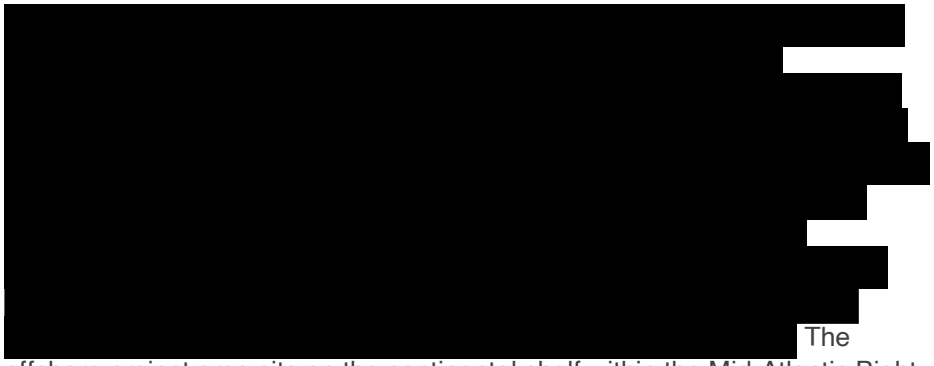
[5] NOAA Fisheries. NOAA Fisheries Essential Fish Habitat Mapper. Accessed April 27, 2023. www.habitat.noaa.gov/apps/efhmapper.

Leading Light Wind will use a variety of noise mitigation technologies to reduce the effects of construction and vessel noise on marine organisms. Additionally, Leading Light Wind will develop and follow a sediment sampling and analysis plan and follow all sediment disruption mitigation techniques included in the plan. Removal of infrastructure during decommissioning will use similar noise and sediment mitigation techniques as the construction phase to reduce noise and sediment plumes from the removal of infrastructure.

Aquatic invertebrates

Existing conditions

Benthic invertebrates. Benthic surveys carried out by NJDEP categorize the benthic environment of the region through all seasons from 2007 through 2009. These studies allow the environment of the offshore project area to be characterized based on species composition, abundance, and density. Offshore benthic habitat varies due to the highly stratified nature of the continental shelf (NJDEP, 2010). Inshore, coastal areas have the highest production area due to nutrient upwelling coming from coastal inlets. Offshore areas experience much less upwelling and are significantly striated.



The offshore project area sits on the continental shelf within the Mid-Atlantic Bight. Benthic biomass surveys of the region primarily reveal presence of Atlantic sea scallops (*Placopecten magellanicus*), Atlantic horseshoe crab (*Limulus polyphemus*), Jonah crab (*Cancer borealis*), and blue crab (*Callinectes sapidus*).[6]

Aquatic invertebrates. The rivers and streams of New Jersey have a diverse range of aquatic invertebrates that depend on differing habitats and water qualities. The submarine export cable makes landfall at the NGTC in Sea Girt, bordering Stockton Lake, which flows into the Manasquan River estuary. The area between Stockton Lake and the Manasquan River, and 0.5 nautical miles offshore of the landfall is prohibited from aquaculture development.[7] Common freshwater and estuarine invertebrates in the project area are characterized as Coastal Plain Macroinvertebrate Index invertebrates.[8] Macroinvertebrates can be used as stream health indicators, as they spend most of their lives in the same body of water, unable to escape from pollution (EPA, 2022).

Impacts assessment

Both onshore and offshore construction will cause temporary impacts to aquatic invertebrates in the form of silt disturbance and possible temporary redirection of water flow. These impacts may be caused by submarine and terrestrial cable burial and seabed preparation activities such as boulder removal and sandwave clearance. Permanent impacts may include individual fish mortality due to construction, and habitat shifts and reduction in response to construction activities. If the cables are removed during decommissioning, there will be similar temporary environmental impacts as during construction, including sediment suspension and resettlement and individual mortality from disruptive decommissioning activities.

Environmental protection measures

Leading Light Wind will adhere to local, state, and federal clean water and pollutant regulations. Leading Light Wind will develop pre-construction Tier-2 Submerged Aquatic Vegetation (SAV) surveys and plans to avoid sensitive habitats within the offshore project area and landfall following *Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy*

[6] NOAA Fisheries. Northeast Benthic Invertebrates; Integrated Ecosystem Assessment. Accessed April 27, 2023. www.integratedecosystemassessment.noaa.gov/regions/northeast/.

[7] New Jersey Department of Environmental Protection. (2016). *Sanitary survey of shellfish growing area NE5 Manasquan River.*

[8] New Jersey Department of Environmental Protection. (2018). *New Jersey Department of Environmental Protection Announces Coastal Resiliency Projects*. Press Release, March 20, 2018. www.njdep.gov/dep/newsrel/2018/18_0096.htm.

Development on the Atlantic Outer Continental Shelf pursuant to 30 CFR Part 585.[9] During construction, ramp-up soft starts will be used to allow mobile species to vacate an area prior to drilling and pile driving. During decommissioning, survey data will inform removal of infrastructure in an appropriate manner.

Seagrass beds

Existing conditions

SAV in New Jersey coastal areas is predominately made up of two species: eelgrass (*Zostera marina*) and widgeongrass (*Ruppia maritima*).[10] Both species are found throughout brackish wetlands, coastal areas, and estuaries, and use shallow, soft bottom habitat. These species form habitat for numerous organisms, in particular shellfish.[11] Not only are seagrass beds integral in the early lifecycles of commercially important shellfish, but they also play a critical role in climate resiliency. Seagrass beds act as a stabilizer in reducing sediment disruption and reducing wave action while also acting as a highly efficient carbon burial ecosystem. In recent decades, New Jersey's seagrass beds have declined in size due to development, dredging, and eutrophication.[12]

Impacts assessment

During pre-construction and construction, the seagrass beds near the landfall and in Barnegat Bay may face temporary and/or permanent impacts from increased pollution from vessel traffic and increased sediment disruption from cable burial. There may be temporary loss of SAV due to cable burial/encampment. During the operations phase, there is the potential for temporary sediment disruption if cable maintenance needs to occur.

Environmental protection measures

Leading Light Wind will prepare and conduct pre-construction surveys to understand SAV composition and extent in the project area. This will inform construction activities and where to avoid seabed disturbance and impacts to SAV beds. Where temporary seabed disturbance occurs, replanting of juvenile seagrasses may support habitat regrowth following construction. Other site characterization surveys will inform Leading Light Wind's approach to reducing impacts (spill prevention, seabed disturbance prevention) to complex benthic and coastal habitats. Leading Light Wind will prepare all applicable waste management and hazardous materials plans, including a Spill Prevention, Control, and Countermeasures Plan (which includes an Oil Spill Response Plan), as required by federal, state, and local law.

Wetlands

Existing conditions

The NGTC landfall borders Stockton Lake which flows into the Manasquan River estuary. At the landfall, there is a 1.45-acre freshwater emergent wetland, which is adjacent to the approximately 42-acre marine and estuarine wetland of the coast.[13] [redacted] These wetlands provide habitat for aquatic and estuarine organisms such as stone and mayflies which act as indicators of water quality and pollution (NJ NWLS, 2021).

New Jersey has two federally endangered species potentially found in its wetlands. Swamp pink (*Helonias bullata*) is a federal threatened, state endangered wildflower found in wetlands with a large pink flower. This flower depends on stable high-water tables to survive. As development in New Jersey has grown and wetlands have diminished, this species has become endangered. The bog turtle (*Glyptemys muhlenbergii*) is the smallest turtle species in North America, growing up to 4.5 inches. Bog turtles rely on forested wetland habitat for their semi-aquatic life stages, which has become significantly diminished due to road and housing development.

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[9] Bureau of Ocean Energy Management. (2019). *Guidelines for providing benthic habitat survey information for renewable energy development on the Atlantic outer continental shelf.*

[10] New Jersey Department of Environmental Protection. *Natural and Working Lands Strategy: Scoping Document 2021.*

[11] Bologna, P., and Sinnema, M. (2012). Restoration of seagrass habitat in New Jersey, United States. *Journal of Coastal Research, 28*(1A), 99-104.

[12] Lathrop, R. G., and Haag, S. (2011). *Assessment of seagrass status in the Barnegat Bay-Little Egg Harbor estuary system: 2003-2009.* Rutgers University, Grant F. Walton Center for Remote Sensing and Spatial Analysis, New Brunswick, NJ, CRSSA Report #2011-01.

[13] US Fish and Wildlife Service. *National Wetlands Inventory.* Accessed April 27, 2023.

Impacts assessment

Because the terrestrial export cables will be buried, there may be temporary impacts to wetlands and road culverts in the form of increased sediment disruption and surface water alterations. There may also be temporary loss of SAV in wetland areas due to cable burial/encampment during the construction phase.

Environmental protection measures

All local, state, and federal wetland protections will be followed including the Clean Water Act (33 U.S.C. §§ 1251). This includes consultation with NJDEP and USACE to establish any known impacts and/or required mitigations.

[redacted] Pre-construction wetland surveys and delineations will provide guidance as to the extent of potential impacts and mitigation efforts. During construction and cable burial, ensuring culverts are open and passable in areas with potential bog turtle and other wetland species habitat will reduce permanent and temporary impacts.

Additionally, Leading Light Wind will prepare all applicable waste management and hazardous materials plans, including a Spill Prevention, Control, and Countermeasures Plan (which includes an Oil Spill Response Plan) and a Stormwater Pollution Prevention Plan. An environmental monitoring program will be implemented in the project area to monitor environmental changes and necessary impact mitigation.

Marine mammals and sea turtles

Existing conditions

Several migratory marine mammal species use the coastal and offshore habitat of the New York Bight (an area offshore along the Atlantic coast that generally extends from Cape May Inlet in New Jersey to Montauk Point on the eastern tip of Long Island), including the project area that are protected under the ESA (16 U.S.C. § 1531 et seq) and the Marine Mammal Protection Act (MMPA) (16 U.S.C. §§ 1361).

Fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaengliae*), blue whale (*Balaenoptera musculus*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter microcephalus*) have been detected year-round in the New York Bight through passive acoustic monitoring.[14] North Atlantic right whale (*Eubalaena glacialis*) migrate through the mid-Atlantic from seasonal foraging in the Gulf of Maine and calving grounds in Florida, and have also been identified in the New York Bight year-round.

Digital aerial surveys conducted for NYSERDA identified three seal species in the project area. Harbor, gray, and harp seals can be found year-round in the region, but with higher densities in winter and summer (Wilmott et. al, 2021).

Several sea turtle species can also be found in the New York Bight, including Kemp's ridley, green, leatherback, and loggerhead turtles, all of which are ESA-listed as endangered (NYDEP, 2020). These sea turtle species tend to migrate northward along inshore space during the spring, and do the reverse in the late fall, with the highest number of sightings in the New York Bight occurring in July.[15]

Impacts assessment

Marine mammals are susceptible to the effects of human use of coastal and offshore waters. Vessel strikes and entanglement from fishing gear and other lines are the leading causes of mortality for the critically endangered North Atlantic right whale.[16]

Increased underwater noise from construction activities, increased vessel traffic, seafloor preparation activities, and foundation pile driving may cause species to temporarily avoid the project area. During construction, noise impacts will be direct and temporary for the duration of the noise-producing activity. During operations, noise impacts will be minimal and limited to regular vessel traffic associated with maintenance. While unlikely, permanent impacts may occur if an individual, particularly an ESA (16 U.S. Code § 1531), or MMPA (16 U.S.C. 1361 § et. Seq.) listed species is harmed during construction or operations.

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[14] Whitt AD, Dudzinski K, and Laliberté JR. (2013). *North Atlantic right whale distribution and seasonal occurrence in nearshore waters off New Jersey, USA, and implications for management*. Endang Species Res 20:59-69.

[15] New York State Energy Research and Development Authority (NYSERDA). Offshore Wind Master Plan 1.0: Marine Mammals and Sea Turtle Study 2017.

[16] NOAA Fisheries. *US Atlantic and Gulf of Mexico Marine Mammal Stock Assessment 2022*. Accessed April 27, 2023.

Seals use the offshore project area as well as beaches and rocky outcrops to haul out. While known haul out sites are north of the project area, it is not uncommon for seals to haul out on beaches. Construction activities and noise may cause temporary avoidance of potential haul out sites.

Environmental protection measures

Leading Light Wind will work in consultation with NOAA Fisheries to obtain the appropriate permits before conducting any in water activities. [redacted] Leading Light Wind will coordinate with NOAA Fisheries on mitigation measures such as timing windows and ramp-up soft starts for pile driving, adaptive vessel speed restrictions (10 knots), and exclusion zones, which will further reduce risk.

[redacted] The state of New Jersey's Research and Monitoring Initiative (RMI) has committed to a dedicated seal assessment to understand how harbor seals use the offshore space of the New Jersey lease areas. These studies will guide Leading Light Wind in understanding how pinnipeds will respond to construction and operations activities.

Artificial reefs

Existing conditions

Artificial reefs provide substrate for fish and crustacean species while also providing grounds for fishing and scuba diving.[17] These reefs have been built over the past several decades through USACE rock dumps and USACE disposal sites for dredged materials. There are three existing artificial reefs immediately offshore of the landfall site in Sea Girt. Sea Girt Reef and Axel Carson Reef are USACE dumping sites, and Manasquan Inlet, situated between the two sites, is a designated artificial reef made up of several scuttled vessels.

Impacts assessment

Impacts to existing artificial reefs during construction would include increased vessel traffic in the reef area due to the potential use of these disposal sites to dispose of materials from dredging activities associated with the project. Impacts may include increased dredge materials and large boulders being added within the existing reef footprint following dredging activities, creating new habitat and structure for the three artificial reef areas.

Additionally, the project is expected to create artificial reefs through the placement of WTG and OFCS foundations with enhanced scour protection, which will create hard substrate habitats for new and more diverse communities of marine life. This overall net gain of artificial reef habitat would benefit reef species in the area and increase habitat and biodiversity.

Environmental protection measures

Per N.J.A.C. 7:7-9.13, all cable installation and maintenance will avoid artificial reef habitats and buffer areas. Dredged materials will be disposed of in the proper USACE disposal/artificial reef site, providing a net benefit to reef habitat and increasing biodiversity. Prior to disposal of any materials (boulders, sand, dredge waste) Leading Light Wind would consult with NJDEP and USACE to ensure proper disposal so as not to affect reef habitat.

[17] New Jersey Department of Environmental Protection. (2017). *Artificial Reef Deployment*. Accessed April 27, 2023. www.nj.gov/dep/fgw/artreefdeployment.htm.

2.3 Cultural, historical, archaeological, and visual resources

Existing conditions

There is potential for submerged cultural resources within the offshore project area.[18, 19, 20] Submerged historic cultural resources that may be located within the offshore project area include indigenous archaeological sites, shipwrecks, downed aircraft, and submerged architectural or built resources. Although no submerged pre-Contact era archaeological sites have been identified within the offshore project area, it is possible that such sites do exist.

Much of the outer continental shelf (OCS) offshore New York and New Jersey was subaerial before sea levels began to rise following the Last Glacial Maximum, approximately 20,000 years before present. The exposed landscape would have supported human populations from the Paleoindian through the Early Archaic periods before sea levels submerged much of the project area by 10,000 years before present.[18] Portions of the OCS closer to shore, through which submarine export cables might traverse, were submerged later and thus would have supported more recent human populations.

[redacted] The New Jersey and National Registers of Historic Places provides recognition of a resource as historically significant and worthy of preservation. [redacted]

At its closest point to shore, the lease area is approximately 41 miles (61 kilometers) east of Long Beach, NJ. The distance to the project from onshore viewing locations will minimize or eliminate the visibility of WTGs. The degree to which the WTGs will be visible or noticeable depends on several factors including WTG height, distance from viewer, curvature of the Earth, atmospheric conditions, surf conditions, and lighting.

Impacts assessment

The IPFs affecting cultural, historical, and archeological resources include physical seabed/land disturbance and visible structures/lighting. The above water infrastructure could potentially affect the visual character-defining feature of historic properties and result in a loss of historic or cultural value. Seabed disturbance such as dredging, cable laying, and other activities that disturb the seafloor may potentially impact submerged cultural and archaeological resources (e.g., shipwrecks, debris fields, ancient, submerged landforms) resulting in a loss of scientific or cultural value. The terrestrial export cables and ground disturbing activities may potentially impact buried cultural and archaeological resources.

With respect to visual resources, ground-level oceanfront viewpoints would not experience noticeable visual change from installation of the project. [redacted]

The 2017 New York State Offshore Wind Master Plan, Visibility Threshold Study analyzed frequency of certain meteorological conditions and the impact of those conditions on visibility of hypothetical wind turbines over distance.[19] The study indicated that "...offshore wind energy projects would

[18] Bureau of Ocean Energy Management. (2016). *Programmatic Agreement Among the U.S. Department of the Interior, Bureau of Ocean Energy Management, the State Historic Preservation Officers of New Jersey and New York, the Shinnecock Indian Nation, and the Advisory Council on Historic Preservation Regarding Review of Outer Continental Shelf Renewable Energy Activities Offshore New Jersey and New York Under Section 106 of the National Historic Preservation Act. Executed June 3, 2016.* Accessed April 27, 2023. www.boem.gov.

[19] New York State Energy Research and Development Authority (NYSERDA). *Offshore Wind Master Plan 1.0: Cultural Resources Study 2017.* Accessed April 27, 2023. www.nyserda.ny.gov.

[20] TRC Environmental Corporation. (2012). *Inventory and Analysis of Archaeological Site Occurrence on the Atlantic Outer Continental Shelf.* U.S. Department of the Interior, Bureau of Ocean Energy, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2012-008. Accessed April 27, 2023. www.boem.gov.

have minimal visual impact at a distance of 20 miles from shore and negligible impact beyond 25 miles". [redacted] Because the project is significantly farther than 20 statute miles from the nearest shoreline, there are no potential adverse impacts related to visibility of turbines, including potential impacts on the local and state economy, and historic and visual resources (see Appendix A, Visibility and Viewshed Impacts Assessment).

Environmental protection measures

To avoid, minimize, and mitigate impacts to visual, cultural, historical, and archaeological resources, Leading Light Wind will abide by existing BOEM Programmatic Agreements,[18] regulatory requirements (e.g., BOEM's Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585), and lease stipulations. These guidelines and requirements prescribe that a qualified marine archaeologist identify historic properties through analysis of HRG data before bottom disturbance occurs to avoid cultural, historical, and archaeological resources during pre-construction to decommissioning activities. Leading Light Wind will implement an Unanticipated Discovery Plan to reduce the risk of impacts to submerged resources in the event cultural resources are encountered while conducting activities in the project area.

The project design will be visually unobtrusive along with being approximately 41 miles (61 kilometers) from the closest point to shore. Prior to construction, Leading Light Wind will use appropriate viewshed mapping, photographic, and virtual simulations, and field inventory techniques to determine, with reasonable accuracy, the visibility of the proposed project. [redacted] If any historic structures become listed under the New Jersey or National Registers of Historic Places, proper protection measures will be followed. Additionally, the project will follow all New Jersey Historic Preservation Office Section 106 consultations as required by federal and state regulations.

Lighting controls. The lighting design of a project has the potential to impact biological and visual resources. As it is with all OCS infrastructure and activities, the lighting of an offshore wind facility should be safe, not interfere with other uses of the OCS, not cause undue harm, use best available and safest technology, and employ best management practices. Due to BOEM's regulatory responsibilities under the Outer Continental Shelf Lands Act, BOEM must ensure that activities on offshore wind leases are carried out in a manner that provides for safety and protection of the environment.

In the 2021 "Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development", BOEM provides recommendations to assist lessees in demonstrating that their projects adequately address potential lighting concerns. Leading Light Wind will implement the aviation and marine lighting recommendations from BOEM that are consistent with FAA regulations for structures 200 feet or more in height above the sea surface. A detailed description of these recommendations can be found in the BOEM guidance document.

Based upon existing studies and literature related to lighting impacts on biological and visual resources, BOEM has included a list of environmental recommendations in the guidance document. The recommendations include minimized lighting, flashing lights where practicable, avoiding direct and flood lighting, using automatic timers or motion-activated shutoffs for all lights not related to aviation obstruction lighting, and using aviation obstruction lighting with minimal lighting spread below the horizontal plane of the light. The final facility design will comply with BOEM's Guidelines. The project should minimize visual impacts through appropriate application.

2.4 Environmental benefits and emissions impacts

Due to its zero-emission production of electric power, renewable energy sources such as offshore wind have the potential to offset significant volumes of pollutant emissions from the fossil-fired fleet of the electric power generation sector relying on natural gas and coal for fuel. Offsets of directly emitted particulate matter ($PM_{2.5}$), and $PM_{2.5}$ precursor compounds including sulfur dioxide (SO_2) and oxides of nitrogen (NOx) from fossil-fired generation may result in significant beneficial environmentally-related health outcomes, particularly for environmental justice communities, racial and ethnic minority communities, and other socially vulnerable populations that historically have been disproportionally impacted by emissions from fossil power plants located in their midst.[21]

Further, offsets of carbon dioxide (CO_2) releases will result in a significantly reduced carbon footprint for New Jersey and the region that will help mitigate the effects of global climate change. Governor Murphy's Executive Order No. 315 sets a target of 100% clean energy by 2035; therefore, the carbon reduction strategies offered by Leading Light Wind move New Jersey a significant way forward in the achievement of its own climate goals. As reflected in Governor Murphy's words in Executive Order No. 315, the United States and the rest of the world has a narrow moment to pursue actions to avoid the most catastrophic impacts of the climate crisis. By reducing greenhouse gas emissions and reaching net-zero emissions through the deployment of the New Jersey offshore wind portfolio, New Jersey and Leading Light Wind together can do our part to avoid the worst and irreversible impacts of climate change.[22]

As part of the cost-benefit analysis (see Section 17 of the Application Narrative), Leading Light Wind has documented, quantified, and monetized these expected beneficial environmental impacts of the project, across all phases from pre-construction through decommissioning. The monetization of the benefits provided by net fossil emission reductions was completed using technical data provided by the US Environmental Protection Agency (EPA) regarding PM2.5 and precursor compounds[21] and the US Interagency Working Group (IWG) on the Social Cost of Greenhouse Gases.[22]

As described in Section 17 of the Application Narrative, and detailed further below, the environmental impacts of the project also include project emissions directly related to operation of equipment (marine vessels, on-road trucks, non-road equipment such as excavators, stationary generators, worker transportation, and other machinery) during all phases of the project, and these "disbenefits" are subtracted from the overall total of estimated benefits in the cost-benefit analysis. No other potential environmental benefits or disbenefits of the project as described in the Environmental Protection Plan are considered in the cost-benefit analysis due to the large uncertainties involved in quantifying and monetizing these impacts.

Avoided emissions

To provide a forecast of the annual emissions from fossil-fired generation that would be avoided by operation of the proposed projects, Leading Light Wind modeled the regional electric system covering the footprint of PJM using the market and operational conditions described in the Revenue Plan (Section 7 of the Application Narrative), in **"with-project"** and **"without-project"** scenarios. As detailed in Section 7, Leading Light Wind used Hitachi Energy's PROMOD IV regional power generation and transmission modeling system to estimate relevant future market conditions that will drive the regional use of fossil-fired electric generation units. PROMOD IV is a highly detailed model operating at the level of pricing nodes that calculates hour-by-hour production

[21] "$PM_{2.5}$" describes fine inhalable particles (Particulate Matter or "PM"), with diameters generally 2.5 micrometers and smaller. The US EPA sets and reviews national air quality standards for PM under the Clean Air Act. Particles in the $PM_{2.5}$ size range can travel deeply into the respiratory tract and can affect lung function and worsen medical conditions such as asthma and heart disease. Increases in daily $PM_{2.5}$ exposure have been linked by EPA with increased respiratory and cardiovascular hospital admissions, emergency department visits, and deaths. (See US EPA. January 2023. "Technical Support Document. Estimating the Benefit per Ton of Reducing Directly Emitted $PM_{2.5}$, $PM_{2.5}$ Precursors and Ozone Precursors from 21 Sectors.")

[22] According to the US government, climate change impacts on a regional, national, and global setting include changes in net agricultural productivity, human health effects, property damage from increased flood risk and natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. (See: Interagency Working Group (IWG) on Social Cost of Greenhouse Gases. 2021. "Technical Support Document - Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990." Executive Office of the President.)

costs while recognizing the constraints on the dispatch of generation imposed by the transmission system.

The baseline conditions that underlie the "with-project" and "without-project" scenarios of the avoided emissions analysis assumes the full 3,758 MW build out of the three previously awarded New Jersey offshore wind projects (i.e., Ocean Wind 1 and 2, and Atlantic Shores 1) with no other additional large-scale onshore wind or solar projects.[23] The "without-project" scenario further assumes that no other equivalent competing wind farm will be constructed in the place of the proposed project and the benefits of the "with-project" scenario will be measured against the existing current baseline and expected future conditions, assuming normal anticipated growth to the economy and energy sector matching market conditions as described in the Revenue Plan. The "with-project" scenario includes the development, construction, operation, and decommissioning of the proposed projects, including the 20-year OREC period, during which the ratepayers will provide a stream of OREC payments to the project in return to produce clean energy.

Using this model, Leading Light Wind estimated the change in regional dispatch under the two different scenarios and changes in generation and emissions for individual power plants. This method thereby indirectly estimates the change in emissions from these alternative scenarios by computing emission factors annually for CO_2 and monthly for NOx, SO_2 and $PM_{2.5}$.[24] With these emission factors, Leading Light Wind calculated the annual differences in CO_2 between the with-project and without-project scenarios across the model footprint. Given that the estimation of future climate change damages by the US IWG was developed from an ensemble of three integrated assessment models using highly aggregated representations of climate processes and the global economy, it is appropriate that the scale of assessment of the project's avoided CO_2 emissions include the broadly interconnected RTOs and ISOs of the greater northeast to test the full impact and value of New Jersey offshore wind clean energy generation contributions throughout the entire market area.

In contrast, given the state-level scope of the health assessment by the US EPA of emissions of $PM_{2.5}$ and its precursor compounds, the appropriate scale for the analysis includes the monthly differences in emissions of NOx, SO_2, and $PM_{2.5}$ over the more compact Mid Atlantic Area Council (MAAC) sub-market portion of PJM.[25] In this manner, displacement of upwind sources in nearby states that contribute to air quality and health outcomes in New Jersey are included in the analysis.

The modeled annual average avoided emissions as reported in the Application Form are summarized in Table 10.1-1. A complete description and results of the monetization of these benefits and their use in the cost-benefit analysis are provided in Section 17.4 of the Application Narrative.

Volumetric emissions (short tons)	CO_2	SO_2	NOx	$PM_{2.5}$
1,200 MW project	2,815,585	130.9	454.5	179.47
1,342 MW project	3,069,988	139.8	501.3	193.22
2,400 MW project	4,077,278	203.5	824.4	156.05

Table 10.1-1. Indicative average annual avoided emissions (short tons).

Direct project emissions

The project's "direct" emissions will include fuel combustion-related releases from the project itself across all project phases. These include emissions from vessels used for offshore construction and operations, heavy equipment used for onshore construction, and operational emissions from pollutant-emitting diesel-fired electric generating sets ("gen-sets") located on the wind turbine generators and electrical service platforms.

As described in the Economic Development Plan (Section 8 of the Application Narrative), Leading Light Wind utilizes a "bill-of-goods" approach to input-output analysis for the estimation of in-state economic effects and job claims of the project's direct expenditures for supply chain purchases and capital investments. This detailed bill-of-goods methodology specifies each individual intermediate input associated with the project rather than the total output change in the project, thereby allowing detailed definition of the

[23] This formulation of the baseline condition assures that avoided emissions are ascribable to the offshore wind sector.

[24] Unsynchronized seasonal variations in sulfate and nitrate concentrations and $PM_{2.5}$ formation have been reported by EPA requiring the calculation of emission factors on a monthly or seasonal basis.

[25] "MAAC" is the Mid-Atlantic Area Council sub-market region of the PJM RTO including all or parts of Delaware, Maryland, Washington, D.C., Pennsylvania, as well as New Jersey.

source and anticipated outcomes of all project-related direct expenditures.[26] This methodology allows for the direct incorporation of specific and relevant technical and economic information developed by the engineering and financial expertise in all divisions and elements of the Leading Light Wind team and gathered from our potential suppliers.

This same bill-of-goods methodology has been applied to our environmental accounting and calculation of the direct project emissions using "environmentally extended" input-output analysis (EEIOA). As described by the EPA, like traditional input-output analysis, EEIO models are based on economic input-output tables that represent monetary exchanges between industrial sectors in an economy as well as consumption by final consumers in a balanced accounting framework.[27] A comprehensive data set for use in EEIOA, based on the US Bureau of Economic Analysis and US Census input-output analysis and industrial sector framework, has been developed by EPA. This data set consists of industry-specific coefficients of physical emissions and resource use per dollar of industry output (i.e., an industry expenditure on its inputs and production factors such as labor and capital). The EPA EEIOA environmental data consists of ratios (or coefficients) representing physical emissions or inputs per dollar of industry output, with the physical unit depending on the pollutant or input under consideration.

As with dollar-denominated input-output analysis that tracks the production and consumption of commodities, the coefficients do not double count in the calculation of direct effects in that they do not include the emissions associated with the upstream industries and suppliers. These are considered "indirect" or supply chain emissions that are relevant to life-cycle analysis and are not included here in the estimation of the project's direct effects.

However, as indicated above, rather than relying on broad industry averages for economic production and impact data as represented by the EPA EEIOA data, Leading Light Wind relies, to the greatest extent practical, on specific and relevant data developed by our teams of engineering and financial experts and informed by proprietary data provided by our suppliers and contractors to utilize within the input-output analysis framework and based on *specific estimated expenditures on fuel and labor* for specific tasks within the bill-of-goods.

As the bill-of-goods input-out model is also the basis for tracking and reporting the economic benefits of the wind project, the environmental extensions used for the direct project emission analysis can leverage the same production model used in that effort, providing an efficiency of effort and harmonization of results. As we are utilizing our carefully developed pricing and financial models used to develop the OREC price, the output modelled in the bill-of-goods is highly accurate leading to highly accurate estimates of environmental impacts associated with such changes in output for each activity in the pre-construction, construction, operation, and decommissioning phases of the project.

An additional benefit of this methodology is that there will be a continuity of emission tracking and reporting efforts through the bid and award phase to pre-construction and complete project execution, providing a unique opportunity for accurate and complete transparent public communication of the environmental benefits and costs of the project in near real-time. For example, we fully expect that our suppliers' vessels will be providing significant reduced emissions than what is reported here as the new generation of low NOx emitting diesel engines, and zero greenhouse gas emitting synthetic fuels come online in the next few years. Our methodology of tracking and reporting project emissions will be able to identify and clearly communicate these important environmental benefits of the project life cycle to the public. The following assumptions were used when formulating the estimated fuel and labor costs that drive the emissions EEIOA:

- All offshore emission sources are assumed to make use of the "best available control technologies" selection methodology standards as part of the EPA OCS Air Permit (40 CFR Part 55) to minimize fuel combustion-related emissions from applicable OCS major sources. The applicable OCS major sources will include transport and construction vessels, gen-sets

[26] "Input-output" analysis refers to an economic interindustry analysis used to analyze the interdependence of industries in an economy. The basic concepts of input-output analysis have been in usage for nearly 100 years and comprise the key components of many types of economic analysis, making input-output analysis one of the most widely applied methods in economics. For further information see Miller, R., & Blair, P., Input-Output Analysis: Foundations and Extensions (2009, 2nd ed.), Cambridge: Cambridge University Press.

[27] See US EPA. *Environmentally Extended Input-Output (USEEIO) Models*. www.epa.gov. The original 2017 release of the EPA USEEIO was updated in July 2020 to develop a complete set of US domestic supply chain GHG emission factors from the production and upstream supply chain activities of different sectors and products in the US economy. These GHG supply chain factors were incorporated into the latest version (2.0) of the USEEIO tools released in April 2022.

used to provide prime, continuous, or standby power, as well as auxiliary diesel-powered engines on jack-up vessels, cable-laying vessels, crew transportation vessels, and other various support vessels.

- Main and auxiliary engines on vessels that are OCS sources (operating inside the 25 nautical mile radius around the project OCS sources) are continuously operational during their scheduled usage durations (continuous operation assumes operation 24 hours per day, 7 days per week).
- Major auxiliary engines on vessels that are included in the project emissions include prime movers for large compressors that operate pneumatic barriers ("bubble curtains") for noise reduction, onboard cranes, backup power, vessel jacking systems, etc.
- Onshore and marine construction sources located within the project scope area and upland of landfall are also assumed to operate continuously during their scheduled usage durations. Construction sources are assumed to include major pieces of diesel-engine heavy equipment operated by engineers such as excavators, loaders, haul trucks, and cranes.
- Emissions from trucks providing transportation of equipment and materials to the onshore construction sites are excluded as these would be used otherwise within the region.
- Helicopter use is planned only on a contingent basis when economic or safety conditions compel or warrant their use. As the majority of the helicopter emissions in these rare cases will be released outside of the 25-nautical mile radius around the project OCS sources during takeoff, transit, and landing, helicopter emissions are excluded from the analysis.
- Emissions from minor sources such as small equipment (i.e., small air compressors and other tools and equipment handled directly by workers, etc.) and solvents are assumed to be negligible.

The following methodologies have been employed regarding the estimation of emission coefficients for our bill-of-goods model that quantifies marine vessel and gen-set emissions:

1. Fuel consumption and emission factors are based on conservative average values provided by our suppliers and contractors that own and operate the indicative equipment used in the analysis and based on vessel/equipment types, engine ratings, and the number of engines. In general, average fuel consumption and emission factors for vessels are estimated using load factors associated with transit and maneuvering although they may include more refined definition depending on the operator and use (i.e., vessel load conditions, standby status, jacked-up operations).
2. Emission factors are based on the suppliers and contractor's selection of fuel type. If no fuel type for vessels is provided, a typical low-sulphur (<0.50%) marine distillate fuel (marine gasoil or "MGO") is assumed.
3. Total fuel volume estimates for vessels are based on scheduled durations of vessel use including the estimated number of trips to and from the project area and the distance traveled per trip.
4. Gen-sets to be used on the WTG and offshore electrical service platforms are assumed to be Category 1 engines with a power rating of 150 kW and representative emissions factors provided by the gen-set original manufacturers are used to estimate their emissions. Emissions from these stationary engines are based on the expected number of hours of usage.

Leading Light Wind depended on our extensive database of vessels and equipment with associated economic and performance values provided by our suppliers and confirmed with our in-house construction and engineering experts as inputs to our emission models. Our database includes a wide variety of service and support ships and auxiliary on-board equipment (e.g., compressors, heavy lift engines), including classes of very large wind turbine installation vessels, construction support vessels, offshore installation vessels and offshore support vessels, as well as a fleet of ancillary service vessels including feeder barges, tugboats, crew transfer vessels, service operation vessels, oceanographic survey vessels, and support vessels that will be used throughout every phase for the construction and operation of the project.

The following methodologies have been employed regarding the estimation of emission coefficients for our bill-of-goods model that quantifies onshore construction emissions:

1. All onshore construction and production activities have been assigned an indicative North American Industrial Classification System (NAICS) 6-digit code including: Power and Communications Systems Construction (237100), Heavy Civil and Marine Construction (237000), Road Construction (237310), Industrial and Manufacturing Buildings Construction (236210), and Marshalling & Assembly (488390).[28]
2. The coefficients for the emission volume per dollar of output in the EPA EEIOA data for these construction sectors are then calibrated using the bill-of-goods specific FTE multiplier as developed with our suppliers and contractors for the scope of work. As construction emissions are directly tied to heavy equipment utilization, the budgeted use of operating engineers and other labor provides a good estimate of actual use.

The total project emissions across all phases for the various bid alternatives are provided in the Application Forms. Results for the 1.2 GW, 1.34 GW, and 2.4 GW capacity projects are summarized in Table 10.1-2 through Table 10.1-4. A complete description and results of the monetization of these disbenefits and their use in the cost-benefit analysis are provided in Section 17.4 of the Application Narrative.

Comparing the total direct emissions in Table 10.1-2 through Table 10.1-4 to the average annual avoided emissions as presented in Table 10.1-1, the project "carbon pay-back" period (I.e., the time required for the system carbon emissions displaced by wind power to equal the life cycle carbon emissions of the wind farm) is approximately 8.6 and 11.5 months for the 1.34 GW and 2.4 GW capacity projects, respectively.[29] The avoided emissions as calculated for the cost-benefit analysis is unavoidably subject to high levels of uncertainty as it is dependent on the ultimate service life of the project, the average capacity factor, and the emission rate of the grid over a 20- to 30-year period. By contrast, the carbon payback period includes only the engineering,

1,200 MW project					
Line	**Project phase**	**CO_2**	**SO_2**	**NOx**	**$PM_{2.5}$**
1	Development	41,564	0.45	14,305	44.5
2	Construction (Offshore)	354,600	24.5	12,987	145.7
3	Construction (Onshore)	123,628	0.57	458.7	141.0
4	Operation	556,272	33.9	20,642	280.2
5	Decommissioning	321,116	19.6	30,250	161.8
6	**Total**	**1,397,181**	**79.1**	**78,643**	**773.2**

Table 10.1-2. Total project emissions all phases (short tons) for 1,200 MW project.

1,342 MW project					
Line	**Project phase**	**CO_2**	**SO_2**	**NOx**	**$PM_{2.5}$**
1	Development	44,089	0.46	14,314	47.4
2	Construction (Offshore)	392,304	27.0	14,177	163.1
3	Construction (Onshore)	128,130	0.59	475.4	146.1
4	Operation	556,272	33.9	20,642	280.2
5	Decommissioning	357,687	21.8	33,450	180.2
6	**Total**	**1,478,482**	**83.8**	**83,058**	**817.0**

Table 10.1-3. Total project emissions all phases (short tons) for 1,342 MW project.

2,400 MW project					
Line	**Project phase**	**CO_2**	**SO_2**	**NOx**	**$PM_{2.5}$**
1	Development	87,851	1.16	42,050	91.7
2	Construction (Offshore)	587,132	41.5	21,654	231.6
3	Construction (Onshore)	203,464	0.93	754.9	232.1
4	Operation	556,272	33.9	20,642	280.2
5	Decommissioning	593,878	36.2	55,539	299.2
6	**Total**	**2,028,597**	**113.7**	**140,640**	**1,134.7**

Table 10.1-4. Total project emissions all phases (short tons) for 2,4MW project.

[28] NAICS code 488390 includes support for the construction and assembly of offshore structures and the use of near-shore stationary marine production facilities such as floating drydocks, feedering barges, and platforms. The production function is closely aligned with NAICS Code 336611 (ship building and repair). The analysis of the project emissions from onshore activity does not include any other production of manufacturing processes including production of major WTG components, foundations, etc.

[29] According to the National Renewable Energy Laboratory (NREL), average carbon payback periods for offshore wind are estimated to be approximately 0.5-1 year when comparing to average US network carbon emission rates, and somewhat less (0.40 years) when modeling marginal displacements (i.e., the displacements of marginal generators, which typically have higher carbon emission rates). See: Life Cycle Greenhouse Gas Emissions from Electricity Generation: Update, NREL. (2021).

procurement, and construction phase of the wind project plus the first one or two years of operation. Therefore, it is subject to less uncertainty and provides a clear measure of the enormous environmental benefit potential of the project.

A summary of the monetization results for the 1.2 GW, 1.34 GW, and 2.4 GW capacity projects for the avoided and project emissions and the net environmental benefits, as calculated in Section 17, are provided in Table 10.1-5 through Table 10.1-7, respectively. Line 1 in each table provides the present value of the Project Emissions across all phases of the project. Line 2 provides the present value of the Avoided Emissions across the 30-year operational period, and Line 3 provides the net benefits, or the present value of the monetized Avoided Emissions net the present value of the monetized Project Emissions. As indicated the net environmental benefits delivered by the projects are quite significant at $4.0 billion, $4.4 billion, and $4.9 billion for the 1.2 GW, 1.34 GW, and 2.4 GW projects, respectively.

As expected, the most significant emission offsets in terms of volume are seen in CO_2 and SO_2 totals, as these two pollutants pertain particularly to power sector emissions. The net benefits in terms of dollars, however, are almost entirely driven by CO_2 providing well over 90% of the total net benefits. This is due to the comparatively large volumes of CO_2 emitted by the power sector, the high climate social costs of CO_2 compared to the health-based costs of $PM_{2.5}$ and the $PM_{2.5}$ precursor compounds, as well as the use of a lower discount rate (3%) for CO_2.[30]

1,200 MW project						
Line	**Monetized value ($Million)***	**Total**	**CO_2**	**SO_2**	**NOx**	**$PM_{2.5}$**
1	Project direct emissions	$887.78	$67.84	$9.46	$655.57	$154.91
2	Avoided emissions	$4,903.5	$4,101.5	$236.1	$54.5	$511.3
3	Net emissions benefits (Line2- Line1)	$4,015.7	$4,033.7	$226.7	($601.0)	$356.35

Table 10.1-5. Net environmental benefits for 1,200 MW project.

1,342 MW project						
Line	**Monetized value ($Million)***	**Total**	**CO_2**	**SO_2**	**NOx**	**$PM_{2.5}$**
1	Project direct emissions	$923.61	$71.66	$10.06	$678.13	$163.76
2	Avoided emissions	$5,334.7	$4,469.6	$251.4	$61.9	$551.8
3	Net emissions benefits (Line2- Line1)	$4,411.1	$4,397.9	$241.4	($616.3)	$388.06

Table 10.1-6. Net environmental benefits for 1,342 MW project.

2,400 MW project						
Line	**Monetized value ($Million)***	**Total**	**CO_2**	**SO_2**	**NOx**	**$PM_{2.5}$**
1	Project direct emissions	$1,695.32	$96.67	$13.43	$1,356.61	$228.60
2	Avoided emissions	$6,526.8	$5,645.2	$344.5	$100.4	$436.7
3	Net emissions benefits (Line2- Line1)	$4,831.5	$5,548.5	$331.0	($1,256.2)	$208.12

Table 10.1-7. Net environmental benefits for 2,400 MW project.

[30] As discussed in Section 17.4, the 2021 Technical Support Document from the Interagency Working Group (IWG) on Social Cost of Greenhouse Gases of the US government recommends that the monetized value of future emission changes are discounted at the same rate used to calculate the initial social cost calculation to ensure internal consistency. Therefore, future damages from climate change using the social cost of CO2 at 3% are discounted in this analysis to the base year of the analysis (2022) using the same 3% rate. See: *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990*, Interagency Working Group (IWP) on Social Cost of Greenhouse Gases (February 2021).

* Present value discounted to December 31, 2022, at a 7% nominal discount rate.

In contrast, the emissions produced by the offshore wind vessel fleet and onshore construction forces are comparatively significant sources of NOx and $PM_{2.5}$ (due to the use of diesel engines as well as uncontrolled releases of dust and relatively dense waste streams from onshore construction), and therefore the volumetric offsets and net benefits in terms of dollars are not as notable for these pollutants. In fact, the analysis that relies on current technology, indicates that the project avoided emissions never do completely offset the NOx project emissions. This finding is mitigated in two ways.

First, as indicated above, we fully expect that our suppliers' vessels will be providing significant reduced emissions than what is reported here as the new generation of low NOx emitting diesel engines, and zero greenhouse gas emitting synthetic fuels come online in the next few years. Second, the emissions from the onshore construction may not be considered incremental to the project as the economies of New Jersey and the whole north Atlantic region are significantly robust that it may be assumed that all construction forces would be entirely engaged with or without the proposed offshore wind projects.

See Section 17 of the Application Narrative for a complete description of the use of the environmental net benefits in the calculation of the projects' cost-benefit analyses.

Randolph Energy Storage Project avoided and direct emissions

As described in Section 2.7 of the Application Narrative, Leading Light Wind has provided an option to include the Randolph Energy Storage facility as a value-added enhancement to the proposed offshore wind energy projects for the New Jersey ratepayers.

In addition to the added revenue for the ratepayers to be earned by the storage project in the PJM wholesale markets for energy, capacity, and ancillary services, the proposed Randolph Energy Storage facility will provide other valuable benefits, including additional net pollutant emission reductions from the PJM fossil fleet that will provide incremental positive health and climate effects for New Jersey.

A summary of the estimated total project emissions from construction of the plant and indicative average annual avoided emissions of the Randolph Energy Storage facility over its projected 20-year life is provided in Table 10.1-8. The monetized present-value of the total benefits of the net emission reductions discounted to December 31, 2022, at a 7% nominal discount rate using the methodology described in Section 17 of the Application Narrative are provided in Table 10.1-9. Please see Section 2.7 of the Application Narrative for a full description of the methodology and context for use of the storage emissions in the project cost-benefit analysis.

Electric vehicle charging infrastructure

As discussed further in Section 8 of the Application Narrative, in addition to the large-scale positive climate and health impacts that will result from the offshore wind projects, Leading Light Wind has also committed to helping clean the air in environmental justice and overburdened communities in New Jersey that have traditionally been saddled with a disproportionate burden of air pollution from the fossil fuel economy.

Volumetric emissions (short tons)	CO_2	SO_2	NOx	$PM_{2.5}$
Indicative average annual avoided emissions	156,184	34.7	74.3	1.48
Total project direct emissions	2,605	0.012	9.7	2.972

Table 10.1-8. Indicative average annual avoided emissions (short tons).

Line	Monetized value ($Million)*	Total	CO_2	SO_2	NOx	$PM_{2.5}$
1	Project direct emissions	$4.45	$0.31	$2.16	$0.13	$1.84
2	Avoided emissions	$272.5	$162.9	$92.2	$12.0	$5.29
3	Net emissions benefits (Line 2-Line 1)	$268.0	$162.6	$90.0	$11.9	$3.44

Table 10.1-9. Monetized net emission reductions at the Randolph Energy Storage facility.

* Present value discounted to December 31, 2022, at a 7% nominal discount rate.

One example is our partnership with Zeem, a provider of commercial electric vehicle charging hubs. Zeem facilitates the transition to the zero-emission future for commercial trucking fleets by providing a turnkey solution that bundles electric vehicle leases and access to high-speed charging equipment. With assistance from Leading Light Wind, Zeem is establishing a new drayage truck charging facility in Newark, an environmental justice community whose proximity to the seaport, airport, and major highways has created a long-standing and significant air pollution issue. Leading Light Wind has committed to making a significant investment in this critical infrastructure, with $10 million as part of a 2,400 MW New Jersey Offshore Wind Third Solicitation OREC award and $5 million for the award of 1,200 MW or 1,342 MW projects. As indicated in Table 10.1-10, these expected emission reductions from the use of drayage trucks and off-road vehicles for short run transportation will make a significant contribution to offsetting the direct onshore construction project emissions presented in Table 10.1-2 and Table 10.1-3.

Project phase	Approx. time period	CO_2	SO_2	NOx	$PM_{2.5}$
Avoided emissions from the transportation sector	20 years	127,319	NA	2,474	67.0

Table 10.1-10. Indicative total avoided emissions for the proposed drayage truck charging facility.

2.5 Environmental protection measures

This section lists the typical mitigation efforts and best management practices (referenced in the Potential Project Impacts Assessment [Sections 2.1 through 2.3]) that Leading Light Wind will follow when conducting impact producing activities. These mitigation and best management practices are designed to minimize or eliminate potential impacts to protected species and sensitive environments.

Resource area mitigated	Description	Measure
Land and Marine Uses	Routing analysis showed the least environmentally disruptive routes for project infrastructure. Leading Light Wind will have appropriate waste and hazardous waste plans to reduce risk in the case of accidental releases.	• Cable Routing Analysis • Wetland buffer and erosion BPM • Noise regulation compliance • Traffic Management Plan
Geologic Resources	Leading Light Wind will conduct seafloor surveys to avoid impacts and characterize topographic features. Adherence to all regulatory measures. Cable burials will avoid shipwrecks and artificial reefs (N.J.A.C. 7:7 9.13).	• Seafloor surveys • Cable Burial Risk Assessment > 2 meters if necessary • Routine surveys following seabed disturbances (hurricanes etc.)
Air Quality	Offshore wind is an air quality impact avoidance measure. During construction, EPA standards for emissions will be followed in infrastructure choice.	• Use of existing onshore facilities • Low sulfur fuels • Tier 3 or 4 certified engines • Engine idle limits
Water Quality	While most water quality impacts are temporary, Leading Light Wind will follow state and federal discharge guidance to reduce and mitigate unforeseen spills or accidents.	• Turbidity reduction measures • Vessel certification to reduce discharge/release

Resource area mitigated	Description	Measure
Avian	Surveys conducted will inform how the Project area is used by migratory birds and bats.	• Follow all voluntary lighting and marking rules • Avian and bat deterrents to reduce bat and avian collision with infrastructure • Surveys and monitoring to understand use of offshore Project area • Compliance with MBTA (16 U.S.C. 703-712) • Collaboration with USFWS and NJDFW to protect shorebird nesting sites
Vegetation	Routing will occur predominantly in heavily developed areas and in existing ROWs. Impacts will be temporary and focused during construction phase.	• Replanting impacted areas with native plants • Erosion mitigation during construction • Coordination with NJDEP for protection zones if endangered plant species are found
Commercial Finfish and Shellfish	Refer to the FPP for all potential impacts and environmental protection measures.	
Aquatic Invertebrates	SAV surveys will show sensitive habitats to avoid during construction. Using soft starts near and offshore will allow species to vacate prior to construction activities.	• SAV surveys to avoid sensitive habitat • Ramp-up soft starts prior to drilling/pile driving
Seagrass Beds	SAV surveys will show sensitive habitats to avoid during construction.	• SAV surveys to avoid sensitive habitat • Replanting SAV to support habitat regrowth • Applicable waste management and hazardous materials plan preparation
Wetlands	Pre-construction surveys and wetland delineation will inform mitigation efforts. Terrestrial export cables will be installed in existing road (ROWs) and other developed environments.	• Wetland buffer and erosion BPM
Marine Mammals and Sea Turtles	Combined use of these measures will reduce human/whale interactions through all project phases. Compliance with ESA and MMPA regulations through NOAA Fisheries will further reduce impacts.	• Clean Water Act (33 U.S.C. §§ 1251) adherence • Cable installation in existing road ROWs • Wetland delineation for onshore Project area • Culvert maintenance for endangered wetland species crossings
Artificial Reefs	Existing USACE and NOAA Fisheries artificial reef areas and disposal sites will be avoided during cable routing. Artificial reef will be created through offshore WTG and OFCS infrastructure.	• Cable installation and maintenance avoidance of reefs (N.J.A.C. 7:7-9.13) • Improved reef habitat through water column with turbine hard structures • Turbine base design optimized for maximized biodiversity
Visual, Cultural, Historical and Archaeological	Leading Light Wind will conduct seafloor surveys to avoid impacts and characterize topographic features. Leading Light Wind will adhere to all regulatory measures	• Viewshed mapping • Identification of historic properties through HRG • Visual Impact Assessment • Cable Burial Risk Assessment > 2 meters if necessary • Tribal consultation

03 Other considerations

3.1 Cumulative impacts

In 2022, Leading Light Wind acquired one of six offshore wind leases auctioned by BOEM in the New York Bight. At the time of this submittal, there are nearly 30 active commercial offshore wind leases in the US, and BOEM is evaluating additional call areas within the US Exclusive Economic Zone. Together, these projects will contribute to the cumulative benefit of reducing the nation's reliance on climate-warming, non-renewable energy resources. Leading Light Wind and other offshore wind projects in the New York Bight may have significant impacts during the pre-construction and construction phases to offshore habitats, but over the proposed 30-year life of the project would lead to a significant net reduction of carbon emissions in the region, providing an overall benefit to air quality and the environment (see Avoided Emissions above in Section 2.4). Additionally, WTG and OFCS foundations from projects in the region will create a network of artificial reefs, which will increase biodiversity and improve recreational fishing grounds.

Cumulative adverse impacts from the development of onshore infrastructure are expected to be minimal [redacted] and, per NJBPU requirements, be co-located with the onshore infrastructure of other New Jersey offshore wind projects. By collocating with existing utilities and infrastructure, Leading Light Wind will reduce cumulative adverse impacts to regional land use and other onshore resources for the life of the project.

Leading Light Wind takes pride in being a responsible developer and is engaging in pre-construction surveys and research and monitoring partnerships to monitor onshore and offshore impacts of the project through all phases of development. This monitoring process enables Leading Light Wind to properly assess and minimize impacts to wildlife, sensitive habitats, and human uses of the environment (see Attachment 10.3 Infrastructure Monitoring Plan). Leading Light Wind will also draw guidance from the New Jersey Offshore Wind Strategic Plan which details natural resource protections related to the cumulative impacts to commercial and recreational fisheries. Protections include using the best available technology for mitigation efforts, commitment to these mitigation and avoidance efforts, and working with state and federal regulators to ensure all impacts are minimized and mitigated.

Cumulative impacts from the build-out of the offshore wind industry will be thoroughly addressed through the project's COP and Environmental Impact Statement process with BOEM; through federal, state, and tribal consultation, continued stakeholder outreach, and collaboration with the New Jersey RMI; and through BOEM's New York Bight Programmatic Environmental Impact Statement (PEIS) process.

BOEM has initiated efforts to evaluate impacts from offshore wind projects in the New York Bight through their PEIS process. Leading Light Wind is actively engaged in that process, including coordination with BOEM and other lessees, attendance at public meetings, and sharing its views. Leading Light Wind submitted comments to BOEM during the scoping period; provided

recommendations for BOEM to coordinate with the lessees and agencies with jurisdiction by law or special expertise in the New York Bight; and encouraged BOEM to adopt guiding principles in developing and analyzing avoidance, minimization, mitigation, and monitoring measures. Leading Light Wind accepted BOEM's invitation to participate as a consulting party under the National Historic Preservation Act. The analysis will include a robust cumulative impacts assessment for the region.

3.2 Environmental impacts compared to other similar Class I renewable energy projects.

In 1999, New Jersey adopted a renewable portfolio standard and restructured its electric power sector through substantial deregulation of power generation. The state legislature has since enacted several substantial revisions to the renewable portfolio standard, including increased use of Class I renewable generation resources including solar energy, offshore wind energy, small-scale hydroelectric (i.e., less than 3 MW), and waste-to-energy facilities. The law was updated most recently in the May 2018 Clean Energy Act and now requires that 50% of electricity sold in New Jersey come from approved Class I renewable sources by 2030, a portion of which must be from offshore wind.

However, according to the US Energy Information Agency (EIA), as of 2022, natural gas and nuclear energy still accounted for almost all of New Jersey's electricity net generation providing 94.5% of the total electricity produced in the state.[31] Class I renewables in total provided only 3.6% of total generation, with over 70% of all renewable power being provided by solar photovoltaic (PV) generation, with the remainder being provided by onshore wind, conventional hydroelectric, and some small landfill gas and biomass pilot projects. In 2022, EIA data indicates that utility scale solar PV power capacity in New Jersey totaled just over 1,060 MW.[32]

Given the current trends, it appears that offshore wind is likely to become the dominant source of Class I renewable power in the state in the next few years and for the long-term. In 2018, the state set a goal to obtain 3,500 MW of offshore wind power by 2030. The goal was subsequently increased to 7,500 MW by 2035. The state increased the wind power goal again in September 2022 to 11,000 MW by 2040. By June 2021, the NJBPU had approved over 3,700 MW of offshore wind capacity and will solicit up to 2,400 MW in the current open solicitation in 2023.

By contrast, the further growth of solar PV appears to be limited due to the large spatial requirements for solar farms and the relative value of land in densely populated New Jersey. According to the US National Renewable Energy Laboratory (NREL), utility-scale solar PV requires on average 6.1 acres per MW of capacity.[33] A 1,200 MW solar project comparable in capacity to the current New Jersey offshore wind small project scenario would cover 7,320 acres (approx. 11.5 square miles). This is roughly 3.6 times the size of Newark Airport and this amount of available land is both expensive and scarce in New Jersey. This has resulted in New Jersey achieving its current level of solar PV generation through the installation of hundreds of small plants. According to EIA, New Jersey has over 340 individual utility-scale solar PV plants with a median size of 1.9 MW. This indicates that additional growth of solar PV in New Jersey may be limited due to scarce land resources.

No other Class I renewables play a significant or growing role in New Jersey's power generation mix. Onshore wind capacity is limited to two facilities totaling 9 MW, which provided only 0.33% of the total net power generation in New Jersey in 2022. Small pilot projects including biogenic municipal solid waste and landfill gas exist but are not expected to play a significant role. At these

[31] US Energy Information Agency (EIA). 2022 Form EIA-923 detailed data with previous form data (EIA-906/920). Accessed on June 16, 2023. www.eia.gov. Form EIA-923 collects detailed electric power data — monthly and annually — on electricity generation, fuel consumption, fossil fuel stocks, and receipts at the power plant and prime mover level.

[32] US Energy Information Agency (EIA). 2022 Form EIA-860 detailed data with previous form data (EIA-860A/860B). Accessed on June 16, 2023. www.eia.gov. Form EIA-860 collects generator-level specific information about existing and planned generators and associated environmental equipment at electric power plants with 1 MW or greater of combined nameplate capacity.

[33] See National Renewable Energy Laboratory (NREL). "Land Use by System Technology." www.nrel.gov.

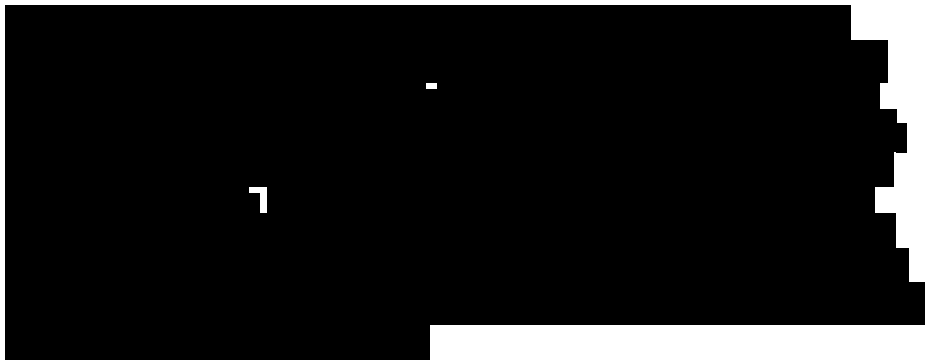
scales, it is not feasible to assume anything definitive regarding the potential environmental impacts of these Class I renewable projects on the state of New Jersey.[34]

Offshore wind vs. solar PV

The NREL Harmonized Life Cycle Assessment of electric generation technologies provides a levelized comparison of global environmental impacts caused by the construction and operation of utility-scale power plants including all upstream processes (raw materials extraction, component manufacturing, and plant construction), operational processes (power generation and plant operation and maintenance) and downstream processes (plant decommissioning and disposal). These assessments estimate not only direct emissions from these processes but also include the indirect emissions released throughout the plant's supply chain and include emissions from raw material extraction and processing, fabrication of parts, manufacturing and assembly of project components, and long-distance transportation of the components to the project site for installation.[35]

The term "embodied carbon" refers to indirect carbon emissions that are "embedded" (or embodied) in the finished facilities. NREL estimates that solar PV has up to four times the levels of direct carbon emissions and embodied carbon associated with its life cycle as compared to offshore wind. Data and analysis provided by NREL indicates that levelized global life cycle assessments for solar PV and offshore wind generation are ~40 grams CO_2e per kilowatt-hour and ~10 grams CO_2e per kilowatt-hour, respectively. For comparison, NREL estimates the levelized global life cycle assessment for coal generation at ~1,000 grams CO_2e per kilowatt-hour.

As New Jersey presently provides neither a significant quantity of raw materials or manufactured components for either solar PV or offshore wind, the principal long-term negative in-state environmental impacts from these Class I renewable energy generation sources are principally around land use and loss of habitat and potentially disposal in-state of plant components after decommissioning. Short-term environmental impacts would include emissions typically associated with onshore construction of civil works and power plants, but offshore development also includes the use of diesel-powered vessels, which are a significant source of pollutant emissions. However, for both Class I renewable energy sources, the net emission offsets deriving from 20 or more years of zero-emission clean energy power production quickly repays these emissions generated during the construction of the power plants.



Given these results it may therefore be assumed that neither solar PV or offshore wind provide a clear advantage over the other in terms of environmental impacts to the state other than offering the long-term net benefits in terms of clean energy production and the associated significant offset of pollutant emissions from the PJM fossil fleet. However, due to the severe limitations placed on the growth of solar PV in New Jersey due to space limitations, offshore wind is the only viable Class I renewable resource capable of helping New Jersey reach its climate goals with minimal environmental impacts as described in this section.

3.3 Environmental stakeholder engagement

Leading Light Wind will build upon NJBPU's and NJDEP's efforts to integrate multifaceted stakeholder engagement strategies throughout every stage of the project. Relevant stakeholders include regulatory agencies, marine

[34] Hydropower accounted for slightly less than 0.4% of New Jersey's net generation in 2022. The state has one small operating conventional hydroelectric plant with a capacity of 10 MW near New York City, which is therefore technically a Class II renewable power source.

[35] See National Renewable Energy Laboratory. "Life Cycle Assessment Harmonization." www.nrel.gov. NREL uses "CO_2e" or the carbon dioxide equivalent measure in its presentation of the data. The use of CO_2e is intended to emphasize the impact of other greenhouse gases besides CO_2 by including their volumes as the equivalent volume of CO_2 indexed to their global warming potential.

users, local communities, research organizations (e.g., universities, regional consortiums), subject matter experts, and environmental non-governmental organizations. A comprehensive description of Leading Light Wind's stakeholder engagement strategy, including the process for identifying, communicating with, and responding to stakeholders' concerns, is described in Section 9 of the Application Narrative.

Leading Light Wind is working collaboratively with the other lessees in the New York Bight through coordination with the American Clean Power Association, particularly with adjacent leaseholders Atlantic Shores and Community Offshore Wind. Leading Light Wind acknowledges other developers as stakeholders and plans to work together to identify innovative avoidance, minimization, mitigation, and monitoring measures based on lessons learned in the industry both domestically and globally. Additionally, data collection and research means-and-methods will be coordinated with neighboring developers to maximize benefits. Specific activities undertaken to date include participation on a regular New York Bight leaseholder forum, leaseholder meetings specific to the BOEM PEIS, and engagement with neighboring lease OCS-A 0541 (Atlantic Shores) on turbine layout and spacing and data collection strategies.

Regionally, Leading Light Wind is actively consulting with tribes in addition to BOEM, USACE, NOAA, and EPA, [redacted]

Engaging environmental justice and overburdened communities

Leading Light Wind is committed to authentically involving affected communities in project development and understands the unique challenges faced by environmental justice and OBCs. The project area does not intersect with any OBCs, and therefore no direct impacts are anticipated. [redacted]

As the project matures, Leading Light Wind will continually assess whether the project will intersect with OBCs. As required, community engagement plans will be created if an impact to an OBC is anticipated. [redacted]

Commitment to transparent research

Openness is a core value and cornerstone of Leading Light Wind's approach to engaging with and sharing data with relevant stakeholders. [redacted]

04 Conclusions

This Environmental Protection Plan describes how Leading Light Wind intends to avoid adverse impacts to biota and habitats within the project area and apply beneficial impacts where possible. Where adverse impacts cannot be avoided, this Plan describes how impacts can be minimized, and, if necessary, mitigated. Implementation of environmental protection measures are described where the environment and biota are impacted. Through all phases of the project lifecycle there may be onshore and offshore impacts. This plan strives to deliver reasonable and effective measures to understand where impacts are derived and provide mitigations for every phase of the project.

Appendix

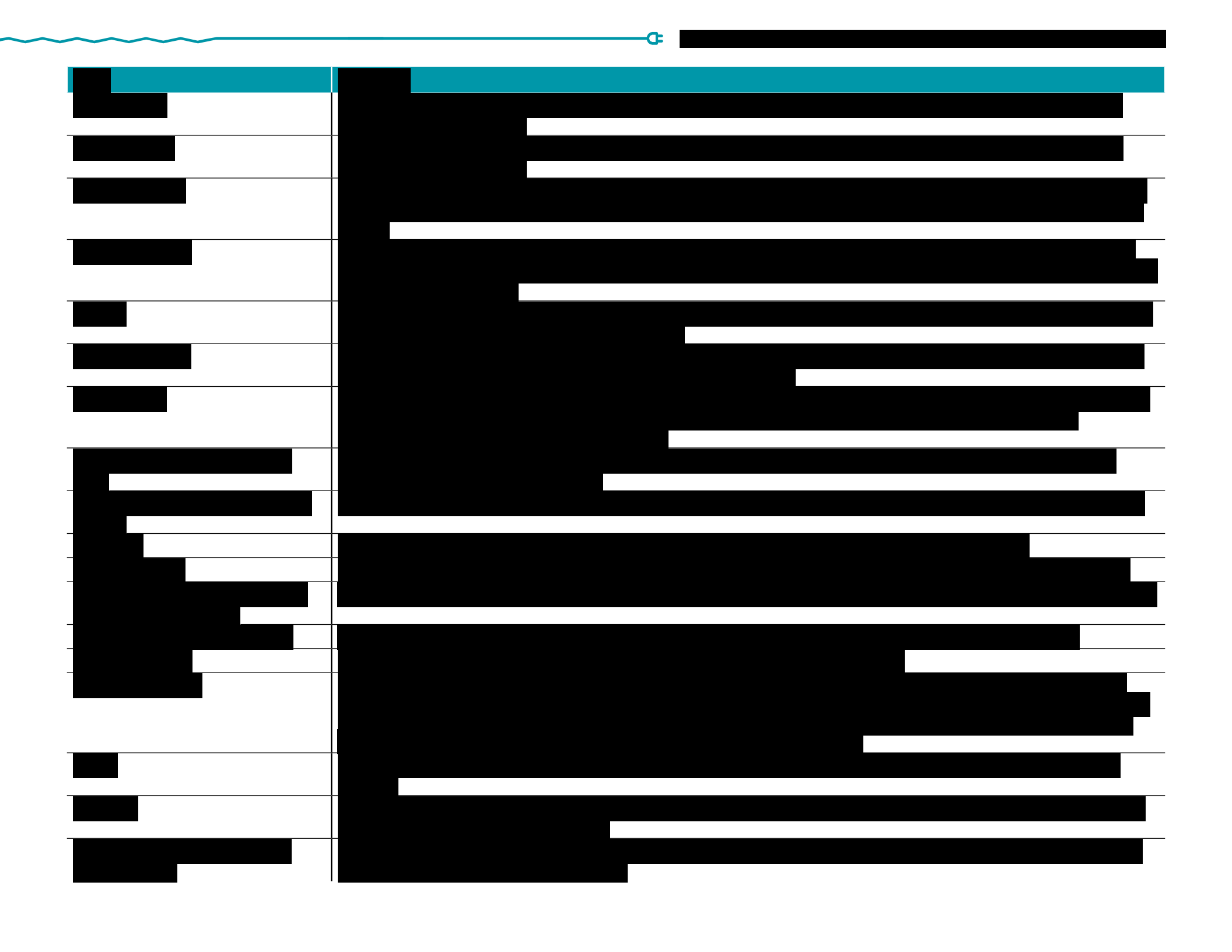
Visibility Study, Including Visual Simulations

Redacted from Public Copy

Attachment 10.2
Data Management Plan

Table of contents

Definitions



01 Introduction

Invenergy Wind Offshore LLC is developing an offshore wind facility, Leading Light Wind (the Project), within Lease Area OCS-A 0542 in the New York Bight that will interconnect into the regional power grid. Leading Light Wind has prepared this *Data Management and Availability Plan* as a requisite component of Leading Light Wind's response to New Jersey Board of Public Utilities (NJBPU) New Jersey Offshore Wind Third Solicitation.[1] This plan covers data collected as part of the *Environmental Protection Plan* (Attachment 10.1) and the *Fisheries Protection Plan* (Section 11) and addresses the data expected to be collected during Project development. This plan describes the standards for data cataloguing and management, data standardization procedures, and data transparency, sharing, accessibility, tools, and best practices.

The Project is located offshore of New Jersey, approximately 77 kilometers (48 nautical miles) east of Atlantic City and approximately 91 kilometers (57 nautical miles) from the National Guard Training Center at Sea Girt, NJ. [redacted] The Project is adjacent, to the east of the Atlantic Shores Offshore Wind lease area (OCS-A 0541).

1.1 Data management approach

Per NJBPU's Third Solicitation, standardized data collection protocols must be followed using best practices, combined with quality assurance/quality control and reporting standards to ensure the collection of high-quality data that can be aggregated for large-scale analyses. [redacted]

[1] NJBPU. 2022. Third New Jersey Offshore Wind Solicitation Documents. Attachment 7: https://njoffshorewind.com/third-solicitation/solicitation-documents/Att-7-Data-Management-and-Availability-Plan-Requirements.pdf.

[2] Terms highlighted in grey are defined in a terms sheet at the end of this data plan.

[3] Other Esri products such as ArcGIS Online Organization have the potential to expose confidential data if the owner or publisher of the data is not careful. ArcGIS Desktop provides greater flexibility for the dissemination of confidential data to selected users.

02 Data catalog

This section describes the methods Leading Light Wind is using to catalog publicly available resources and project specific data used and/or collected for the *Environmental Protection Plan* (EPP), *Fisheries Protection Plan* (FPP), and data to be collected across the life of this Project (to the extent known at the time of this plan submission).

The EPP and FPP use existing datasets (primarily publicly available), including general resources referenced in this *Data Management and Availability Plan*. The datasets are cataloged and stored as a Microsoft Excel spreadsheet that lists all the GIS resources accessed for the Project, including links to publicly available data sources, how the data was obtained, data descriptions, and data types. See preliminary dataset catalog. This spreadsheet is updated as new data is collected, updated, or new datasets are added for the Project.

03 Data standardization

This section provides information on data standardization, including best practices for standardized data collection protocols (standard operating procedures), map templates, **projections** and coordinate systems, **metadata**, data archiving, and quality assurance/quality control (QA/QC) practices. [redacted]

In coordination with environmental data experts, Leading Light Wind will further ensure that federal and state environmental data standards are met to allow ingestion of data into a range of NOAA regional weather and climate forecast models of value to New Jersey stakeholders.

3.1 Data collection protocols

[redacted]

[4] This Data Management Plan, including data collection protocols, applies to Leading Light Wind vendors, contractors, consultants, and subconsultants involved in the Project. However, there will be instances where specialty proprietary software is utilized for data collection or processing. Leading Light Wind maintains responsibility for data integration and aligning the data standardization procedures, and data transparency, sharing, and accessibility protocols with those detailed in this plan.

[redacted]

As mentioned above, publicly available datasets utilized as part of the EPP and FPP are catalogued in a Microsoft Excel spreadsheet. Data collected as part of Leading Light Wind's Project surveys will be included in the data catalog as they become available. The following data types are anticipated to be collected over the course of the Project:

- Air Emissions/Air Quality
- Airspace Assessment (ADLS, Air Traffic Flow, Obstruction Eval., Radar and Nav Aid Screening)
- Avian and Bat Risk Assessment
- Bat Acoustic Surveys (appended on geophysical and geotechnical vessels in the Lease Area)
- Benthic Habitat Mapping Report
- Benthic Survey Reports
- Cable Burial Risk Assessment
- Commercial and Recreation Fishing
- Demographics
- Electrical and Magnetic Fields Assessment Offshore
- Electrical and Magnetic Fields Assessment Onshore
- Employment and Economics, Economic Impact Study
- Environmental Chemistry of Nearshore Sediments
- Environmental Justice
- Essential Fish Habitat Assessment
- Fish
- Geophysical Mapping
- Geotechnical Mapping
- Geological Coring
- Hazardous Materials (solid and chemical waste to be generated and chemical products to be used)
- Historic and Architectural Resources
- In-Air Acoustic Assessment
- Land and Transportation Traffic
- Land Use and Zoning
- Marine Archaeological Resources Assessment (Full MARA)
- Marine Archaeological Resources Assessment (Abbrev. MARA for Article VII)
- Marine Energy and Coastal Infrastructure
- Marine Mammal and Sea Turtle Assessment/ COP PSMMP
- Marine Site Investigation Report
- Marine Transportation
- Metocean Monitoring Data Analysis
- Micro-Siting to Avoid or Minimize Impacts to Submerged Historic Properties
- Military Uses (DoD) and National Security Uses
- Munitions and Explosives of Concern and Unexploded Ordnance Risk Assessment Report
- Navigation Safety Risk Assessment
- Preliminary Cable Burial Risk Assessment
- Public Health and Safety
- Recreation and Tourism
- Sediment soil and quality types
- Sediment Transport Analysis/Hydrodynamic Mod/Seabed Mobility/Scour Assessment
- Socioeconomic Impact
- Terrestrial Archaeological Resource Assessment
- Terrestrial Vegetation and Wildlife
- Underwater Acoustic Assessment
- UXO/MEC Desktop Assessment
- UXO/MEC Archaeological Clearance/ Monitoring of Potential
- Visual Effects to Historic Properties
- Visual Impact Assessment
- Water Quality
- Wetlands and Waterbodies

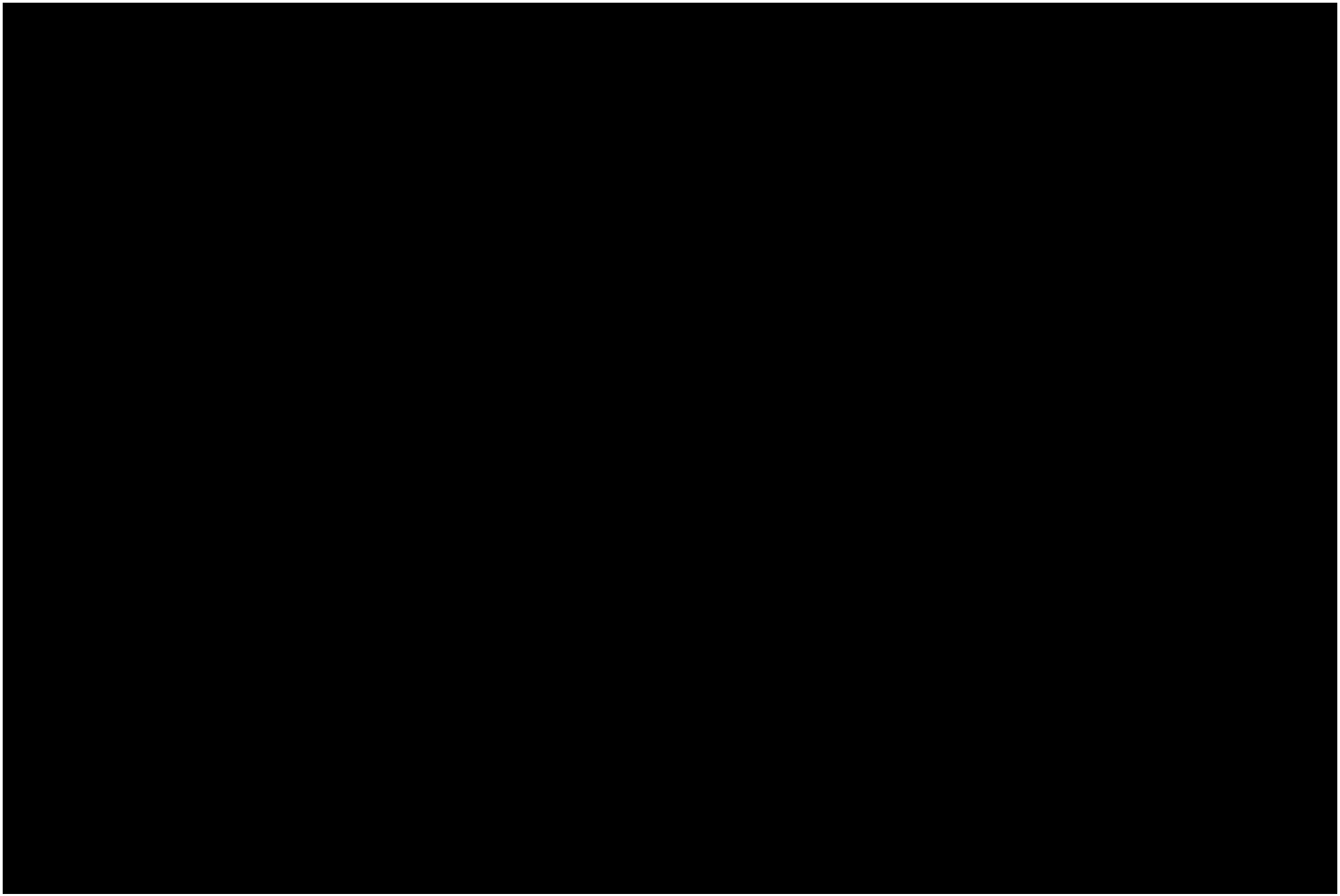
Dedicated benthic surveys will be conducted in the lease area and export cable corridors. Separate benthic survey plans have been prepared and submitted to BOEM. Benthic surveys (described in the separate Benthic Survey Plan) will collect plan view and sediment profile imagery, grab samples, and video transects. The geophysical/geotechnical survey data and benthic survey data will be used to support the characterization of seafloor, benthic habitats, and essential fish habitat (EFH).

[redacted] The infauna samples will follow benthic community metrics from three diversity indices that capture different aspects of species-abundance relationships, consisting of:

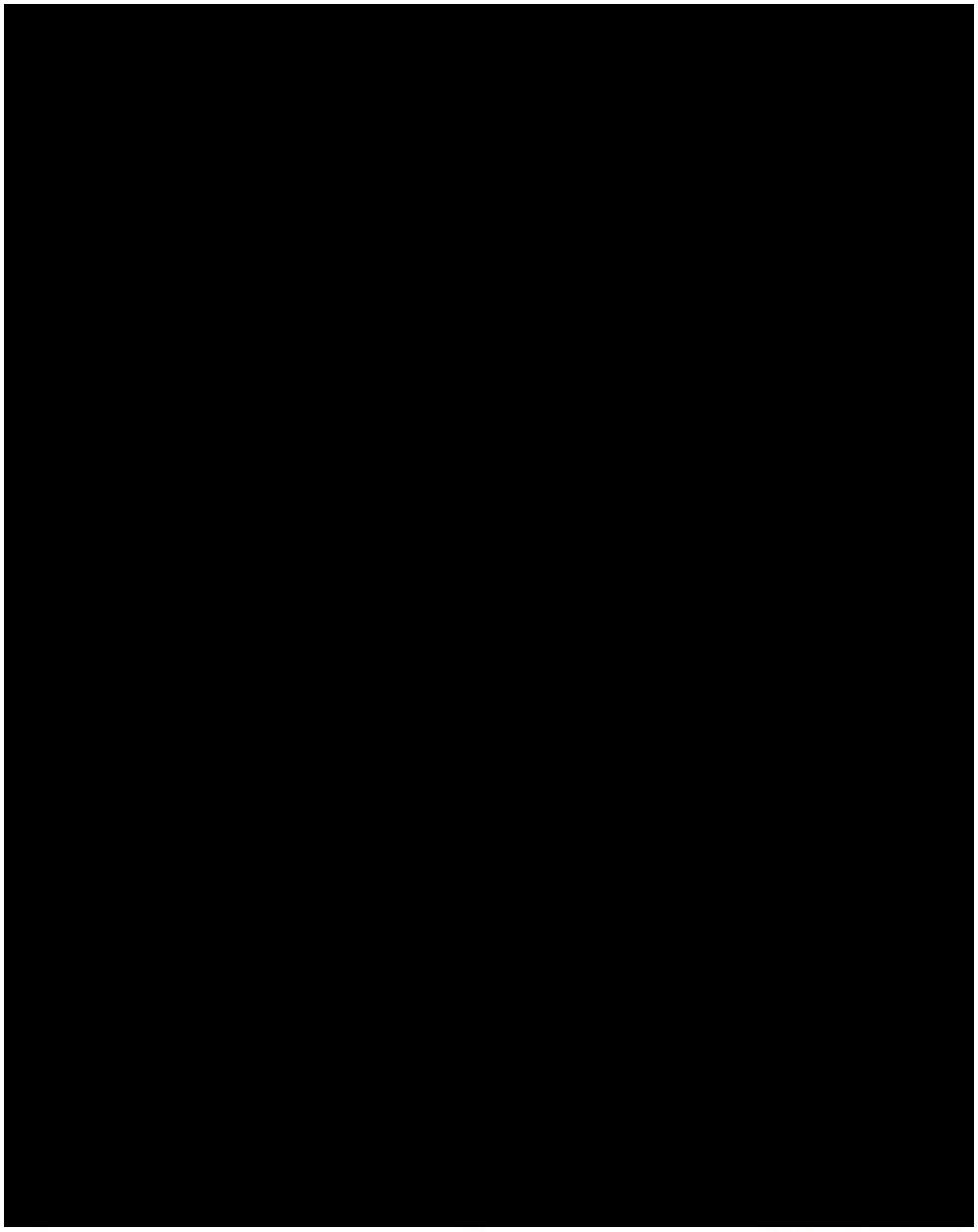
- **Margalef's richness index (d)** is a measure of diversity that indicates the relative number of different species in each sample and/or stratum.
- **The Shannon-Wiener diversity index (H')** emphasizes species in the middle (not common or rare) of the species rank abundance sequence and accounts for both abundance and evenness of the species present. The greater the H' value, the greater the diversity and evenness of the sample; the values are generally between 1.5 and 3.5 with the index rarely greater than 4.
- **Pielou's evenness index (J')** measures how evenly the number of individuals are distributed among the species. J' ranges between 0 and 1; a lower J' value indicates less evenness in community structure and possible presence of a dominant species, while a higher J' value indicates more evenness.

The data collection stations will provide:

- Grain Size, Sediment Structure and Composition
- Small-Scale Surface Boundary Roughness
- Apparent Redox Potential Discontinuity Depth
- Presence of Organic Loading, Sedimentary Methane, and Thiophilic Bacterial Colonies
- Infaunal Successional Stage
- CMECS Substrate Classification



[redacted]



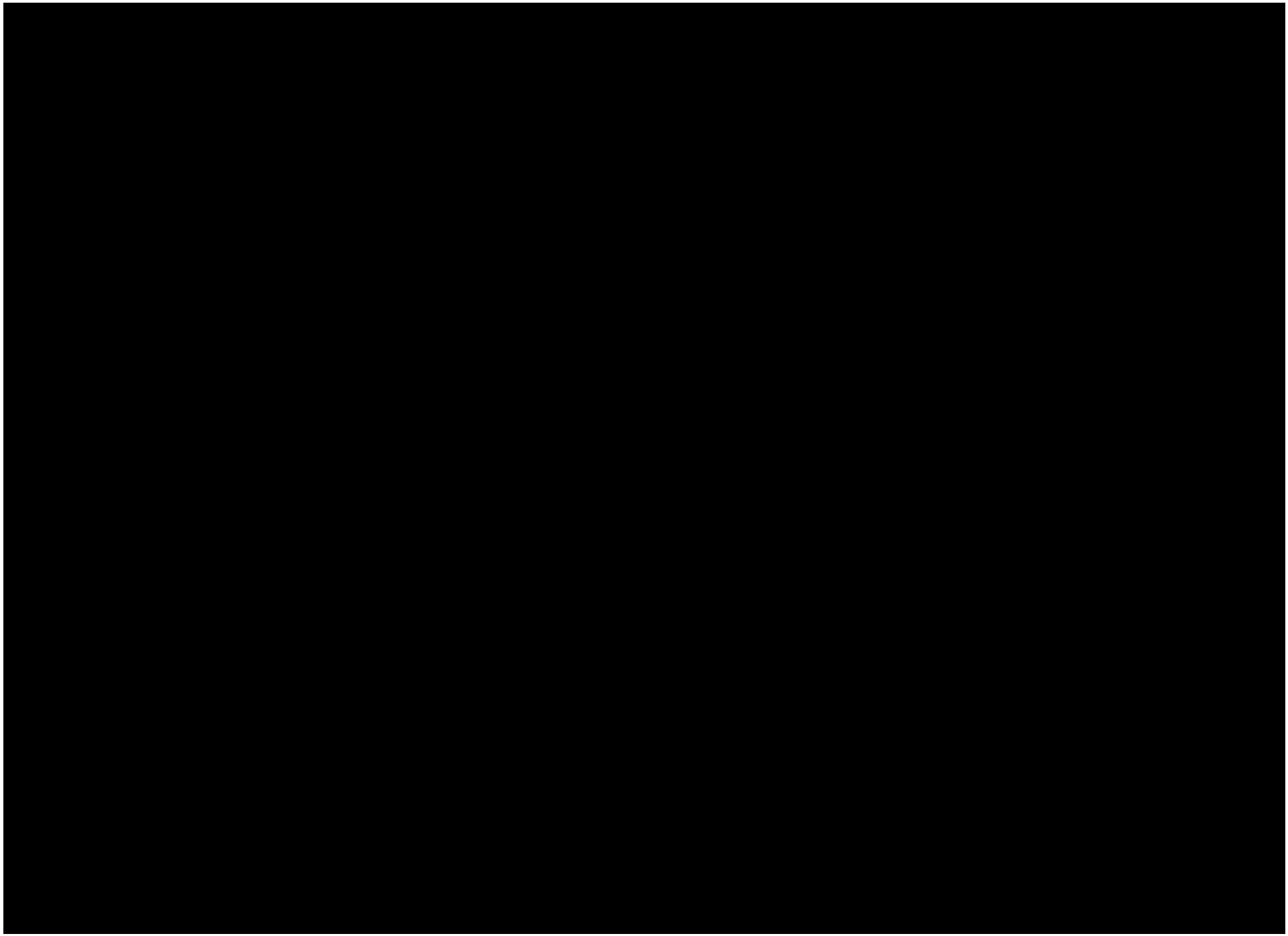
[redacted]

[redacted]

[redacted]

[redacted]

[redacted]



3.2 Templates

[redacted] For example, BOEM requires map figures to include:

- Project area
- Map scale
- Map title
- Company name and personnel names
- Activity dates
- File and job numbers
- Map numbers (e.g., map 1 of 2)
- Map borders
- North arrow
- OCS (lease) area name(s)
- Block number(s) and lease numbers
- Federal/state boundaries
- Latitude and longitude **graticules**
- Tic marks used to delineate state plane or **Universal Transverse Mercator (UTM)** coordinates

Leading Light Wind's map figure templates can be adjusted to meet specific government agency requirements (e.g., to include space for a signature stamp with tracking on the PDF), while including general cartographic elements required for most maps such as the scale bar, north arrow, title block, date, project components, and source information.

3.3 Projections and coordinate systems

To ensure that all spatial data is collected reliably and can be shared across multiple organizations and with Leading Light Wind's internal team and subconsultants, all GIS datasets will be maintained in a consistent coordinate system via the **North American Datum of 1983 [NAD83 (2011)]**, which is a standard spatial reference system. It is possible regulating agencies may require datasets be provided in a different projection, Leading Light Wind will integrate any customizations into the data management system. Specific details regarding the projection and coordinate systems used by the Project are provided in the tables below.

Geodetic Datum	NAD83 (2011)
Projection	UTM Zone 18 North
Unit	Meters (m)
Vertical reference (offshore)	Heights shall be relative to Mean Lower Low Water (MLLW). Height referencing shall be determined using NOAA's– VDatum model (https://vdatum.noaa.gov/)
Vertical reference (onshore)	Heights shall be relative to North American Vertical Datum of 1988 (NAVD88). Height referencing shall be determined using NOAA's– VDatum model (https://vdatum.noaa.gov/)

Table 10.2-3. North American Datum of 1983 [NAD83 (2011)].

For onshore data, the following standards will be applied, consistent with industry best practices for spatial data collection.

- To meet state data requirements or other United States quality standards, the data will use NAD83 (2011) State Plane New Jersey FIPS 2900 Ft US [EPSG 6527] for onshore data that is created using feet as the linear unit. This original data in linear feet units will be maintained alongside the data converted to meters linear units NAD83 (2011) UTM 18N [EPSG 6347] for verification purposes. A simple readme.txt text file with the same file name would be maintained explaining the method of the conversion.

- The **vertical datum (VDatum)** model is comprised of offset grids between the **World Geodetic System 1984 [WGS84]** (aligned to the **International Terrestrial Reference Frame 2014 [ITRF2014]**) or NAD83 (2011), to NAVD88 and then to Mean Lower Low Water (MLLW). This enables conversion from ellipsoidal heights measured by **Global Navigation Satellite System [GNSS]** (with or without **real-time kinematic positioning**) to MLLW referenced levels.

  This offset (referenced above) varies depending on the specific geographic location on the Lease Area, therefore, Leading Light Wind will use the discrete offsets for values relating directly to wind turbine generator (WTG) foundations. For any area of the Lease Area not relating directly to foundations, the full VDatum model will be used. The offset will vary along the export cable routes and therefore, Leading Light Wind will use the full VDatum model for any work requiring precise vertical measurements along the cable route.

All operations carried out below the low water mark (i.e., MLLW) are classified as Marine Operations. All marine operation data will be maintained in accordance with North American Datum of 1983 (2011), NAD83 (2011) UTM18N.

Projected coordinate system	NAD83 (2011) UTM18N
Datum	**North American 1983 (2011)**
Spheroid	GRS 1980
Projection	Transverse Mercator
False Easting	500,000 meters
False Northing	0 meters
Central Meridian	-75.0
Scale Factor	0.9996
Latitude of Origin	0°
Linear Unit	Meter
Authority	EPSG 6347

Table 10.2-4. Projection and coordinate systems used by Leading Light Wind.

All land operation data will be maintained in accordance with North American Datum of 1983 (2011), NAD83 (2011) UTM18N.

Projected coordinate system	NAD83 (2011) UTM18N
Datum	**North American 1983 (2011)**
Spheroid	GRS 1980
Projection	Transverse Mercator
False Easting	500,000 metros
False Northing	0 meters
Central Meridian	-75.0
Scale Factor	0.9996
Latitude of Origin	0°
Linear Unit	Meter
Authority	EPSG 6347

Table 10.2-5. Projection and coordinate systems used by Leading Light Wind.

3.4 Metadata

Leading Light Wind will provide accompanying metadata since sharing of data between the Project, subconsultants, and government agencies will occur. Metadata, or 'data about data', document data content, quality, condition, and other characteristics. Leading Light Wind will write the metadata for each dataset using ArcGIS software, populating the required *Tags* and *Summary* attributes at a minimum.

Metadata written with ArcGIS Desktop software satisfies the Federal Geographic Data Committee and ISO (19139 and 19115-3) standards and can then be exported to an .xml format as needed for portability between software platforms. In addition to 19115 standard metadata, Esri metadata will be included for all spatially projectable files at feature/raster level (feature classes, ASCII files, Excel files, rasters, grids, .las [lidar], etc.) to the requirements described in this plan by Leading Light Wind. The full list of metadata is listed below and the minimum acceptable fields that Esri requires for project specific datasets are shown in bold:

- **Title**
- **Tags**
- **Summary**
- Description – Abstract
- Credits/Source – will list Leading Light Wind and/or any subconsultant who developed the data
- Creation/Download Date
- Fields
- Use Limitations – this highlights if the data is sensitive/proprietary in any way and should not be shared further
- Scale Range – will specify if the data should not be viewed at a certain scale

For any data that Leading Light Wind does not produce and is retrieved from external proprietary sources, it will be covered by the appropriate data licenses and the relevant copyright information will be included in the delivery of the data. Note that metadata guidelines are continuously evolving at an international level and these guidelines are therefore subject to change.

3.5 Data archiving

[redacted] Archiving public datasets is not necessary, but authoritative sources may remove or move services without warning which could cause an error on the web applications and maps. If there is a need to maintain a history of public datasets as they are accessed, a copy of the data will be stored for posterity on Leading Light Wind's local servers.

It is important to note that given that certain datasets would not be compatible with GIS, other data applications may be used to provide the metadata. Therefore, Leading Light Wind will ultimately work with New Jersey on ensuring these data management standards are met to the extent practicable.

3.6 Quality assurance/ quality control and reporting standards

The QA/QC of data and data reporting standards ensure high-quality information that can be aggregated for large-scale analyses. For instance, in ArcGIS Desktop, the use of **domains**, attribute rules, and geodatabase topology rules are applied whenever possible, and are consistent with industry best practices for spatial data management.

Leading Light Wind will provide QA/QC on datasets conducted by subject matter experts. This will consist of reviewing datasets for completeness and accuracy including, but not limited to, the presence of metadata, review for incomplete or empty feature classes, **ground-truthing** for offshore and onshore wind project components. Leading Light Wind will provide comments on reporting map figures and provide final approval.

Specific Esri applications that may aid in QA/QC for field data collection include Forms in Field Maps, an Esri application for field data collection. Forms may be used to require responses and streamline any conditional responses. If specific data collection formatting is required by agencies, then other types of field data applications can be leveraged to aid in report generation. For instance, the New jersey Department of Environmental Protection (NJDEP) has an extensive protocol for data collection of various forms, which may be used over the course of the Project.[5]

[5] NJDEP. 2021. NJDEP Mapping and Digital Data Standards: https://www.nj.gov/dep/gis/assets/NJDEP_GIS_Spatial_Data_Standards_Edition_2_7_2021.pdf.

04 Data transparency, sharing, and accessibility

This section describes data transparency, sharing, and accessibility protocols, and how baseline and monitoring site and environmental data listed in the catalog will be made available to the NJBPU and NJDEP. Data sharing will occur on an ongoing basis as soon after collection as practicable, but no later than the public release of the BOEM Construction and Operations Plan.

4.1 Internal

Consistent with industry best practices, the AGOL Organization will be used for internal project analyses or subject matter expert view and access to the data (field collected or publicly available datasets) in the form of web maps and applications. AGOL Organization will be utilized for streamlining the data management process and sharing. In AGOL, published (hosted) feature services and Views (which limit editing and access to internal attributes) of the master geodatabase are used for the web. AGOL allows users to build interactive maps, share maps with user-defined groups, or make those maps public. AGOL allows users to work across an organization to build and use maps where users receive secure, straightforward access to data, maps, and applications. A variety of analysis tools can be used, and data can be updated.

4.2 External

Baseline and monitoring site and environmental data listed in the data catalog will be made available to the NJBPU and NJDEP on an ongoing basis as soon after collection as is practicable, but no later than the public release of the BOEM Construction and Operations Plan. This data will be handled within a single geodatabase. A log of transferred files, as a copy of the data shared, will be kept on Leading Light Wind's server. [redacted]

4.3 Accessibility

Leading Light Wind will make every effort to remove barriers to web accessibility when sharing data externally. According to the US Department of Justice Civil Rights Division, the Americans with Disabilities Act applies to state and local governments (Title II) and businesses that are open to the public (Title III). Given that publicly available resources will be utilized in data collection efforts, resulting map figures, data collection forms, and other materials will implement the following measures to be compliant with the Americans with Disabilities Act to the greatest extent practicable:

- Color contrast between text and the map background, so that it is visually comprehensive to people with limited vision or color blindness
- Avoiding the use of color alone to convey information
- Use of text alternatives on images such as captions or callouts
- Accessible online forms that include labels, clear instructions, and error indicators

Attachment 10.3
Infrastructure Monitoring Plan

Table of contents

Acronyms and abbreviations

Acronym/ abbreviation	Meaning
AC	Alternating current
AUV	Aerial underwater vehicle
BOEM	Bureau of Ocean Energy Management
CO_2	Carbon dioxide
DC	Direct current
EMF	Electromagnetic field
eDNA	Environmental DNA
EFH	Essential fish habitat
eNGO	Environmental non-governmental organization
HFR	High-frequency radar
IOOS	Integrated ocean observing system
MARACOOS	Mid-Atlantic Regional Association Coastal Ocean Observing System
MWTS	MOTUS wildlife tracking system
NJBPU	New Jersey Board of Public Utilities
NJDEP	New Jersey Department of Environmental Protection

Acronym/ abbreviation	Meaning
NOAA	National Oceanic and Atmospheric Administration
NOx	Nitrogen oxides
OCS	Outer Continental Shelf
$PM_{2.5}$	Particulate matter ≤ 2.5 µm
POI	Point of interconnection
RMI	Research and Monitoring Initiative
RODA	Responsible Offshore Development Alliance
ROSA	Responsible Offshore Science Alliance
RWSC	Regional Wildlife Science Collaborative
SO_2	Sulfur dioxide
SST	Surface sea temperature
UAV	Unmanned aerial vehicle
USFWS	US Fish and Wildlife Service
WTI	Wind turbine interference

01 Introduction

Leading Light Wind has prepared this preliminary Infrastructure Monitoring Plan (monitoring plan) for leveraging on- and offshore infrastructure for environmental and ecological monitoring off the coast of New Jersey associated with the Leading Light Wind project (the Project). This monitoring plan is prepared as a requisite component of Leading Light Wind's response to the New Jersey Board of Public Utilities (NJBPU) New Jersey Offshore Wind Third Solicitation.[1]

This monitoring plan evaluates and describes:

- Monitoring opportunities afforded through Project infrastructure
- Scope of monitoring (what, where, when)
- Considerations for data analyses, syntheses and sharing
- Implementation/integration of data into the Project's adaptive management strategy
- Opportunities for collaboration to help advance regional understanding of current environmental conditions and impacts

1.1 Objectives

The objectives of the monitoring plan are to:

1. [redacted]
2. [redacted]

This plan articulates how proposed monitoring efforts will align with regional research objectives, including the New Jersey Research and Monitoring Initiative (RMI), and how implementation of the plan will inform project planning related to Project construction, operations, and decommissioning activities, as well as inform assessment of potential impacts and avoidance and mitigation measures. Specifically, proposed monitoring efforts described herein should contribute to:

- [redacted]

[1] New Jersey Board of Public Utilities, "New Jersey Offshore Wind Solicitation #3: Solicitation Guidance Document" (2022), Trenton, NJ, 133 pp.

1.2 Project description

The Project is located offshore of New Jersey, approximately 70 kilometers (40 nautical miles) east of Atlantic City and approximately 91 kilometers (57 nautical miles) from the National Guard Training Center at Sea Girt, NJ. [redacted] The Project is adjacent, to the east, of the Atlantic Shores Offshore Wind lease area (OCS-A 0541).

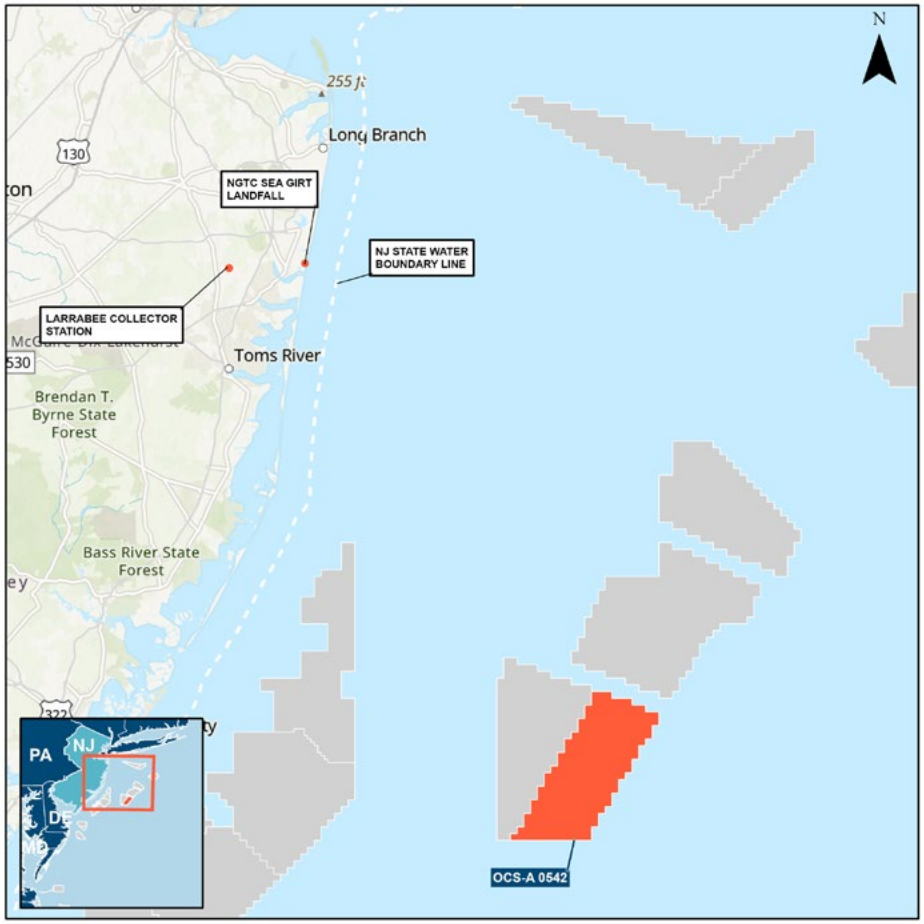


Figure 10.3-1. Site overview map.

1,200-2,400 MW
Renewable electricity

800,000 homes
Powered annually

1.3 Plan scope

[redacted]

This monitoring plan does not constitute the full suite of anticipated environmental and ecological monitoring associated with the Project; rather, this plan focuses on how infrastructure associated with the Project may be leveraged to support an overall monitoring plan. [redacted] Table 10.3-3 in Section 7 of this plan details next steps to further develop this Infrastructure Monitoring Plan, including proposed collaborations.

02 Infrastructure components

This section summarizes how specific Project infrastructure components may be leveraged for use in offshore and onshore physical, chemical, and ecological monitoring programs. [redacted] Section 3 and Table 10.3-3 provide additional description of the incorporation of specific infrastructure in environmental monitoring activities.

[redacted]

2.1 [redacted]

[redacted]

Table 10.3-1. Proposed use of offshore infrastructure in environmental monitoring (preliminary[1]).

Table 10.3-1 (continued). Proposed use of offshore infrastructure in environmental monitoring (preliminary[1]).

Footnotes

1. Proposed use of infrastructure to facilitate environmental monitoring is subject to further local/regional/federal collaboration and concurrence.

Table 10.3-1 (continued). Proposed use of offshore infrastructure in environmental monitoring (preliminary[1]).

2.2 [redacted]

[redacted]

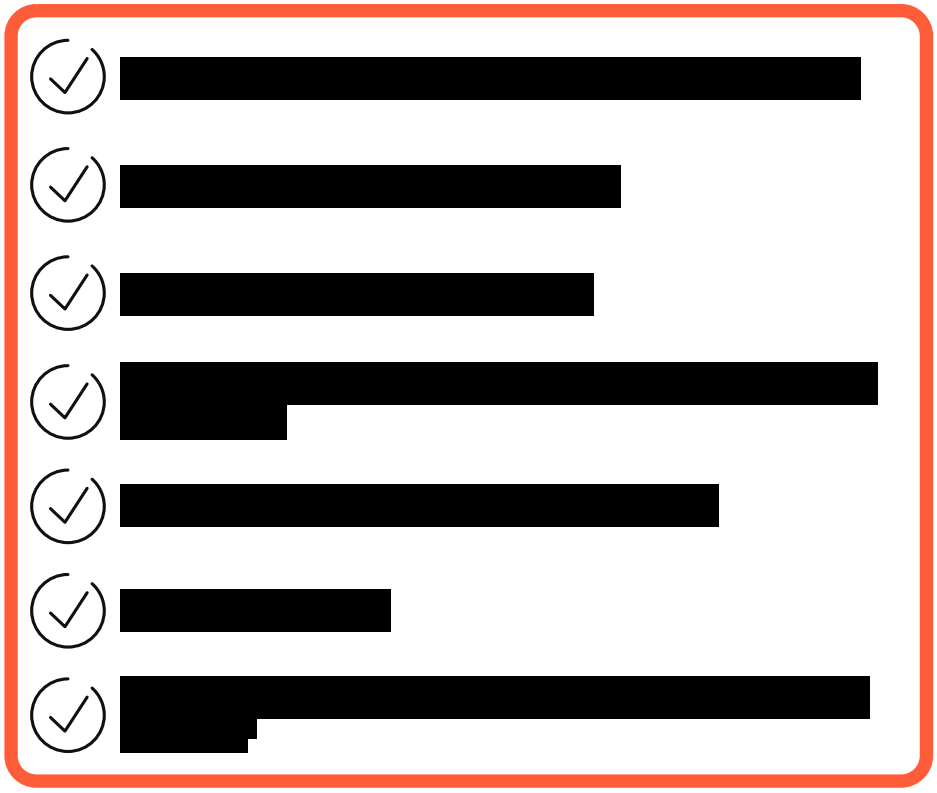
Footnotes

1. Proposed use of infrastructure to facilitate environmental monitoring is subject to further local/regional/federal collaboration and concurrence.

Table 10.3-2. Proposed use of onshore infrastructure in environmental monitoring (preliminary[1]).

03 Monitoring parameters and studies

Infrastructure monitoring encompasses multiple studies targeting specific environmental variables. Each individual study will follow an integrated monitoring approach and include:



[redacted]

For purposes of offshore wind infrastructure accommodated monitoring, Leading Light Wind identifies environmental and ecological monitoring parameters and studies that address the scientific objectives described in Section 1 of this plan. [redacted]

Proposed parameters of interest and associated infrastructure that will support monitoring are summarized in Table 10.3-3.

[2] Responsible Offshore Science Alliance (ROSA), "Offshore Wind Project Monitoring Framework and Guidelines" (2021), 57 pp.

3.1 [redacted]

[redacted]

Physical and chemical parameters that can be monitored using project infrastructure include:

- [redacted]

3.1.1 [redacted]

[redacted]

- [redacted]

[3] NJDEP, Research and Monitoring Initiative (2023), www.dep.nj.gov/offshorewind/rmi/. Accessed April 10, 2023.

[4] Kershaw, F., *Monitoring of Marine Life during Offshore Wind Energy Development – Guidelines and Recommendations* (December 2022), NRDC, 68 pp.

[redacted]

Examples of the use of offshore wind infrastructure to directly support physical-chemical monitoring programs in the offshore environment are provided below.

[redacted]

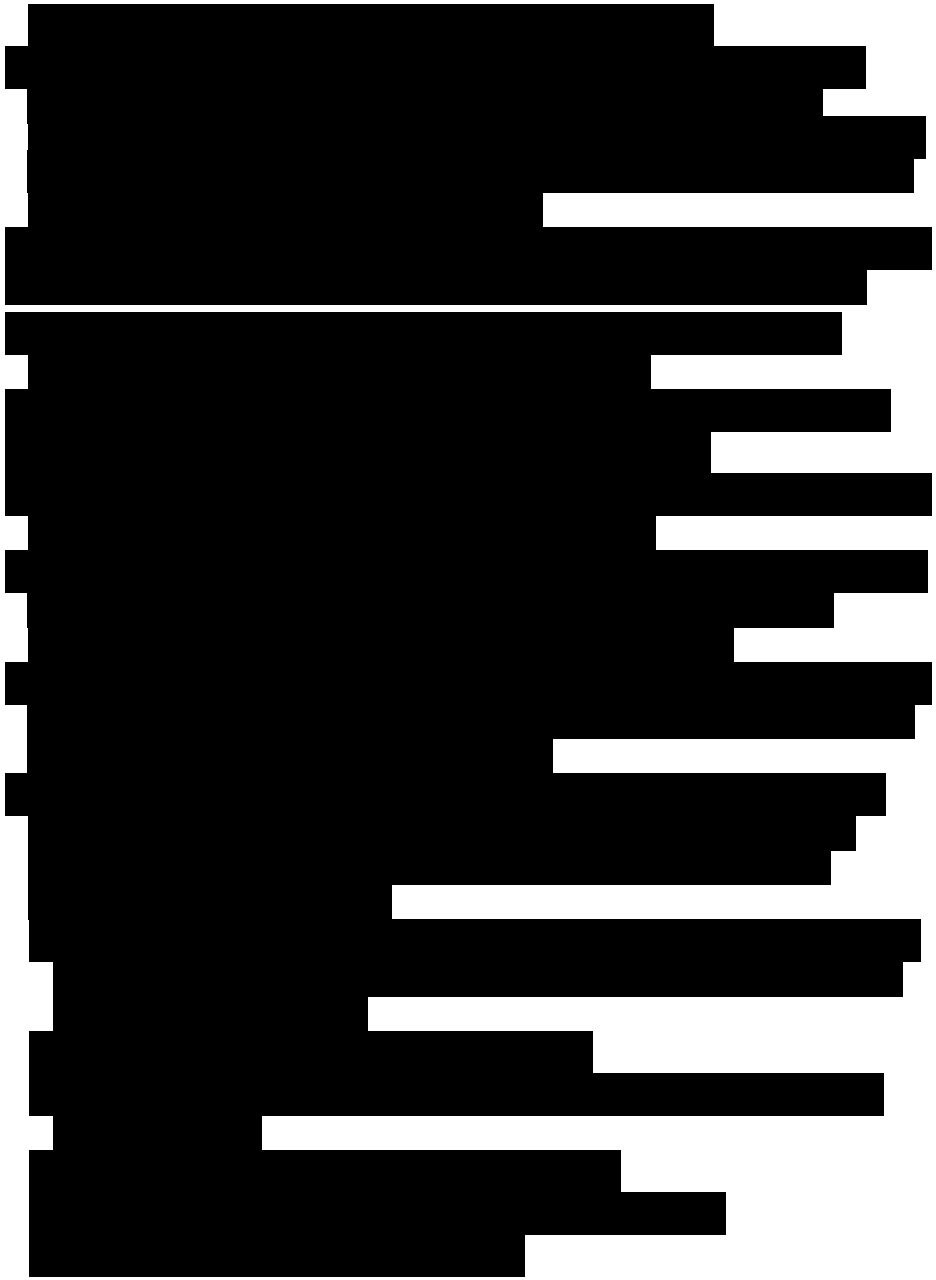
[5] If unavailable, the wind turbines' status also could be obtained from video recordings in some limited cases.

[6] Regional Synthesis Workgroup, "Atlantic Offshore Wind Environmental Research Recommendations" (2022), www.tethys.pnnl.gov/atlantic-offshore-wind-environmental-research-recommendations.

3.2 [redacted]

[redacted]

[redacted]



[redacted]

[redacted]

[redacted]

04 Onshore data management and use

Data is critical to understanding the environment in which we operate and understanding changes in the ocean and upland environments and their respective ecosystems as offshore wind development progresses, while informing responsible decision making and adaptive management throughout the lifecycle of the Project.

[redacted]

05 Adaptive management strategy

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

07 Summary

This preliminary monitoring plan identifies Project infrastructure that supports environmental and ecological monitoring that may be conducted for the lifecycle of the Leading Light Wind project off the coast of New Jersey and in project upland areas on the New Jersey mainland. This Infrastructure Monitoring Plan considers the entire footprint of the project including wind project area, cable routes, landfall locations and upland routes, and addresses how implementation of the plan will inform outstanding questions related to — and reduce impacts associated with — wind project construction and operation. This plan is designed to align with the Project's Data Management and Availability Plan.

Further, this plan describes how Leading light Wind will work collaboratively with and leverage relevant work from Federal, state, academic institutions, other ocean user groups, and developers of other wind projects in the region.

This offshore wind infrastructure monitoring plan does not constitute the full suite of anticipated environmental and ecological monitoring associated with the Project; rather, the plan focuses on how infrastructure associated with the Project may be leveraged to support an overall monitoring plan.

[redacted]

[redacted]

This preliminary monitoring plan will continually evolve, however, specific studies to address plan objectives can be finalized once 1) Project design has advanced (e.g., final number, orientation and location of wind turbines selected; and inter-array, export, and upland cables and POI footprint are established), 2) stakeholder input on monitoring studies' design has been gained (see Table 10.3-3); and 3) monitoring partnerships are formalized.

[redacted]

[redacted]