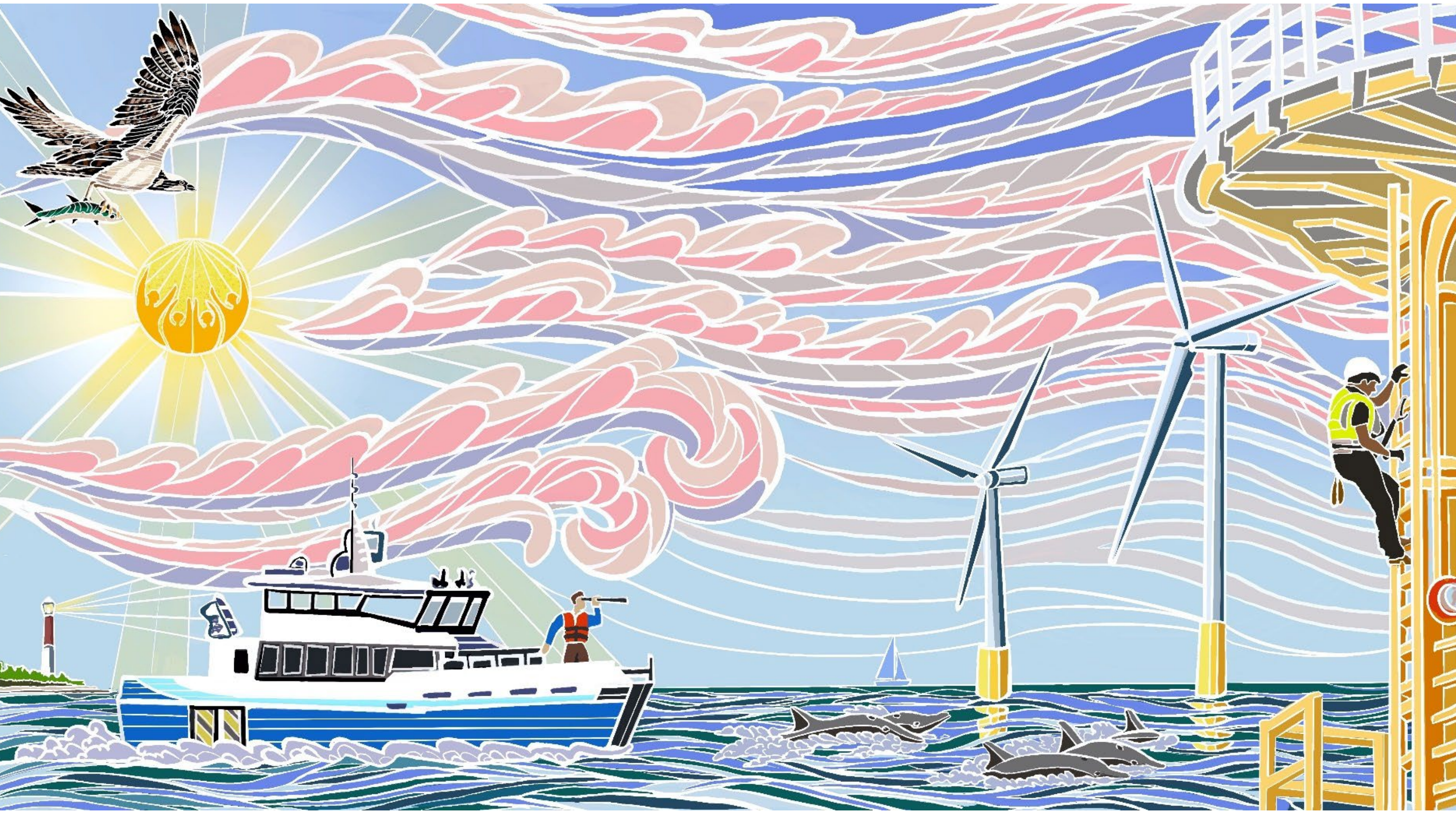

Appendix II-T

Navigation Safety Risk Assessment

March 2024

Atlantic Shores Offshore Wind

Navigation Safety Risk Assessment for Lease Area OCS-A 0549

March 3, 2023 | 13294.301.R1.Rev2

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Atlantic Shores Offshore Wind

Navigation Safety Risk Assessment for Lease Area OCS-A 0549

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13294.301.R1.Rev2

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Revision	Date	Status	Comments	Prepared	Reviewed	Approved
1	03Mar2023	Final		AM/KR/HD	LW	RDS
2	08Sep2023	Final		KMH/AS		

Executive Summary

Atlantic Shores Offshore Wind, LLC (Atlantic Shores), a 50/50 joint venture between EDF-RE Offshore Development, LLC (a wholly owned subsidiary of EDF Renewables, Inc. [EDF Renewables]) and Shell New Energies US LLC, is proposing to develop an offshore wind energy generation project (the Project) within Lease Area OCS-A 0549 (the Lease Area). Lease Area OCS-A 0549 is located north of and adjacent to Atlantic Shores' Lease Area OCS-A 0499. Atlantic Shores applied to the Bureau of Ocean Energy Management (BOEM) in 2021 to formally segregate Lease Area OCS-A 0549 from Lease Area OCS-A 0499. The segregation was approved by BOEM in April 2022. In this report, the term "Lease Area" refers to Lease Area OCS-A 0549 and the term "combined Lease Areas" refers to both OCS-A 0499 and OCS-A 0549.

The Lease Area is approximately 81,129 acres (328.3 square kilometers [km^2]) in size and is located on the Outer Continental Shelf (OCS) within the New Jersey Wind Energy Area. The New Jersey Wind Energy Area was identified as suitable for offshore renewable energy development by BOEM through a multi-year, public environmental review process. Through this review process, the New Jersey Wind Energy Area was sited to exclude areas of high-value habitat and conflicting water and air space uses.

At its closest point, the Lease Area is approximately 7.3 nautical miles (nm) (13.5 kilometers [km]) from the New Jersey coast and approximately 52 nm (96.6 km) from the New York State coast. The facilities to be installed within the Lease Area will include:

- A maximum of up to 157 wind turbine generators (WTGs);
- Up to 8 small, 4 medium, or 3 large offshore substations (OSSs);
- Inter-array and/or inter-link cables connecting the WTGs and OSSs;
- Up to two temporary meteorological and oceanographic (metocean) buoys; and
- Up to one permanent meteorological tower (Met Tower).

The Lease Area layout is designed to maximize offshore renewable wind energy production while minimizing effects on existing marine uses. The structures will be aligned in a uniform grid with multiple lines of orientation allowing straight transit through the Lease Area. Given the proximity to and shared border between the two Atlantic Shores lease areas, the layouts of both lease areas form a continuous regular grid with consistent grid alignment and spacing. In developing the layout, existing vessel traffic patterns and feedback from agencies and stakeholders (including the U.S. Coast Guard [USCG] and commercial and recreational fishermen) were considered.

The Project is being permitted using a Project Design Envelope (PDE), which provides a reasonable range of designs for proposed components and installation techniques to deliver the Project. The Project includes three options for WTG and OSS foundations: piled, suction bucket, or gravity foundations.

The primary east-northeast to west-southwest transit corridors through the Lease Area were selected to align with the predominant flow of vessel traffic; accordingly, WTGs will be placed along east-northeast to west-southwest rows spaced 1.0 nm (1.9 km) apart to allow for two-way vessel movement. The proposed grid also facilitates north to south transit by positioning WTGs along rows in an approximately north to south direction spaced 0.6 nm (1.1 km) apart. The WTG grid will also create diagonal corridors of 0.54 nm (1.0 km) running approximately northwest to southeast as well as diagonal corridors of 0.49 nm (0.9 km) running approximately north-northeast to south-southwest. The OSS positions will be located along the same east-northeast to west-southwest rows as the proposed WTGs, preserving all of the primary east-northeast transit corridors.

Atlantic Shores will position the OSSs within a maximum of two north to south corridors to preserve the spacing in the majority of the north to south transit corridors.

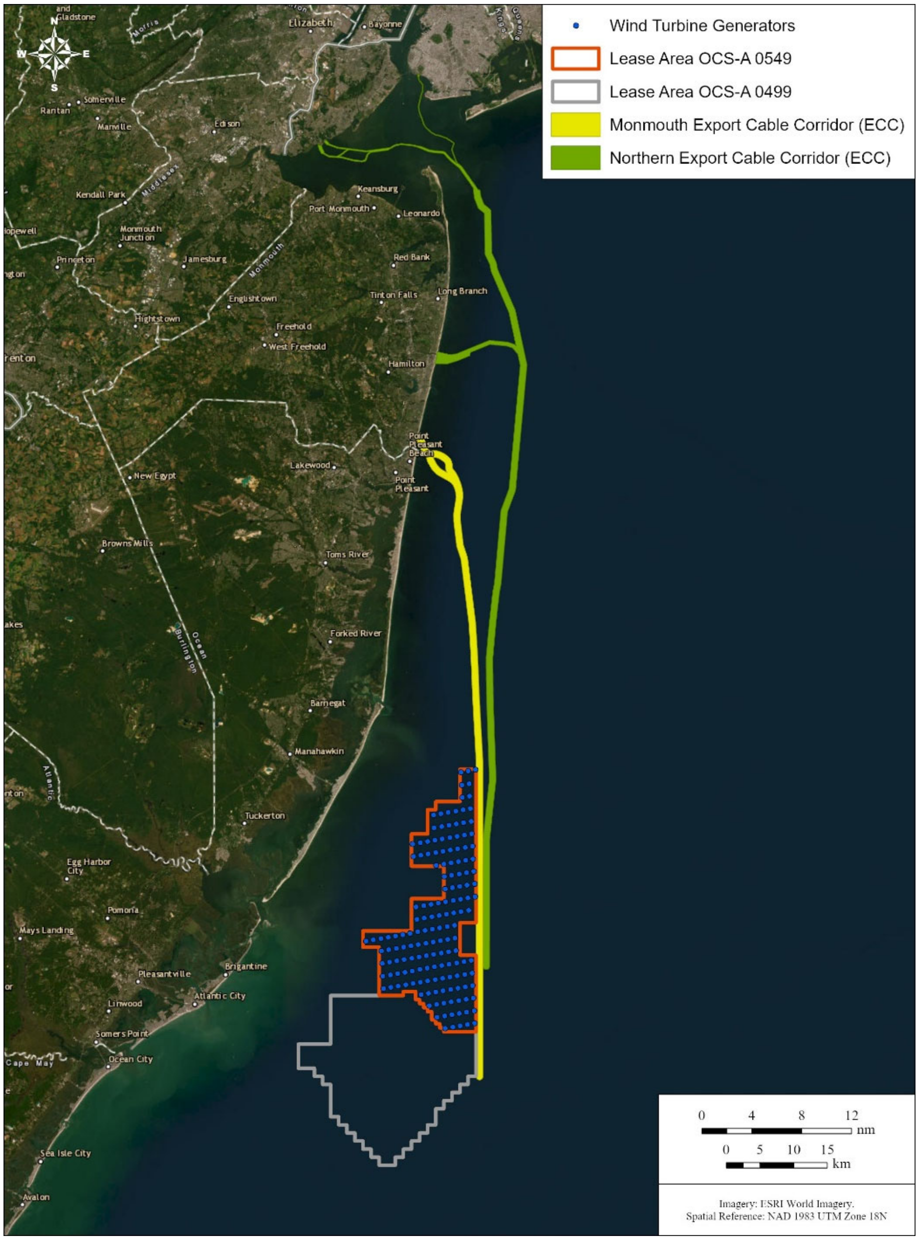

Figure E.1: Regional Map showing Atlantic Shores Offshore Lease Area and Export Cable Corridors

Within the Lease Area, the WTGs and OSSs will be connected by two separate, electrically distinct systems of inter-array cables and/or inter-link cables. Energy from the OSSs will be delivered to landfall sites in New Jersey and/or New York via 230 kV to 275 kV HVAC and/or 320 kV to 525 kV high voltage direct current (HVDC) export cables. Atlantic Shores has identified potential landfall sites in southern Monmouth County, New Jersey (the Monmouth Landfall Sites); in the vicinity of Asbury in northern Monmouth County, New Jersey (the Asbury Landfall Sites); on southwest Staten Island, New York (The Raritan Bay Landfall Sites); and in

Brooklyn, New York (The Narrows Landfall Site). In this report, the term “Offshore Project Area” refers to the offshore area where the Project facilities are physically located, including the Lease Area and the ECCs.

The Monmouth ECC extends from the Lease Area to the potential Monmouth Landfall Sites in southern Monmouth County, New Jersey. The total length of the Monmouth ECC associated with the Project is approximately 52.8 nm (97.9 km) from the Lease Area to the farthest landfall site in New Jersey. While the Monmouth ECC is also included in the COP (Atlantic Shores, 2022) for Lease Area OCS-A 0499, there is sufficient space within the ECC to co-locate the export cables for the Project with those for Lease Area OCS-A 0499.

The Northern ECC extends north from the Lease Area to the New York State waters boundary, where it splits into branches to reach the Raritan Bay Landfall Sites on Staten Island in Richmond County, New York and The Narrows Landfall Site in Brooklyn in Kings County, New York. The total length of the Northern ECC associated with the Project from the Lease Area to the furthest potential landfall location is approximately 90.2 nm (145.1 km).

The Asbury Branch extends westward from the Northern ECC approximately 7.5 nm (13.9 km) to the potential Asbury Landfall Sites in northern Monmouth County, New Jersey.

During construction and operation of the Project, Atlantic Shores will use port facilities in New Jersey, New York, the mid-Atlantic, and/or New England. In addition, some components, materials, and vessels could come from U.S. Gulf Coast or international ports. During operation, the Project will be supported by existing O&M and port facilities.

The Navigation Safety Risk Assessment

This document provides a summary of the methodology and findings of a navigation safety risk assessment (NSRA) conducted for the Project in accordance with USCG Navigation and Vessel Inspection Circular No. 01-19 (NVIC 01-19). The NSRA is intended to identify hazards to navigation and associated consequences that might be created by the potential Project during the construction and installation, operations and maintenance, and decommissioning phases. Key considerations include: (1) safety of navigation; (2) the effect on traditional uses of the waterway; and (3) the impact on maritime search and rescue activities by the USCG and others.

Existing Vessel Traffic

A detailed analysis of existing vessel traffic patterns was carried out through stakeholder consultation and through use of vessel Automatic Identification System (AIS) data and the National Oceanic and Atmospheric Administration (NOAA) Vessel Monitoring System (VMS) and Vessel Trip Report (VTR) datasets. Six years of AIS data (2016-21, inclusive) were obtained for the coastline of New Jersey, comprising over 21 million records at variable temporal resolution. These data were processed into individual vessel tracks by means of proprietary software and then categorized by vessel type. VMS mapping data for 2 years between 2015 and 2016 were analyzed along with 5 years of VTR mapping data (2011-15) and included in the assessment of fishing activities. In addition, BOEM provided polar histograms (plots of the frequency of vessel tracks by track heading) developed from 6 years of VMS fishing vessel data (2014 to 2019, inclusive) that were also considered.

The AIS data indicated that the majority of unique vessels entering the Lease Area were cargo (21%) and recreational craft (43%); however, the majority of unique vessel tracks were by cargo (19%) and commercial fishing vessels (40%). There is strong seasonality as to the number of vessels transiting the Lease Area, varying from 6.6 transits per day on average in the winter to 14.7 transits per day in the summer. This seasonality is primarily driven by fishing and recreational vessels, as the transits of commercial (non-fishing) vessels were relatively consistent from month to month. The overall traffic density within the Lease Area was found to be relatively low, with two or more vessels present in the Lease Area for only 1,460 hours per year on average (16.6% of the time).

The commercial fishing vessel traffic was sub-categorized as either "actively fishing" or "transiting." Actively fishing was defined as a sustained vessel speed of less than 4 knots (7.4 kilometers per hour [kph]). There were approximately 211 times per year on average that active fishing tracks were identified within the Lease Area. Review of the NOAA VMS data indicated that this fishing activity was primarily surf clam/quahog dredging.

The transiting fishing vessels followed a wide range of track orientations depending on the port of origin/destination, with many of the vessels departing from Atlantic City, Cape May, and Barnegat Inlet. Similarly, the AIS-equipped recreational craft followed a wide range of track orientations. The proposed WTG grid within the Lease Area consists of multiple corridors in a variety of orientations to accommodate this traffic.

An assessment of vessel traffic crossing the ECCs was also conducted. The highest volumes of traffic occurred immediately offshore of the landfall locations with the Monmouth ECC. With the Northern ECC, the highest volumes were identified within the New York harbor area and immediately offshore of the New Jersey landfall site.

In undertaking the NSRA, was Atlantic Shores recognized that AIS equipment is only required on vessels greater than 65 ft (19.8 m) in length, although a sizeable percentage of fishing and recreational vessels with shorter lengths were found to have AIS transponders. To address this, the AIS traffic volumes assumed in the risk modeling were increased by 100% for fishing and recreational vessels. Three other AIS vessel categories may include some vessels smaller than 65 ft (19.8 m), including passenger, unspecified AIS type, and "other" vessels, but the volume of traffic for these categories was low, and very few of the vessels in these categories had tracks that traversed across the Lease Area. The additional traffic in these categories would fall within the increases assumed for the fishing and recreational craft.

Vessel Navigation Impacts

The existing navigation features in the region, including existing and proposed fairways, aids-to-navigation (ATONs) and marine hazards, were reviewed as part of this NSRA. The proposed Project is not anticipated to have an adverse impact on vessel traffic, although Atlantic Shores anticipates that commercial (non-fishing) vessels will likely choose to navigate around the Lease Area rather than transit through it. Most of the cargo vessels and tankers have lengths exceeding 450 ft (137 m), with some having lengths exceeding 1,000 ft (305 m), which exceed recommended guidelines (USCG 2022a) for the Lease Area corridor spacing. Similarly, Atlantic Shores anticipates that future tug-barge traffic will not pass through the Lease Area but will transit to the west of the Lease Area (only 2% of the tug traffic currently enters the Lease Area). The additional time required to travel around versus through the combined Lease Areas (OCS-A 0499 and 0549) was estimated to be on the order of 15 to 20 minutes.

This re-routing of commercial traffic is clearly recognized in the recent Consolidated Port Approaches and International Entry and Departure Transit Area Port Access Route Studies (CPAPARS) completed by the USCG in August 2022 with the identification of a fairway to the east of the Lease Area, termed the St. Lucie to New York Fairway, and a proposed New Jersey to New York Connector Fairway to the west of the Lease Area.

Smaller vessels, particularly fishing and recreational vessels, are expected to choose to transit through and to fish within the Lease Area. The navigational safety for these activities has been evaluated based on turbine spacing and size of vessels. Given the relatively deep water at the Lease Area, which ranges from 66 to 98 ft (20 to 30 m), navigation is not limited by water depth.

A desktop analysis of corridor spacing based on international technical guidance indicated that the 1.0 nm (1.9 km) east-northeast corridors will accommodate all of the existing AIS-equipped fishing fleet and 99.9% of the AIS-equipped recreational vessels. A 0.60 nm (1.1 km) corridor will accommodate 99.7% of the fishing fleet and 98.6% of the recreational vessels. A 0.54 nm (1.0 km) diagonal corridor will accommodate 99.7% and 98.1% of the fishing and recreational vessels, respectively, while the 0.49 nm (0.9 km) corridors will accommodate 99.5% and 96.5%, respectively. It is important to note that the large vessels in the recreational craft AIS category are, in reality, commercial vessels with licensed captain and crew. It is also important to recognize that the corridor widths are not actual channels with physical limits at the channel edges. Once the Project is constructed and in operation, vessels can navigate from one corridor to the next without restriction.

There are air draft restrictions within the Lease Area due to the WTG blades. The minimum proposed rotor tip clearance above Highest Astronomical Tide (HAT) is 72.2 ft (22.0 m). Large sailing craft transiting in this region may have mast heights that exceed this elevation, but the risk is considered to be very low as the vessel would need to be immediately adjacent to a turbine for a potential strike to occur.

A quantitative navigation safety risk assessment was conducted for existing and post-construction conditions within the Lease Area using Baird's proprietary Navigational and Operational Risk Model (NORM). The model utilizes raw AIS, wind, current, and visibility data as inputs along with the geometric layout and characteristic dimensions of the WTGs, OSSs and Met Tower. To account for non-AIS equipped vessels, fishing and recreational traffic volumes were significantly increased, as mentioned previously. The model computes the risk of vessel collision and allision with an offshore structure by vessel category.

The NORM model estimated that the risk of accidents may increase by a small amount in the future. The annual frequency of accidents changed from 0.090 under existing conditions to a range of 0.103 to 0.107 post-construction. However, if one considers the risk to existing vessel traffic (i.e., excluding collisions between O&M vessels themselves or allisions by O&M vessels), the overall frequency range drops to 0.098 to 0.107 accidents per year. This change from the base case represents one additional accident every 59 to 130 years, depending on the foundation type.

Much of the increase in risk is associated with the increased volume of traffic due to the transits of operations and maintenance (O&M) crew transfer vessels (CTVs). Atlantic Shores estimates that an average of two to six daily vessel round trips to the Lease Area will occur due to these vessels, depending on the type of vessel utilized. For the purposes of the modeling, the upper end of the estimate range (2050 annual round trips, which is equivalent to approximately six round trips per day) was assumed, which was based on the use of CTVs staged from Atlantic City. However, is important to recognize that the CTVs will be modern, highly specialized vessels manned by professional crew who will be trained in First Aid. They will be outfitted with recent technology in terms of marine radar, AIS, and chart display. These vessels also will have specified weather thresholds in which transits will not be carried out. These additional safety factors associated with the CTVs, which would further decrease the risk and potential severity of collisions / allisions, were not accounted for in the modelling to ensure that the results were conservative.

Effect on Search and Rescue Activity

There have been a total of 38 historical search and rescue (SAR) missions that have occurred within a 2 nm "drift buffer" around the combined Lease Areas during the period from 2011 to 2020, with six of these occurring specifically in Lease Area OCS-A 0549. The drift buffer allowed for the possible drift of a vessel into the Lease Area with wind and/or currents based on an assumed two-hour SAR response time. These historical missions were associated with a variety of incidents including vessel capsizing, disabled vessels, taking on water, medical evacuation, and persons in water. Commercial salvors also conduct a number of operations each summer to assist disabled recreational vessels in the area.

The minimum WTG blade tip vertical clearance is not expected to affect the operation of the local USCG marine SAR assets, such as the 154 ft (46.9 m) long Sentinel class Fast Response Cutters or the 87 ft (26.5 m) Protector class Patrol vessels, as the vessel air draft is smaller than the clearance. Atlantic Shores assumes that these marine assets will be able to safely navigate and maneuver adequately within the Lease Area. Atlantic Shores expects that the Project will not affect travel times to and within the Lease Area by vessels responding to SAR distress calls.

To address aerial SAR, a Risk Assessment Workshop was held in July 2021 to methodically review the potential impacts of the proposed offshore wind projects within the combined Lease Areas on USCG SAR operations and to identify safeguards and additional recommended measures to mitigate identified concerns. The workshop was held over a 2-day period with participation by the USCG, BOEM, Atlantic Shores and other relevant stakeholders. The workshop team evaluated 13 hazardous scenarios in four hazard categories and identified 16 recommendations to support the reduction of overall risk to USCG aerial SAR missions. Atlantic Shores is reviewing these recommendations in coordination with the USCG and key stakeholders and may elect to implement recommendations that could meaningfully reduce risk. As part of this work, various possible mitigations to aid in detection of disabled vessels or persons in water are being considered, as summarized below.

Marine Radar, Communications, and Vessel Positioning

Studies have been conducted to evaluate concerns that the WTGs may affect some shipborne radar systems, potentially creating false targets on the radar display or causing vessels navigating within the Lease Area to become "hidden" on radar systems due to shadowing created by the WTGs. The effectiveness of radar systems and any effects from WTGs will vary from vessel to vessel based on several factors, including radar equipment type, settings, and installation (including location of placement on the vessel). As identified in previous studies of this issue in Europe (BWEA 2007), the potential effects of WTGs may be reduced through adjustment of the radar controls.

In 2021, at the request of BOEM, the National Academy of Sciences (NAS) conducted a study of the effects of WTGs on marine vessel radar based on a review of technical literature, information gathering sessions held with key stakeholders and analyses of radar data. The results of the study indicated that WTGs could affect marine radar systems in a situation-dependent manner. Distinctions were drawn between the older magnetron-based radar systems and the newer solid-state systems that can incorporate more sophisticated processing techniques. The NAS noted that there have been no field tests in offshore wind farms of these newer systems, and the NAS made recommendations for more comprehensive data collection efforts. A number of possible mitigations were identified including improved operator training, the requirement for smaller vessels to carry radar reflectors to improve detectability, the deployment of reference buoys adjacent to wind farms to give a reference target for appropriate adjustment of the radar gain, and the standardization of radar mounting procedures on vessels. The NAS also encouraged the development of improvements in solid-state radar design by manufacturers, noting that solid-state radar technology allows for signal processing methods and filtering to create WTG-resilient systems.

Accordingly, Atlantic Shores expects that radar operator training and dissemination of information regarding proper installation and adjustment of equipment will reduce potential Project-related effects on use of radar systems. The use of radar reflectors on small craft will be encouraged. Additionally, Atlantic Shores plans to use AIS to mark the presence of WTGs, which will further limit potential effects.

Based on a review of various studies conducted for existing offshore wind fields, the WTGs are expected to have little effect on VHF and digital select calling (DSC) communications or AIS reception.

Construction Impacts

The specific vessels to be used in construction are not yet known, and the numbers of vessels cannot be readily defined. The maximum estimates for the total number of vessels required for any single offshore construction activity range from two vessels for scour protection installation to up to 16 vessels for OSS installation. If all construction activities occur simultaneously (which is unlikely), a total of 51 vessels could be present in the Lease Area and along the ECCs at any one time.

Many of the construction activities are sequential, meaning that not all vessels involved in a given activity (such as OSS installation) will be operating simultaneously. Additionally, many of the construction vessels will remain in the Lease Area or ECCs for days or weeks at a time and will not be transiting to construction staging port facilities on a frequent basis. Considering these factors, Atlantic Shores estimates that there will be between 4 to 12 daily transits (equivalent to two to six daily round trips) between construction staging port facilities under consideration and the offshore construction areas.

Cable laying activities for the Northern ECC within the New York harbor may result in short term impacts on vessel traffic. Note that the Northern ECC also runs along the perimeter of the southbound Ambrose to Barnegat Traffic Separation Scheme (TSS) to avoid impacting designated sand borrow areas.

Atlantic Shores will coordinate with the USCG to designate Safety Zones, or other means as considered appropriate, at working areas to reduce hazards during construction. These Safety Zones will only cover a small portion of the Lease Area at any one time, and there will be limited interaction between construction vessels and existing traffic. Atlantic Shores anticipates that the presence of the temporary Safety Zones will be communicated by means of Local Notices to Mariners (LNMs) in coordination with the USCG. There will also be communication through the Project's website and by Atlantic Shores Marine Coordinator and Fisheries Liaison Officer.

Proposed Mitigations

A series of measures to mitigate the navigational risks identified during both the construction and operation of the Project has been developed based on the NSRA's findings, as summarized below.

Construction & Installation and Decommissioning Phases

During the construction and decommissioning phases, there will be an increase in vessel traffic at the staging ports as well as the navigational obstacles created by the presence of installed or partially installed offshore WTGs, OSSs, and the Met Tower. The potential change in risk is expected to be small, but various mitigation strategies have been developed to reduce the possible risk. These mitigation strategies include:

- Prior to construction, Atlantic Shores will develop a mariner communication and outreach plan for vessel users / operators (commercial, vessels, military vessels, tug / tow vessels, etc.) that are not involved in the fishing industry.
- Atlantic Shores will utilize a Marine Coordinator to manage vessel movements throughout the Offshore Project Area. The Marine Coordinator will be Atlantic Shore's primary point of contact with USCG, port authorities, state and local law enforcement, marine patrol, port operators, and commercial operators (e.g., ferry, tourist, and fishing boat operators).
- A construction communications plan will be developed (working channels, crisis communications, etc.).

- Atlantic Shores has developed a Fisheries Communication Plan that defines outreach and engagement with fishing interests during all phases of the Project. To support the execution of the FCP, Atlantic Shores employs a Fisheries Liaison Officer (FLO) and a Fishing Industry Representative (FIR). Additional FIRs may be nominated to represent specific fisheries identified within the Lease Area or along the ECCs as the Project progresses or a need is identified. The FLO and FIR(s) will communicate and coordinate with the local commercial and recreational fishing community during the construction phase. A "For Mariners" project webpage (www.atlanticshoreswind.com/mariners/) has been developed that contains the latest news and events, real-time Project buoy data display and Project vessel tracking chart, Project vessel schedules, and FLO and FIR contact information.
- Atlantic Shores will coordinate with the USCG to establish Safety Zones (or alternative as approved by the USCG) demarcated around working areas and the means of communicating these safety zones to stakeholders throughout the different phases of construction.
- Atlantic Shores will regularly coordinate with the USCG and NOAA on chart updates as components (e.g., foundations, WTGs, OSSs) of the Project are constructed and regarding the issuance of LNMs.
- Coordination will be carried out with local port authorities on the development of vessel traffic management plans for the various staging ports.
- All construction vessels will display appropriate navigation lights and day shapes as per regulatory requirements.
- Fully and partially constructed WTGs, OSSs, and the Met Tower will be marked and lit in accordance with USCG and BOEM requirements. Contingency plans will be developed in conjunction with the USCG to address aids to navigation requirements in the event a WTG or OSS experiences any issues with marking or lighting.
- Aviation obstruction lighting will be provided on constructed WTGs, OSSs (if needed), and the Met Tower in accordance with FAA (2020) and BOEM requirements. This will include the provision that the lights are visible to those pilots using night vision goggles (FAA, 2017).
- Coordination will be carried out with USCG on operational protocols for the WTG braking system and any SAR activity that might occur within the constructed turbine field or working areas.

Operations & Maintenance Phase

The presence of the WTGs, OSSs, and Met Tower within the Lease Area will lead to changes in traffic patterns and possible increases in navigational risk. The change in risk is expected to be small, but various mitigation strategies have been developed to reduce the possible effects of the Project. These mitigation strategies include:

- A Project-specific Marine Coordinator will manage vessel movements throughout the Offshore Project Area. The Marine Coordinator will be responsible for monitoring daily vessel movements, implementing communication protocols with external vessels, and monitoring safety buffers. The Marine Coordinator will be Atlantic Shores' primary point of contact with USCG, port authorities, state and local law enforcement, marine patrol, port operators, and commercial operators (e.g., ferry, tourist, and fishing boat operators).
- The FLO and FIR(s), as part of an overall FCP, will communicate and coordinate with the local commercial and recreational fishing community.
- The WTGs, OSSs, and Met Tower will be marked and lit in accordance with USCG and BOEM requirements, including alphanumeric tower designation and distinct lighting on corner towers/significant peripheral structures (SPSs), outer boundary towers, and interior towers. Mariner Radio Activated Sound Signals (MRASS) on corner towers/SPSs and perimeter structures will be provided.

- Aviation obstruction lighting will be provided on the WTGs, OSSs (if needed), and the Met Tower in accordance with FAA (2020) and BOEM requirements. This will include the provision that the lights are visible to those pilots using night vision goggles (FAA, 2017).
- Contingency plans will be developed in conjunction with the USCG to address aids to navigation requirements in the event a WTG or OSS experiences any issues with marking or lighting.
- Atlantic Shores will coordinate with the USCG and NOAA on navigational chart updates showing positions of constructed WTGs and OSSs. Similarly, Atlantic Shores will coordinate with the USCG on the issuance of LNMs.
- A variety of mitigations are proposed for assistance with USCG SAR activity. Certain mitigations may be directly controlled by the USCG. These mitigations include:
    - Provision of aviation obstruction lighting on WTGs, OSSs (if needed), and the Met Tower in accordance with FAA and BOEM requirements, which will aid aerial SAR activities. Atlantic Shores is considering the use of an Aircraft Detection Lighting System (ADLS), subject to FAA and BOEM approval, to reduce the potential impacts of light at night on migratory birds and to address potential visual impacts from shore.
    - Implementation of WTGs' rotor emergency braking systems to stop and maintain the position of the WTG blades, nacelles, and other appropriate moving parts.
    - Direct coordination in SAR missions within the Lease Area by the Marine Coordinator.
    - Possible mitigations to assist in search detection, including installation of VHF direction finding equipment, real-time meteorological/oceanographic measurements (waves, wind, currents), and high-resolution infrared detection systems to assist in location of persons in water and/or vessels.
    - Atlantic Shores expects that the access ladders on the WTG and OSS foundations will be designed to allow distressed mariners access to an open refuge area on top of the ladder. The presence of a person on the offshore structure will be detected using cameras and intrusion detectors.
    - Bi-annual testing of the communication and rotor braking systems.

Development of an Emergency Response Plan (ERP) to specify coordination, shutdown, and rescue procedures. The ERP will be reviewed and updated at least annually between Atlantic Shores and the USCG.

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Figures

Acronyms

ACPARS	Atlantic Coast Port Access Route Study
ADLS	Aircraft Detection Lighting System
AIS	Automatic Identification System
ANPRM	Advanced Notice of Proposed Rulemaking (USCG procedure)
ARI	Average Recurrence Interval
ATON	Aids to Navigation
BOEM	Bureau of Ocean Energy Management
C&I	Construction and installation
CFR	Code of Federal Regulations
CFSR	Climate Forecast System Reanalysis
COLREGS	International Regulations for Preventing Collisions at Sea
COP	Construction and Operations Plan
CTV	Crew Transfer Vessel
DSC	Digital Selective Calling
DWT	Deadweight Tonnage
ECC	Export Cable Corridor
ECDIS	Electronic Chart Display and Information System
EMF	Electromagnetic Field
eNGO	Environmental Non-Governmental Agency
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
ft	feet
GIS	Geographic Information System
GPS	Global Positioning System
GPSR	General Provisions on Ships' Routing
hr	Hour
HVAC	High voltage AC
HVDC	High voltage DC
Hz	Hertz
IALA	International Association of Lighthouse Authorities
IMO	International Maritime Organization
IPS	Intermediate Peripheral Structures
km	Kilometer
kts	Knots – vessel speed in nautical miles per hour
kph	Kilometers per hour

LOA	length overall
LNM	Local Notice to Mariners (USCG publication)
m	meter
MER	Marine Environmental Response
MGN	Marine Guidance Note
MHHW	Mean Higher High Water
MISLE	Marine Information for Safety and Law Enforcement
mi	Statute mile
MLLW	Mean Lower Low Water
MMSI	Maritime Mobile Service Identity
MRASS	Mariner Radio Activated Sound Signal
MSL	Mean Sea Level
MTS	Marine Transportation System
MW	megawatt
NCEI	National Centers for Environmental Information
NCEP	National Centers for Environmental Prediction
NDBC	National Data Buoy Centre
NJDEP	New Jersey Dept. of Environmental Protection
NJPARS	New Jersey Port Access Route Study
nm	nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NORM	Navigational and Operational Risk Model
NSRA	Navigation Safety Risk Assessment
NVIC	Navigation and Vessel Inspection Circular (USCG publication)
O&M	Operations and Maintenance
OREI	Offshore Renewable Energy Installation
PARS	Port Access Route Study
PATON	Private Aids to Navigation
PIANC	World Association for Waterborne Transport Infrastructure
POI	Point of Interconnection
RACON	Radar Transponder
Ro-Ro	Roll-on roll-off vessel
SAR	Search and Rescue
SOLAS	International Convention for the Safety of Life at Sea
SOV	Service Operational Vessel
SPS	Significant Peripheral Structure
TN	True North

TSS	Traffic Separation Scheme
UNCLOS	United Nations Convention on the Law of the Sea
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
UXO	Unexploded Ordinance
VHF	Very High Frequency Radio
VTS	Vessel Traffic Service
VMS	Vessel Monitoring Service
VTR	Vessel Trip Report
WIS	Wave Information Study
WTG	Wind Turbine Generator

1. Introduction

1.1 Project Overview

Atlantic Shores Offshore Wind, LLC (Atlantic Shores), a 50/50 joint venture between EDF-RE Offshore Development, LLC (a wholly owned subsidiary of EDF Renewables, Inc. [EDF Renewables]) and Shell New Energies US LLC, is proposing to develop an offshore wind energy generation project (the Project) within Lease Area OCS-A 0549 (the Lease Area). Lease Area OCS-A 0549 is located north of and adjacent to Atlantic Shores' Lease Area OCS-A 0499. Atlantic Shores applied to the Bureau of Ocean Energy Management (BOEM) in 2021 to formally segregate Lease Area OCS-A 0549 from Lease Area OCS-A 0499. The segregation was approved by BOEM in April 2022. In this report, the term "Lease Area" refers to Lease Area OCS-A 0549 and the term "combined Lease Areas" refers to both OCS-A 0499 and OCS-A 0549.

The Lease Area is approximately 81,129 acres (328.3 square kilometers [km^2]) in size and is located on the Outer Continental Shelf (OCS) within the New Jersey Wind Energy Area. The New Jersey Wind Energy Area was identified as suitable for offshore renewable energy development by BOEM through a multi-year, public environmental review process. Through this review process, the New Jersey Wind Energy Area was sited to exclude areas of high-value habitat and conflicting water and air space uses.

At its closest point, the Lease Area is approximately 7.3 nautical miles (nm) (13.5 kilometers [km]) from the New Jersey coast and approximately 52 nm (96.6 km) from the New York State coast. The facilities to be installed within the Lease Area will include:

- A maximum of up to 157 wind turbine generators (WTGs);
- Up to 8 small, 4 medium, or 3 large offshore substations (OSSs);
- Inter-array and/or inter-link cables connecting the WTGs and OSSs;
- Up to two temporary meteorological and oceanographic (metocean) buoys; and
- Up to one permanent meteorological tower (Met Tower).

The Lease Area layout is designed to maximize offshore renewable wind energy production while minimizing effects on existing marine uses. The structures will be aligned in a uniform grid with multiple lines of orientation allowing straight transit through the Lease Area. Given the proximity to and shared border between the two Atlantic Shores lease areas, the layouts of both lease areas form a continuous regular grid with consistent grid alignment and spacing. In developing the layout, existing vessel traffic patterns and feedback from agencies and stakeholders (including the U.S. Coast Guard [USCG] and commercial and recreational fishermen) were considered.

The Project is being permitted using a Project Design Envelope (PDE), which provides a reasonable range of designs for proposed components and installation techniques to deliver the Project. The Project includes three options for WTG and OSS foundations: piled, suction bucket, or gravity foundations.

The primary east-northeast to west-southwest transit corridors through the Lease Area were selected to align with the predominant flow of vessel traffic; accordingly, WTGs will be placed along east-northeast to west-southwest rows spaced 1.0 nautical mile (nm) (1.9 km) apart to allow for two-way vessel movement. The proposed grid also facilitates north to south transit by positioning WTGs along rows in an approximately north to south direction spaced 0.6 nm (1.1 km) apart. The WTG grid will also create diagonal corridors of 0.54 nm (1.0 km) running approximately northwest to southeast as well as diagonal corridors of 0.49 nm (0.9 km) running approximately north-northeast to south-southwest. The OSS positions will be located along the same east-northeast to west-southwest rows as the proposed WTGs, preserving the spacing in all of the primary east-northeast transit corridors. Atlantic Shores will align the OSSs within a maximum of two north to south corridors to preserve the spacing in the majority of the north to south transit corridors.

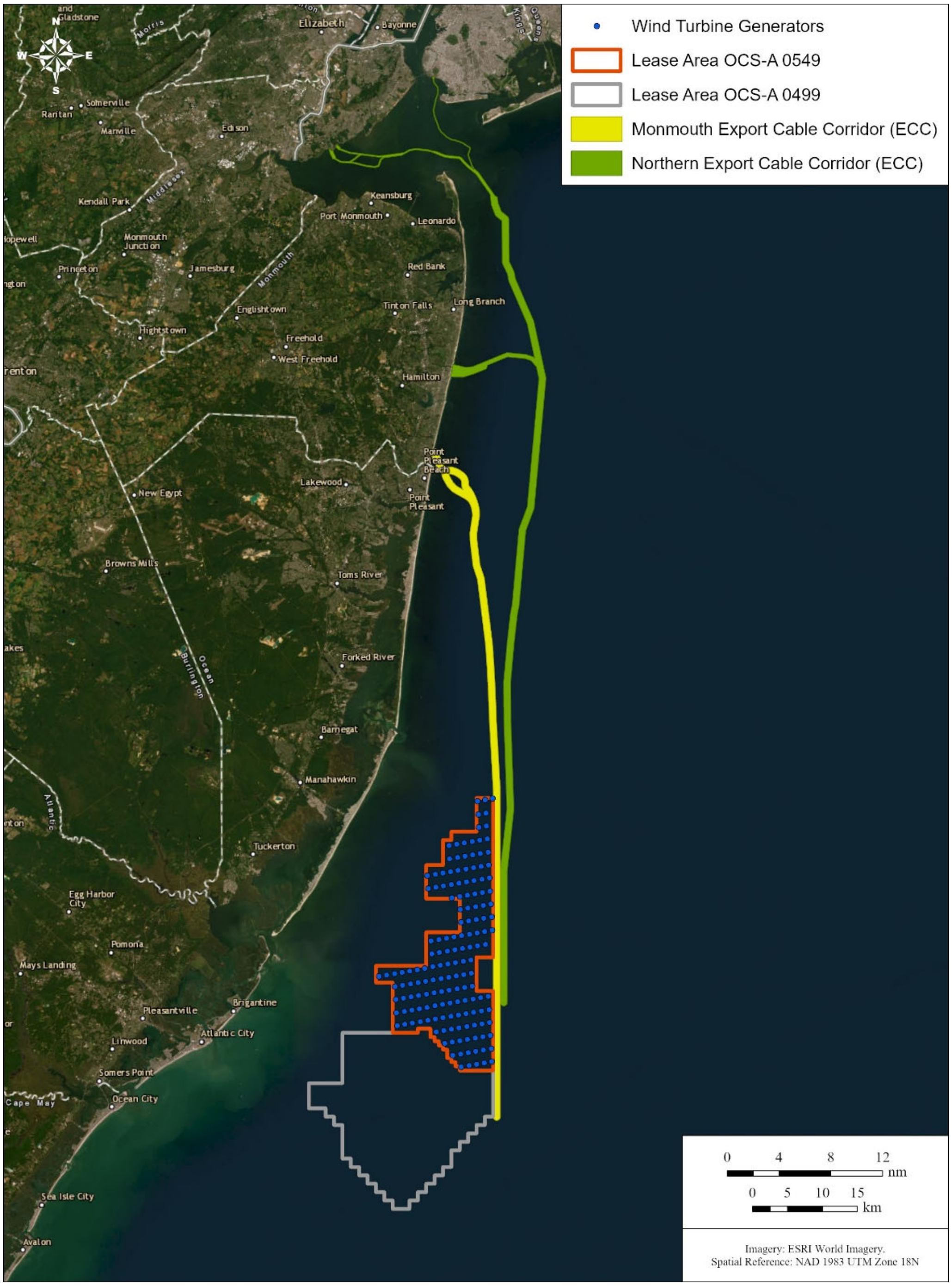

Figure 1.1: Regional Map showing Atlantic Shores Offshore Lease Area and Export Cable Corridors

Within the Lease Area, the WTGs and OSSs will be connected by two separate, electrically distinct systems of inter-array cables and/or inter-link cables. Energy from the OSSs will be delivered to landfall sites in New Jersey and/or New York via 230 kV to 275 kV HVAC and/or 320 kV to 525 kV high voltage direct current (HVDC) export cables. Atlantic Shores has identified potential landfall sites in southern Monmouth County, New Jersey (the Monmouth Landfall Sites); in the vicinity of Asbury in northern Monmouth County, New Jersey (the Asbury Landfall Sites); on southwest Staten Island, New York (The Raritan Bay Landfall Sites); and in Brooklyn, New York (The Narrows Landfall Site). In this report, the term "Offshore Project Area" refers to the offshore area where the Project facilities are physically located, including the Lease Area and the ECCs.

The Monmouth ECC extends from the Lease Area to the potential Monmouth Landfall Sites in southern Monmouth County, New Jersey. The total length of the Monmouth ECC associated with the Project is approximately 52.8 nm (97.9 km) from the Lease Area to the farthest landfall site in New Jersey. While the Monmouth ECC is also included in the COP (Atlantic Shores, 2022) for Lease Area OCS-A 0499, there is sufficient space within the ECC to co-locate the export cables associated with the Project with those associated with Lease Area OCS-A 0499.

The Northern ECC extends north from the Lease Area to the New York State waters boundary, where it splits into branches to reach the Raritan Bay Landfall Sites on Staten Island in Richmond County, New York and The Narrows Landfall Site in Brooklyn in Kings County, New York. The total length of the Northern ECC associated with the Project from the Lease Area to the furthest potential landfall location is approximately 90.2 nm (145.1 km). The Asbury Branch extends westward from the Northern ECC approximately 7.5 nm (13.9 km) to the potential Asbury Landfall Sites in northern Monmouth County, New Jersey.

During construction and operation of the Project, Atlantic Shores will use port facilities in New Jersey, New York, the mid-Atlantic, and/or New England. In addition, some components, materials, and vessels could come from the U.S. Gulf Coast or international ports. To support operation of the Project, Atlantic Shores is also proposing to establish an O&M Facility at a port in Atlantic City, New Jersey.

1.2 Purpose of the Navigation Safety Risk Assessment

The USCG provides guidance on the information and factors that will be considered when reviewing an application for a permit to build and operate an Offshore Renewable Energy Installation (OREI), such as the proposed Project. This information, which is outlined in USCG Navigation and Vessel Inspection Circular No. 01-19 (NVIC 01-19), is to be summarized through conducting an NSRA. The NSRA is intended to identify hazards to navigation, associated consequences that might be created by the potential Project during the construction and installation, operations and maintenance, and decommissioning phases, and proposed mitigations to these hazards. Key considerations include: (1) safety of navigation; (2) the effect on traditional uses of the waterway; and (3) the impact on maritime search and rescue activities by the USCG and others.

The NSRA process is conducted in cooperation and consultation with a wide range of stakeholders, including federal, state, and local agencies, tribal entities, local maritime representatives, and the general public.

1.3 Report Organization

This report is organized to generally follow the outline of NVIC 01-19. The report sections include Project Information; Site Information; Proposed Structures; Metocean Characterization and Impacts; Visual and Electronic Navigation; Risk of Collision, Allision or Grounding; Emergency Response Considerations; Facility Characteristics and Design Requirements; and Operational Requirements and Procedures. The NVIC 01-19 Checklist is provided as Appendix A. The WTG Coordinates, AIS Data Analysis, VMS Data Maps, and NORM Risk Model Summary are also provided as appendices.

2. Project Information

The Project will consist of up to 157 WTGs oriented in an approximate east-northeast to west-southwest and north to south grid arrangement, as shown in Figure 2.1 and Figure 2.2. The grid "rows" will have an orientation of 80° True North (TN) and will be spaced 1 nm (1.9 km) apart. The grid "columns" will have an orientation of 357° TN and will be spaced 0.6 nm (1.1 km) apart. This grid also creates diagonal corridors with an orientation of 325° TN that are 0.54 nm (1.0 km) wide and orientation 28°TN that are 0.49 nm (0.9 km) wide. The grid orientation and spacing will be consistent with that of the adjacent Lease Area OCS-A 0499, presenting to the mariner a single uniform layout over the two lease areas.

This uniform grid layout, which creates numerous straight transit corridors through the Lease Area in a variety of orientations, was developed to maximize offshore renewable wind energy production while minimizing effects on existing marine uses. As will be discussed later in this report, the proposed layout has been designed to facilitate the transit of vessels through the Lease Area based on a review of existing vessel traffic patterns. Atlantic Shores anticipates that the larger commercial vessels (e.g., cargo, tanker, passenger and tug-barge vessels), which have dominant north-south transit headings, will route around the Lease Area and not through it; therefore, the layout is designed to accommodate the commercial fishing fleet and recreational craft, as these vessels are the predominant vessels anticipated to transit through the Lease Area.

Atlantic Shores has developed the layout of the Project in consideration of commercial fishing patterns and in close coordination with the surf clam/quahog dredging fleet, which is the predominant commercial fishery within the Lease Area (see the Construction and Operation Plan [COP], [Atlantic Shores, 2022]). Prior to the segregation of Lease Area OCS-A 0549 from Lease Area OCS-A 0499, an independent study was conducted by Last Tow LLC on behalf of representatives of the New Jersey surf clam industry to provide Oceanside Marine (a clam fishing fleet based in Atlantic City) and LaMonica Fine Foods (a seafood processor in Millville, New Jersey) with a better understanding of fishing vessel traffic characteristics within the combined Lease Areas (Azavea 2020). Based on 2008-2019 Vessel Monitoring System (VMS) data for several surf clam/quahog fishing vessels that operate in the Lease Area, the study found that a significant majority of fishing vessel traffic (trawling/dredging and transiting) had headings between east to west and east-northeast to west-southwest (with average headings of 80° and 260° TN). This finding was supported by an analysis of VMS data between 2014 and 2019 conducted by BOEM for the combined Lease Areas (prior to segregation) as well as by an analysis of three years (2017-2019) of Automatic Identification System (AIS) data included in Section 3.2.2 of this report, which showed that 48% of fishing vessels transit the Lease Area along tracks that range in orientation between east to west and northeast to southwest and the reciprocal headings. A large proportion of the fishing vessel traffic (approximately 40%) and the recreational vessel traffic (50%) also transit approximately north to south (a sector defined by track orientations of north-northwest to south-southwest and north-northeast and south-southwest) and the reciprocal headings; this traffic will be accommodated by the approximately north to south corridors. Based on the findings of those studies and consultation with USCG and commercial fishing representatives, Atlantic Shores developed a uniform grid layout of facilities with east – northeast and west – southwest transit corridors across both Lease Area OCS-A 0549 and Lease Area OCS-A 0499.

While the primary direction of fishing vessel traffic varies somewhat across the Lease Area, commercial fishermen and USCG have indicated a preference for a uniform layout across the entire Lease Area to facilitate navigation and search and rescue (SAR) missions.

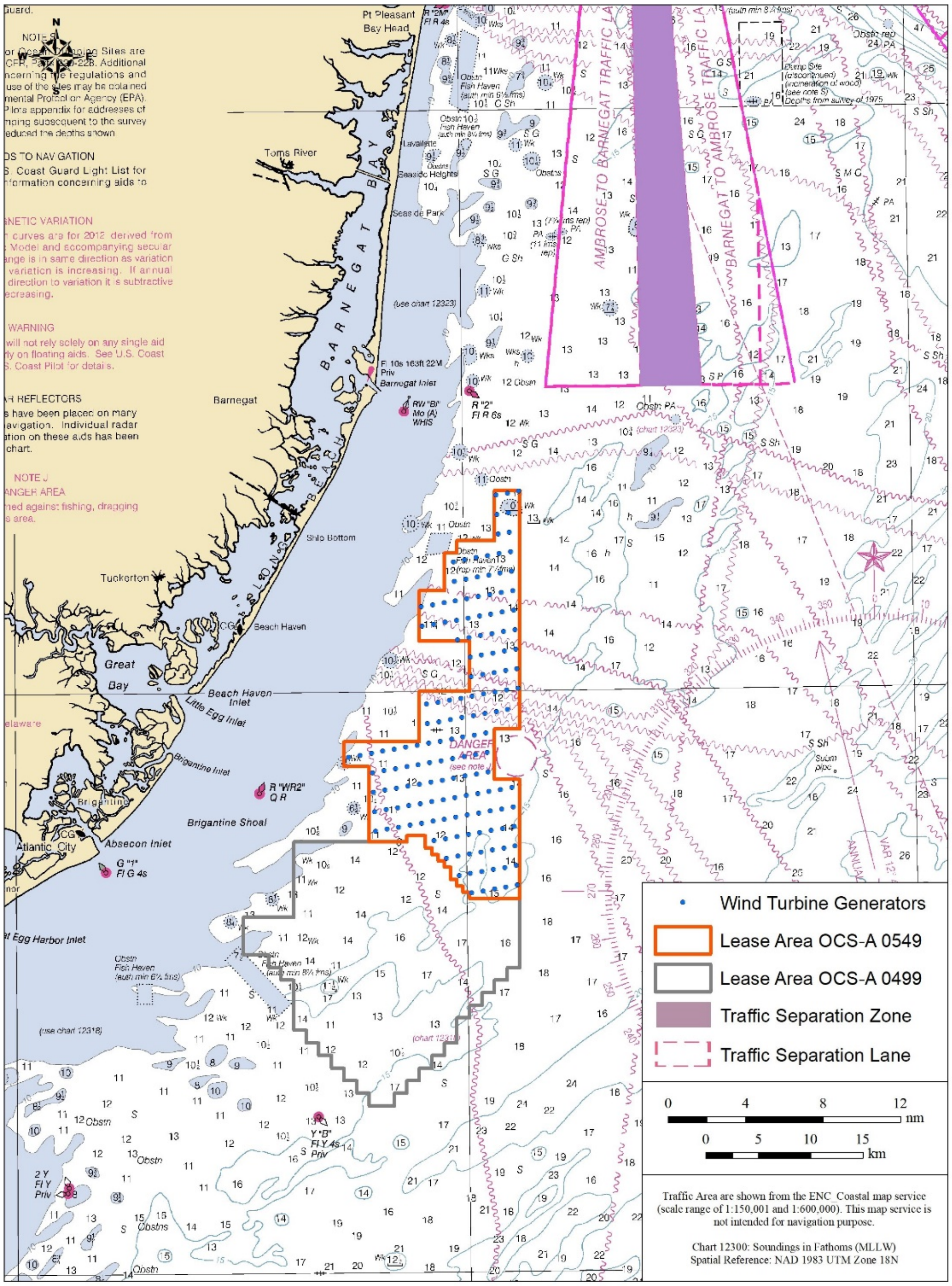

Figure 2.1: Outline of the Atlantic Shores Offshore Wind Lease Areas on NOAA Navigational Chart 12300 (depths in fathoms)

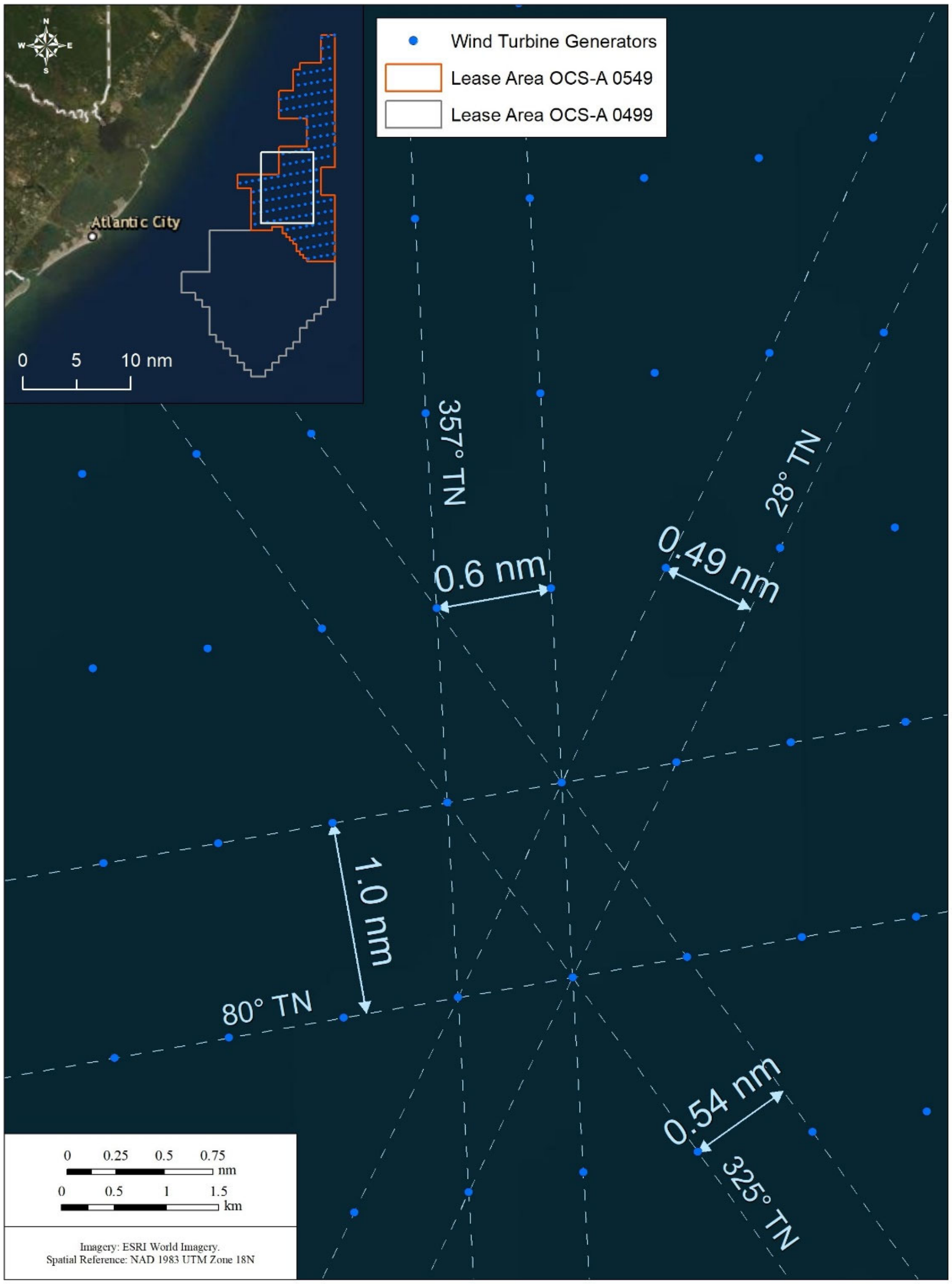

Figure 2.2: Proposed Corridor Dimensions and Orientations within Lease Area OCS-A 0549

The OSS positions will be located along the same east-northeast to west-southwest rows as the proposed WTGs, preserving the spacing in all of the primary east-northeast transit corridors. Atlantic Shores has identified two areas where OSSs will be placed, as illustrated in Figure 2.3. Within these areas a minimum of three and a maximum of eight OSSs will be positioned within a maximum of two north to south corridors to preserve the majority of the north to south corridors (note that there are 12 north-south corridors in the widest portion of the Lease Area).

The two north-south corridors where OSSs may be placed include a setback from the shoreline to minimize visual impacts: small OSSs will be placed no closer than 12 statute miles (mi) (19.3 km) from shore and medium or large OSSs will be placed no closer than 13.5 mi (21.7 km) from shore. The WTGs and OSSs will be located on a relatively flat portion of the Outer Continental Shelf with water depths ranging from 66 to 98 ft (20 to 30 m), which gradually increases with distance from shore.

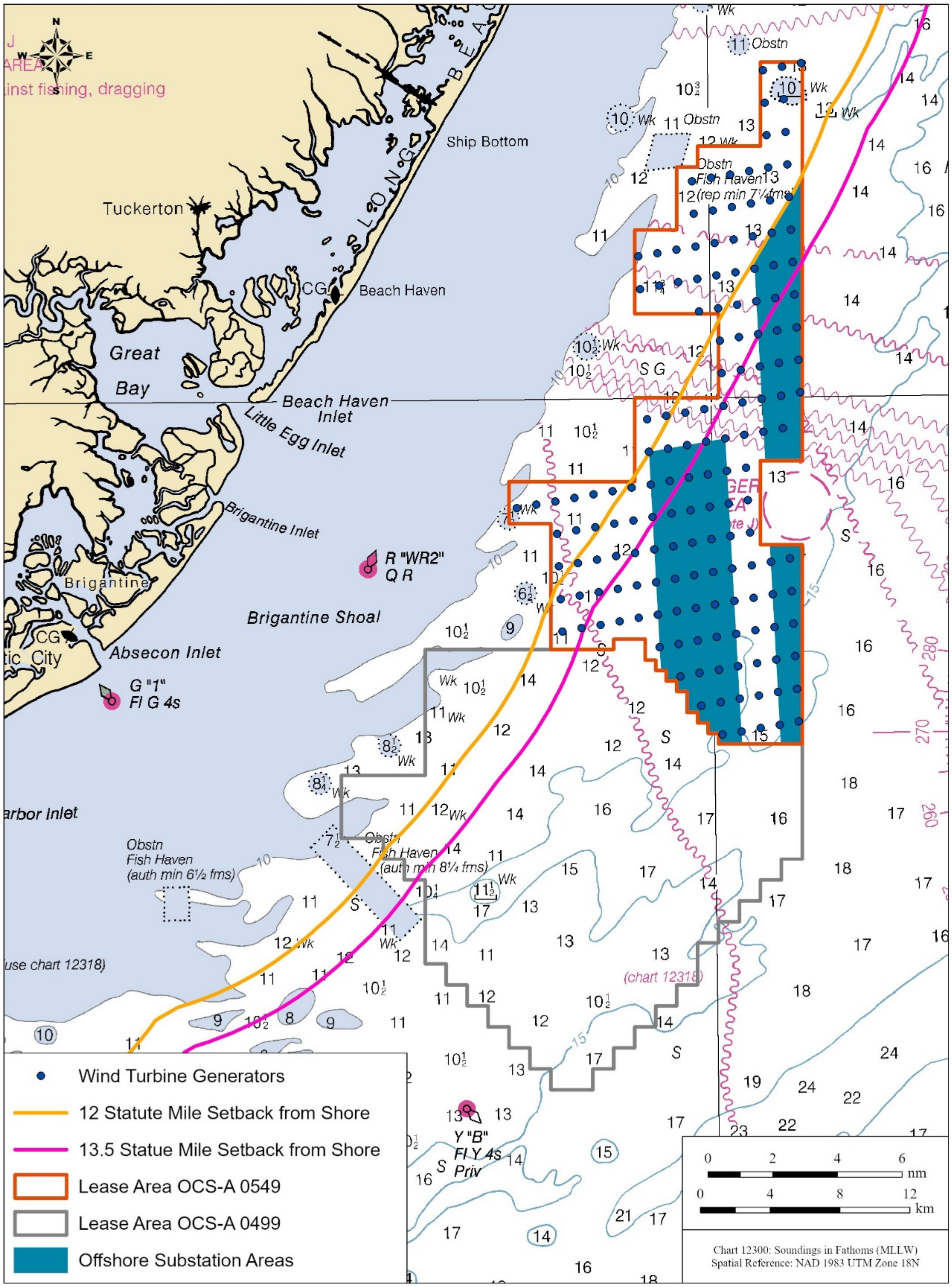

Figure 2.3: Offshore Substation Areas (depths in fathoms)

3. Site Information

This report section addresses Sections 1 and 2 of the NVIC 01-19 checklist (Appendix A).

3.1 WTG Installation Coordinates

Appendix B provides the proposed installation coordinates for the WTGs.

3.2 Vessel Traffic Survey

A comprehensive traffic survey was carried out by means of the following data sources: (1) stakeholder consultations; (2) AIS data analyses; and (3) NOAA VMS data mapping. The results of the traffic survey are presented in the following report sub-sections. More detailed summaries and maps may also be found in Appendices C and D.

3.2.1 Stakeholder Consultations

Atlantic Shores is actively engaged with stakeholders in both New Jersey and New York to identify and discuss their interests and concerns regarding offshore wind and the development of the Project. Since early 2019, Atlantic Shores has conducted hundreds of meetings and working sessions with stakeholders, suppliers, interest groups, and local communities that have an interest in or may be affected by the Project. The community groups and stakeholders that Atlantic Shores is engaged with include:

- Residents of Monmouth County, New Jersey and Richmond and Kings Counties, New York: Residents of these counties may live near the Project's landfall sites, onshore interconnection cable routes, onshore substations and/or converter stations, and/or O&M facility. Some residents may have a view of some Project components.
- Business groups/associations: Atlantic Shores has strategically identified business groups and associations that it can join in diverse partnerships. The goals of these partnerships include information sharing, workforce training, and supply chain contacts.
- Environmental non-governmental organizations (eNGOs): Atlantic Shores has conducted environmental resource and issue-focused meetings with representatives from local, regional, and national eNGOs.
- Academia and research/scientific institutes.
- Commercial and recreational fishermen and boaters: Atlantic Shores engages with commercial and recreational boaters and fishermen that are active in and around the Atlantic Shores' Offshore Project Area.

To engage in productive and effective dialogue with key stakeholders, Atlantic Shores has assembled a Stakeholder Communications Team comprised of Atlantic Shores management, Community Liaison Officers, community relations staff, and government relations staff. All have prior experience working cooperatively within New Jersey and New York coastal communities, allowing Atlantic Shores to better understand the interests and concerns of stakeholder groups.

Atlantic Shores has developed and implemented a wide array of stakeholder engagement tools to establish two-way dialogue with interested parties and to educate people and organizations about Atlantic Shores and more broadly offshore wind. Atlantic Shores engages stakeholders by:

- attending community events and hosting in-person community meetings;
- maintaining an up-to-date and interactive website;

- distributing quarterly newsletters containing Project updates to over 1,000 stakeholders;
- using social media platforms (e.g., Facebook and Twitter) for educational videos, project updates, promoting opportunities;
- hosting informational sessions and open houses (in-person and/or virtually);
- participating in and organizing workshops with key local, regional, and national eNGOs; and
- conducting polling and focus groups.

These tools also provide opportunities for people and organizations to express interest in partnering with Atlantic Shores on workforce, supply chain, port development, or other related activities.

Atlantic Shores' stakeholder engagement strategy creates effective mechanisms for capturing, documenting, and responding to stakeholder feedback to ensure that the outcomes of each interaction can be incorporated into the Project's development efforts.

Atlantic Shores understands the socioeconomic importance of commercial and recreational fishing to the States of New Jersey and New York and is committed to achieving coexistence with those who fish within the Offshore Project Area. Atlantic Shores has developed a Project-specific Fisheries Communication Plan (FCP) that defines outreach and engagement with fishing interests during all phases of the Project, from development through decommissioning. To support the execution of the FCP, Atlantic Shores will employ a Fisheries Liaison Officer (FLO) and a Recreational Fishing Industry Representative (FIR). Additional FIRs may be nominated to represent specific fisheries identified within the Lease Area or along the ECCs as the Project progresses or a need is identified.

To facilitate open engagement with the fishing community that is active in and around the Offshore Project Area, Atlantic Shores maintains a "For Mariners" webpage, distributes updates on Atlantic Shores' activities (via an email distribution list, print and online industry publications, local news outlets, etc.), coordinates with the USCG to issue Notices to Mariners, plans to establish a 24-hour phone line, and attends fishing conferences, trade shows, and tournaments. Atlantic Shores will continue to hold and attend meetings with local fishermen, professional associations/organizations representing commercial and recreational fishermen, and local offshore fishing clubs during the lifetime of the Project. Atlantic Shores will also continue to participate in Fisheries Management Council meetings, university-sponsored activities (e.g., webinars held by Rutgers New Jersey Cooperative Extension), and regional efforts led by BOEM, National Oceanic and Atmospheric Administration (NOAA), and the commercial fishing industry (including the Responsible Offshore Development Alliance [RODA] and the Responsible Offshore Science Alliance [ROSA]).

Additionally, Atlantic Shores is committed to finding ways to integrate both the skills and infrastructure of the local fishing communities into the Project by planning, brainstorming, and executing early economic opportunities. Atlantic Shores is already employing local fishermen and their facilities for scouting and dock-side vessel support. Building on this model, Atlantic Shores is actively pursuing avenues to help fishermen meet Atlantic Shores' HSSE standards for vessels and workforce, so that they can be eligible to apply as contractors to support environmental surveys as well as the Project's construction and operations activities. In September 2020, Atlantic Shores distributed a formal Request for Interest to identify fishing businesses that had available docks and port real estate that could support Atlantic Shores' construction and operations; Atlantic Shores received strong responses from four local fishing companies in New Jersey, indicating that the fishing industry does find valuable economic opportunities in the offshore wind industry. Subsequent to that request, Atlantic Shores has engaged with several of these companies and organizations in support of the ongoing marine investigation work associated with the Project.

3.2.2 AIS Vessel Traffic Survey

A comprehensive traffic survey was carried out by performing an analysis on Marine Cadastre AIS data over the period from January 1, 2016 to September 30, 2021. A regional subset of the data was extracted for longitudes between -75.0° to 73.7° TN, and latitudes between 38.8° and 40.6° TN. In total, there were 570,943 records and 5,074 unique vessels passing through the Lease Area in the dataset. Table 3.1 provides a summary by year of the number of unique vessels in the AIS data that were analyzed. Note that the AIS vessel types and details are not always accurately reported (they are input by vessel owners); therefore, there may be slight variations.

Table 3.1: Summary of AIS Dataset Analyzed (Data Source: Marine Cadastre)

Parameter	2016	2017	2018	2019	2020	2021	2016-2021
Number of Unique Vessels	1,356	1,413	1,481	1,473	1,432	1,241	5,074

Figure 3.1 shows a color contour map of average annual traffic density for all vessel types, while Table 3.2 provides a breakdown of vessel traffic types through the AIS analysis area. Commercial fishing, recreational and cargo vessels dominate the traffic, representing 76% of the unique tracks. Approximately 10% of the vessels did not have an AIS vessel code and could not be classified; likely these are primarily fishing and recreational vessels. The “other” vessel category, which comprises about 3% of the unique vessels, includes survey vessels, research vessels, drilling ships and similar.

Table 3.2: Numbers of Vessels Entering the Lease Area (2016-2021)

	Unique Tracks		Unique Vessels	
Vessel Type	Number	Percentage	Number	Percentage
Cargo	4,506	19%	1,072	21%
Tankers	447	2%	264	5%
Passenger	501	2%	107	2%
Tug-barge	1,770	8%	243	5%
Recreational	3,963	17%	2,179	43%
Fishing	9,398	40%	522	10%
Other	1,011	4%	172	3%
Unspecified AIS Type	1,841	8%	515	10%
Total (2016–2021)	23,437	100%	5,074	100%
Annual Average	4,076.0		882.4	

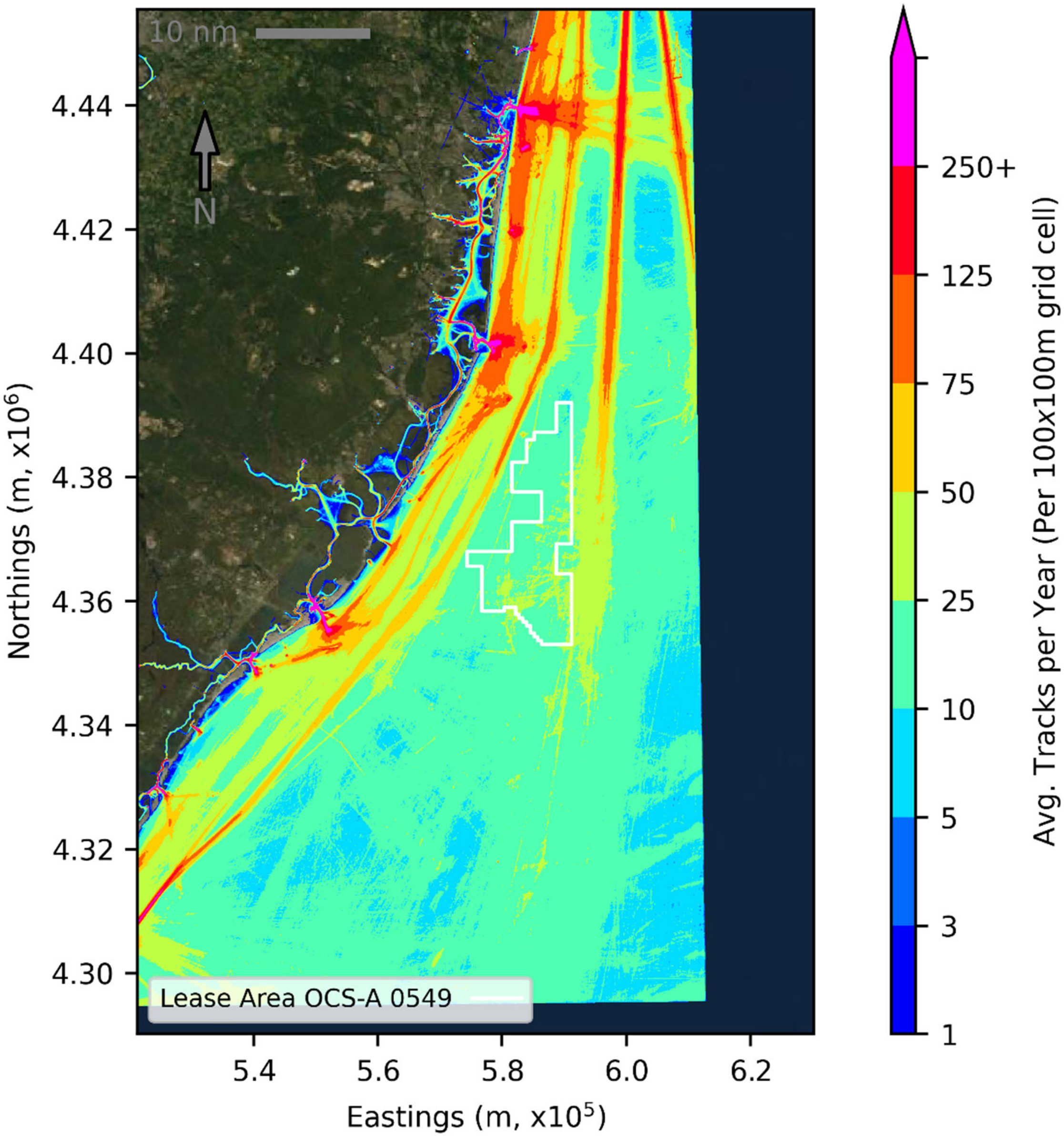

Figure 3.1: Annualized Vessel Traffic Density for AIS-equipped Vessels

AIS is only required on commercial vessels 65 ft (20 m) and longer and, as a result, not all vessels, particularly fishing and recreational vessels, are equipped with AIS equipment. The maximum and mean vessel length for each vessel type is presented in Table 3.3. For the collision and allision risk modeling presented in Section 7 of this report, the number of fishing vessels that potentially transit near or within the Lease Area was increased by 100% (i.e., an assumed AIS adoption rate of 50% of vessels). Similarly, many recreational vessels do not carry AIS equipment; therefore, a 100% increase in traffic volume has also been applied to this vessel class.

Table 3.3: Vessel Detail Summary

	Maximum Vessel Length		Mean Vessel Length		Mean Vessel Speed
Vessel Type	in feet	in meters	in feet	in meters	(knots)
Dry Cargo	1204	367	783	239	14.6
Tankers	909	277	615	188	12.9
Passenger	1150	350	398	121	15.4
Tug-barge	145	44	109	33	8.8
Recreational	316	96	62	19	12.4
Fishing (transiting)	200	61	78	24	8.3
Other	820	250	208	63	7.2

If there are any other smaller commercial vessels that are not AIS-equipped, the number of these vessels is likely very small and would not have an impact on the vessel traffic analyses presented in this report. Figure 3.2 presents a distribution of all vessel lengths passing through the lease area.

Although AIS data may not include the total number of vessels that could potentially transit the AIS analysis area, the data are believed to provide a suitable representation of the overall fleet distribution and traffic patterns in terms of track density and orientation. The direction and speed distribution of vessel tracks is presented in Figure 3.3.

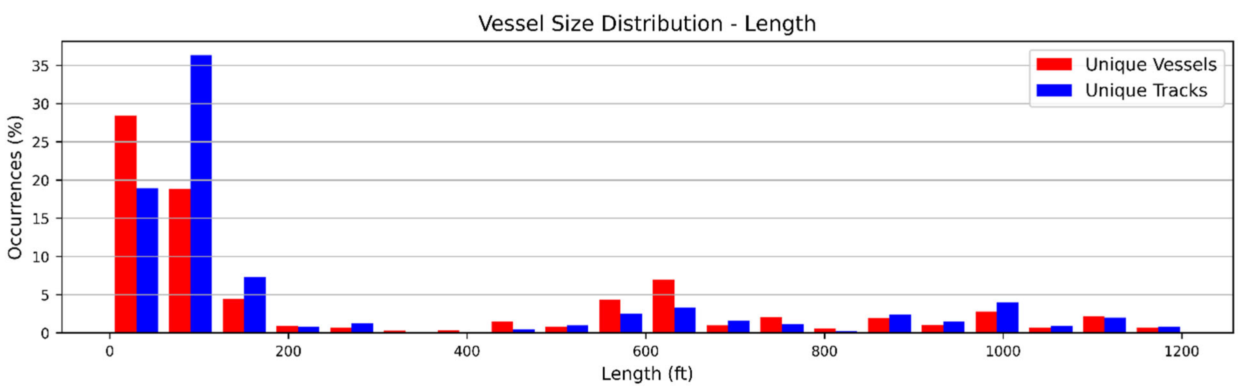

Figure 3.2: Summary of AIS Vessel Lengths through the Lease Area

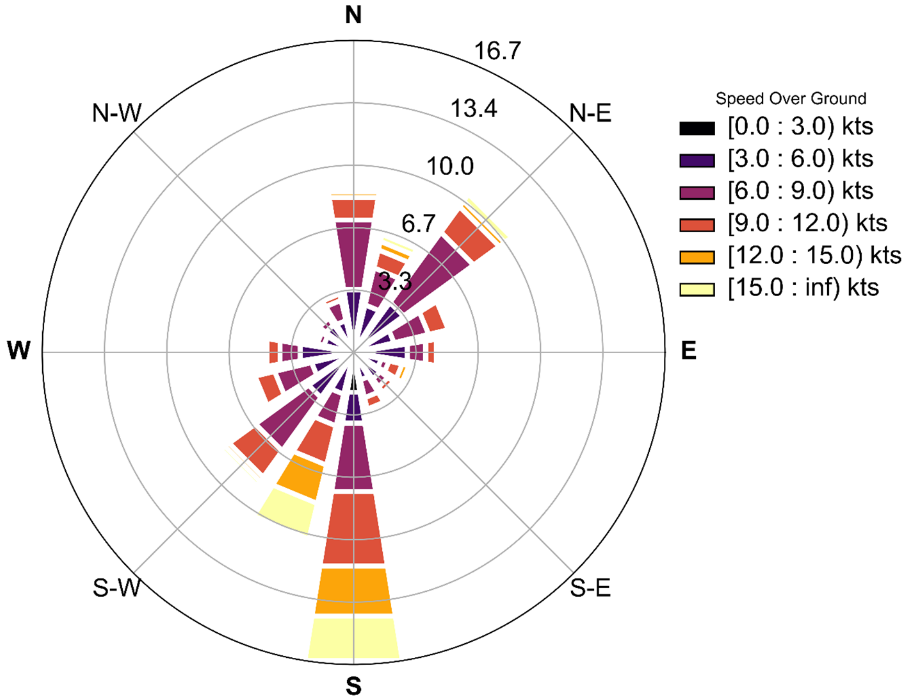

Figure 3.3: All AIS Vessel Speed and Track Orientations in the Lease Area

More detailed summaries for individual vessels can be found in Appendix C, including a breakdown of fishing vessels that are transiting and actively fishing.

3.2.2.1 Commercial (Non-Fishing) Traffic

Non-fishing commercial vessels represent approximately 35% of vessel tracks that pass through Lease Area OCS-A 0549. Dry Cargo is the most significant commercial vessel, representing 19% of all unique tracks and 21% of unique vessels passing through the Lease Area. Vessels classified as “others” represent 4% of unique tracks in the Lease Area; however, this includes survey vessels which are not a consistent source of traffic. The track density plots for vessels intersecting the Lease Area are summarized in Figure 3.4 for dry cargo, passengers, tanker and tugging/towing vessels. Many of the vessels which are classified as passenger vessels may be chartered recreational fishing vessels.

The dry cargo, passenger, tanker, and tug/towing vessel categories show the use of the same typical routes, and have very similar vessel courses, with south and south-southwest being the dominant track direction (as well as the reciprocal direction). Tug tow courses tend to follow the shoreline. Cargo, passenger and tanker vessels have speeds typically greater than 12 kts, and the tug/towing vessels are slower with speeds ranging from 3 to 12 kts.

The size of non-fishing commercial vessels varies significantly between the different categories, and the range for the 10 largest vessels for each category are summarized in Table 3.4. Dry cargo vessels typically have the greatest lengths, and tugs/towing vessels have the smallest lengths. Tug/towing vessels are required to provide the dimensions in AIS of any barges which they may be towing; however, in practice, it appears the vessel dimensions typically reflect the tug/towing vessel only.

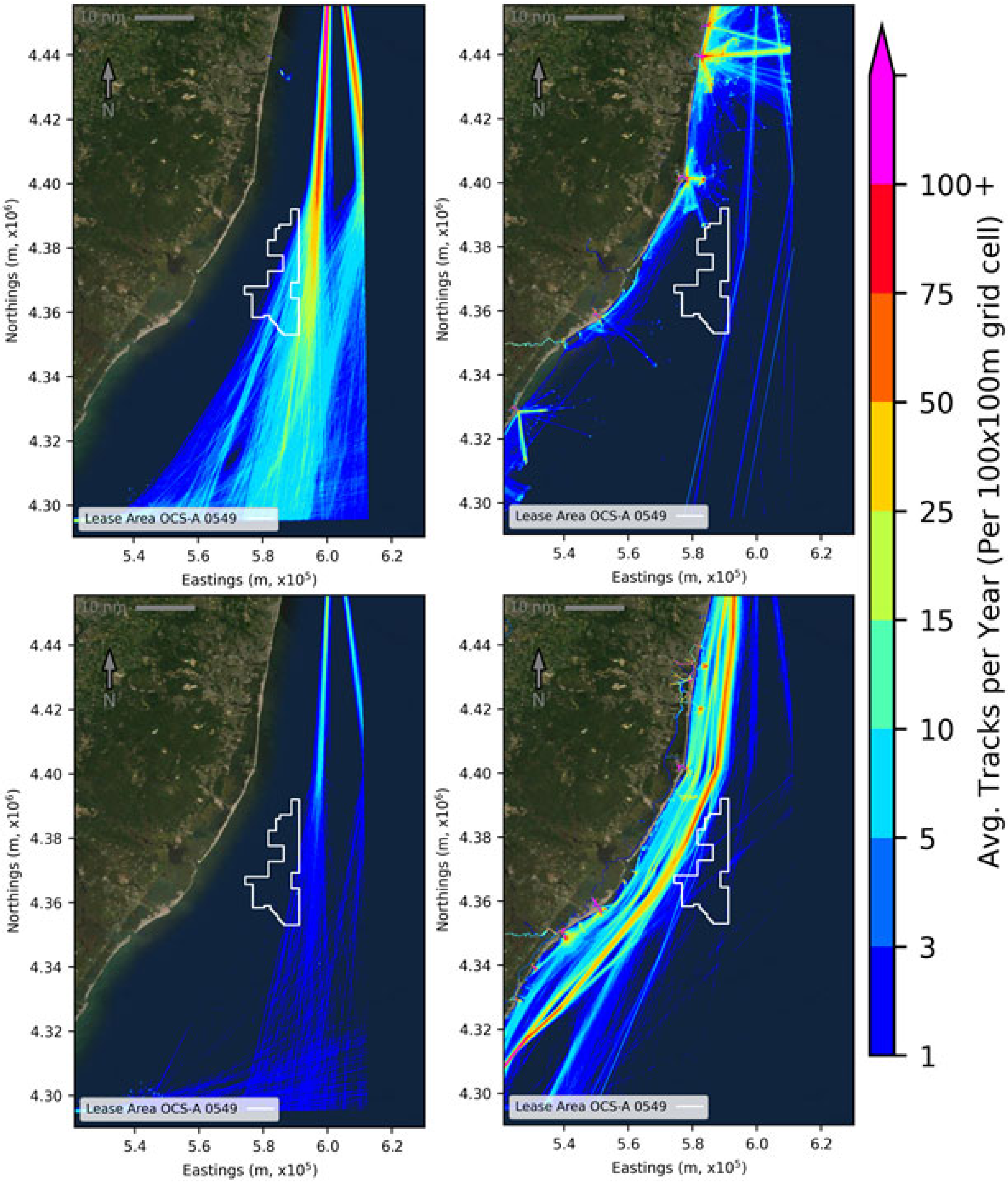

Figure 3.4: Track Density of Dry Cargo (top left), Passenger (top right), Tanker (bottom left), and Tug/Towing (bottom right) Commercial Vessels

Table 3.4: Range of Vessel Dimensions for the Ten Largest Vessels by Category Transiting the Lease Area

Vessel Category	Length Overall Range	Breadth Range
Passenger	864 – 1,149 ft (264 – 350 m)	105 – 136 ft (32 – 41 m)
Tanker	813 – 909 ft (248 – 277 m)	136 – 158 ft (41 – 48 m)
Dry Cargo	1,157 – 1,204 ft (353 – 367 m)	140 – 158 ft (43 – 48 m)
Tug/Tows	136 – 145 ft (42 – 44 m)	35 – 60 ft (11 – 18 m)
Other	362 – 820 ft (110 – 250 m)	50 – 107 ft (15 – 33 m)

3.2.2.2 Types of Cargos (Commercial Vessels)

A wide range of cargos are handled by the commercial vessels navigating to the nearby ports including containers, dry bulk and break-bulk commodities, liquid commodities (petroleum, chemicals) and livestock. Principle cargo terminals in the region are within the Port of New York / New Jersey north of the Lease Area and along the Delaware River estuary south of the Lease Area.

3.2.2.3 Commercial Fishing Traffic

Forty percent of the unique tracks that intersect the Lease Area are fishing vessels. There were only 522 unique AIS-enabled commercial fishing vessels that intersect with the Lease Area. The average track density for the AIS dataset is summarized in Figure 3.5.

The track orientations of the commercial fishing vessels vary significantly, as illustrated in Figure 3.6. The dominant direction ranges from north to northeast and from south to southwest.

The track orientations are represented well in the track density plots for vessels intersecting the Lease Area. Figure 3.7 presents the track segments for the vessels actively transiting and actively fishing that have crossed the Lease Area. Figure 3.8 presents the vessel length distribution.

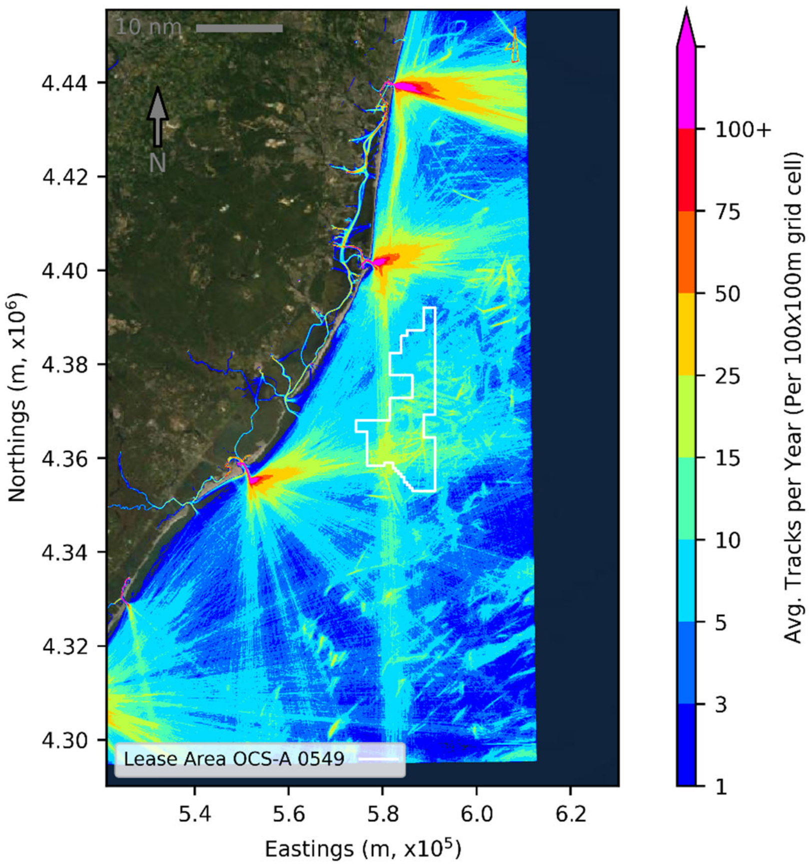

Figure 3.5: Annualized Commercial Fishing Vessel Traffic Density for AIS-Equipped Vessels

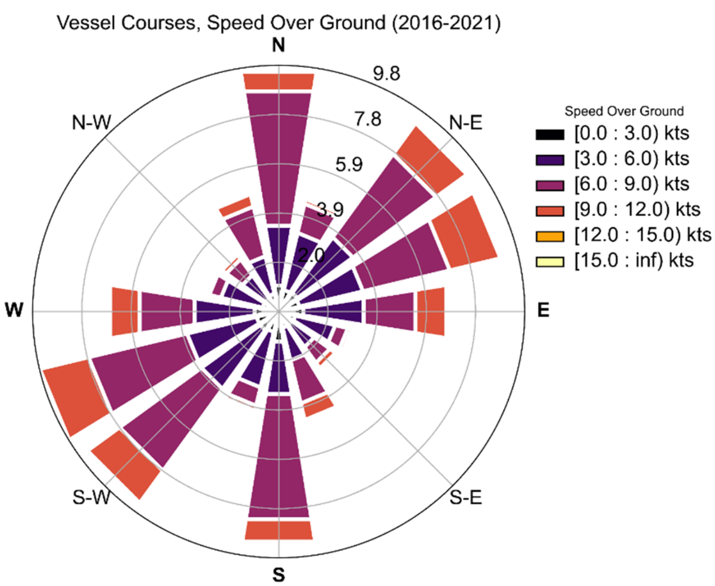

Figure 3.6: Commercial Fishing Vessel Speed and Track Orientations in the Lease Area

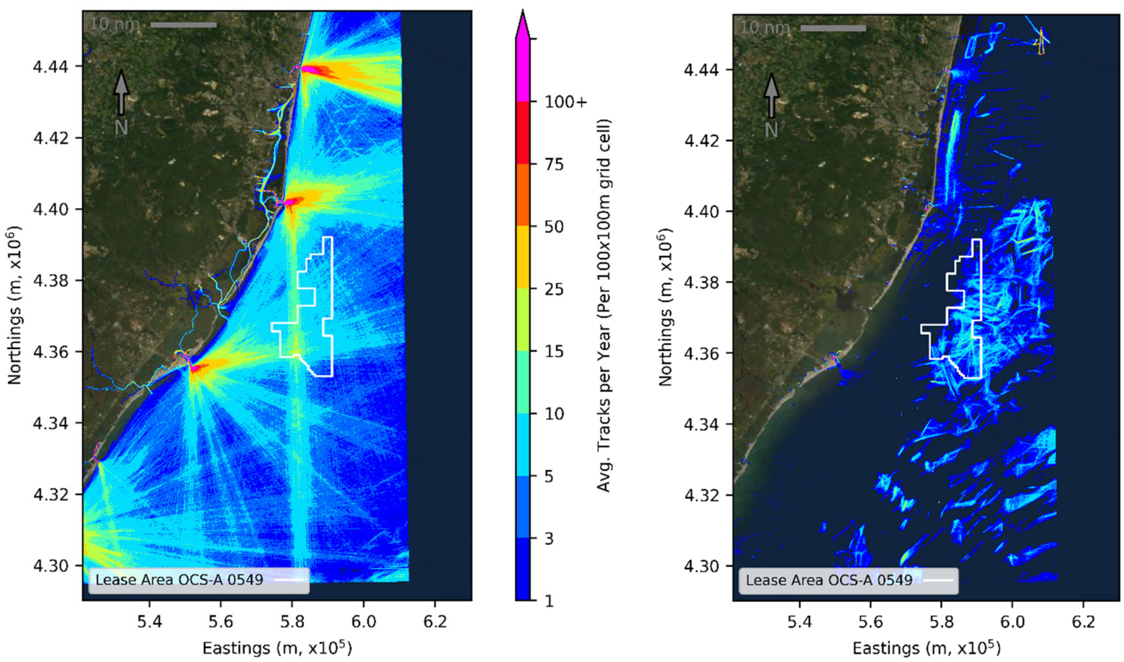

Figure 3.7: Track Density of Transiting (>4 knots; left) and Actively Fishing (<4 knots; right) Commercial Fishing Vessels

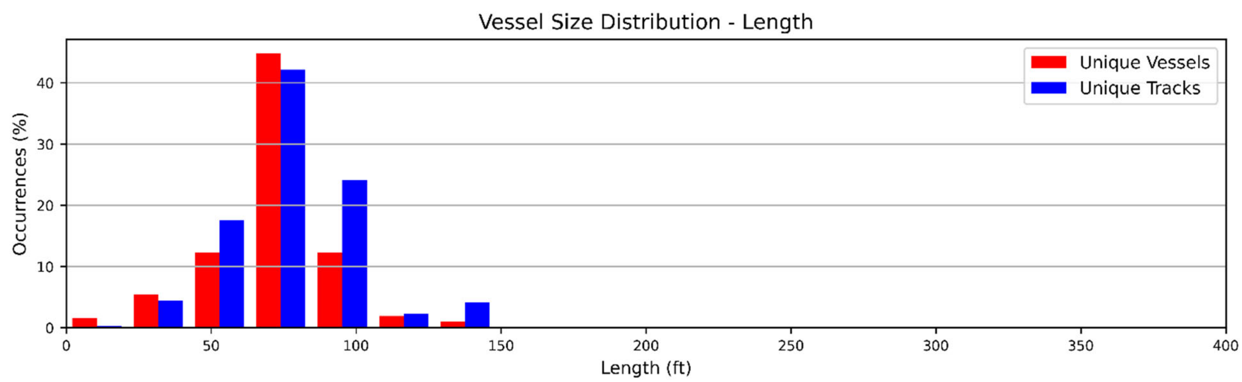

Figure 3.8: Fishing Vessel Length Distribution

3.2.2.4 Recreational Traffic

A total of 2,179 unique recreational vessels of various types transited through the Lease Area during the period of January 2016 to September 2021 representing 43% of all unique vessels in the Lease Area. The 10 largest vessels had lengths that ranged from approximately 190 to 318 ft (58 to 97 m) and a breadth ranging from approximately 38 to 79 ft (12 to 24 m). The distribution of recreational vessel lengths is summarized in Figure 3.9. Figure 3.10 illustrates the track densities for recreational vessels crossing through the Lease Area.

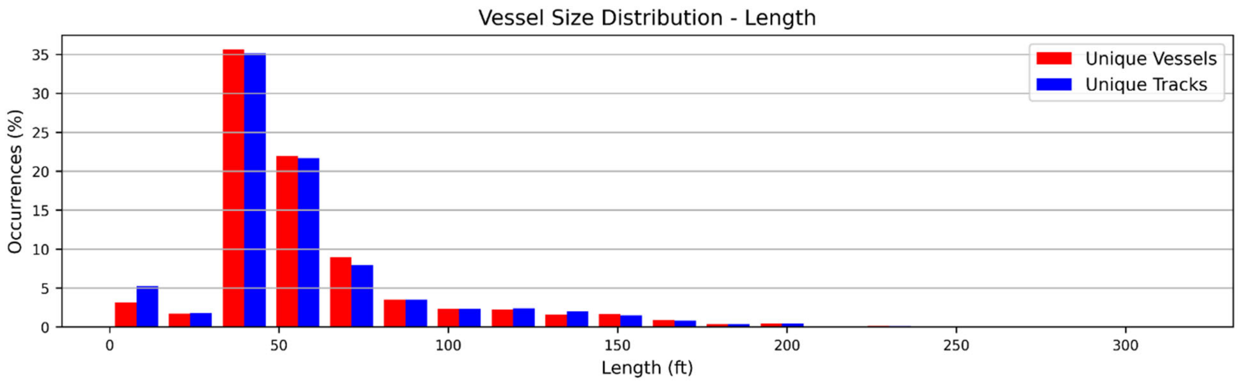

Figure 3.9: Recreational Vessel Length Distribution

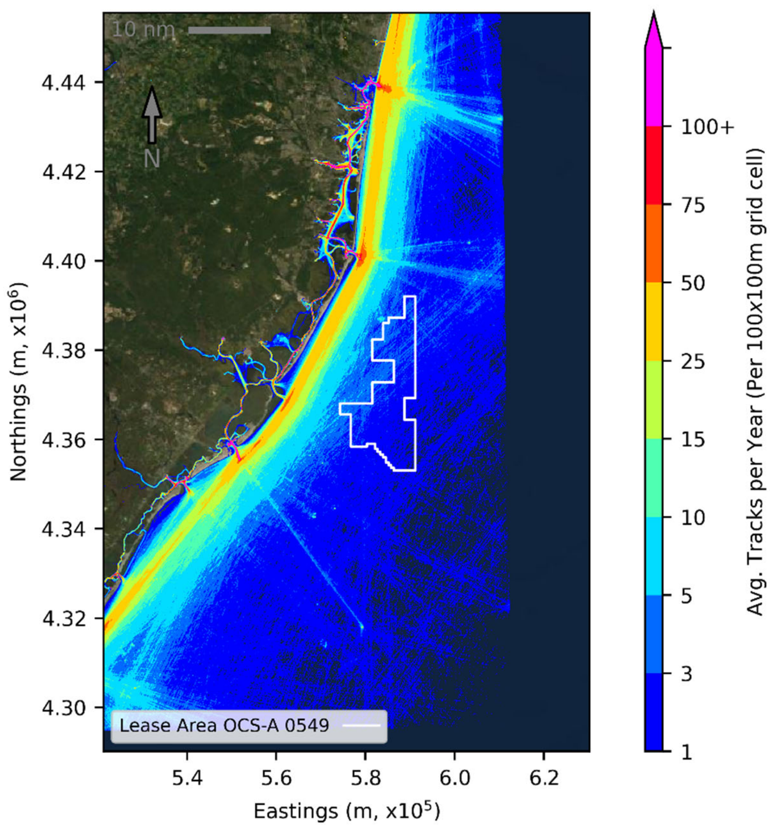

Figure 3.10: Track Density of Recreational Vessels

The speed and orientation of these vessels in summarized in Figure 3.11. Approximately 20% of vessels come from the northeast and southwest, which is represented well by the recreational vessel track density.

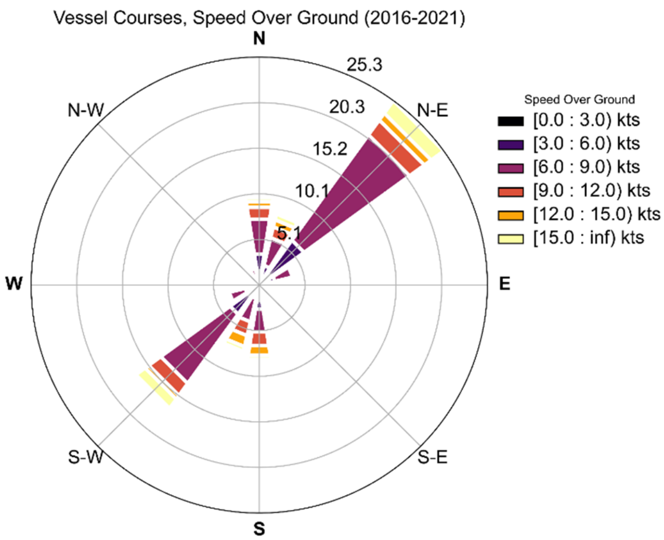

Figure 3.11: Recreational Vessel Speed and Track Orientations in the Lease Area

3.2.3 Vessel Crossings of the ECCs

An AIS analysis was conducted to assess the number of vessels crossing the proposed Export Cable Corridors (ECCs). There are two cable route options anticipated for the project: the Monmouth ECC and the Northern ECC. There is also a westward lateral off the Northern ECC known as the Asbury Branch of the Northern ECC. The annual average track density for the ECCs is shown in Figure 3.12. Approximately 3.9 nm (7.3 km) of the length of the Monmouth experiences a track density exceeding 100 vessel crossings per 100 m length per year. This higher track density occurs immediately offshore of the landfall site. For the Northern ECC, an annual track density exceeding 100 crossings per 100 m is exceed over approximately 11.9 nm (22 km), primarily within New York Harbor and immediately offshore of the New Jersey landfall site associated with the Asbury Branch.

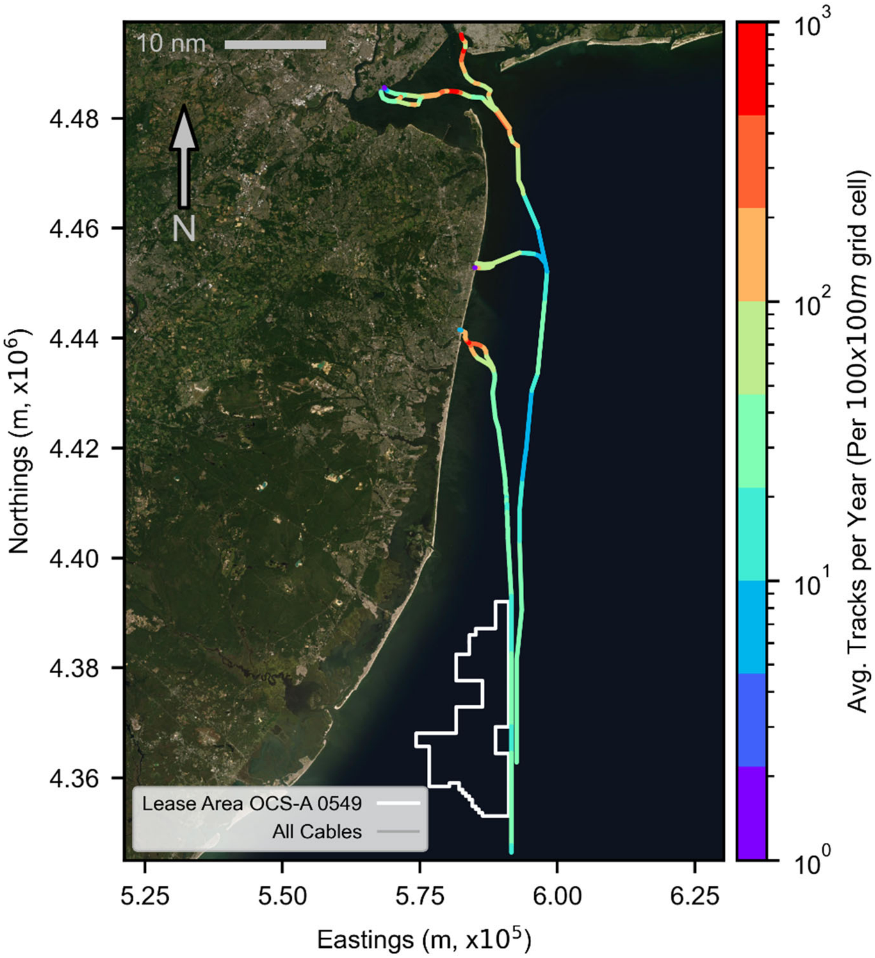

Figure 3.12: Average Track Densities for Vessels Crossing the Export Cable Corridors

3.2.4 VMS Traffic Analysis

The AIS data for fishing vessels is supplemented with a review of NOAA's VMS data. VMS is a satellite surveillance system primarily used to monitor the location and movement of commercial fishing vessels within the coastal waters of the U.S. Unlike the AIS dataset, VMS data provide a description of fishing activities for regulated commercial fisheries. The system uses satellite-based communications from on-board transceiver units, which certain vessels are required to carry. The transceiver units send position reports that include vessel identification, time, date, and location, and are mapped and displayed at NOAA. The system is used to support fisheries law enforcement initiatives and to prevent violations of laws and regulations.

The raw VMS data were not available due to privacy constraints, but GIS mapping of the resultant analyses of fishing traffic density are provided based on data provided by NOAA. Appendix D provides density maps for several fish species for the 2015 to 2016 time period (more recent data was not available online), including:

- Herring
- Monkfish

- Multispecies (Groundfish)
- Pelagics (Herring, Mackerel, Squid)
- Scallop
- Squid
- Surf clam / ocean quahog

In addition, BOEM has extracted and processed raw VMS data for both Lease Area OCS-A 0499 and Lease Area OCS-A 0549 (combined Lease Areas) and provided data summaries to Atlantic Shores in terms of polar histograms showing the variation in vessel track headings and vessel counts by regulated fishery (as summarized in Table 3.5). These polar plots are also provided in Appendix D.

In the VMS dataset, vessel speed is used to distinguish vessels that are actively fishing as opposed to transiting. For most species, vessels traveling at less than 4 knots are considered fishing, but for scallop fishing, the vessel speed is assumed to be less than 5 knots. Thus, density maps and polar histograms for both actively fishing and all vessel speed are present for both species in Appendix D.

Figure 3.13 provides an example density plot for surf clam/quahog fishing while actively fishing, and Figure 3.14 shows a density plot for movement of scallop vessels at all speeds. These plots are generally consistent with what was observed for fishing activity in the AIS dataset. Table 3.5 provides a summary of the total unique vessels found within the combined Lease Areas based on the VMS data while transiting and/or actively fishing. Most of the activity is associated with surf clam/ocean quahog and scallop fishing.

Table 3.5: Number of Unique Vessels within the Combined Lease Area from VMS Data (2014-19)

Fish Species	Transiting	Actively Fishing
Herring	7	4
Monkfish	11	0
Northeast Multispecies	15	0
Surf clam/Ocean Quahog	40	27
Scallop	325	117
Squid, Mackerel, and Butterfish	62	13

Figure 3.15 provides two example polar histograms for transiting vessels participating in surf clam/ocean quahog and scallop fisheries in the combined Lease Areas. The surf clam/ocean quahog vessels follow track orientations that are north of east (~60° to 90°) and south of west (~240° to 270°). The scallop vessels tend to transit the Lease Areas along north-south track orientations.

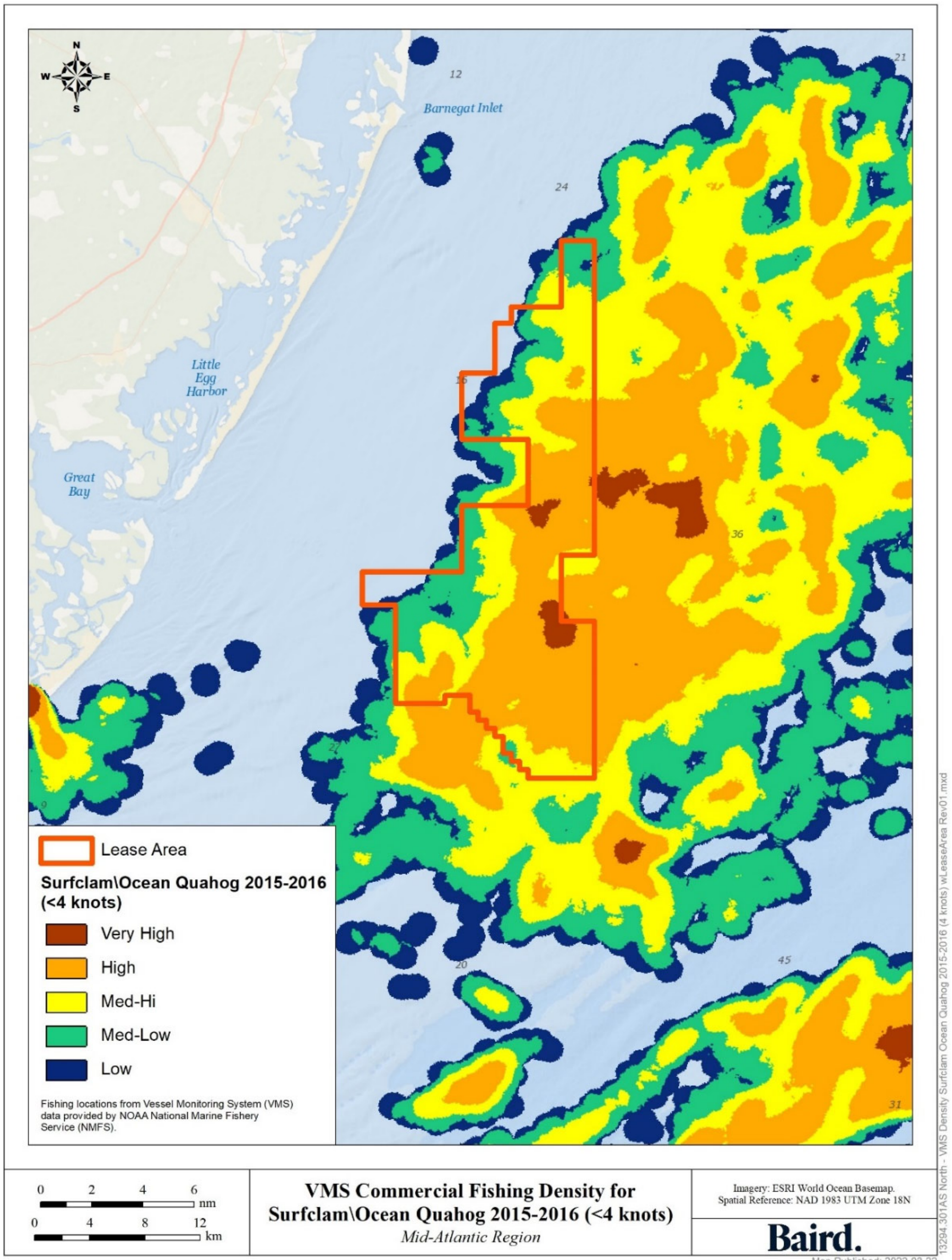

Figure 3.13: VMS Density for Surf clam/Quahog While Fishing (<4 knots) (2015-16)

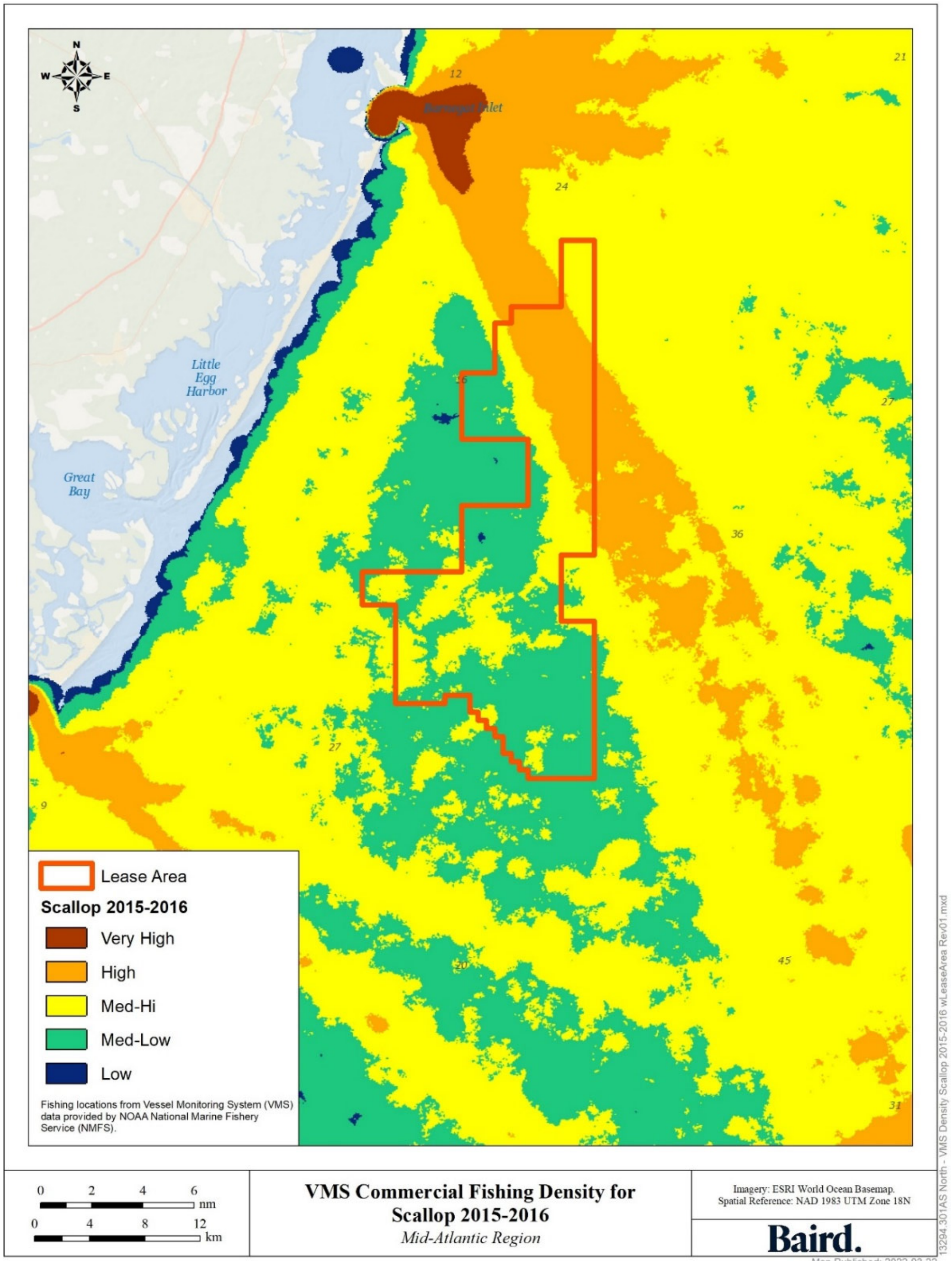

Figure 3.14: VMS Density for Scallop – All Vessel Speeds (2015-16)

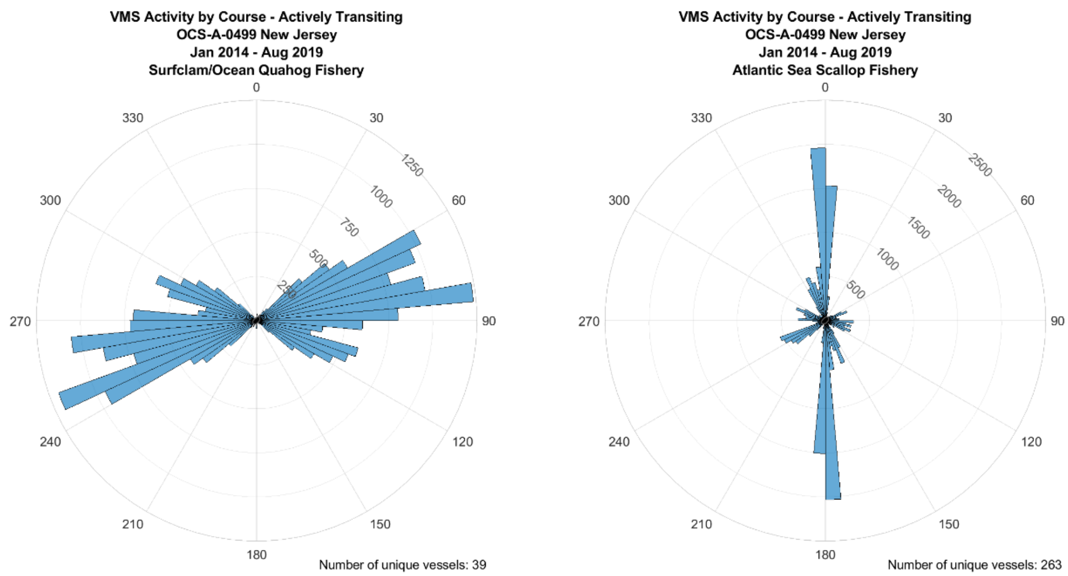

Figure 3.15: Polar Histograms for Transiting Surf clam/Ocean Quahog Vessels (left) and Scallop Vessels (right)

The following observations were made based on a review of the VMS plots and data:

- Based on the plots and data provided by BOEM, there was little or no fishing activity shown in or around Lease Area OCS-A 0549 associated with squid, multispecies groundfish, monkfish, herring, and pelagics (herring/mackerel/squid).
- The largest amount of fishing activity within Lease Area OCS-A 0549 is associated with surf clam/ocean quahog, which is present within nearly the entire Lease Area. The fishing activity is greatest within the eastern portion of the Lease Area.

There are differences in the time periods of the VMS (2015-2016) density plots and AIS (January 2016–September 2021) datasets, but the Atlantic Shores Fisheries Liaison Officer has not noted any significant changes in fishing activity over these time periods. This was confirmed in the polar histogram data provided by BOEM (see Appendix D.2).

3.2.5 VTR Traffic Analysis

NOAA collects fishery data by means of VTR in which commercial fishing vessels report the details of each individual trip including vessel details, type of gear used, location, and type of catch. These data have been analyzed and mapped by NOAA and are available online as GIS map files broken out by type of fishing activity and time period.

Appendix D.3 contains maps of the VTR data in the Project region. The primary fishing activity indicated within the Lease Area is dredging (see Figure 3.16) which would be associated with the surf clam/ocean quahog fishing. There is a small amount of fishing charter activity, small pockets of trawling, and some gillnet activity at the north end of the Lease Area.

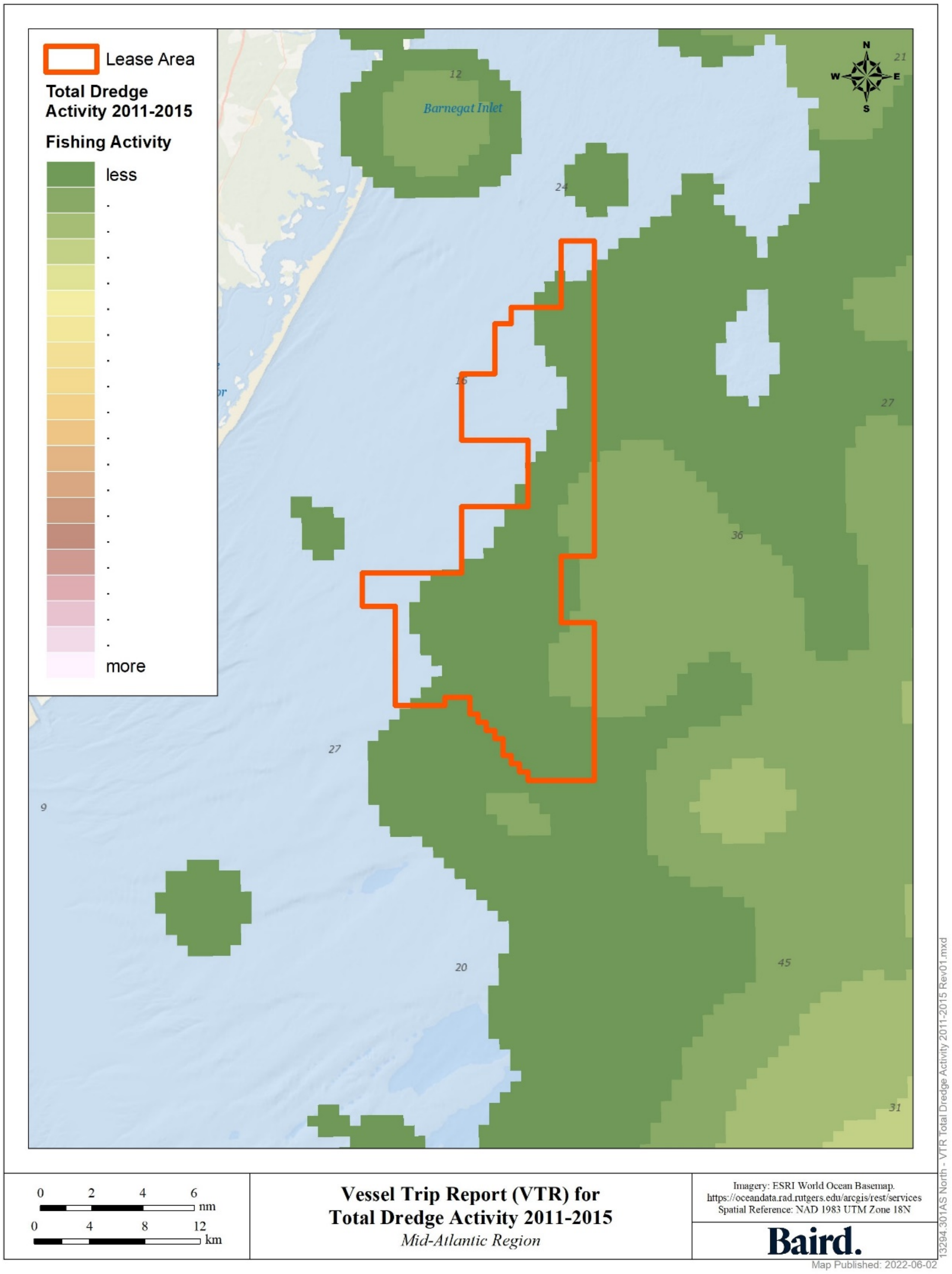

Figure 3.16: Map of VTR Total Dredge Activity

3.2.6 Existing Navigation Features and Hazards

The Lease Area is located on the eastern U.S. continental shelf approximately 7.3 nm (13.5 km) from the New Jersey coast and approximately 52 nm (96.6 km) from the New York State coast at its closest point (see Figure 3.17 and Figure 3.18). There are various navigational features in and around the Lease Area. Key waterway characteristics can be identified on the relevant navigational charts (e.g., NOAA Charts 12318, 12323, and 12326) and are described in the United States Coastal Pilot Volume 3 (2020) for the New Jersey area. The following sub-sections describe the various navigation features and hazards.

3.2.6.1 Existing Aids to Navigation Near the Lease Area

Several private aids-to-navigation (PATONs) and Federal aids-to-navigation (ATONs) are located in the vicinity of the Lease Area. They consist of lights, sound horns, buoys, and onshore lighthouses and are intended to serve as visual and aural references to support safe maritime navigation. ATONs are established, operated, and maintained or regulated by the USCG to assist mariners in determining their position, identifying safe courses, and to warn of dangers and obstructions. ATON's marked on NOAA nautical charts are shown in Figure 3.18.

There are no ATONs, either federal or private, within the Lease Area. Near the Lease Area, there are several ATONs, with the closest USCG ATON, red "2" buoy marking an offshore foul/wreckage area for the entrance to Barnegat Inlet, located 5.2 nm (9.7 km) north-northwest of the northern boundary of the Lease Area. A red "WR2" buoy adjacent to a foul/wreck at the northeast end of the Brigantine Shoal with a depth of 29 ft (8.8 m) lies 5.7 nm (10.5 km) west of the western boundary of the Lease Area near its southern end. There is a USCG ATON, red/white whistle buoy "B" for the entrance to Barnegat Inlet, located 6.2 nm (11.4 km) northwest of the northwestern corner of the Lease Area. The red "2" marker for the entrance channel to Absecon Inlet is 13.6 nm west of the southwestern corner of the Lease Area.

There are also a number of PATONs near the Lease Area, with the closest being a yellow buoy "A" located 3 nm (5.6 km) south of the southeastern edge of the Lease Area. There is also a yellow buoy (unnamed on chart) near Little Egg Inlet at an obstruction with a depth of 53 ft which is 3.8 nm (7.1 km) west-northwest of the westernmost portion of the Lease Area. There is also a yellow "B" buoy, located approximately 4.5 nm (8.3 km) southwest of the southwestern edge of the Lease Area. The buoy is a metocean buoy permitted and maintained by Atlantic Shores Offshore Wind. A yellow "A" buoy is located 9.7 nm (18 km) northeast of the northeastern edge of the Lease Area near the southern end of the Ambrose to Barnegat Traffic Separation Scheme (TSS). The buoy is permitted and maintained by the University of California as a data buoy. A yellow "B" buoy is located 13.7 nm (25 km) southwest of the southern edge of the Lease Area. This buoy was not listed in the latest revision of the USCG Light List, and the owner and purpose are unknown. There is a PATON, yellow "OT2", located approximately 23.7 nm (43.9 km) east of the northern portion of the lease boundary. The buoy is a research buoy permitted and maintained by Ocean Tech.

Other ATONs are located farther inshore of the Lease Area compared to those noted above. These additional ATONs mark inlets and coastal navigation channels as well as the Atlantic Intracoastal Waterway.

A historic lighthouse demarcating Barnegat Inlet is located approximately 8.6 nm northwest of the Lease Area. The tower has a height of 163 ft (49.7 m) and reported visibility of 22 nm (40.7 km). The lighthouse is maintained as a PATON.

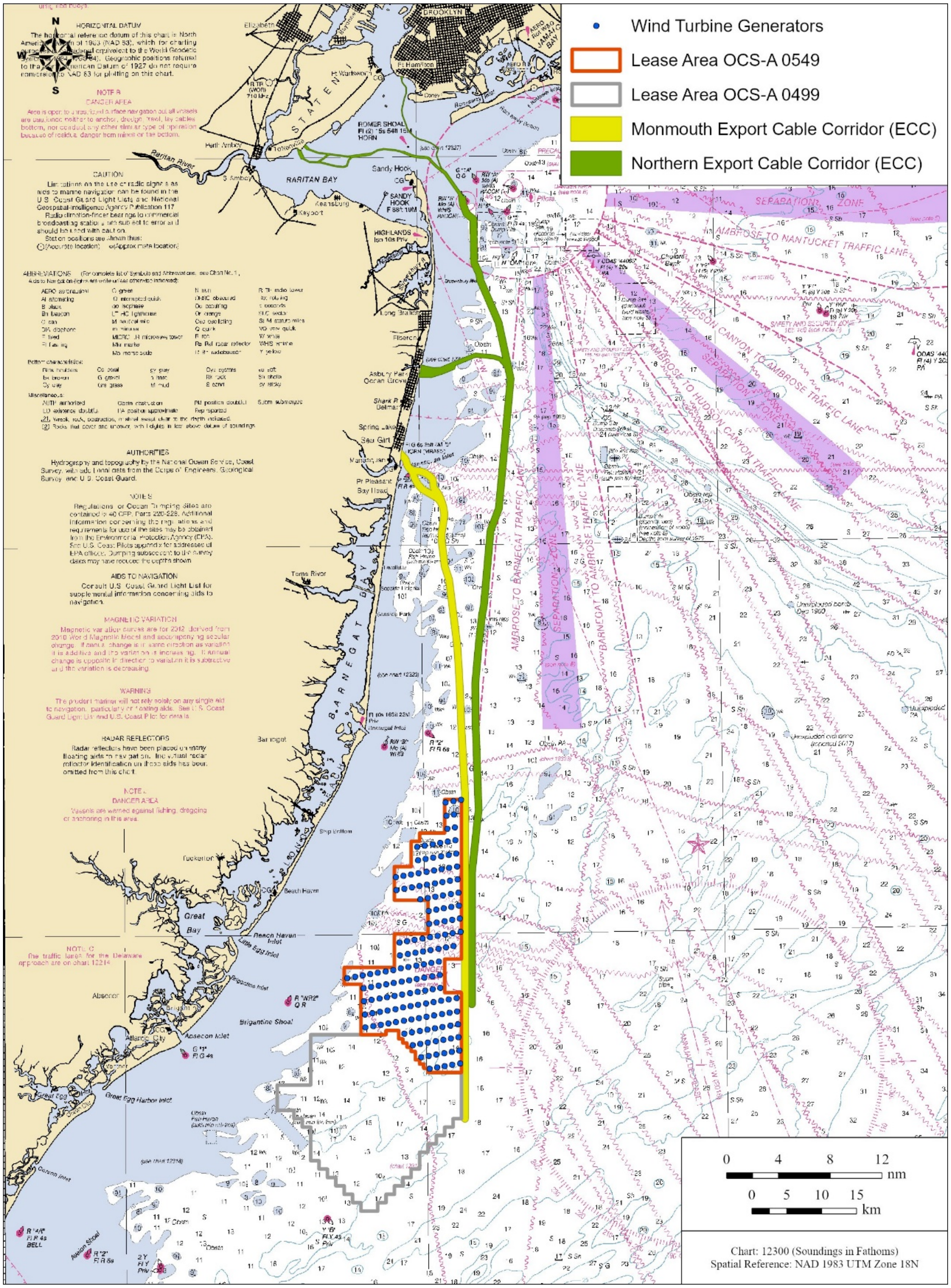

Figure 3.17: Area Navigation Chart (Excerpt of NOAA Chart 12300)

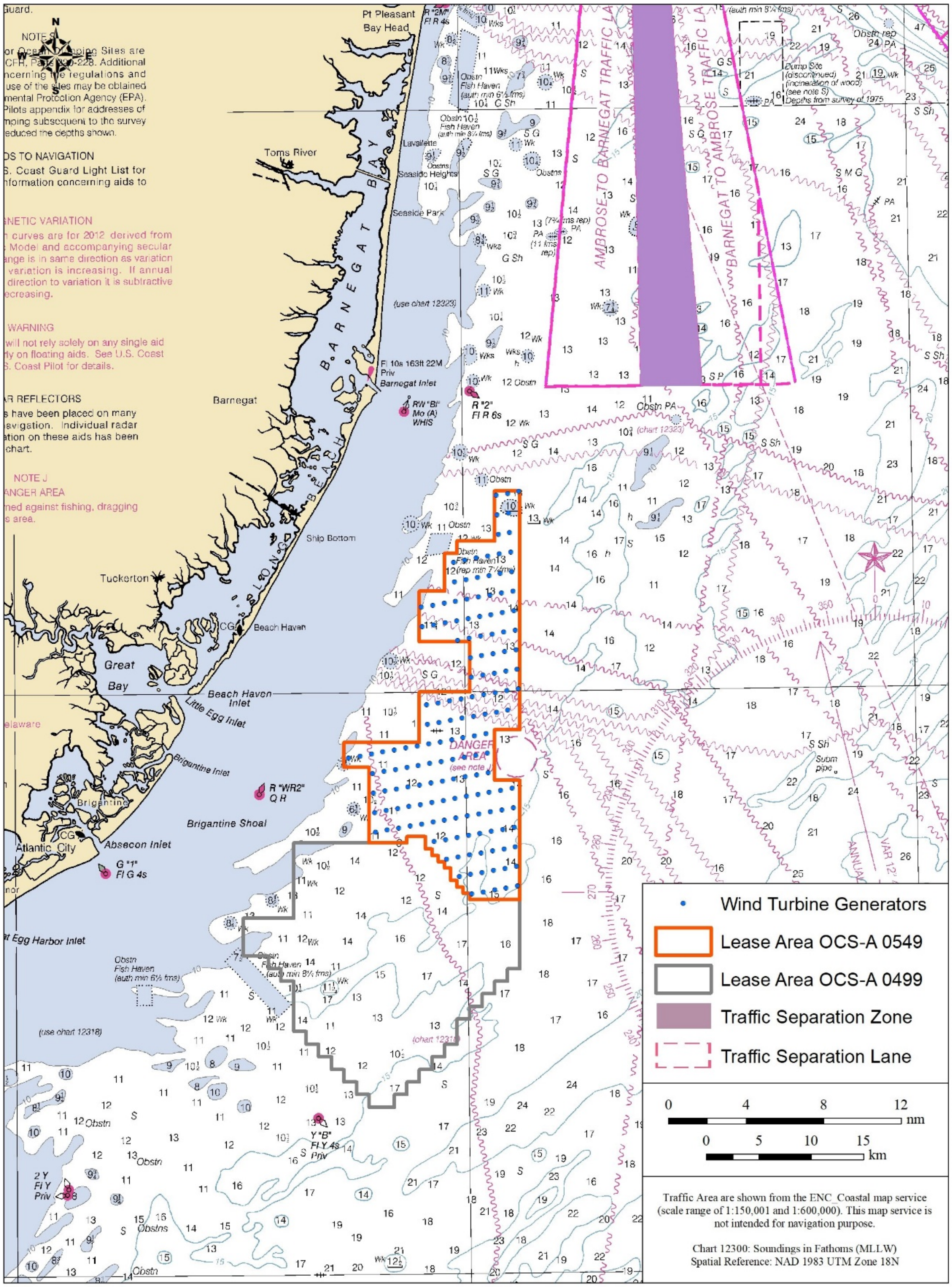

Figure 3.18: Navigation Chart (12300) Showing PATONs and ATONs Near the Lease Area

3.2.6.2 Existing Aids to Navigation Adjacent to the ECCs

Figure 3.19 shows the existing ATONs and PATONs in the region with Figure 3.20 and Figure 3.21 providing closer views of the Monmouth and New York Harbor areas. ATONs within 1000 ft (305 m) of the edge of a cable corridor are colored burgundy in the figures. Two ATONs, one at Monmouth and one near Staten Island, are located within the ECCs and are shown in blue on the figures. Atlantic Shores will coordinate with the USCG regarding any potential conflicts with ATON anchoring.

Table 3.6 provides a list of the ATONs within the 1000 ft (305 m) distance, including the name of the aid, its distance from the edge of the ECC and the approximate water depth. The ATON numeric labels on Figures 3.20 and 3.21 correspond to the first column in the table.

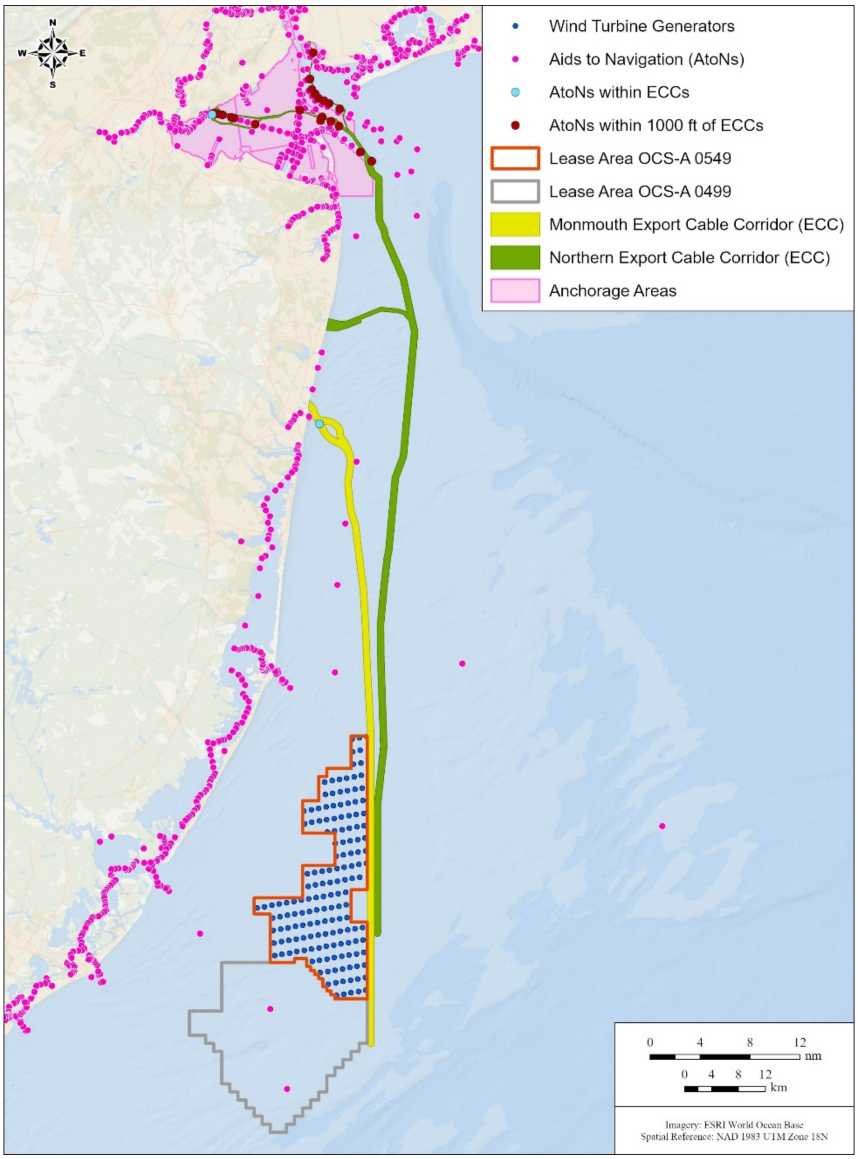

Figure 3.19: Existing ATONs within the Region

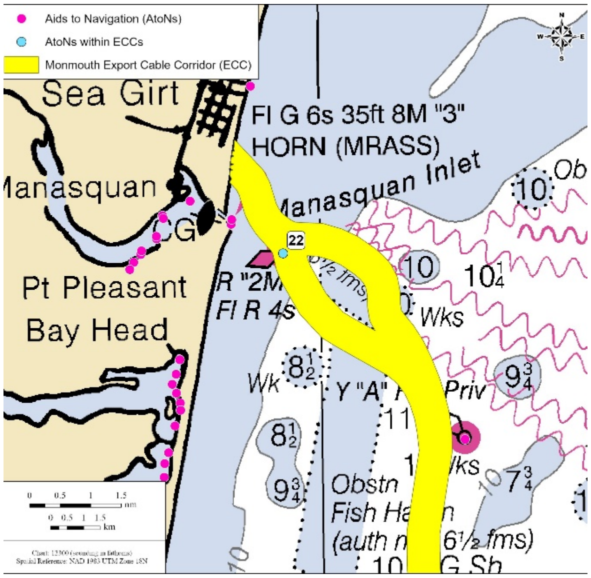

Figure 3.20: Existing ATONs within Proximity of the Monmouth ECC

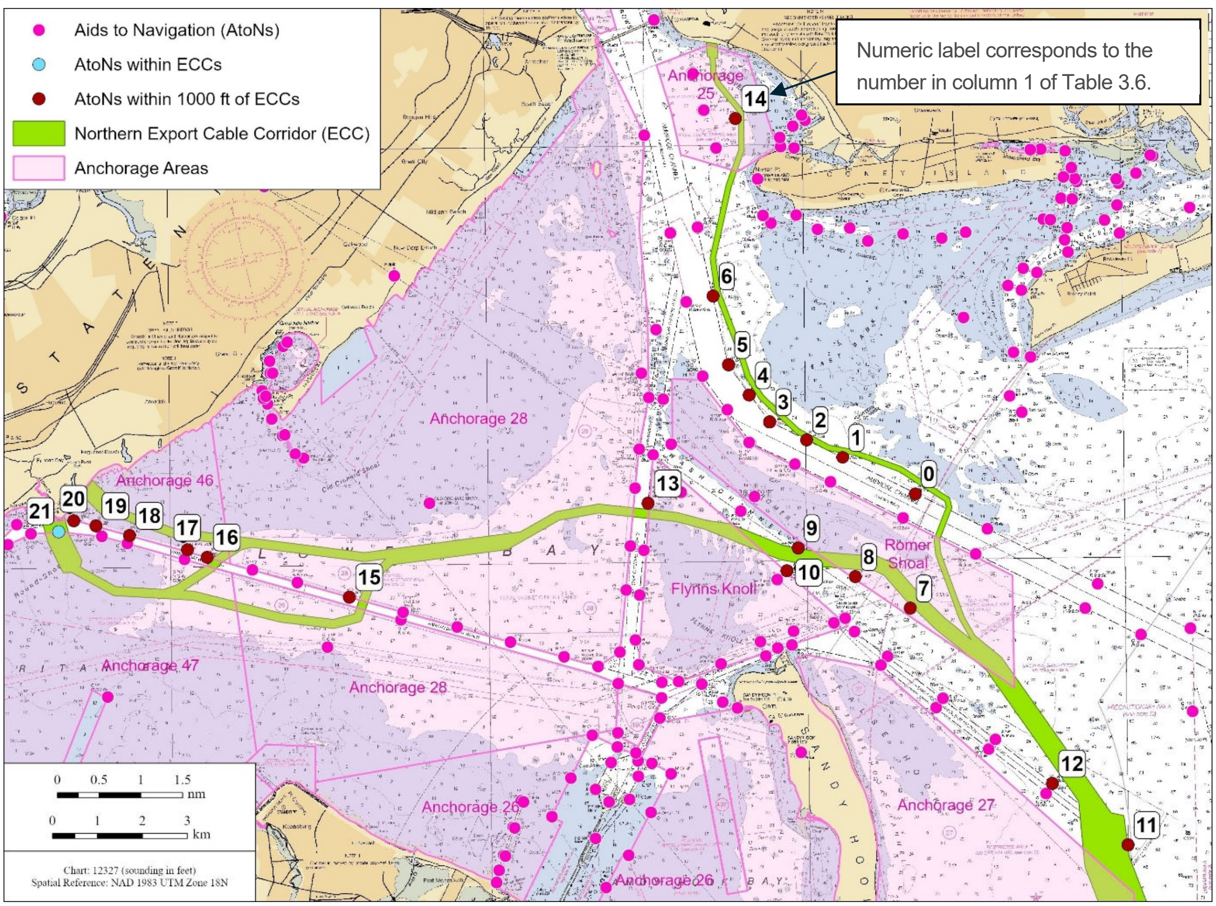

Figure 3.21: Existing ATONS within Proximity of the Northern ECC

Table 3.6: Summary of ATONs within 1,000 ft of Project Export Cable Corridors

No.	ATON Name	Structure	Distance to Cable Corridor Edge	Approximate Water Depth
0	Ambrose Channel Lighted Buoy 10	Red	719 ft (219 m)	20 ft (6.0 m)
1	Ambrose Channel Lighted Buoy 12	Red	320 ft (97 m)	46 ft (14.0 m)
2	Ambrose Channel Lighted Buoy 12A	Red	57 ft (17 m)	33 ft (10.0 m)
3	Ambrose Channel Lighted Bell Buoy 14	Red	708 ft (216 m)	43 ft (13.0 m)
4	Ambrose Channel Lighted Buoy 16	Red	468 ft (143 m)	43 ft (13.0 m)
5	Ambrose Channel Lighted Bell Buoy 18	Red	897 ft (273 m)	43 ft (13.0 m)
6	Ambrose Channel Lighted Buoy 20	Red	225 ft (69 m)	36 ft (11.0 m)
7	Swash Channel Bell Buoy 2S	Red	194 ft (59 m)	26 ft (8.0 m)
8	Swash Channel Buoy 4S	Red nun	543 ft (165 m)	20 ft (6.0 m)
9	Swash Channel Bell Buoy 6S	Red	18 ft (6 m)	26 ft (8.0 m)
10	Swash Channel Buoy 7S	Green can	719 ft (219 m)	26 ft (8.0 m)
11	Scotland Lighted Whistle Buoy S	Red and white stripes	15 ft (5 m)	59 ft (18.0 m)
12	Sandy Hook Channel Lighted Buoy 2	Red	810 ft (247 m)	43 ft (13.0 m)
13	Chapel Hill South Channel Lighted Bell Buoy 10	Red	447 ft (136 m)	23 ft (7.0 m)
14	Gravesend Bay Channel Buoy 1	Green can	221 ft (67 m)	23 ft (7.0 m)
15	Raritan Bay Channel Buoy 12	Red nun	738 ft (225 m)	23 ft (7.0 m)
16	Raritan Bay Channel Bell Buoy 18	Red	403 ft (123 m)	23 ft (7.0 m)
17	Raritan Bay Light 20	TR on skeleton tower	776 ft (237 m)	20 ft (6.0 m)
18	Raritan Bay Channel Lighted Bell Buoy 26	Red	935 ft (285 m)	16 ft (5.0 m)
19	Raritan Bay Channel Buoy 28	Red nun	887 ft (271 m)	10 ft (3.0 m)
20	Raritan Bay Channel Lighted Bell Buoy 30	Red	585 ft (178 m)	7 ft (2.0 m)
21	Raritan Bay Channel Lighted Buoy 31	Green	0 ft (0 m)	10 ft (3.0 m)
22	Manasquan Inlet Lighted Buoy 2M	Red	0 ft (0 m)	49 ft (15.0 m)

3.2.6.3 Proximity to Transit Routes

Key commercial traffic waterways near the Lease Area, existing and proposed, are shown in Figure 3.22. The Lease Area is located in charted water depths of 56 to 94 ft (16.7 to 28.6 m), and there are presently no impediments to navigation through the Lease Area for vessels drafting approximately 50 ft (15.2m) or less. There are no presently demarcated waterways adjacent to or within the Lease Area. The Coast Pilot advises that deep draft vessels should stay outside of Barnegat Lighted Horn B and Five Fathom Bank Lighted Buoy F between New York and Delaware Bay. The Ambrose-Barnegat Traffic Separation Scheme (TSS) leading to and from New York City is located approximately 5.5 nm (10.1 km) north-northeast of the northeastern limit of the Lease Area. A TSS separates opposing streams of vessel traffic by creating separate unidirectional traffic lanes and is designated to safely guide commercial vessels transiting to and from major ports.

The USCG has completed several recent Port Access Route Studies (PARS) to better define key navigational corridors. The Atlantic Ocean Port Access Routing Study (ACPARS) was first completed by the USCG in 2017, analyzing the longshore and predominantly north/south vessel transit routes along the Atlantic Coast. Subsequently, the USCG undertook four supplemental PARS to examine port approaches and international entry and departure areas along the Atlantic Coast. One of these studies was the Port Access Route Study for the Seacoast of New Jersey Including Offshore Approaches to Delaware Bay, Delaware (NJPARS). The NJPARS, finalized in March 2022, examined potential traffic fairways for the New Jersey and Delaware coastal waters to manage the navigation of large commercial vessels and the linkages to the offshore fairways. While the Supplemental PARS were ongoing the USCG published an Advanced Notice of Proposed Rulemaking (ANPRM, USCG 2020). On August 31, 2022, the USCG published the Consolidated Port Approaches and International Entry and Departure Transit Areas Port Access Route Studies (CPAPARS) that consolidated the recommendations of the four Supplemental PARS, including NJPARS, with approved recommendations and alternatives for a system of shipping safety fairways and routing measures along the Atlantic Coast.

Of relevance to this Project, three additional fairways are recommended, but not presently designated, by the CPAPARS in the immediate proximity of the Lease Area, as shown in Figure 3.22. The proposed New Jersey to New York Connector Fairway is located immediately west of the Lease Area. This fairway was proposed in the NJPARS primarily for tug/tows and other vessels which typically stay closer to shore when transiting from Delaware Bay to the Ambrose to Barnegat TSS (and the reverse course). The St. Lucie to New York Fairway is likewise proposed for vessels transiting from Florida to New York (and the reverse course). Lastly, the Barnegat to Narragansett Fairway is proposed immediately north of the northern edge of the Lease Area.

There are no precautionary areas immediately adjacent to the Lease Area. A Right Whale restricted area (speed restrictions to protect North Atlantic Right Whales per 50 CFR § 224.105) lies 30 nm (56 km) north of the Lease Area near Sandy Hook and the entrance to New York Harbor. Likewise, a Right Whale restricted area near Cape May and the entrance to Delaware Bay lies 33 nm (62 km) southwest of the Lease Area. There are no safety or security zones in the project vicinity.

There are no designated anchorages, pilot boarding areas, safe havens, or port approaches in the immediate vicinity of the Lease Area. Pilot boarding areas and offshore anchorages for New York and New Jersey Harbor and the Delaware Bay and River each lie more than 30 nm (56 km) from the Lease Area. The Coast Pilot notes that light draft vessels can anchor within Absecon Inlet and interior bays.

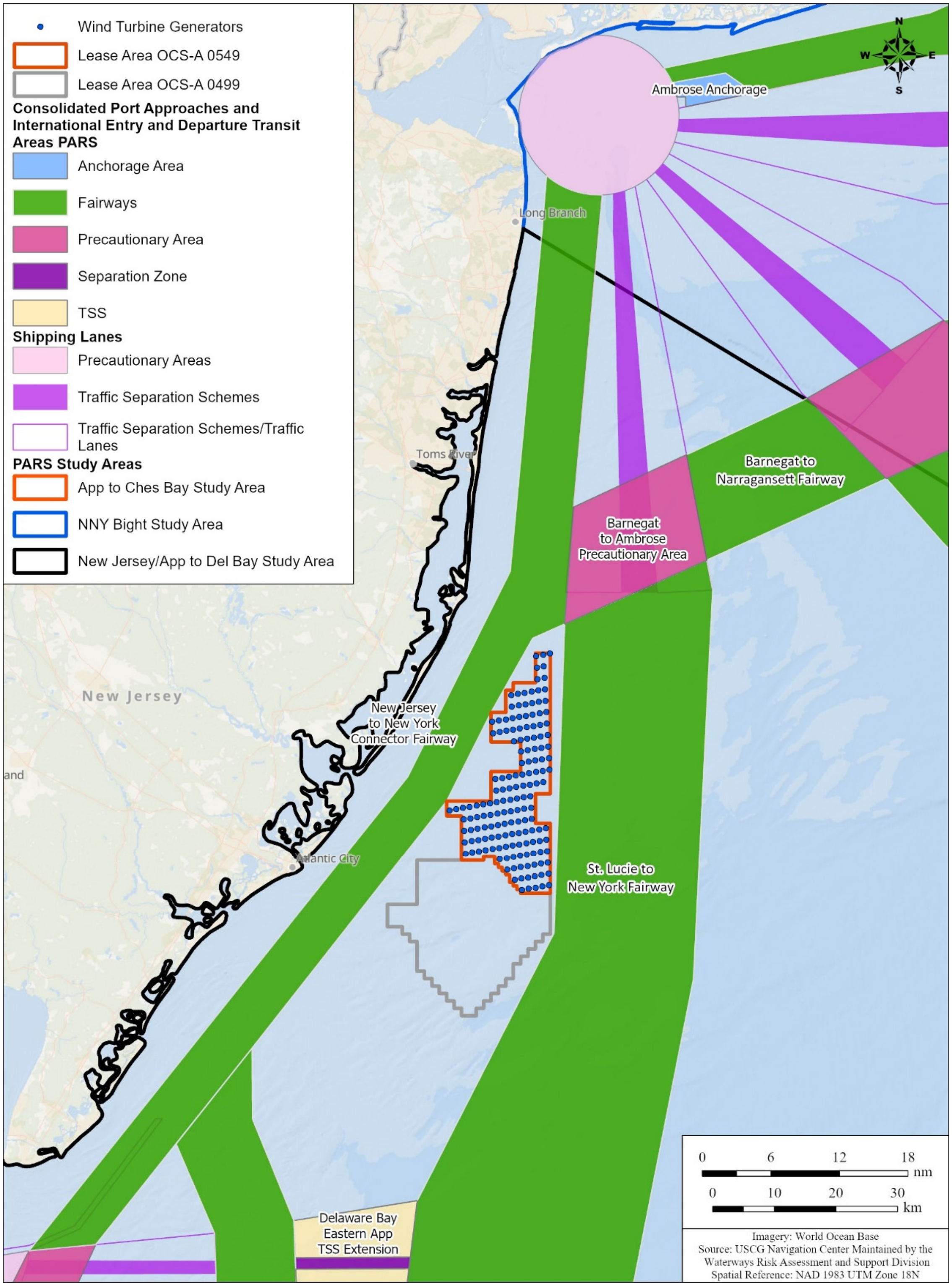

Figure 3.22: Existing and Proposed Transit Routes

The project is not located within the jurisdiction or limits of any port or navigation authority. The principle commercial shipping ports in the area are at New York and New Jersey Harbor (primarily the Port Authority of New York / New Jersey) and Delaware Bay and River (primarily the Port of Wilmington and the Port of Philadelphia). There is no Vessel Traffic Service (VTS) covering the Lease Area, the nearest is for New York and New Jersey Harbors which would be relatively unaffected by the project. Federally maintained dredged channels in the project vicinity include Absecon Inlet, Barnegat Inlet and the New Jersey Intracoastal Waterway.

Pilotage for vessels in the area is provided by Interport Pilot Agency, Inc. and the Sandy Hook Pilot Association. The Interport Pilots provide pilotage to U.S. flagged vessels. The Sandy Hook Pilots provide pilotage to all foreign flagged vessels, primarily those entering New York Harbor.

There are no operating ferries along this section of the coast. The nearest ferries are at Cape May – Lewes across the mouth of Delaware Bay and ferries originating near Sandy Hook in New York Harbor, all of which would be relatively unaffected by the project.

3.2.6.4 Non-Transit Uses of the Area

There are a number of non-transit uses in the proximity of the Lease Area. There are two fish havens/obstructions located west of the Lease Area. The northern fish haven, located offshore of the town of Surf City, is immediately adjacent to the Lease Area. The central fish haven, located offshore of the town of Beach Haven, is 2.1 nm (3.9 km) west of the Lease Area. The southern fish haven, located offshore of Little Egg Inlet, is 1.6 nm (2.9 km) west-northwest of the Lease Area.

There is an area 4.1 nm (7.6 km) west of the westernmost portion of the Lease Area, adjacent to Little Egg Inlet, which is noted as containing numerous research buoys.

There are currently no designated or in-use offshore OREI, oil/gas platforms, or marine aggregate mining areas in the project area. The nearest designated ocean dumping site is located offshore of Absecon Inlet approximately 9.4 nm (17.3 km) west-southwest of the southwestern corner of the Lease Area.

There are no known major regattas, marine parades, or racing areas in the project vicinity. The area is used for fishing, both commercial and recreational, as described elsewhere in this report.

There is a designated sand borrow source (Figure 3.23) for beach nourishment at Long Beach Island. The borrow area is 3.8 nm (7 km) west-northwest of the northwestern corner of the lease area. Other potential sand borrow areas for beach nourishment are located along Brigantine Shoal and near Long Beach Island, but none are known to be presently permitted for use. There are no other known designated mineral, sand/gravel, or marine aggregate mining operations in the area.

The proposed Northern ECC route will be along the eastern edge of the sand aliquots and on the edge of the Barnegat to Ambrose TSS.

There are presently no existing or proposed offshore structures in proximity to the project area.

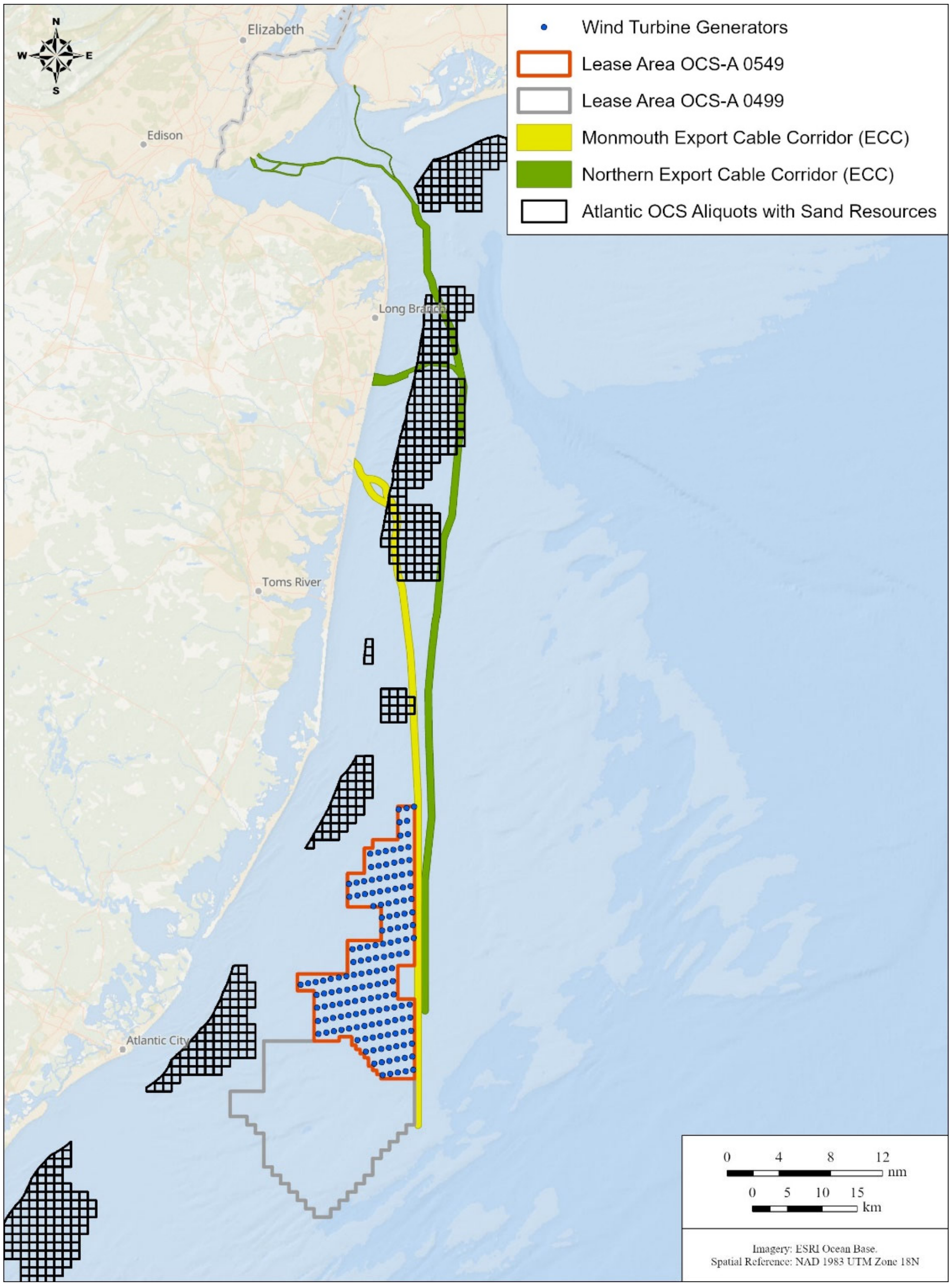

Figure 3.23: Location of Sand Aliquots

3.2.6.5 Site Proximity to Other Waterway Uses

Recreational and commercial shallow draft vessels, primarily involved in fishing activities, use a variety of inlets along the central New Jersey coast. The principal inlet used are Absecon Inlet, at Atlantic City, and Barnegat Inlet farther north. All of these inlets are well marked. Other inlets – Beach Haven Inlet and Brigantine Inlet – are shallower and less well marked. Little Egg Inlet and Great Egg Inlet are still used by a number of shallow draft vessels and are reportedly well marked although the buoys are not charted as they are frequently moved as the natural channel shifts.

A number of fishing grounds in the area are used by both recreational and commercial fishers. There are several such sites, as designated by the New Jersey Dept. of Environmental Protection (NJDEP), lying along the western side of the Lease Area (Figure 3.24). Dominant recreational vessel routes are also shown on Figure 3.24 as derived from the Northeast Recreational Boater Density Survey (SeaPlan, 2013).

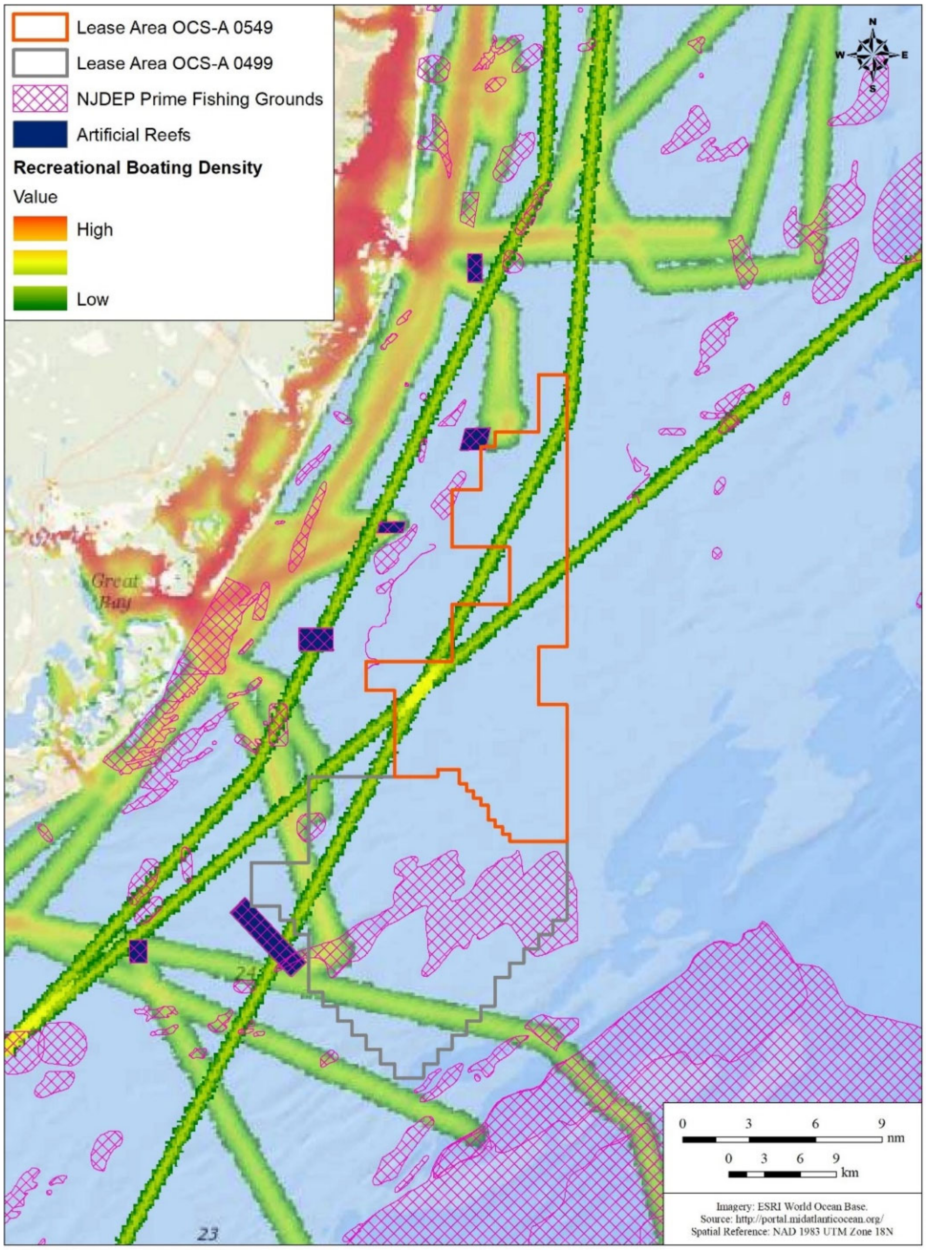

Figure 3.24: Non-Transit Waterway Uses

3.2.6.6 Marine Hazards

The Coast Pilot describes that the principal dangers along this coast are outlying sand shoals, fog, and variable currents following heavy gales. Gales from the northeast to southeast cause heavy wave breaking along the shore and out to a depth of up to 30 ft (9 m).

Figure 3.25 shows other navigational features and hazards in the area. Of note, there are three artificial reef fish havens / obstructions located to the west of the Lease Area as described in the prior subsections. There are also a number of charted obstructions to the west of the Lease Area with depths of 40 ft (12 m) or greater.

The northeastern limits of Brigantine Shoal lie approximately 7 nm (13 km) west of the Lease Area's southwestern limit.

There is a designated danger area located immediately adjacent to the eastern edge of the Lease Area (Figure 3.25). Per the navigation chart, vessels are warned against fishing, dragging, or anchoring in this area, but there is no specific hazard cited. There is no known unexploded ordinance (UXO) in the project area.

There are several historical wrecks located on the seabed within and around the Lease Area. Atlantic Shores plans to avoid shipwrecks and will consider micro-siting turbines if needed to avoid shipwrecks. In particular, any historic wrecks that are listed or eligible for listing on the National Register of Historic Places will be avoided.

There are numerous cable routes through the Lease Area (Figure 3.25). Most of the cable routes follow a bearing of approximately 30º TN from the community of Beach Haven and cross through the Lease Area. Two additional cables follow a bearing of approximately 80º TN from the community of Harvey Cedars and lie just north of the Lease Area. One cable route passes through the westernmost portion of the Lease Area nearest to Little Egg Inlet at a bearing of approximately 170º TN. There are two fiber optic cables that run through the Lease Area but have been determined by Atlantic Shores to be out of service.

Areas along the shoreline, particularly from Little Egg Inlet to Barnegat Inlet and from Absecon Inlet to Great Egg Harbor Inlet, from approximately 1 nm (1.8 km) to 3 nm (5.6 nm) offshore, are noted on the navigation chart to have fish traps and/or structures. There are numerous outfalls along this section of coast extending to water depths of approximately 40 ft (12 m).

There are no designated bombing ranges used for marine or airborne military purposes in the project vicinity; however, the Lease Area is located within a portion of the military Atlantic City Operating Area. An Operating Area is the bounded area in which national defense training exercises and system qualification tests may be routinely conducted. The Lease Area is also located within military regulated airspace W-107C. The closets submarine transit lane is located more than 100 nm (185 km) offshore.

3.2.7 Seasonal Variations in Traffic

Analyses of AIS vessel traffic data (see tables in Appendix C.2) show that vessel movements are seasonal in nature with the largest amount of traffic during the summer months and least in the winter months.

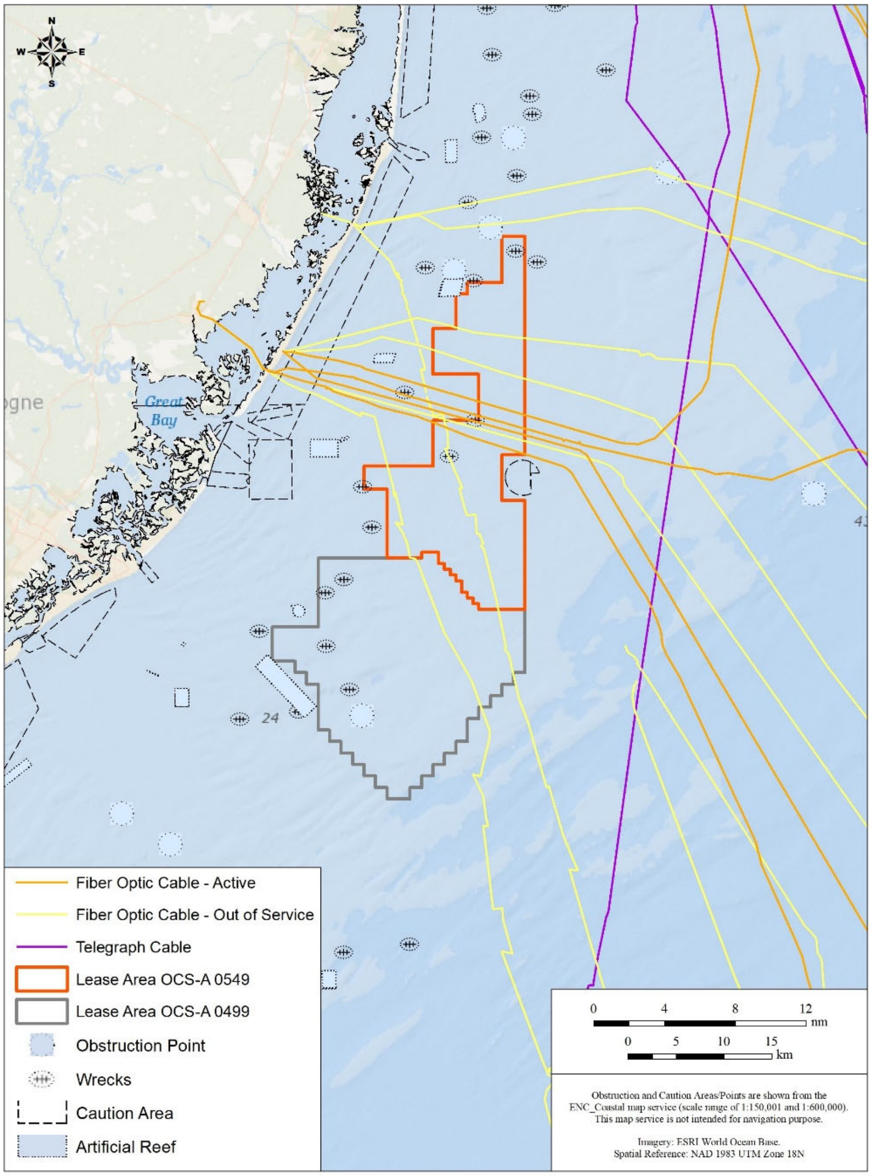

Figure 3.25: Marine Hazards

3.3 Effects of the Project on Existing Vessel Traffic

This report sub-section addresses the issue of vessels navigating through or around the proposed Project. Atlantic Shores anticipates that recreational and commercial fishing vessels will continue to operate within the confines of the Lease Area and to transit through the Lease Area. Section 3.3.1 discusses the adequacy of transit corridor widths for such traffic. Section 3.3.2 summarizes the impact of re-routing on large commercial vessels while Section 3.3.3 addresses the effect of the Project on recreational fishing vessel transits.

3.3.1 Transit Corridor Widths

Smaller vessels, particularly fishing and recreational vessels, are expected to choose to transit through and to fish within the Lease Area. The navigational safety for these activities has been evaluated based on turbine spacing and size of vessels. Given the relatively deep water at this site (66 to 98 ft [20 to 30 m]), navigation is not limited by water depth.

Although there are various international guidelines that address required spacing between commercial shipping lanes and the perimeter of an offshore wind development (e.g., PIANC 2018; UK Maritime MGN 654), there is no specific guidance provided regarding the routing of small vessels (e.g., commercial fishing and recreational vessels) through a wind turbine field.

The USCG NJPARS (2022) provided turbine corridor width calculations based on the PIANC (2018) guidance as an illustration of what would be considered safe navigation parameters for the majority of commercial fishing vessels that transit to/from New Jersey inlets and the offshore fishing grounds should these vessels choose to transit through a wind farm. These calculations considered the following spacing provisions:

- Sufficient navigational spacing of two ship lengths in two directions. It was recognized that this spacing, which would accommodate up to 4,400 vessel transits in a single corridor, is conservative and gives additional buffering space and allowances for inclement weather and vessel emergencies. Under existing conditions, there are less than 4,400 vessels per year that transit through the Lease Area (and would be much less through a single corridor).
- A collision avoidance zone on either side of 1.5 vessel lengths.
- A safety margin of six ship lengths on either side of the corridor to allow for a full round turn.

Figure 3.26 illustrates the spacing assumed between the WTGs in the Lease Area based on the above provisions.

PIANC (2018) does mention the consideration of 1,640 ft (500 m) “safety zones” around the WTGs as referenced in Article 60 of the United Nations Convention of the Law of the Sea (UNCLOS) but notes that this safety zone is for the protection of the structures and is not meant as a safe distance for maneuvering. NJPARS states that such a safety margin may be excessive or overly conservative for vessels 200 feet or less in length. This is also supported in MGN 654 (UK Maritime & Coastguard Agency 2021), which states “The mention of the IMO/UNCLOS safety zone limited to 500 meters does not imply a direct parallel to be applied to OREIs[1].”

In this NSRA, Baird has applied the NJPARS approach for estimating maximum vessel lengths for the largest commercial fishing and recreational vessels based on the proposed corridor widths without consideration of an additional 1,640 ft (500 m) safety margin. Table 3.7 below shows the maximum allowable vessel length that can be accommodated by the four different corridor widths present in the Lease Area: (1) 1.0 nm (1.9 km) east-northeast to west-southwest corridors; (2) 0.6 nm (1.1 km) approximately north to south corridors; (3) 0.54 nm (1.0 km) corridors on the northwest-southeast diagonal; and (4) 0.49 nm (0.9 km) corridors on the northwest-southeast diagonal.

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[1] OREI is an acronym for Offshore Renewable Energy Installation

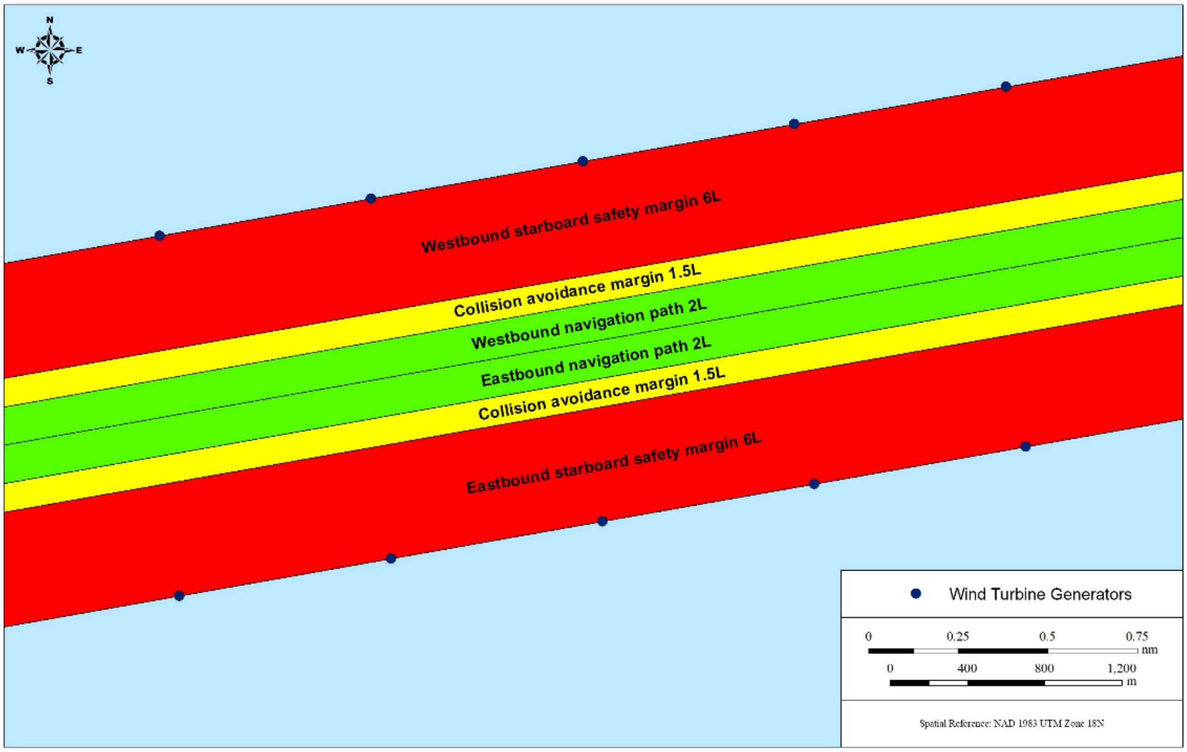

Figure 3.26: NJPARS Illustrative Corridor Width

Table 3.8 and Table 3.9 indicate the percentage of fishing and recreational fleets, respectively, that have lengths less than the values given in Table 3.7. Based on this comparison, all of the AIS fishing vessels (see Section 3.2.2) and 99.9% of the recreational vessels would be able to transit through the primary 1 nm east-northeast to west-southwest corridors. For the 0.6 nm corridors, 98.6% of the recreational vessels and 99.7% of the commercial fishing vessels could transit through these corridors. Similarly, for the 0.54 nm corridors, 98.1% of the recreational vessels and 99.7% of the commercial fishing vessels could transit through these corridors.

Table 3.7: Estimated Maximum Vessel Length by Corridor Width

Width	Max. Vessel Length (ft)
1.0 nm Corridors	320 ft (97.5 m)
0.60 nm Corridors	192 ft (58.5 m)
0.54 nm Corridors	173 ft (52.7 m)
0.49 nm Corridors	157 ft (47.9 m)

Table 3.8: Percentage of AIS-Equipped Fishing Fleet with Length Less than Maximum

Width	Cumulative Percentage
1.0 nm Corridors	100.0%
0.60 nm Corridors	99.7%
0.54 nm Corridors	99.7%
0.49 nm Corridors	99.5%

Table 3.9: Percentage of AIS-Equipped Recreational Fleet with Length Less than Maximum

Width	Cumulative Percentage
1.0 nm Corridors	99.9%
0.60 nm Corridors	98.6%
0.54 nm Corridors	98.1%
0.49 nm Corridors	96.5%

It is very important to recognize that the corridor widths are notional and not actual channels with continuous physical limits at the channel edges. Vessels can certainly navigate from one corridor to the next without restriction.

3.3.2 Future Vessel Traffic Changes

The proposed Lease Area will have some impacts on future vessel traffic, particularly with respect to the large commercial passenger, tanker, cargo, and tug/tow vessels which are assumed to reroute around the Lease rea. Table 3.10 summarizes the average number of vessel tracks per day within the entire AIS data region compared to the number of tracks that enter the Lease Area. Due to the size of the smaller vessels, Atlantic Shores anticipates that the fishing and recreational vessels will generally transit through the Lease Area. Also shown in the table are the anticipated number of O&M transits from the Project's vessels.

Section 3.2.2.1 showed that the majority of large commercial vessels transiting the Lease Area are heading in a north-south direction and the reciprocal direction. Figure 3.27 presents a selection of prevailing transit routes of dry cargo vessels through the Lease Area and various alternative bypass routes to avoid Lease Areas OCS-A 0498 and 0499 during and post-construction. Table 3.11 presents a summary of the transit distances and estimated transit times (based on average vessel speed in the AIS dataset). The impact on transit time as a result of bypassing the Lease Area is small (typically 15 to 20 minutes or less). Figure 3.28 and Table 3.12 present similar existing transit routes through the Lease Area and bypass routes for tanker vessels and the impact on transit time as a result of bypassing the Lease Area is also typically 15 to 20 minutes or less.

As mentioned in Section 3.2.6.2, the USCG recently completed the CPAPARS with recommendations for establishing fairways along the Atlantic seacoast (USCG 2022b). If fairways are implemented for the region surrounding the Lease Area, this will control the navigation of large commercial vessels (presuming they follow the recommended routes), including tug-barge tows, and there would be no variation in the navigation tracks of these vessels for existing conditions and post-development. Specifically, there is a St. Lucie to New York Fairway proposed to the east of the Lease Area and the New Jersey to New York Connector Fairway to the west of the Lease Area intended for use by near coastal vessels such as tug-tows. The St. Lucie to New York fairway is proposed to have a minimum width of approximately 12 nm (22.2 km). The New Jersey to New York Connector Fairway is to have a minimum width of approximately 4 nm (7.4 km).

Table 3.10: Summary of Potential Impacts of the Lease Area on Vessel Traffic

Vessel Type	Average Tracks per Day: AIS Data Region	Average Tracks per Day: Lease Area	Vessel Traffic Potentially Impacted by Lease Area (% of tracks in region)
Passenger	40.5	0.2	1%
Tanker	8.5	0.2	2%
Dry Cargo	18.8	2.1	11%
Military	0.1	0	0%
Tug/Towing	45.9	0.8	2%
Other Commercial	17.4	0.5	3%
Fishing – Fishing	41.8	3.9	9%
Fishing – Transiting	38.5	4.5	12%
Recreational	62.7	1.9	3%
Project O&M	–	4 – 12	

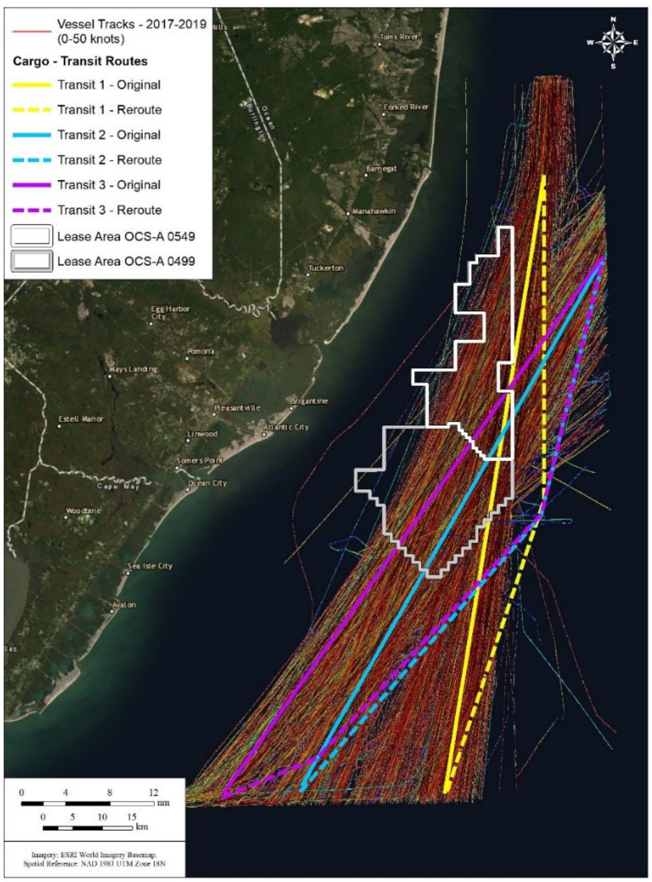

Figure 3.27: Analysis of Transit Routes for Dry Cargo Vessels: Existing and Post-Construction (Bypassing Combined Lease Areas)

Table 3.11: Transit Route Analysis for Dry Cargo Vessels Currently Transiting the Combined Lease Area: Existing and Lease Area Bypass Route

		Existing Route		Bypass Route		
Transit Route	Avg. Vessel Speed (knots)	Distance (nm)	Transit Time (hr)	Distance (nm)	Transit Time (hr)	Change in Time (min)
1	14.6	57	3.90	58	3.97	4
2	14.6	55	3.77	57	3.90	8
3	14.6	59	4.04	64	4.38	21

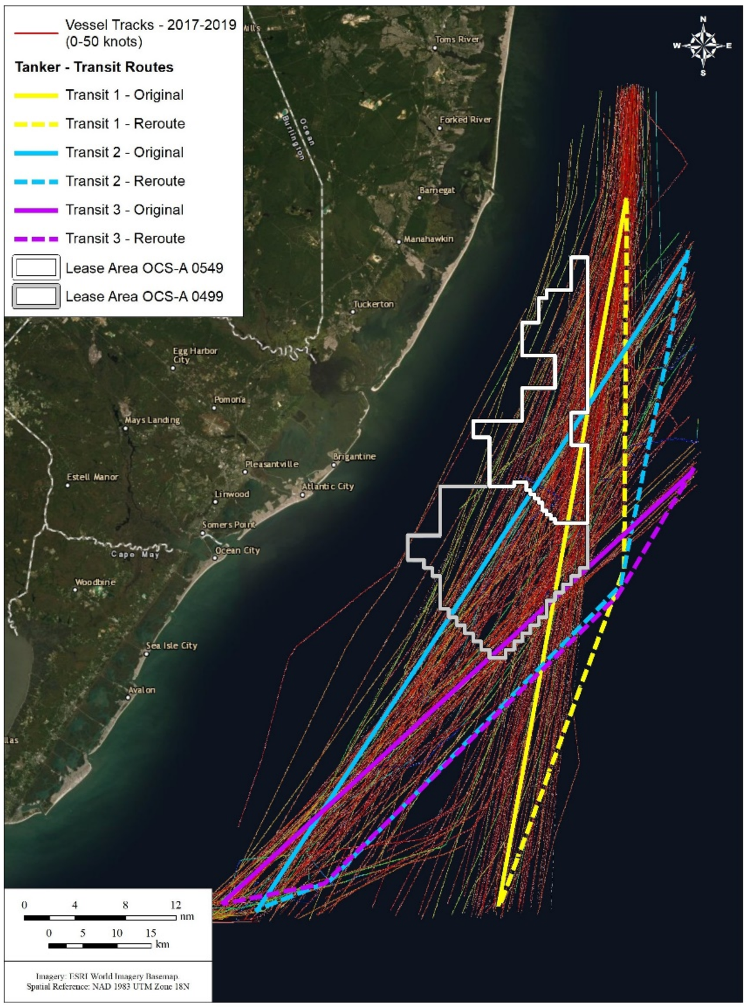

Figure 3.28: Analysis of Transit Routes for Tanker Vessels: Existing and Post-Construction (Bypassing Lease Area).

Table 3.12: Transit Route Analysis for Tanker Vessels Currently Transiting the Lease Area: Existing and Lease Area Bypass Route

		Existing Route		Bypass Route		
Transit Route	Avg. Vessel Speed (knots)	Distance (nm)	Transit Time (hr)	Distance (nm)	Transit Time (hr)	Change in Time (min)
1	12.9	57	4.42	57	4.42	1
2	12.9	62	4.81	66	5.12	19
3	12.9	51	3.95	53	4.11	9

There is a reasonable frequency of towed vessel traffic through and near the Lease Area based on the AIS data analyses presented previously. Figure 3.29 and Table 3.13 present comparisons of transit distance and time for current towed routes through the Lease Area, and alternative routes that bypass and follow the possible future tug fairway. As noted in Section 3.2.6.2, the recent CPAPARS by the USCG (2022b) has indicated the potential future identification of the New Jersey to New York Connector Fairway west of the Lease Area. While towed vessels are transiting at slower speeds than tankers or cargo vessels, the impact of bypassing the Lease Area on transit time is still small (26 minutes or less). If the proposed tug-barge fairway is adopted, there would be no difference in navigational distance for existing and future conditions.

Table 3.13: Transit Route Analysis for Towed Vessels Currently Transiting the Lease Area: Existing and Lease Area Bypass Route

		Existing Route		Bypass Route		
Transit Route	Avg. Vessel Speed (knots)	Distance (nm)	Transit Time (hr)	Distance (nm)	Transit Time (hr)	Change in Time (min)
1	8.8	61.4	6.98	64.7	7.35	23
2	8.8	73.4	8.34	76.8	8.73	23

Overall, the effect of re-routing on commercial (non-fishing) vessels is expected to be small.

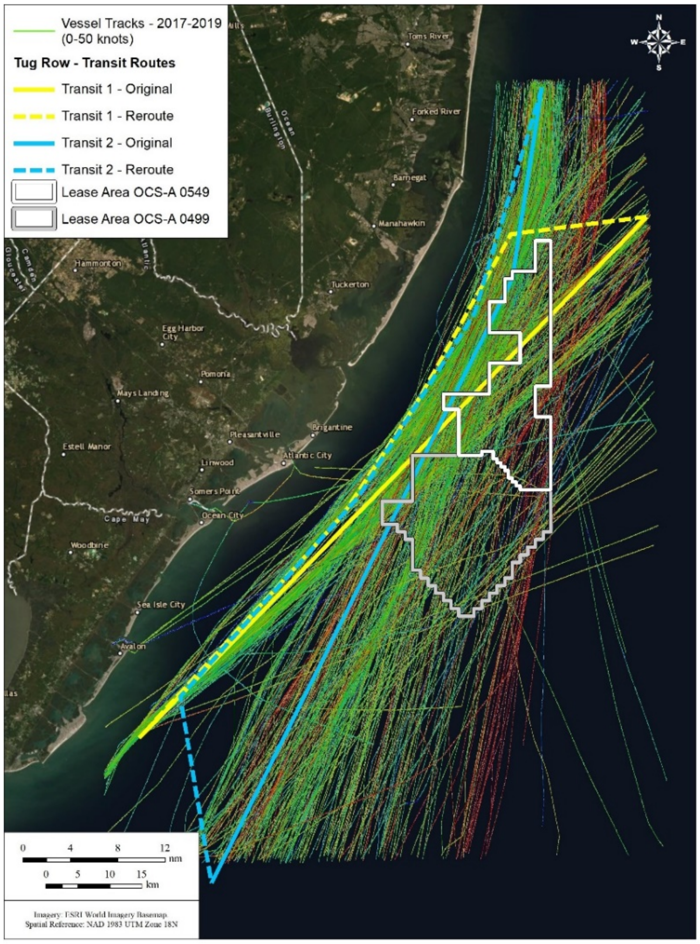

Figure 3.29: Analysis of Transit Routes for Towed Vessels: Existing and Post-Construction (Bypassing Lease Area)

3.3.3 Effect on Recreational Fishing Transits

As was identified in Section 3.2.2, approximately 17% of the unique vessel tracks through the Lease Area are due to recreational vessels. Many of these tracks and vessels are likely associated with offshore recreational fishing activity. The Atlantic Shores Recreational Fishing Industry Representative (FIR) held discussions with members of the recreational fishing community at a number of local harbors along the New Jersey coastline and identified the typical destination fishing grounds for these vessels. The harbors visited included Shark River Inlet, Manasquan Inlet, Barnegat Inlet, Little Egg Inlet, Absecon Inlet, Great Egg Inlet, Townsend Inlet, and Cape May Inlet. Figure 3.30 provides an illustration of potential transit routes through or near the Lease Area with straight lines connecting the harbors to the fishing grounds that were identified.

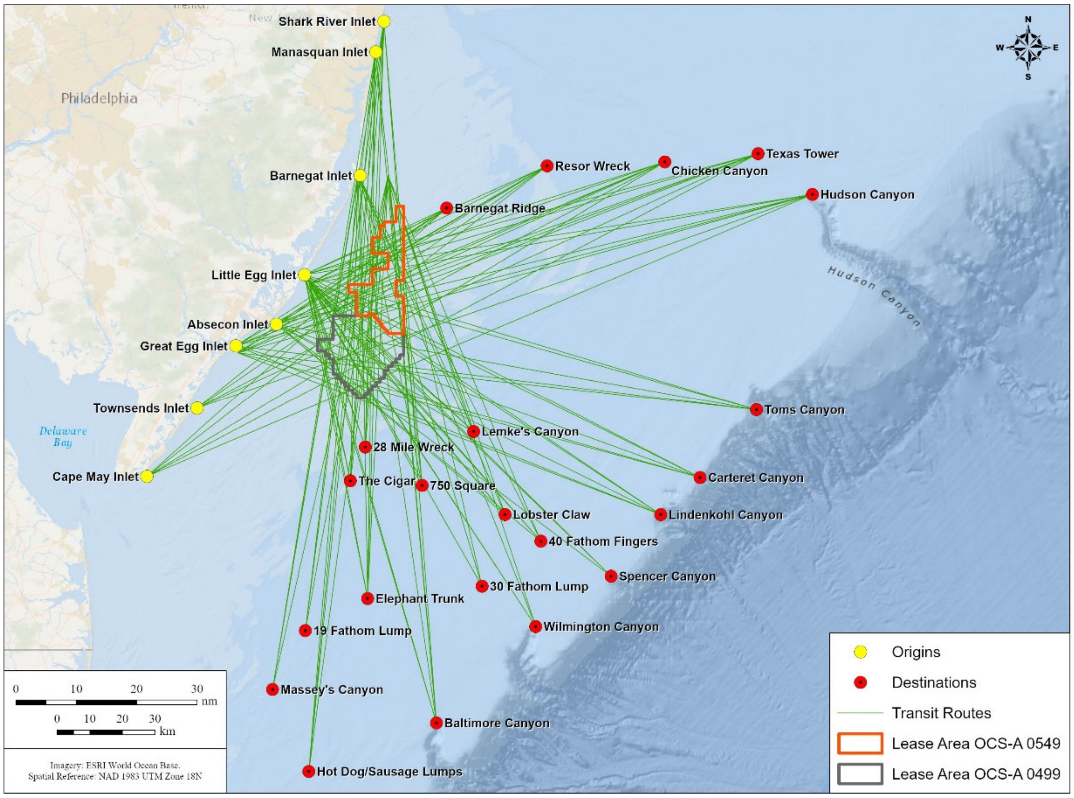

Figure 3.30: Recreational Fishing Transit Routes

Several routes representative of the range of track orientations and fishing destinations were selected for more detailed review. In this analysis, potential rerouting of vessels through the WTG field was identified based on feedback from the FIR. Two possible changes in routing were considered:

1. The vessel stays on a direct heading between the harbor origin and destination, maneuvering around turbines where and if necessary while navigating through the Lease Area.
2. The vessel follows a direct heading between origin and destination until reaching the perimeter of the Lease Area then travels down a suitable corridor that is roughly aligned with the travel direction.

There would be very little change in overall travel distance associated with the first approach, but it is possible a vessel might slow down when traveling within the Lease Area. The change in travel distance and time was estimated for the second approach in which vessels reroute down corridors. The selection of a route may depend on weather conditions at the time of transit.

As an example, Figure 3.31 shows those routes originating at Little Egg Inlet while Figure 3.32 presents the rerouting alternatives for four of these routes. Additional figures showing the routes and rerouting by harbor are given in Appendix E. The distance for each of the existing transit routes and the rerouting alternatives was estimated with GIS tools.

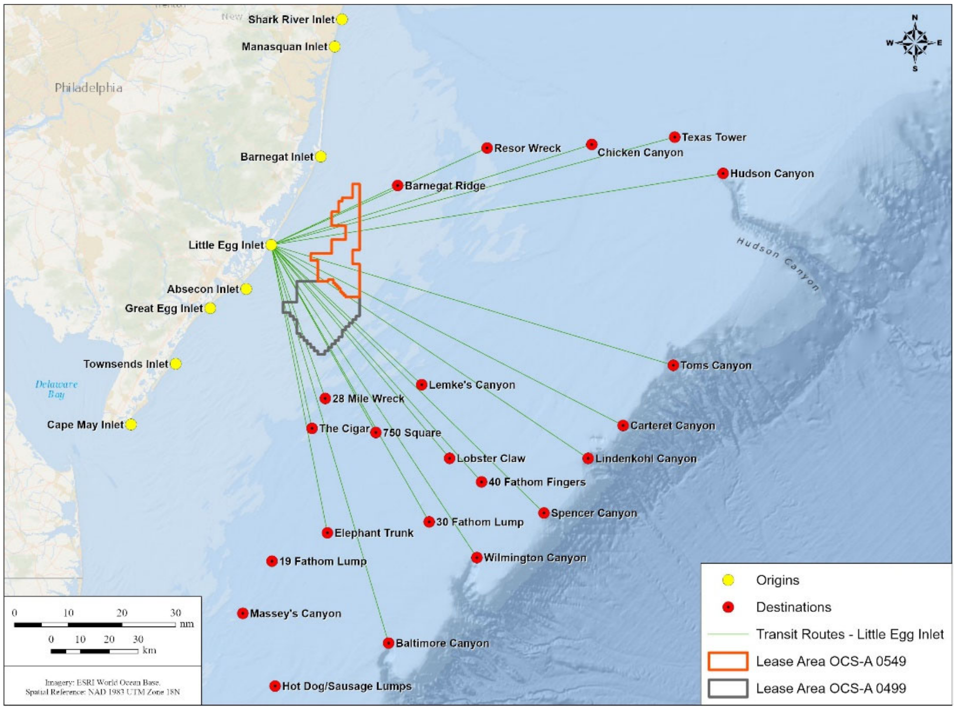

Figure 3.31: Routes to Fishing Destinations for Little Egg Inlet

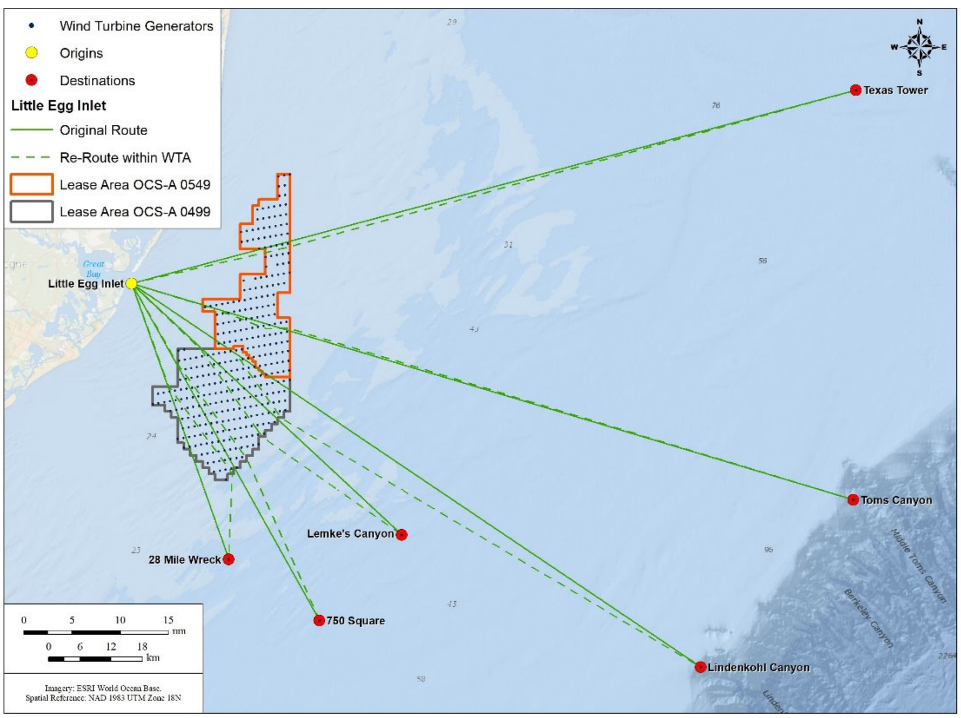

Figure 3.32: Rerouting of Recreational Fishing Vessels for Little Egg Inlet

Table 3.14 presents a summary for each harbor and fishing ground analyzed in terms of transit distance, change in distance for rerouting through or around the Lease Area, and the change in travel duration for each routing alternative assuming a 25 knot (46 kph) transit speed. Many of the recreational vessels headed to the offshore fishing grounds are capable of traveling at a relatively high speed (25 to 35 knots [46 to 65 kph]) due to the distance involved. It may be observed from the results presented in the table that routing through the Lease Area will have a small effect on travel distance and time.

3.4 Impact of Vessel Emission Regulations

Starting in 2005, the International Maritime Organization (IMO) through the International Convention for the Prevention of Pollution from Ships, 1973 (known as MARPOL) began a process to set more stringent fuel sulfur limits and more stringent Nitrous Oxide (NOx) emissions from commercial ships as part of a worldwide effort to improve air quality. These regulations applied to vessels operating within designated Emission Control Areas (ECAs). The U.S. ECA includes coastal waters up to 200 nautical miles from the coasts of the continental United States and large portions of coastal waters around Alaska, Hawaii, Puerto Rico, and the U.S. Virgin Islands.

The latest regulation came into effect on January 1, 2020 and is known as IMO2020. This regulation limits the amount of sulfur permitted in commercial ship fuel to 0.5% for all ships operating worldwide while ships operating in ECAs must utilize a fuel with a maximum sulfur content of 0.1%.

Inbound vessels typically switch to lower sulfur fuel when entering the ECA as it is more expensive.

These emissions regulations are not expected to have any effect on vessel traffic near the Project nor increase the risk associated with a loss of ship propulsion and potential allision with a WTG.

Table 3.14: Change in Transit Distance and Duration for Rerouting of Recreational Fishing Vessels

Harbor of Origin	Destination	Distance (nm [km])		Change in Distance (nm [km])	Increase in Duration (min.) for 25 knot Speed
		Original	Rerouted	Rerouted	Rerouted
Manasquan / Shark Inlet	750 Square	77.2 (143.0)	77.2 (143.0)	0.0 (0.0)	0.0
	Elephant Trunk	95.7 (177.2)	95.7 (177.2)	0.0 (0.1)	0.1
	Massey's Canyon	107.0 (198.1)	107.1 (198.4)	0.1 (0.2)	0.3
Barnegat Inlet	19 Fathom Lump	75.9 (140.6)	76.1 (141.0)	0.2 (0.4)	0.5
	Elephant Trunk	70.1 (129.8)	70.1 (129.9)	0.0 (0.1)	0.1
	750 Square	52.4 (97.1)	52.5 (97.1)	0.0 (0.1)	0.1
	Wilmington Canyon	80.2 (148.4)	80.3 (148.8)	0.2 (0.3)	0.4
	40 Fathom Fingers	67.6 (125.2)	67.7 (125.3)	0.1 (0.2)	0.2
Little Egg Inlet	28 Mile Wreck	30.3 (56.2)	30.6 (56.6)	0.2 (0.4)	0.6
	750 Square	40.0 (74.1)	40.1 (74.3)	0.1 (0.2)	0.2
	Lemke's Canyon	38.3 (70.8)	38.5 (71.4)	0.3 (0.5)	0.7
	Lindenkohl Canyon	71.2 (131.8)	71.7 (132.8)	0.5 (1.0)	1.3
	Toms Canyon	78.1 (144.7)	78.3 (144.9)	0.1 (0.2)	0.3
	Texas Tower	77.8 (144.0)	77.8 (144.0)	0.0 (0.0)	0.0
Absecon Inlet	Lemke's Canyon	37.2 (68.9)	39.1 (72.5)	1.9 (3.5)	4.6
	Lobster Claw	49.3 (91.3)	49.3 (91.4)	0.0 (0.1)	0.1
	Tom's Canyon	80.8 (149.6)	81.4 (150.7)	0.6 (1.1)	1.5
	Hudson Canyon	80.8 (149.6)	81.7 (151.4)	1.0 (1.8)	2.4
	Resor Wreck	52.0 (96.2)	52.2 (96.6)	0.2 (0.4)	0.5
Great Egg Inlet	Hudson Canyon	98.7 (182.8)	98.7 (182.8)	0.0 (0.0)	0.0
	Tom's Canyon	86.8 (160.8)	87.4 (161.9)	0.6 (1.1)	1.4
	Resor Wreck	59.6 (110.3)	59.6 (110.4)	0.1 (0.1)	0.2
Townsend's Inlet	Chicken Canyon	87.6 (162.2)	87.9 (162.9)	0.4 (0.7)	0.9
	Hudson Canyon	107.9 (199.8)	108.1 (200.2)	0.2 (0.3)	0.4
	Barnegat Ridge	53.0 (98.2)	53.4 (99.0)	0.4 (0.8)	1.0
Cape May Inlet	Chicken Canyon	100.4 (185.9)	101.4 (187.8)	1.0 (1.9)	2.5
	Resor Wreck	84.0 (155.5)	84.0 (155.6)	0.0 (0.1)	0.1
	Hudson Canyon	119.7 (221.7)	119.8 (221.9)	0.1 (0.2)	0.2

4. Proposed Structures

4.1 Introduction

This report section provides a description of the above and below water components of the proposed WTGs, OSSs and Met Towers, and an assessment of access to and navigation within, or close to, structures as per Sections 3, 4 and 5 of the NVIC 0-19 checklist (Appendix A).

4.2 Above Water Structure Description

4.2.1 Wind Turbine Generators (WTGs)

As noted previously, the Project's offshore facilities will consist of up to 157 WTGs and their foundations, along with up to eight OSSs and their foundations, inter-array cables, export cables, and possibly inter-link cables.

Table 4.1 summarizes the PDE of parameters for the WTGs. With respect to vessel navigation, an important consideration is the minimum tip clearance, which is 72.2 ft (22.0 m) relative to Highest Astronomical Tide (HAT).

The WTG foundation concepts, and sub-types are described in subsequent report sub-sections.

Table 4.1: WTG Dimensional Envelope

Parameter	Size
Maximum Tip Height	1,048.8 ft (319.7 m) MLLW[1]
Maximum Top of The Nacelle Height	605.9 ft (184.7 m) MLLW
Maximum Hub Height	576.4 ft (175.7 m) MLLW
Maximum Rotor Diameter	918.6 ft (280.0 m)
Minimum Tip Clearance	78.0 ft (23.8 m) MLLW 72.2 ft (22.0 m) HAT[2]
Maximum Tower Diameter (bottom)	32.8 ft (10.0 m)

1. MLLW refers to Mean Lower Low Water, which is the average height of the lowest daily tide. Navigational charts in the U.S. normally refer to this as the elevation datum.
2. HAT refers to Highest Astronomical Tide, which is an estimate of the highest expected tide to occur over a 19-year tidal epoch.

4.2.2 OSS

The Project will include up to eight offshore substations (OSSs), which will serve as common collection points for power from the WTGs and also serve as the origin for the export cables that deliver power to shore. Atlantic Shores is considering three sizes of OSS. Depending on the final OSS design, there will be up to eight small OSSs, up to four medium OSSs, or up to three large OSSs. Atlantic Shores has identified two areas where OSSs will be placed as illustrated in Figure 2.3. Within these areas a minimum of three and a maximum of eight OSSs will be placed in a maximum of two north to south corridors in order to preserve the majority of the north to south corridors. The spacing in all of the primary east-northeast transit corridors will be preserved.

The anticipated maximum dimensions (length x width x height) of the OSS topsides are:

- Small OSSs: 131.2 x 114.8 x 98.4 ft (40.0 x 35.0 x 30.0 m) with maximum topsides elevation of 53.3 m MLLW
- Medium OSSs: 213.3 x 147.6 x 114.8 ft (65.0 x 45.0 x 35.0 m) with maximum topsides elevation of 58.3 m MLLW
- Large OSSs: 295.3 x 164.0 x 131.2 ft (90.0 x 50.0 x 40.0 m) with maximum topsides elevation of 63.3 m MLLW

4.2.3 Met Tower and Metocean Buoys

Atlantic Shores may install one permanent meteorological tower (Met Tower) in the southwest perimeter of the Lease Area and up to two temporary meteorological and oceanographic (metocean) buoys, as shown in Figure 4.1. The maximum height of the Met Tower will not exceed 16.5 ft (5 m) above the hub height of the largest WTG installed. Therefore, it is conservative to assume the maximum height of the Met Tower will be 590.6 ft (180 m) above MSL. The foundation options for the Met Tower include all options under consideration for WTG foundations (see Section 2.2). The up to two temporary metocean buoys may be installed and kept in place during construction to monitor weather and sea state conditions.

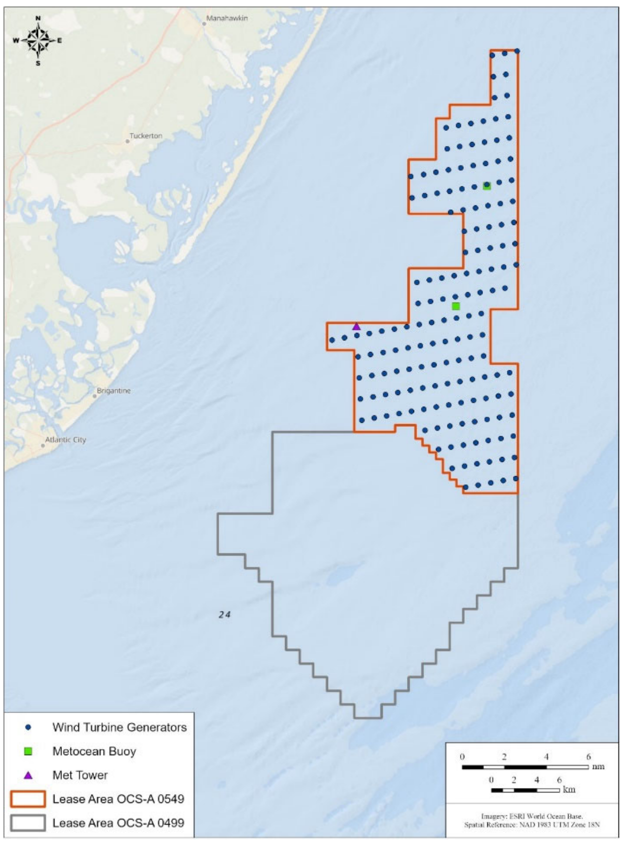

Figure 4.1: Potential Met Tower and Metocean Buoy Location

4.2.4 Above Water Structure Impacts on Navigation

4.2.4.1 Vertical Clearance (Air Draft)

Air draft refers to the distance from the top of a vessel's highest point to its waterline. Figure 4.2 shows the maximum dimensions associated with the WTGs and the minimum vertical clearance from the water surface to the blades. The minimum blade tip vertical clearance from Highest Astronomical Tide (HAT) is 72.2 ft (22.0 m) and from Mean Lower Low Water (MLLW) is 78 ft (23.8 m). This clearance can be compared to the vessel air draft in order to assess potential for allision with a blade. Note that this is the minimum vertical clearance under calm conditions; waves cause vessel vertical motions and will reduce the vertical clearance above the vessel air draft.

Large sailing craft transiting in this region may have mast heights that exceed the minimum vertical clearance and may elect to travel around the Lease Area rather than through it. Large commercial craft (cargo, tankers, etc.) may also exceed the clearance, but as discussed earlier, it is unlikely that such vessels would transit through the Lease Area based on other considerations.

Sailing vessels are at little risk of interacting with the WTGs under normal conditions, but the risk increases considerably should the vessel lose power and/or steerage and become adrift, or if there is a breakdown in navigational capability under poor visibility conditions. The vessel must be in very close proximity to the WTG in order for turbine strike to be feasible and would likely be associated with a co-incident allision between the vessel and the turbine base.

Based on the above, it is recommended that the air draft restrictions within the Lease Area be identified by means of Notice to Mariners (LNMs) and on the navigational chart, subject to USCG practices and regulations.

4.2.4.2 Emergency Rescue Activities

The issue of USCG emergency rescue activities is discussed in Section 8.5.

4.2.4.3 Noise

The potential effect of noise and vibration on USCG missions is discussed in Section 6.4.

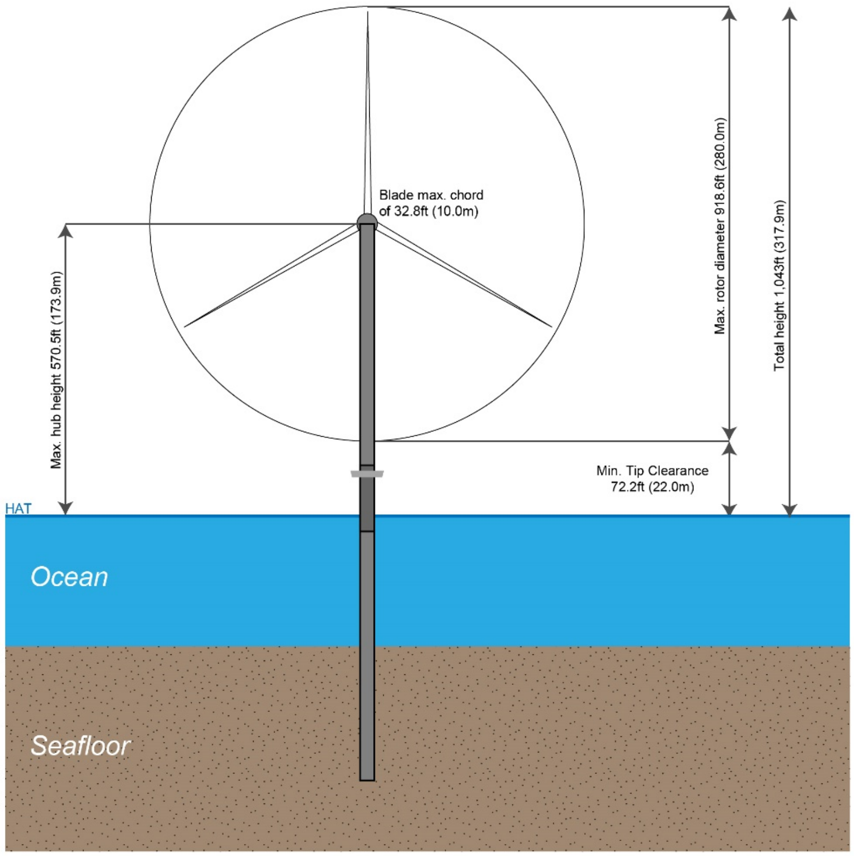

Figure 4.2: WTG Maximum Dimensions and Minimum Vertical Clearance of the Blade Tip Above the Water Surface

4.2.4.4 Structural Allision

There are two types of potential allision, drifting and powered, with the WTGS that have different potential consequences. A drifting allision is the result of an inoperable vessel (generally, a mechanical breakdown) drifting due to environmental conditions. During such an event, the vessel drift speed will be low (assumed to typically be less than 1.9 knot or 1.0 m/s), as it is moved by the actions of wind and current and result in a smaller amount of energy transfer during impact as compared to a powered allision. Given that the traffic expected to be transiting within the Lease Area during the operational phase is comprised of recreational and fishing vessels with relatively small sized vessels, Atlantic Shores does not anticipate that there would be any appreciable structural damage to the WTGs or OSSs for either type of allision. However, the vessel would likely experience moderate damage.

For a direct powered allision event, the consequences could be severe depending on the vessel characteristics and approach conditions. Most of the traffic expected to transit through the Lease Area after construction (and thus be at risk to powered allisions) will be either recreational or fishing vessels. As such, the small size of the vessels in relation to the WTG and OSS foundations would likely result in only minor consequences for the WTG or OSS and likely more damage to the vessel. In addition, fishing vessels undertaking fishing activities in the Lease Area would be traveling at low speeds, typically less than 4 knots. However, the consequences of a powered allision at speed for the vessel and crew are likely to be severe and possibly life-threatening.

Larger vessels (e.g., cargo, tanker, passenger) will likely be present near the perimeter of the Lease Area as they are expected to re-route around. In the unlikely event one of these larger vessels drifts off-course and strikes a perimeter WTG or OSS at speed, the consequences could be significant. Structural damage could be experienced by the WTG or OSS structure, though the design of the WTGs and OSSs considers such an allision potential and will avoid toppling. The damage to the vessel may be moderate to severe and could include loss of cargo containment and/or sinking of the vessel.

4.3 Below Water Structure Description

4.3.1 Foundations

4.3.1.1 WTG Foundations

The WTGs will be supported on foundations, as described later in this report, that may be placed into three general categories:

- Piled foundations (monopiles or jackets);
- Suction bucket foundations (mono-buckets, suction bucket jackets, or suction bucket tetrahedron bases); and
- Gravity foundations (gravity-base structures [GBS] or gravity-pad tetrahedron bases).

Figure 4.3 provides graphical images of the various concepts while the PDE of dimensions for the WTG foundations is provided in Table 4.2. This NSRA has considered the overall envelope of the dimensions. Scour protection may be placed around the bases of the foundations on the seabed; the horizontal extent of the scour protection depends on the foundation type. The foundation types are briefly described below.

Piled Foundations

A piled foundation employs steel piles that are driven into the seabed. There are two design sub-types:

- Monopiles – Monopile foundations, which are driven into the seabed, typically consist of a single steel tube composed of several sections of rolled steel plates that are welded together. A transition piece may be mounted on top of the monopile. Alternatively, the monopile length may be extended to the interface with the WTG tower; this is referred to as an “extended monopile.” The transition piece or the top of the extended monopile contains a flange for connection to the WTG tower and may include secondary structures such as a boat landing, ladders, a work platform, a crane, and other ancillary components.
- Piled Jacket – Piled jacket foundations are steel lattice structures comprised of tubular steel members and welded joints that are fixed to the seabed using piles connected to each leg of the jacket. Piled jacket foundations may include three or four legs. Typically, piles are hollow steel cylinders that are driven into the seabed. The top of the jacket foundation contains a flange for connection to the WTG tower as well as secondary structures such as a boat landing, ladders, a work platform, a crane, and other ancillary components.

Suction Bucket Foundations

A suction bucket is essentially a large upside-down steel “bucket” that is placed on the sea floor. Water is then pumped out of the bucket to create a negative pressure differential that embeds the bucket into the seabed. This foundation type does not need to be driven or drilled into the seabed.

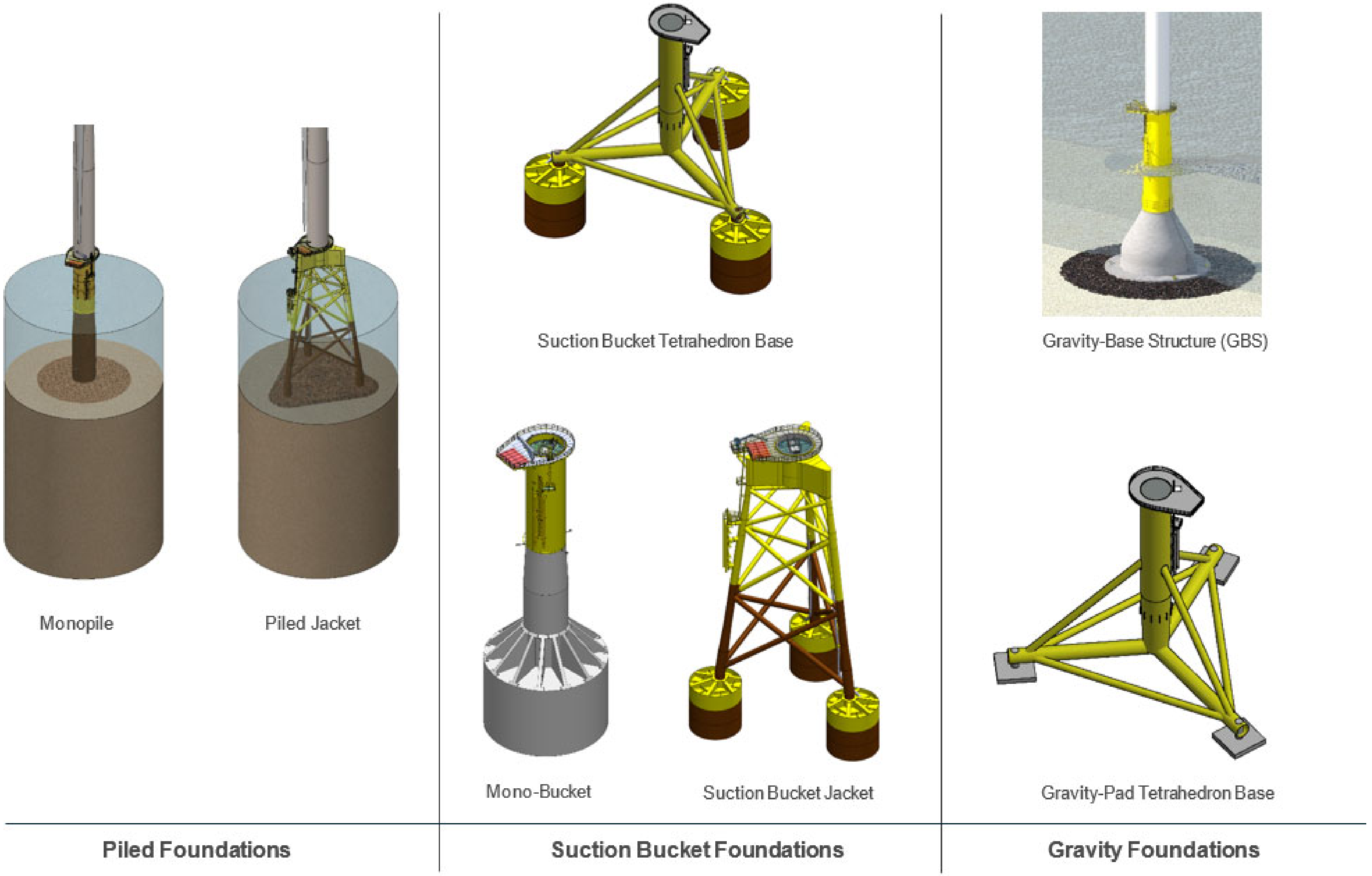

Figure 4.3: Example Images of WTG Foundations Under Consideration

Table 4.2: WTG Foundation Dimensions

	Piled Foundations		Suction Bucket Foundations			Gravity Foundations	
Parameter	Monopile	Piled Jacket	Mono-Bucket	Suction Bucket Jacket	Suction Bucket Tetrahedron Base	Gravity-Pad Tetrahedron Base	Gravity-Base Structure (GBS)
No. of legs or contact pts	1	4	1	4	3	3	1
Max. foundation diameter/leg spacing at Mean Sea Level	39.4 ft (12.0 m)	98.4 ft (30.0 m)	39.4 ft (12.0 m)	98.4 ft (30.0 m)	39.4 ft (12.0 m)	39.4 ft (12.0 m)	39.4 ft (12.0 m)
Max. diameter / size at seabed for each contact point	49.2 ft (15.0 m)	16.4 ft (5.0 m)	114.8 ft (35.0 m)	49.2 ft (15.0 m)	52.5 ft (16.0 m)	36.1 ft x 36.1 ft (11.0 m x 11.0 m)	180.5 ft (55.0 m)
Length	410.1 ft (125.0 m)[1]	249.3 ft (76.0 m)	147.6 ft (45.0 m)	82.0 ft (25.0 m)	82.0 ft (25.0 m)	N/A	N/A
Max. representative outer diameter/size of scour protection[2]	269.0 ft (82.0 m)	98.4 ft (30.0 m) per pile	295.3 ft (90.0 m)	334.6 ft x 334.6 ft (102.0 m x 102.0 m)	347.8 ft x 328.1 ft (106.0 m x 100.0 m)	98.4 ft x 98.4 ft (30.0 m x 30.0 m) per pad	272.3 ft (83.0 m)

1. The maximum length of a monopile that uses scour protection is 344.5 ft (105.0 m).

2. Scour protection may occur in any shape and size up to the maximum footprint provided above, including the possibility of no scour protection.

The use of suction buckets is being considered for three possible foundation sub-types:

- Mono-Buckets – A mono-bucket consists of a single suction bucket supporting a single steel or concrete tubular structure (similar to a monopile) upon which the WTG is mounted. The suction bucket is typically a hollow steel cylinder that is capped at the upper end; the open end of the bucket faces downward into the seabed. A transition piece may be mounted on top of the mono-bucket (similar to the monopile foundation type).
- Suction Bucket Jackets – This structure is similar to the piled jacket. Suction bucket jackets are steel lattice structures comprised of tubular steel members and welded joints that are fixed to the seabed by suction buckets installed below each leg of the jacket. The suction bucket jacket may have three or four legs. Similar to piled jacket foundations, the top of the jacket foundation contains a flange for connection to the WTG tower as well as secondary structures such as a boat landing, ladders, a work platform, a crane, and other ancillary components.
- Suction Bucket Tetrahedron Bases – A suction bucket tetrahedron base foundation is a tetrahedral-shaped (i.e., three-legged pyramidal) frame that rests on the seabed and is secured to the seafloor using suction buckets. This foundation design has a maximum of three contact points with the seabed, and a suction bucket is located at each contact point. Like jacket foundations, the tetrahedron base foundation contains a flange for connection to the WTG tower as well as secondary structures (e.g., a boat landing, ladders, a work platform, and a crane).

Gravity Foundations

These foundations are heavy concrete and/or steel structures that sit on the seabed to support the WTG tower. These structures do not require piles or suction buckets and are stable by virtue of their weight and design. Two different sub-types have been identified:

- Gravity-Base Structures (GBS) – A GBS is a heavy steel-reinforced concrete and/or steel structure that sits on the seabed. The GBS foundation's concrete base may be filled with additional ballast material (e.g., sand, gravel, iron ore, or water). Above the concrete base, there is a column made of concrete or steel that supports the WTG tower. A transition piece may be mounted on top of the GBS foundation (similar to the monopile foundation).
- Gravity-Pad Tetrahedron Bases – Gravity-pad tetrahedron bases are similar to the suction bucket tetrahedron bases but are secured in place using high weight pads (i.e., gravity pads) below each leg. Similar to piled jacket, suction bucket jacket, and suction bucket tetrahedron base foundations, the top of the foundation contains a flange for connection to the WTG tower as well as secondary structures such as a boat landing, ladders, a work platform, a crane, and other ancillary components.

4.3.1.2 OSS Foundations

There could be up to eight small OSSs. For these OSS, the PDE for each foundation type is identical to the PDE for the WTG foundations provided in Table 4.3. The PDE of foundation dimensions for the medium and large OSSs is defined in Table 4.4.

As noted previously, the OSS positions will be located along the same east-northeast to west-southwest rows as the WTGs thereby preserving the 1.0 nm (1.9 km) wide corridors between the structures.

Table 4.3: OSS Foundation Types

Foundation Types		Small OSSs	Mediums OSSs	Large OSSs
Piled	Monopile	✓		
	Piled Jacket	✓	✓	✓
Suction Bucket	Mono-Bucket	✓		
	Suction Bucket Jacket	✓	✓	✓
Gravity	Gravity-Base Structure (GBS)	✓	✓	✓

4.3.1.3 Met Tower Foundation

The Met Tower foundation will be similar to that of the WTGs.

Table 4.4: Medium and Large OSS Foundation Dimensions

Parameter	Medium OSSs			Large OSSs		
	Piled Jacket	Suction Bucket Jacket	GBS	Piled Jacket	Suction Bucket Jacket	GBS
Max. number of legs / discrete contact points with seabed	6	6	2	8	8	2
Max. number of pin piles per leg	2	N/A	N/A	3	N/A	N/A
Max. foundation size/leg spacing at MSL	393.7 ft x 196.9 ft (120.0 m x 60.0 m)	393.7 ft x 196.9 ft (120.0 m x 60.0 m)	262.5 ft x 246.1 ft (80.0 m x 75.0 m)	492.1 ft x 328.1 ft (150.0 x 100.0 m)	492.1 ft x 328.1 ft (150.0 m x 100.0 m)	393.7 ft x 328.1 ft (120.0 m x 100.0 m)
Max. pin pile, suction bucket, or gravity-base diameter at seabed[1]	16.4 ft (5.0 m)	49.2 ft (15.0 m)	262.5 x 65.6 ft (80.0 x 20.0 m)	16.4 ft (5.0 m)	49.2 ft (15.0 m)	393.7 x 98.4 ft (120.0 x 30.0 m)
Max. jacket pile/bucket length	295.3 ft (90.0 m)	98.4 ft (30.0 m)	N/A	295.3 ft (90.0 m)	98.4 ft (30.0 m)	N/A
Maximum representative[2] outer diameter/size of scour protection	131.2 ft (40.0 m) per leg	196.9 ft (60.0 m) per leg	393.7 ft x 377.3 ft (120.0 m x 115.0 m) per foundation	147.6 ft (45.0 m) per leg	695.5 ft x 203.4 ft (212.0 m x 62.0 m) per row of four legs	524.9 ft x 459.3 ft (160.0 m x 140.0 m) per foundation

1. Including the piling template (if used), the maximum size/diameter of the contact points for piled jacket foundations is 49.2 ft (15.0 m) for medium OSSs and 65.6 ft (20.0 m) for large OSSs.
2. Scour protection may occur in any shape and size up to the maximum footprint provided above, including the possibility of no scour protection.

4.3.2 Cable Corridors

Energy from the OSSs will be delivered to shore via high voltage alternating current (HVAC) or high voltage direct current (HVDC) export cables. The Monmouth ECC will have the capacity to contain up to five export cables including up to four HVAC export cables and one HVDC export cable. The Northern ECC, from the interconnection with the Lease Area to the Asbury Branch will have the capacity to contain up to five export cables in one of three configurations: (1) four HVAC export cables and one HVDC export cable; (2) three HVAC export cables and two HVDC export cable; or (3) four HVDC export cables. The Asbury Branch of the Northern ECC will have the capacity to contain four HVAC export cables or two HVDC export cables. North of the Asbury Branch of the Northern ECC to its terminus in New York, the Northern ECC will have the capacity to contain up to two HVDC export cables. The WTGs and OSSs will be interconnected by a system of inter-array cables.

Atlantic Shores is working to minimize impacts to commercial and recreational fishing from the presence of offshore cables (i.e., export, inter-array, and inter-link cables). All offshore cables will have a target minimum burial depth of 5 to 6.5 ft (1.5 to 2 m) and a maximum cable burial depth of approximately 10 ft (3 m). The cable burial depth is based upon a cable burial risk assessment that considers activities such as commercial fishing practices and anchor use to develop a safe target burial depth for the cables. Atlantic Shores has determined that the target burial depth is sufficient to protect the cables from expected commercial fishing practices, so the presence of these cables is not anticipated to interfere with any typical fishing practices except in limited locations where cable protection may be required.

If the cable burial depth cannot be achieved (for example due to sediment properties), cable protection may be required. While the extent of cable protection will be minimized to the extent practicable, Atlantic Shores conservatively assumes that up to 10% of the export cables, inter-array cables, and inter-link cables may require cable protection where sufficient burial depth is not achieved. Atlantic Shores is considering five types of cable protection: (1) rock armoring; (2) concrete mattresses; (3) rock bags; (4) grout-filled bags; and (5) half-shell pipes. One of more of these types of cable protection may be used. Where insufficient burial depth cannot be achieved, the maximum thickness of cable protection is expected to be 4.6 ft (1.4 m).

The ECCs will also cross existing marine infrastructure, including submarine cables (see Figure 3.25). The two ECCs in combination may cross approximately 121 cables or pipelines between the Lease Area and the Landfall Sites. The Northern ECC is located to the east of both the Lease Area and the Monmouth ECC and does not have direct connectivity to the Lease Area. To enable the export cables to reach the Northern ECC from the Lease Area, they will need to cross the Monmouth ECC. Atlantic Shores also estimates that up to 10 inter-array cable crossings and up to two inter-link cable crossings may be required.

Any foreign cable crossing will be carefully surveyed and, if the cable is still active, Atlantic Shores will develop a crossing agreement with its owner. At each crossing, before installing the Atlantic Shores cable, the area around the crossing will be cleared of any marine debris. Depending on the status of the existing cable and its location, such as burial depth and substrate characteristics, cable protection may be placed between the existing cable and Atlantic Shores' overlying cable. However, if sufficient vertical distance exists, such protection may be avoided. It is likely that the presence of an existing cable will prevent Atlantic Shores' cable from being buried to its target burial depth. In this case, cable protection may be required on top of the proposed cable at the crossing location. Following installation of the proposed cables, the cable crossing will be surveyed again.

Atlantic Shores is considering the same five types of cable protection at infrastructure crossings as described above. The maximum thickness of the cable protection at infrastructure crossings is estimated to be 5.6 ft (1.7 m).

If an existing cable is inactive, it will be cut and removed prior to installing Atlantic Shores's cables. Removal of the inactive cables will enable burial of Atlantic Shores' cables and avoid the need for cable protection. Where removal is not feasible, standard cable crossing techniques will be employed, which may require cable protection.

4.3.3 Below Water Structure Impacts on Navigation

4.3.3.1 Ship Underkeel Clearance

Although it is theoretically possible that a keel of a vessel could strike a jacket pile, the vessel would have to be operating unsafely in close proximity to the WTG.

As noted previously, the bathymetry is relatively deep and none of the vessels operating in this region would have an under-keel clearance limitation.

4.3.3.2 Export and Inter-Array Cables

A potential hazardous situation could result if an anchor penetrates the seabed to snag an export or inter-array cable. As noted previously, the cables will have a target minimum burial depth of 5 to 6.5 ft (1.5 to 2 m) and a maximum cable burial depth of approximately 10 ft (3 m) based on a cable burial risk assessment. Where suitable burial depths cannot be achieved, cable protection will be provided as described previously.

4.3.3.3 Fishing Gear Snag

Fishing gear can potentially snag the structure foundations or scour protection if the vessel was operating in close proximity to a WTG or OSS; suitable clearance from these structures is advised while fishing.

Gear snags can also potentially occur in areas where ECC and inter-array cable protection has been placed. The ECC and inter-array cable routes have been selected, in part, based on the suitability of substrate conditions and the lack of encumbrances to allow cable burial and minimize the use of protection.

4.4 Project Vessel Traffic

4.4.1 Construction and Installation

Construction of the offshore portion of the Project will require the use of many different types of vessels. Some of these vessels are typical ocean-going vessels, while others are designed to perform specific tasks related to construction of large projects such as offshore wind and/or buried cable installation. Alongside these vessels, helicopters are sometimes used for crew transfer operations and may also be used for visual inspection of equipment while vessels continue with installation activities. Atlantic Shores may also use fixed-wing aircraft to support environmental monitoring and mitigation.

Offshore construction will be divided into different campaigns including foundation installation, scour protection, OSS installation, WTG installation, inter-array cable installation, inter-link cable installation (if needed), and export cable installation. While performing construction tasks, vessels may anchor, jack-up, or maintain their position using Dynamic Positioning (DP) systems. DP systems use a continually adjusting propulsion system to keep the vessel steady in a single location. Jack-up vessels have legs that lower into the seabed and brace the vessel as it elevates above sea level, where it can safely perform operations in a stable, elevated position.

As the Project is still in a relatively early stage of planning, the specific vessels that will carry out construction activities have not been selected. Table 4.5 summarizes the approximate lengths of the larger vessels anticipated for use in the Project.

Table 4.5: Larger Representative Construction Vessels

Vessel Type	Approximate Length
Barges	394 – 410 ft (120 – 125 m)
Bulk Carrier	722 – 755 ft (220 – 230 m)
Cable Installation Vessel	246 – 541 ft (75 – 165 m)
Crew Transfer Vessel	82 – 98 ft (25 – 30 m)
Dredger	640 – 656 ft (195 – 200 m)
Fall Pipe Vessel	623 – 640 ft (190 – 195 m)
Harbor Tug	98 – 115 ft (30 – 35 m)
Jack Up Vessel	407 – 607 ft (124 – 185 m)
Large Heavy Lift Vessel	640 – 656 ft (195 – 200 m)
Medium Heavy Lift Vessel	591 – 722 ft (180 – 220 m)
Service Operation Vessel	295 – 344 ft (90 – 105 m)
Support Vessel	312 – 328 ft (95 – 100 m)
Tugs	98 – 262 ft (30 – 80 m)

Currently, maximum estimates for the total number of vessels required for any single offshore construction activity range from two vessels for scour protection installation to up to 16 vessels for OSS installation. For export cable installation, Atlantic Shores estimates that up to six vessels could be operating at once. If all construction activities were occurring simultaneously (which is unlikely), a total of 24 vessels could be present in the Offshore Project Area at any one time.

Many of the construction activities are sequential, meaning that not all vessels involved in a given activity (such as OSS installation) will be operating simultaneously. Additionally, many of the construction vessels will remain in the Lease Area or ECCs for days or weeks at a time and will not be transiting to construction staging port facilities on a frequent basis. Considering these factors, Atlantic Shores estimates that the Project will require a total of approximately four to 12 daily transits (equivalent to two to six daily round trips) between construction staging port facilities under consideration and the offshore construction areas.

Atlantic Shores has identified several port facilities in New Jersey, New York, the mid-Atlantic, and New England that may be used for major construction staging activities for the Project. In addition, some components, materials, and vessels could come from the U.S. Gulf Coast or international ports. Table 4.6 identifies the ports that may be used for major construction staging activities.

Other industrial ports not identified in Table 4.6 may be utilized for limited, basic activities associated with marine construction in general rather than offshore wind specifically. These activities may include, but are not limited to, refueling (although some limited refueling is expected to occur offshore), restocking supplies, and sourcing parts for repairs.

Table 4.6: Ports that May be Used During Construction of the Project

Port	Location
New Jersey Wind Port	Lower Alloways Creek, New Jersey
Port of Paulsboro	Paulsboro, New Jersey
Repauno Port & Rail Terminal	Greenwich Township, New Jersey
Port of Albany	Albany, New York
Port of Coeymans Marine Terminal	Coeymans, New York
Arthur Kill Terminal	Staten Island, New York
Portsmouth Marine Terminal	Portsmouth, Virginia
Ingleside	Ingleside, Texas

4.4.1.1 Hudson River Ports for Construction Staging

Should a port on the Hudson River, such as Port of Albany, be solely selected for construction staging, Atlantic Shores anticipates that approximately four to 12 transits per day would occur in the Hudson River during the construction period.

4.4.2 Operations and Maintenance

Once the Project's facilities are commissioned, operations and maintenance (O&M) activities will ensure the offshore facilities function safely and efficiently.

Once operational, the Project will be supported by an O&M Facility that Atlantic Shores is proposing to establish in Atlantic City, New Jersey. The O&M Facility will be the primary location for O&M operations including material storage, day-to-day management of inspection and maintenance activities, vehicle parking, marine coordination, vessel docking, and dispatching of technicians.

A combination of Crew Transfer Vessels (CTVs), Service Operation Vessels (SOVs), other smaller vessels, and helicopters may be used to access infrastructure in the Lease Area. CTVs are small, specialized vessels used to transport wind farm technicians and other personnel out to sites on a daily basis. SOVs are relatively large vessels that offer considerable capacity for crew and spare parts, allowing for service trips that are several weeks in duration. SOVs include sleeping quarters for technicians and may include workshop space. SOVs are only limited by the need to return to port to restock fuel, food, and spare parts but are typically used in conjunction with smaller daughter crafts/workboats or CTVs to enable quick transport of personnel or supplies between the vessel and port or offshore assets. CTVs enable faster, more practical transport of personnel and equipment to the Project's offshore facilities than SOVs when the transit distance is relatively short.

Atlantic Shores will likely establish a long-term CTV base at the O&M Facility in Atlantic City. If Atlantic Shores employs a Service Operation Vessel (SOV) O&M strategy, those SOVs would likely be operated out of existing ports such as Lower Alloways Creek Township, the Port of New Jersey/New York, or another industrial port identified in Table 4.6 that has suitable water depths to support an SOV. Atlantic Shores may use other ports listed in Table 4.6 to support O&M activities such as some crew transfer, bunkering (some refueling could occur offshore), spare part storage, and load-out of spares to vessels. In addition, normal port activities such as refueling, and supply replenishment may occur outside of the ports identified in Table 4.6. While Atlantic

Shores anticipates that the ports listed in Table 4.6 can support the Project's needs, it is possible that significant non-routine maintenance could require unplanned use of another U.S. or international port.

Approximately 5 to 11 vessels are expected to operate in the Lease Area at any given time during normal O&M activities when the Project is fully operational, though additional vessels (a maximum of up to 24 vessels) may be required in other maintenance or repair scenarios. Depending on whether SOVs or CTVs are primarily used, Atlantic Shores estimates that approximately 550 to 2,050 vessel trips to the Lease Area will occur annually during operations, which is an average of two to six vessel round trips per day. These vessel trips may be supplemented by helicopters to assist in personnel transport. The actual level of vessel activity during O&M will depend on the specific maintenance needs that develop as well as the final design of the offshore facilities. The effect of O&M vessel traffic on harbor operations is discussed in Section 4.5.

4.4.3 Decommissioning

Once the Project's operational term ends, the facilities will be decommissioned. As per BOEM's decommissioning requirements (30 CFR Part 585, Subpart I), all "facilities, projects, cables, pipelines and obstructions" must be removed or decommissioned within two years following lease termination. Offshore, this will consist of retirement in place or removal of cable systems, dismantling and removal of WTGs, cutting and removal of foundations, removal or retirement in place of scour protection, and removal of OSSs. This process is essentially the reverse of construction and will require similar numbers and sizes of vessels.

4.5 Assessment of Navigation at the Project Site

4.5.1 Navigation Risks During Construction and Installation

During the construction phase, there will be an increase in vessel traffic at the staging ports as well as the navigational obstacle created by the presence of installed or partially installed offshore WTGs, OSSs, and the Met Tower. The potential change in risk is expected to be small, but various mitigation strategies have been developed to reduce the possible risk. These mitigation strategies include:

- Atlantic Shores will utilize a Marine Coordinator to manage vessel movements throughout the Offshore Project Area. The Marine Coordinator will be Atlantic Shores' primary point of contact with USCG, port authorities, state and local law enforcement, marine patrol, port operators, and commercial operators (e.g., ferry, tourist, and fishing boat operators).
- A construction communications plan will be developed (working channels, crisis communications, etc.). This will similarly occur during the decommissioning phase.
- Atlantic Shores has developed a Fisheries Communication Plan that defines outreach and engagement with fishing interests during all phases of the Project. To support the execution of the FCP, Atlantic Shores employs a Fisheries Liaison Officer (FLO) and a Fishing Industry Representative (FIR). Additional FIRs may be nominated to represent specific fisheries identified within the Lease Area or along the ECCs as the Project progresses or a need is identified. The FLO and FIR(s) will communicate and coordinate with the local commercial and recreational fishing community during the construction phase. A "For Mariners" project webpage (www.atlanticshoreswind.com/mariners/) has been developed that contains the latest news and events, real-time Project buoy data display and Project vessel tracking chart, Project vessel schedules, and FLO and FIR contact information.
- Atlantic Shores may request that the USCG establish Safety Zones (or alternative as approved by the USCG) demarcated around working areas and the means of communicating these safety zones to stakeholders throughout the different phases of construction. These Safety Zones will only cover a small portion of the Lease Area at any one time, and there will be limited interaction between construction vessels and existing traffic. Atlantic Shores anticipates that the presence of the temporary Safety Zones

will be communicated by means of Local Notices to Mariners (LNMs) in coordination with the USCG. There will also be communication through the Project's website and by Atlantic Shores Marine Coordinator and Fisheries Liaison Officer.

- Atlantic Shores will regularly coordinate with the USCG and NOAA on chart updates as Project's components (e.g., foundations, WTGs, OSSs) are constructed and regarding the issuance of LNMs.
- Coordination will be carried out with local port authorities on the development of vessel traffic management plans for the various staging ports.
- All construction/decommissioning vessels will display appropriate navigation lights and day shapes as per regulatory requirements.
- Fully and partially constructed/decommissioned WTGs, OSSs, and the Met Tower will be marked and lit in accordance with USCG and BOEM requirements. Contingency plans will be developed in conjunction with the USCG in the event a WTG or OSS experiences any issues with marking or lighting.
- Aviation obstruction lighting will be provided on constructed WTGs, the OSSs (if needed), and the Met Tower in accordance with FAA and BOEM requirements.
- Coordination will be carried out with USCG on operational protocols for the WTG braking system and any SAR activity that might occur within the constructed turbine field or working areas.

Marking and lighting, and WTG operational procedures are further discussed in Sections 9 and 10, respectively.

4.5.2 Navigation Risks During Operations

4.5.2.1 In the Lease Area

Atlantic Shores anticipates that vessels may navigate adjacent to and through the proposed project without restriction. Fishing activities, including trawling and dredging, may also proceed without restriction. Vessel exclusion zones are not anticipated.

As noted previously, it is expected that larger commercial vessels, including cargo vessels, tankers and barge tows, will likely navigate around the Lease Area using the new fairways proposed by the USCG. As the majority of this traffic occurs along approximate north-south tracks, the time associated with rerouting around the Lease Area is considered to be minimal (Section 3.3.2).

The gridded layout of the WTGs allows for four different transit corridor orientations ranging in width from 0.49 to 1.0 nm (0.9 to 1.9 km) safely accommodating vessels ranging from 157 ft (47.9 m) to 320 ft (97.5 m) in length, respectively, as discussed in Section 3.3.1. The transit corridor widths are notional and not actual channels with continuous physical limits at the channel edges; vessels can certainly navigate from one corridor to the next without restriction.

Due to the water depths, there is no grounding risk within the confines of the Lease Area even for the largest vessels. The primary risks are vessels collisions and structural allisions (quantified in Section 7). The change in risk is expected to be small, but various mitigation strategies have been developed to reduce the possible effects of the Project. These mitigation strategies include:

- A Marine Coordinator will manage vessel movements throughout the Offshore Project Area. The Marine Coordinator will be responsible for monitoring daily vessel movements, implementing communication protocols with external vessels, and monitoring safety buffers. The Marine Coordinator will be Atlantic Shores' primary point of contact with USCG, port authorities, state and local law enforcement, marine patrol, port operators, and commercial operators (e.g., ferry, tourist, and fishing boat operators).

- Prior to construction, Atlantic Shores will develop a mariner communication and outreach plan for vessel users / operators (commercial, vessels, military vessels, tug / tow vessels, etc.) that are not involved in the fishing industry (https://atlanticshoreswind.com/mariners).
- The FLO and FIR(s), as part of an overall FCP, will communicate and coordinate with the local commercial and recreational fishing community.
- The WTGs, OSSs, and Met Tower will be marked and lit in accordance with USCG and BOEM requirements, including alphanumeric tower designation as well as distinct lighting on corner towers/significant peripheral structures (SPSs), outer boundary towers, and interior towers. MRASS sound signals on corner towers/SPSs and perimeter structures will be provided.
- Contingency plans will be developed in conjunction with the USCG in the event a WTG or OSS experiences any issues with marking or lighting.
- Atlantic Shores will coordinate with the USCG and NOAA on navigational chart updates showing positions of constructed WTGs and OSSs. Similarly, Atlantic Shores will coordinate with the USCG on the issuance of LNMs.

In addition to navigational risk, there is potential for reduction in USCG aerial SAR capability due to the obstacles created by the WTGs and OSSs. A variety of mitigations are proposed for assistance with USCG SAR activity, including:

- Provision of aviation obstruction lighting on WTGs, OSSs (if needed), and the Met Tower in accordance with FAA and BOEM requirements, which will aid aerial SAR activities. Atlantic Shores is considering the use of an Aircraft Detection Lighting System (ADLS), subject to FAA and BOEM approval.
- Implementation of WTGs' rotor emergency braking systems to fix and maintain the position of the WTG blades, nacelles, and other appropriate moving parts during a SAR event.
- Direct coordination in SAR missions within the Lease Area by the Marine Coordinator.
- Possible mitigations to assist in search detection, including installation of VHF direction finding equipment, real-time weather measurements (waves, wind, currents), and high-resolution infrared detection systems to assist in location of persons in water and/or vessels.
- Atlantic Shores expects that the access ladders on the WTG and OSS foundations will be designed to allow distressed mariners access to an open refuge area on top of the ladder. The presence of a person on the offshore structure will be detected using cameras and intrusion detectors.
- Bi-annual testing of the communication and rotor braking systems.
- Development of an Emergency Response Plan (ERP) to specify coordination, shutdown, and rescue procedures. The ERP will be reviewed and updated at least annually between Atlantic Shores and the USCG.

Marking and lighting, and WTG operational procedures are further discussed in Sections 9 and 10, respectively.

4.5.2.2 Effect of O&M Vessel Traffic on Harbor Traffic

As noted previously, a maximum of 2,050 round trips per year by CTV have been estimated for the Project. If the CTVs are based in Atlantic City, this would represent a maximum of 4,100 transits per year into or out of the Absecon Inlet channel in support of the Project. An analysis of historical AIS data (described in Section 3.2.2) indicated there are approximately 14,400 transits of Absecon Inlet per year on average, or approximately 39 transits per day if averaged throughout the entire year. Approximately 68% of this traffic is associated with fishing and recreational vessels. However, the AIS data under-represents the number of transits, as commercial vessels smaller than 65 ft (19.8 m) in length are not required to utilize AIS equipment. In the risk modeling previously described, the volume of recreational and fishing traffic was doubled to account for non AIS equipped vessels. Thus, the total average annual transits may be on the order of 24,000. The CTV transits would represent an increase of 17% in traffic over the existing traffic volume.

The existing vessels transits are very seasonal with the highest period of activity during the summer months, so the CTV transits would represent a smaller percentage of the traffic in the summer and larger percentage in the winter.

4.5.3 Navigation Risks During Decommissioning

Decommissioning is essentially the reverse of construction and installation utilizing similar types of vessels. The risks and potential mitigations for those risks are similar to construction and installation.

5. Metocean Characterization and Impacts

5.1 Introduction

This section of the NSRA provides a brief overview of the meteorological and oceanographic conditions as relevant to vessel navigation and SAR, addressing Sections 6 and 7 of the NVIC 01-19 checklist. The primary variables of interest are wind speed and direction, visibility, water levels, waves, and currents.

5.2 Data Sources

This section summarizes the metocean conditions in the Atlantic Shores Offshore Lease Area. Primary observations were collected using a floating single Floating Light Detection and Ranging (LiDAR) deployed by Fugro from 29 December 2019 to 26 June 2020 at location MBA6 in the Lease Area (see Figure 5.1). This buoy was equipped with a range of sensors (listed in Table 5.1) to collect a comprehensive range of key design parameters. Notably, this instrument could collect wind speeds at 11 vertical locations between 98 ft and 656 ft (30 m and 200 m) above sea level as well as currents every 1 minute from 10 to 95 ft (3 to 29 m) below sea level.

Table 5.1: Floating LiDAR Buoy Instrumentation and Measurement Capabilities

Environmental Condition	Instrument
Vertical wind profile	ZephIR 300M
Wave height, period, and direction	OCEANOR Wavesense
Single point wind sensor (speed and direction, wind gusts)	Gill Ultrasonic
Air temperature and humidity	Vaisala HMP155
Air pressure	Vaisala PTB330
Vertical profile of current velocity and direction, and water temperature	Nortek Aquadopp Profiler 400 kilohertz (kHz)
Water level	Thelma V3 Tide

For this analysis, field observations were supplemented with historic data from the National Data Buoy Center (NDBC) and NOAA's National Centers for Environmental Information (NCEI 2020). Two NDBC buoys are used: NDBC-44009, located approximately 62 nm southwest of the Lease Area; and NDBC-44066, located approximately 60 nm east of the Lease Area. Additional observations are also used from the Atlantic City Airport (ACY), located 25 nm northwest of the Lease Area. Metocean observations, sources, and conventions are detailed in Table 5.2.

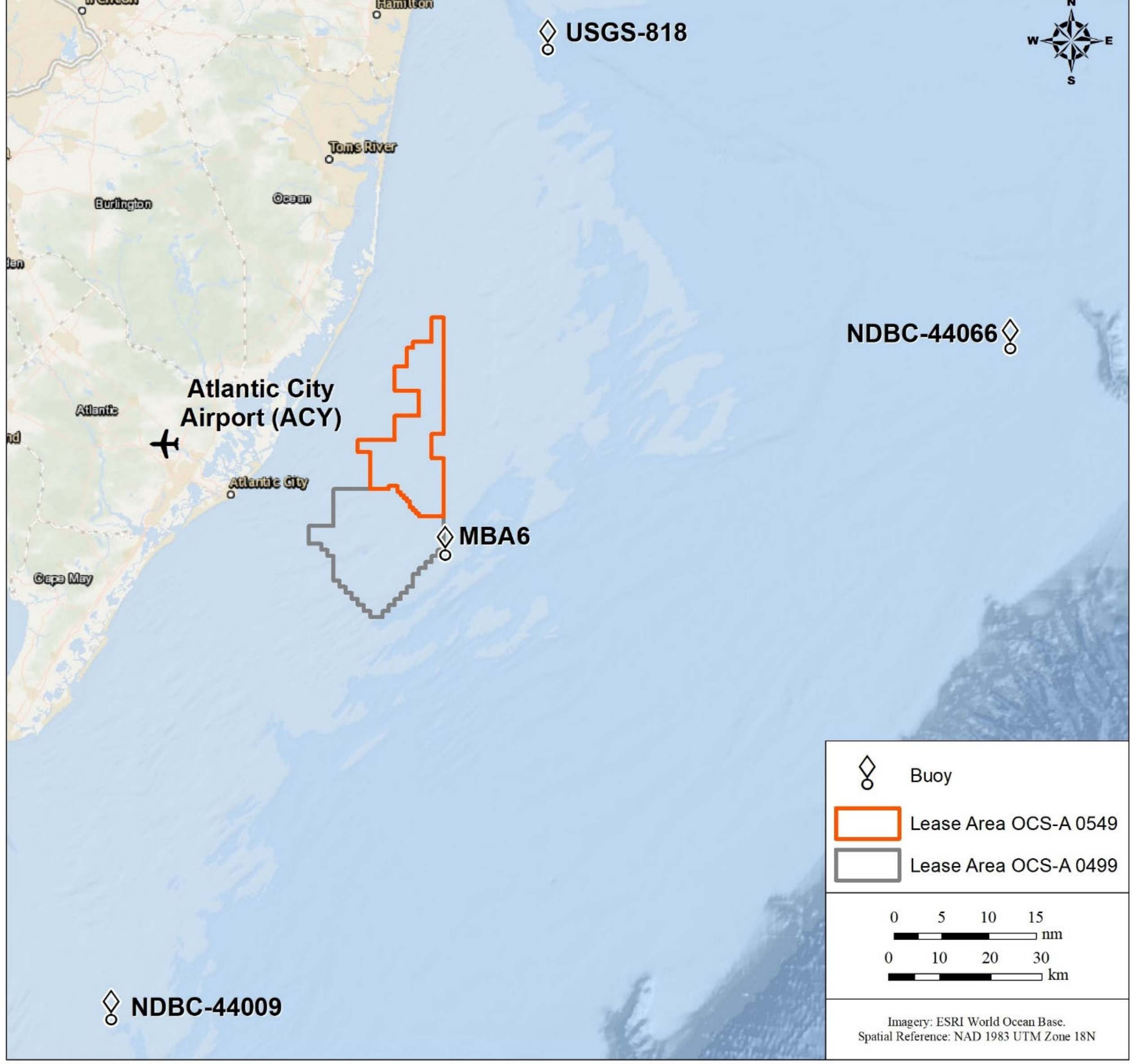

Figure 5.1: Source Data Buoy Locations

Table [illegible].2: Metocean Observations, Sources and Conventions

Parameter	Source	Time Period	Notes
Air Temperature	Atlantic City Airport (ACY)	2000–2019	
	NDBC-44009	2000–2019	
	NDBC-44066	2009–2019	
	SW LiDAR Buoy	Dec 2019–June 2020	
Wind	Atlantic City Airport (ACY)	2000–2019	Direction refers to clockwise degrees from North from which the wind is blowing (ºTN)
	NDBC-44009	2000–2019	
	NDBC-44066	2009–2019	
	SW LiDAR Buoy	Dec 2019–June 2020	
Relative Humidity	Atlantic City Airport (ACY)	2000–2019	
Visibility	Atlantic City Airport (ACY)	2000–2019	
Waves	NDBC-44009	2000–2019	Direction refers to clockwise degrees from North from which the waves are coming (ºTN) and is only available from 2013-2019.
	NDBC-44066		
Water Levels	NOAA Center for Operational Oceanographic Products and Services (CO-OPS) 2009–2019 Station 8534720 (Atlantic City, NJ)	1983–2001	
Currents	SW LiDAR Buoy	Dec 2019–June 2020	Direction refers to the compass direction that the current is flowing towards (ºN).
	Teledyne RD Instruments Acoustic Doppler Current Profiler (ADCP)	April 2006–June 2006	RD Instruments ADCP deployed by USGS (USGS-818).

5.3 Tides and Currents

5.3.1 Available Data

5.3.1.1 Tides

Water level data from the NOAA CO-OPS tidal station located in Atlantic City, NJ (Station 8534720) was used to assess the tidal range near the Lease Area. The area is characterized by a semi-diurnal tidal range, and a full set of tidal constituents (for water level predictions) are available from the NOAA CO-OPS station page (NOAA 2020). Tidal datums, based on measurements from 1983 to 2001 are summarized in Table 5.3. The vertical datum on local navigational charts is referenced to Mean Lower-Low Water (MLLW).

Table 5.3: Tidal Datum Information for CO-OPS station 8534720, Atlantic City, NJ

Datum	Tidal Level (feet MLLW)	Description
MHHW	4.60	Mean Higher-High Water
MHW	4.18	Mean High Water
MTL	2.18	Mean Tide Level
MSL	2.21	Mean Sea Level
DTL	2.30	Mean Diurnal Tide Level
MLW	0.17	Mean Low Water
MLLW	0.00	Mean Lower-Low Water
NAVD88	2.61	North American Vertical Datum of 1988

5.3.1.2 Currents

During strong currents, maintaining proper vessel course can become challenging, and maneuverability can be impacted. Currents are also important in the event of equipment failure or other vessel breakdown, as near-surface currents will dictate the direction and rate at which vessels will drift. The combination of these effects can pose challenges for vessels and therefore affect navigational risk. Local currents and conditions must be well understood and factored into vessel route planning and emergency protocols.

Using a Nortek Aquadopp Profiler mounted on the SW LiDAR Buoy, currents were measured over a six-month period at several depths, with a summary shown in Figure 5.2. Currents speeds were typically low (< 1 knot, [0.51 m/s]) and were relatively uniform through depth. The strongest currents occurred primarily from the northeast (towards the southwest) direction. A summary of these results is shown in Table 5.4.

To further asses the key factors driving surface currents, observations were obtained from an ADCP deployed by the United States Geological Survey (USGS) from April to June 2016 as part of the Hudson Shelf Valley experiment (USGS-818, see Figure 5.1). A polar histogram showing the time the current and wind direction is shown in Figure 5.3 in conjunction with scatterplot of the same variables. This analysis indicates that surface currents are predominantly driven by winds in the Lease Area.

Table 6.4. Summary of Surface Current Observations (from Fugro 2020)

Depth [ft]	Max [kts]	Mean [kts]	Min [kts]	Direction of Max	Date and Time of Max	% QC Data Return	Deployment Period
-9.8	1.57	0.51	0.00	198	2019-12-31 6:40	99.4	Dec 29, 2019 to Jun 26, 2020
-9.8	1.38	0.49	0.02	208	2020-01-18 0:00	99.9	January 01, 2020 to January 31, 2020
-9.8	1.28	0.52	0.00	59	2020-02-28 16:10	99.9	February 01, 2020 to Feb. 29, 2020
-9.8	1.57	0.52	0.04	206	2020-03-07 1:50	99.8	March 01, 2020 to March 31, 2020
-9.8	1.24	0.52	0.02	214	2020-04-04 2:00	99.9	April 01, 2020 to April 30, 2020
-9.8	1.46	0.51	0.02	235	2020-05-24 8:20	98.6	May 01, 2020 to May 31, 2020
-9.8	1.13	0.45	0.02	224	2020-06-01 7:20	98.1	June 01, 2020 to June 26, 2020
Average	**1.57**	**0.50**	**0.0**	**192**			

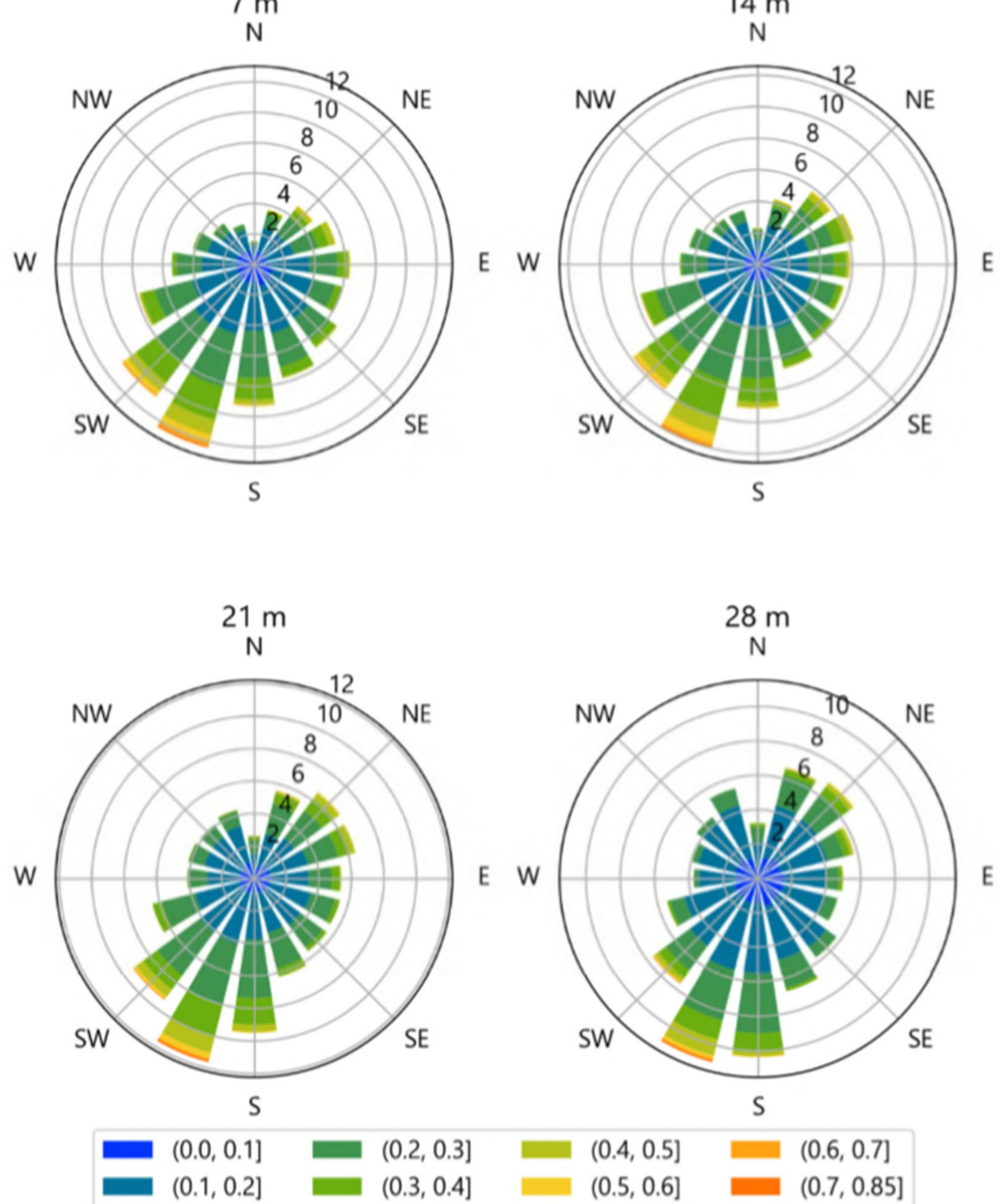

Figure 5.2: Observed Currents at 23, 46, 69, and 29 Ft (7, 14, 21, and 28 m) Depths from the SW Lidar Buoy (Fugro 2020)

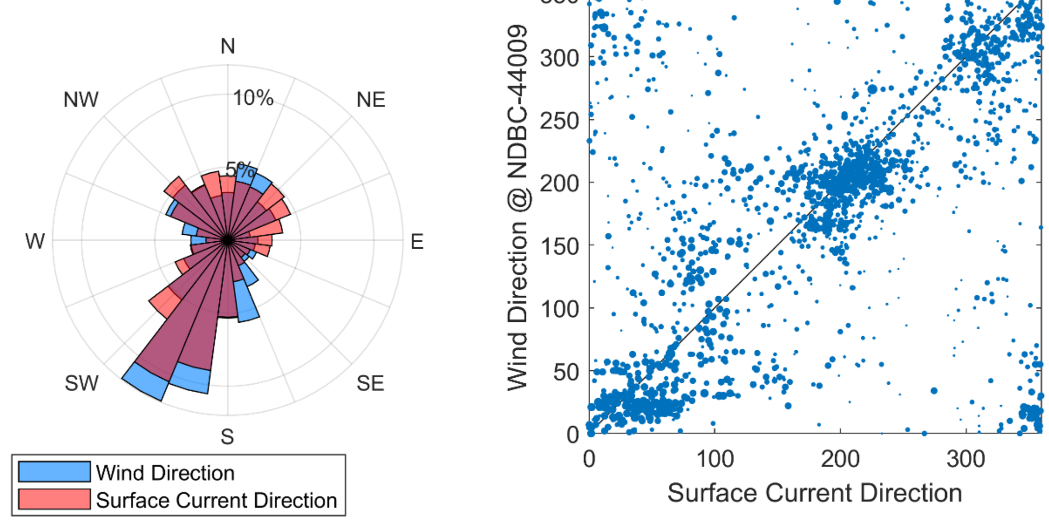

Figure 5.3: Surface Current Direction and Wind Direction Comparison

Note: Directions refer to "Direction from" for both wind and currents.

5.3.2 Impact on Navigation

5.3.2.1 Water Depths

As identified in Section 2, water depths within Lease Area range from 66 to 98 ft (20 to 30 m) and thus are not an impediment to navigation even for the deepest draft vessels.

5.3.2.2 Effect on Tides, Tidal Streams, and Currents

Water depths are such that the tidal range of 4.6 ft (1.4 m) does not affect maritime traffic flows in the Lease Area. Limited siltation or scouring of sediments in the vicinity of the proposed structures would not have an influence on navigability.

The dominant current direction of northeast runs across the major axes of the WTG layout but current speeds are low and would not have a significant influence on vessels in the Lease Area. The WTG and OSS structures are very small compared to the spacing between the structures and would have no influence on the direction or rate of the currents that would influence a vessel, except immediately adjacent to the structures.

5.3.2.3 Disabled Vessel Drift

Should a vessel become disabled due to engine failure or other circumstances, it would drift with the winds and currents occurring at the time of the event. This could result in a potential allision with a WTG or OSS; the risk of this occurring has been estimated in Section 7.2.2.

5.4 Weather

5.4.1 Available Data

5.4.1.1 Winds

Historic wind data at the Atlantic City Airport (ACY, 39.453 ºN, 74.575º W) was obtained from NCEI's Integrated Surface Hourly Database (NCEI 2020) and two offshore buoys, NDBC-44066 (39.618 ºN, 72.644º W) and NDBC-44009 (38.457º N, 74.702º W). An hourly time series overview of available observations is shown in Figure 5.4.

Wind observations from the SW LiDAR buoy are shown in Figure 5.5 (Fugro 2020) at four vertical levels, measuring 13, 197, 394, and 656 feet (4, 60, 120, and 200 m). Winds were typically low (less than 25 mph near the water surface) during the observation period; however, wind speeds increased at higher elevations. A peak wind speed of 82.5 mph (36.9 m/s) occurred at 656 feet (200 m), compared to a peak of 45 mph (20.1 m/s) at the 13 ft (4 m) elevation. Wind directions were broadly consistent between elevations; however, a stronger west/northwest wind was seen at the higher elevation bins.

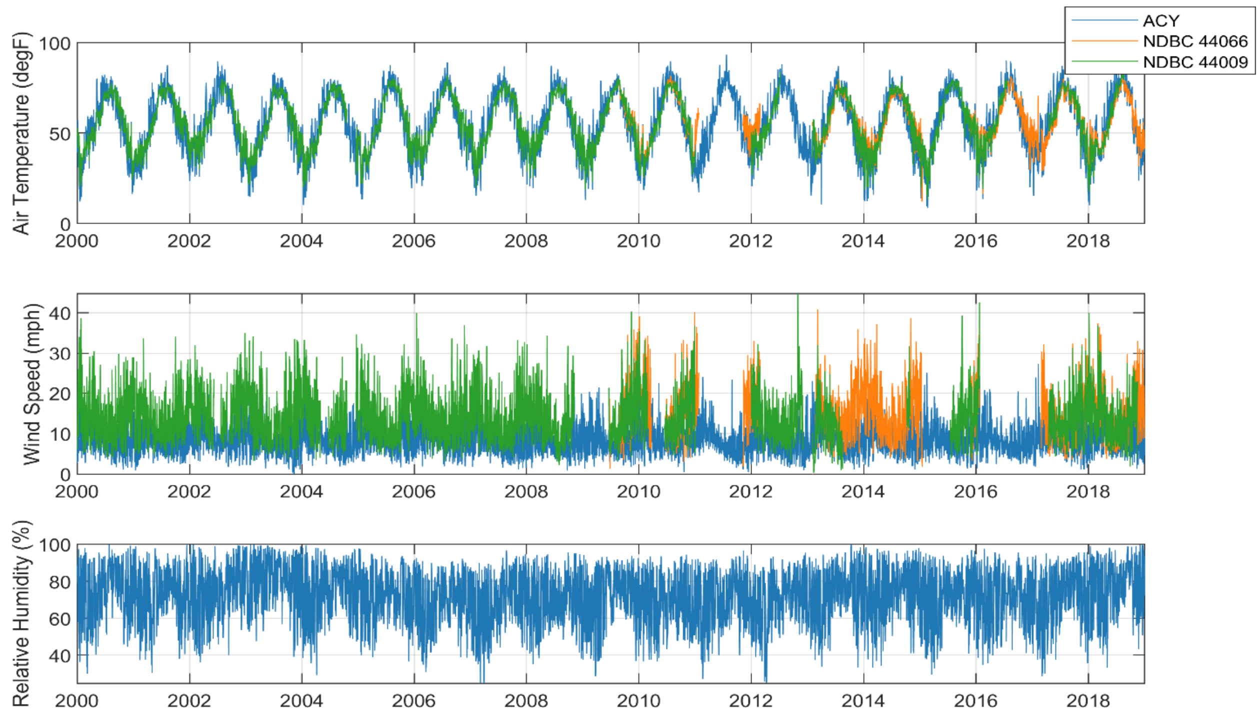

Figure 5.4: Hourly Air Temperatures, Wind Speeds, and Relative Humidity

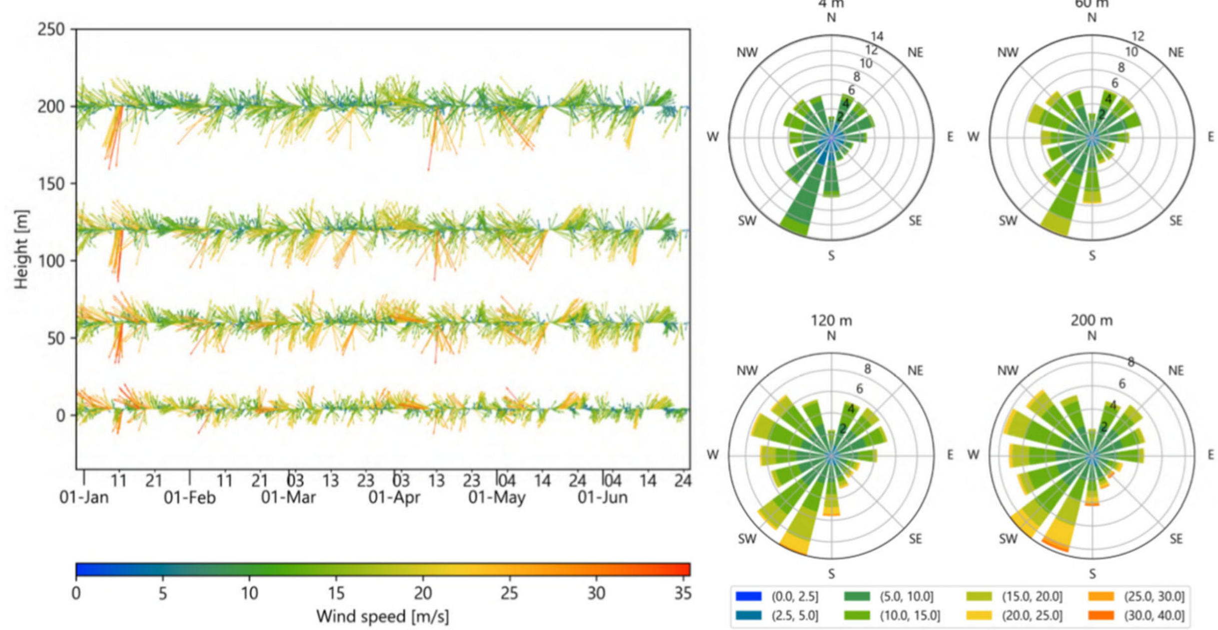

Figure 5.5: Observed Wind Speeds (in m/s) at Heights of 13 – 656 ft (4 – 200 m) (Fugro 2020)

Seasonal wind patterns are shown over a 20-year period at the NDBC-44009 in Figure 5.6. The long-term data, measured at 16.5 feet (5 m) above sea level, is in broad agreement with the observations from the SW LiDAR Buoy. During the spring and summer seasons, winds are generally from the southwest and are typically less than 20 knt (10.8 m/s). Stronger winds, predominantly from the north, occur during the fall coinciding with both tropical and extratropical storms. The strongest winds from the dataset are seen during the winter, with winds from the northwest routinely reaching 25 knt (13.4 m/s) and a peak speed of 38.3 knt (20.7 m/s).

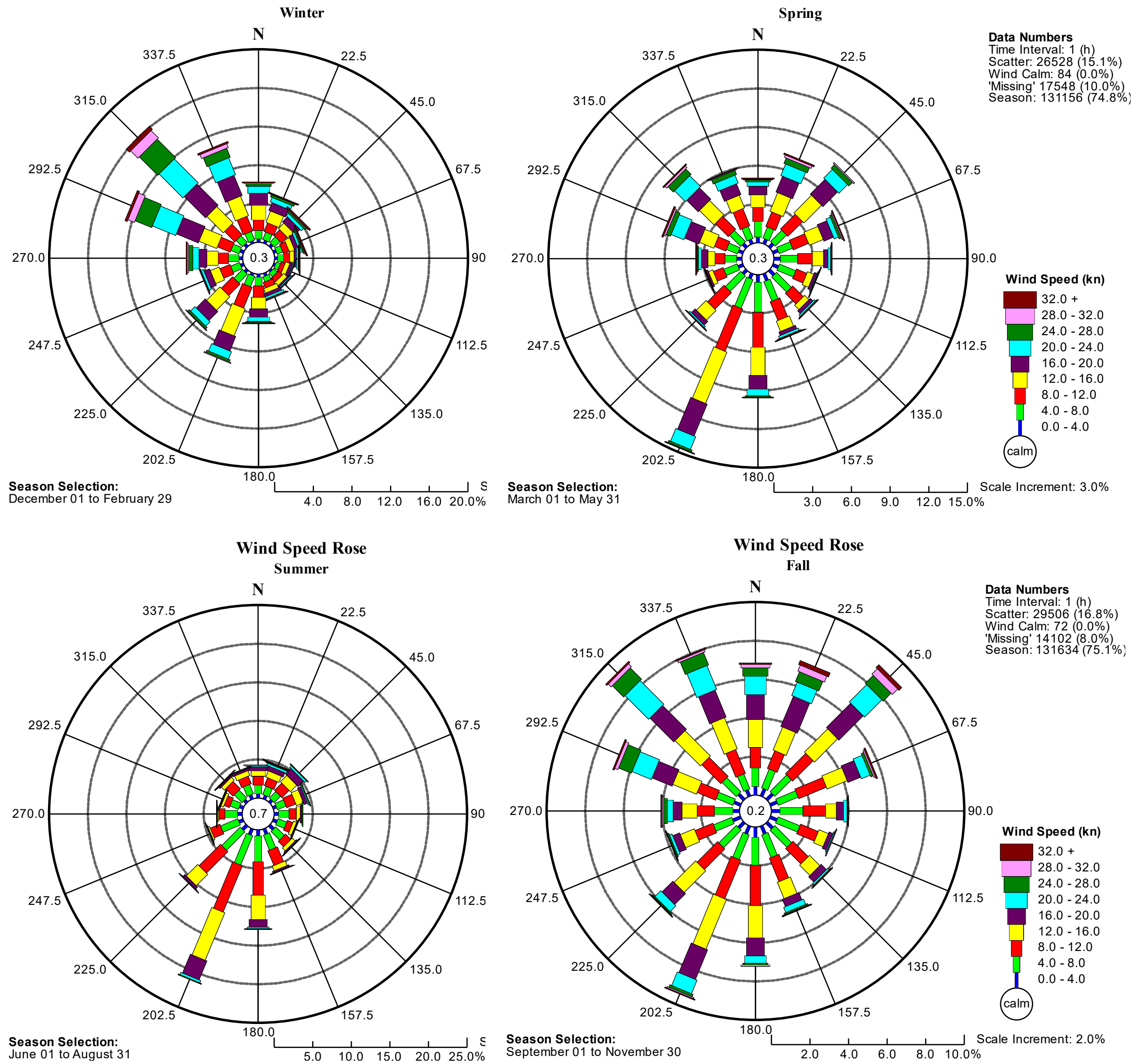

Figure 5.6: Seasonal Wind Rose at NDBC-44009

5.4.1.2 Waves

Wave data from the NDBC-44009 buoy was analyzed over a 20-year period to provide an overview of sea state conditions in the Lease Area. Results are summarized in Table 5.5 and Figure 5.7.

Waves were typically low in height, with an average significant wave height of 4.0 ft (1.2 m). Some seasonal variation occurred, with higher maximum and average waves in the fall and winter compared to the spring and summer seasons. This pattern is also seen in the seasonal wave roses shown in Figure 5.7, which also show that the largest waves are from the east and southeast directions.

Table [illegible]: Wave Summary Statistics

	Significant Wave Height (feet)		Peak Wave Period (s)	
Time Frame	Maximum	Mean	Maximum	Mean
January	28	4.54	17.39	6.86
February	25	4.44	16.67	7.19
March	26	4.71	17.39	8.09
April	17.65	4.40	17.39	7.75
May	21	3.66	16.00	7.47
June	13.58	3.02	19.05	7.23
July	12.53	3.08	16.00	6.99
August	12.60	3.04	20.00	7.38
September	22	4.41	17.39	8.53
October	24	4.53	17.39	7.77
November	27	4.59	16.67	7.46
December	21	4.42	17.39	7.06
Year	**28**	**4.05**	**20.00**	**7.49**

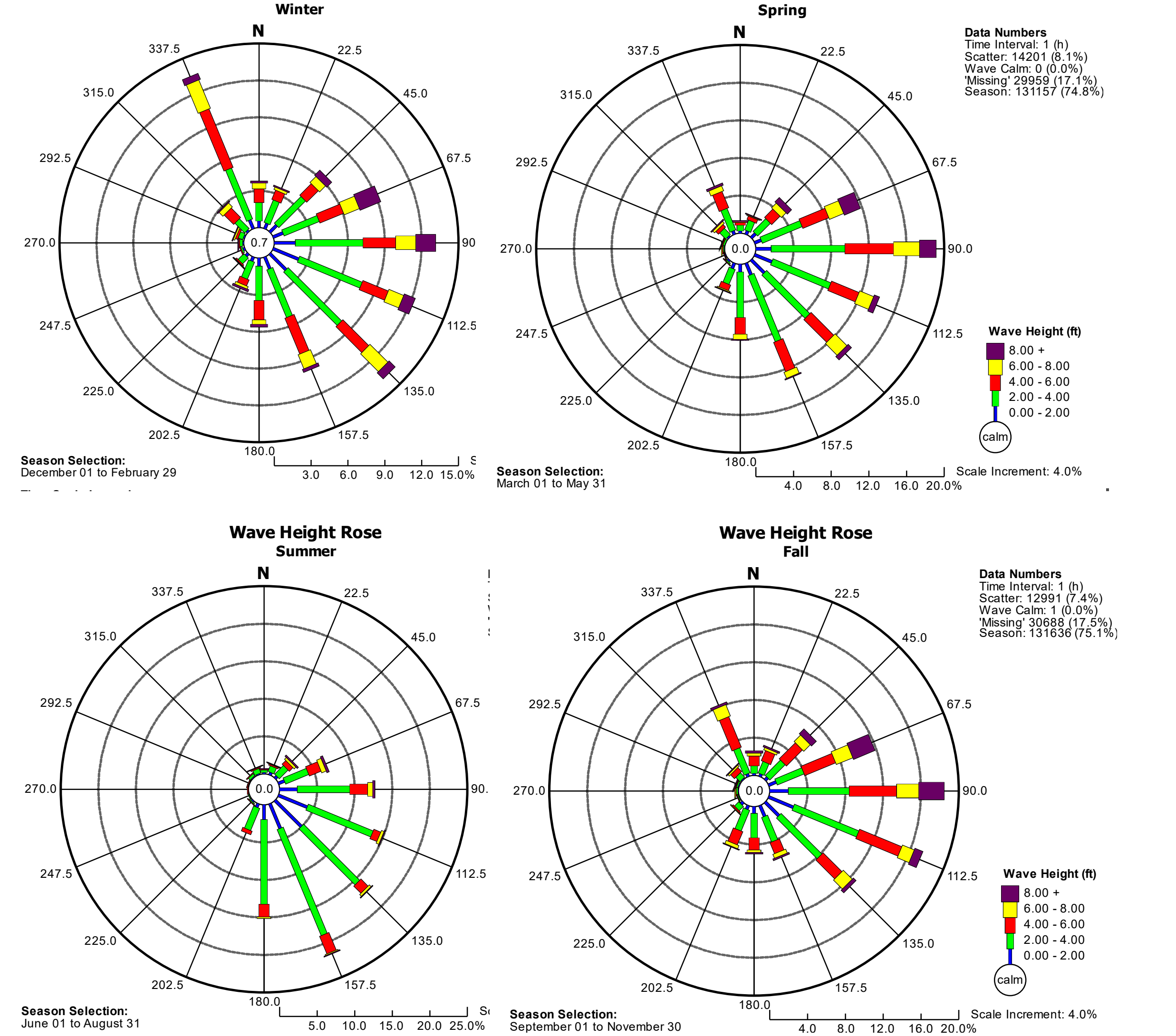

Figure 5.7: NDBC-44009 Seasonal Significant Wave Height Rose

5.4.1.3 Hurricanes and Extratropical Storms

Extreme wind and wave conditions occurred in conjunction with major storms in the Lease Area. Tropical storms, including hurricanes, are characterized by rapidly rotating wind fields and sharp pressure gradients and typically occur in the late summer to early winter. Extratropical storms, which occur more frequently in the Lease Area, typically occur in the winter and early spring and are characterized by a more gradual pressure gradient. Despite these differences, both types of storms have the potential to bring very large wind and wave conditions to the Lease Area. Table 5.6 and Table 5.7 summarize events with wind speeds greater than 33.5 mph (15 m/s) and wave heights greater than 16.5 ft (5 m) that occurred at NDBC-44009 between 2000-2019.

Table 5.6: Hurricane Events Over Threshold Recorded at NDBC-44009 Buoy

Time	Peak Wind Speed (mph [m/s])	Peak Significant Wave Height (ft [m])	Duration (hours)	Storm Name
2003-09-18 20:00	33.6 (17.3)	18.5 (5.6)	5	Hurricane Isabel
2005-10-25 6:00	37.7 (19.4)	21.4 (6.5)	7	Hurricane Wilma
2006-09-02 1:00	39.1 (20.1)	19.0 (5.8)	5	Hurricane Ernesto
2008-09-25 21:50	33.8 (17.4)	16.4 (5.0)	6	Hurricane Kyle
2012-10-29 20:50	44.9 (23.1)	19.6 (6.0)	12	Hurricane Sandy
2015-10-02 21:50	39.1 (20.1)	18.2 (5.5)	10	Hurricane Joaquin

Table 5.7: Extratropical Storm Events Over Threshold Recorded at NDBC-44009 Buoy

Time	Peak Wind Speed (mph [m/s])	Peak Significant Wave Height (ft [m])	Duration (hours)
2000-01-25 14:00	39.9 (20.5)	21.2 (6.5)	13
2003-02-17 9:00	35.8 (18.4)	19.6 (6.0)	5
2003-12-05 22:00	38.7 (19.9)	18.7 (5.7)	10
2006-11-22 14:00	36.9 (19.0)	17.8 (5.4)	6
2008-05-12 14:50	37.3 (19.2)	18.4 (5.6)	18
2009-09-11 2:50	35.2 (18.1)	16.5 (5.0)	6
2009-11-12 20:50	39.9 (20.5)	23.1 (7.0)	10
2009-12-19 17:50	35.0 (18.0)	16.9 (5.1)	17
2010-02-06 15:50	34.2 (17.6)	22.9 (7.0)	5
2013-03-06 21:50	42.0 (21.6)	20.8 (6.3)	5

5.4.1.4 Visibility

Visibility data measured at the Atlantic City Airport (ACY) was obtained from Iowa State University's Iowa Environmental Mesonet database (IEM 2020) and summarized over the 20-year analysis period in Figure 5.8. Visibility was typically good in the Lease Area, with a range of at least 8 nm for 77% of the observations. This broadly aligns with the findings from Rutgers (2020), where the visibility in the Lease Area was expected to be greater than 8.7 nm for 60% of daylight hours.

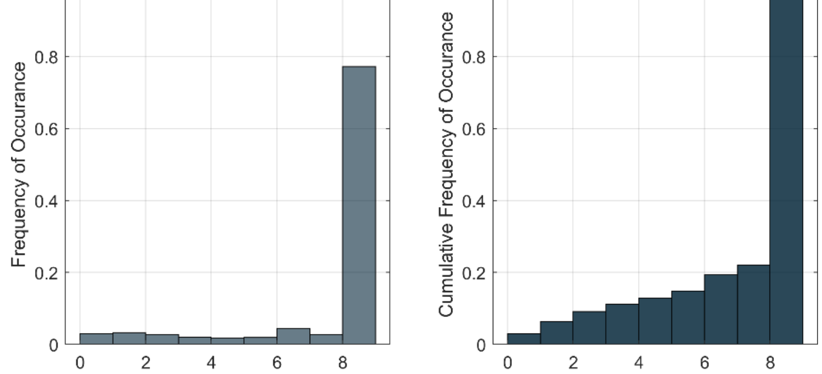

Figure 5.8: Observed 2000-2019 visibility at Atlantic City Airport (ACY)

Visibility conditions varied slightly throughout the year (see Table 5.8), with recoded visibility below 2 nm (3.7 km) occurring during 10% of observations in February, compared to 4% of observations during July and August. Averaged over the entire 20-year analysis period, visibility was less than 0.5 nm (0.9 km) for 2% of observations, and less than 2 nm (3.7 km) for 7% of observations. For this study, a visibility threshold of 0.5 nm (0.9 km) was assumed in the risk modeling (see Section 7.1.4).

Table 5.8: Percentage of Time Visibility Was Below Threshold at Atlantic City Airport (ACY)

Visibility at ACY	<0.5 nm	<1 nm	<2 nm
January	2%	5%	9%
February	3%	5%	10%
March	2%	4%	8%
April	2%	3%	6%
May	3%	5%	8%
June	2%	3%	5%
July	1%	2%	4%
August	1%	2%	4%
September	2%	3%	6%
October	2%	3%	6%
November	2%	3%	5%
December	2%	3%	8%
Average	**2%**	**3%**	**7%**

5.4.2 Sea Ice and Turbine Rotor Icing

Ice presents two primary risks to offshore wind farm navigation. One potential risk is posed by collisions between vessels and floating sea ice near the Lease Area. This aspect of ice risk is not considered a significant source of navigational risk in the Lease Area since meteorological conditions are generally unfavorable to the development of sea ice. Furthermore, the United States Coastal Pilot Volume 3 (2020) was reviewed for the New Jersey Coast area, and ice was not identified as a navigation concern in this area.

Ice can also present a risk after accreting on and dislodging off turbine rotors under specific meteorological conditions. Previous investigations have identified that air temperature, relative humidity, and wind speeds are the key factors controlling the ice accumulation rate (Hudecz 2014, Parent and Ilinca 2011). Specifically, ice accumulation risk was greatest when air temperatures were less than 32°F (0°C), relative humidity (RH) was greater than 95%, and wind speeds were less than 2.2 mph (5 m/s). This risk was assessed over a 20-year period from 2000-2019 using wind and temperature observations from two National Data Buoy Centre (NDBC) ocean buoys (44066, 44009) in combination with relative humidity data from the Atlantic City Airport (ACY).

A visualization of the collected observations is shown on Figure 5.9. Points represent hourly observations, with increasing wind speed along the y-axis and increasing relative humidity along the x-axis. Points are sized and colored according to the observed air temperature, with blue points representing hours below the freezing point. This analysis indicates that conditions favorable for the development of rotor ice (visualized as points in the black rectangle in the lower right corner of the figure) did not occur during the 20-year period at NBDC-44066, and only occurred for four hours at NDBC-44009. Consequently, it is concluded that the risk of ice formation on the turbine rotors is very low in this area.

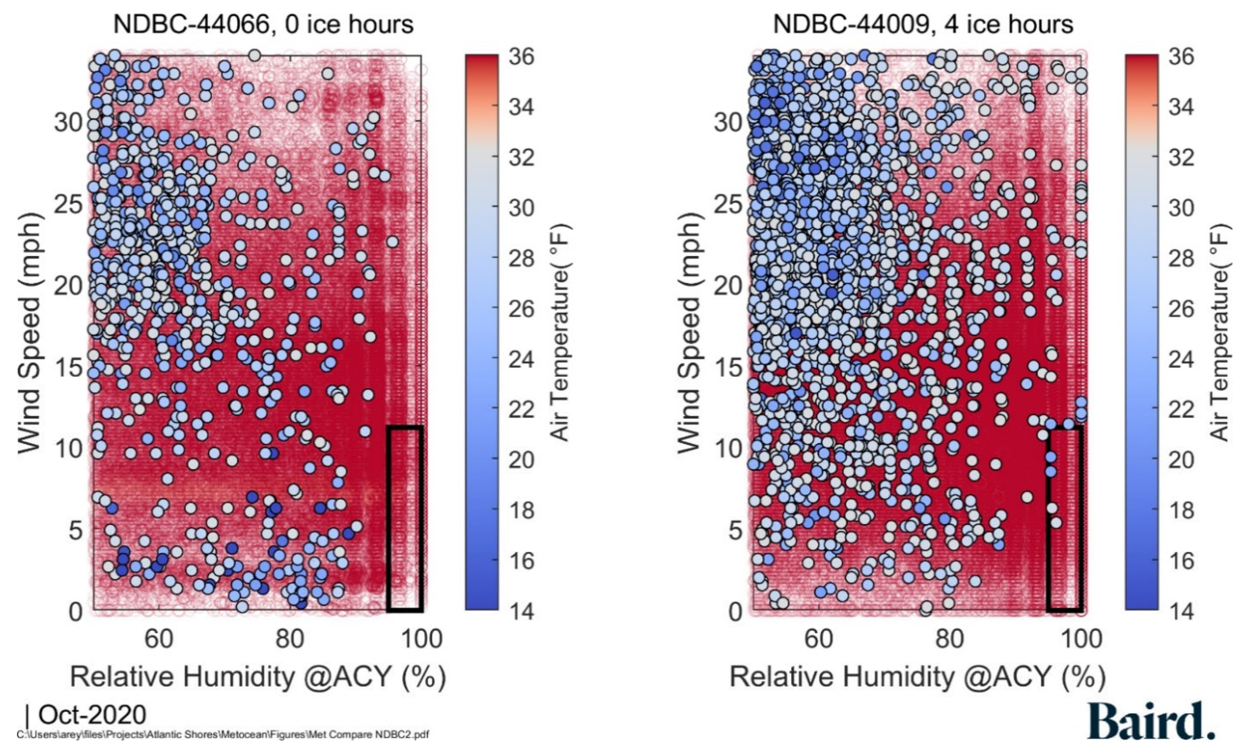

Figure 5.9: Visualization of Icing Risk, Showing Relative Humidity (x-axis), Wind Speeds (y-axis), and Air Temperature (color) at NBDC-44066 and NBDC-44009

5.4.3 Weather Impacts on Navigation

This section describes the results of an analysis conducted on metocean observations obtained from a variety of sources in and around the Lease Area to understand typical environmental conditions and their potential navigational risks. Strong winds and higher wave conditions occur from September to March associated with tropical cyclones (typically September and October) and extratropical cyclones. Historical events have included the measurement of a peak wind speed of 51.7 mph (23.1 m/s) during Hurricane Sandy and a peak wave height of 23.1 ft (7.0 m) during a November 2009 extratropical storm at a nearby NOAA buoy.

Using temperature, wind, and relative humidity observations, an analysis found that ice presents a very low risk in the Lease Area, including both sea ice and turbine icing.

While low visibility can reduce the ability of operators to respond to potential situations, visibility in the Lease Area is generally good. The primary impact on visibility is advection fog, which occurs most often in late spring and early summer.

Typical wind and wave conditions are not expected to present a safety risk for mariners, but wind and waves may pose risks during extreme weather events, particularly for drifting vessels.

5.4.4 Considerations for Sailing Vessels

There are no restrictions on sailing vessels entering the WTG field. Potential impacts from the project on sailing vessels, beyond the air draft and other impacts described in Section 4.2.4, are expected to be minimal. A slight degree of wind masking and/or increased turbulence in proximity to the WTGs is expected, particularly at higher elevations; however, based on Cunliffe (2021), the impact to sailing vessels is expected to be minimal.

6. Visual and Electronic Navigation

6.1 Project Configuration and Collision Avoidance

The Project layout has been developed with consideration of a number of factors including wind speed and direction, water depths, marine hazards, seabed geology, vessel navigational requirements, and USCG SAR requirements. Section 8.5 of this report discusses the potential impacts of the layout on marine and aerial SAR, including the development of potential mitigations. Atlantic Shores has consulted with the USCG with regard to the layout of Lease Area OCS-A 0499, and the present Project maintains identical grid spacing and orientations. This consultation has included a Workshop with the USCG to specifically address aerial SAR concerns.

Lease Areas OCS-A 0499 and 0549 are adjacent and the WTG spacing will be maintained across the boundary between the two projects. The WTG field will present to the mariner or aviator as a single consistent layout across the two lease areas.

6.2 Visual Navigation

6.2.1 Visual Blockage Created by the WTGs

A brief analysis was carried out to evaluate the potential visual blockage created by the WTGs for nearby vessels. The extent of this blockage depends on the foundation type and the relative distances of the point of view and the target vessel from the WTG. When considering the visibility of a foundation above the waterline (and ignoring the method of affixing a foundation to the seabed), there are fundamentally two types of foundation support structures: (1) monopiles and (2) jacket structures. The jacket structures have a relatively open structural framework at sea level and would present very limited visual blockage.

The proposed monopiles have a diameter of 39.4 ft (12.0 m) and can create some limited shadowing if located between two vessels. A geometric analysis was carried out to estimate the size of the visual shadow created. For example, the sighting vessel (point of view) is 500 ft (152 m) from the monopile; this will create a visual blockage of widths of 79 ft (24 m) and 118 ft (36 m) if the target vessel is located 500 ft (152 m) and 1,000 ft (304 m) away, respectively, on the opposite side of the monopile. If a 45 ft (13.7 m) target vessel is traveling at 8 knots (14.8 kph), the sighting vessel would lose visual contact with the target vessel for 2.5 s at 500 ft (152 m) and 5.4 s at 1,000 ft (304 m). The greater the distance the sighting vessel (point of view) is from the monopile, the smaller the visual blockage area. For example, if the sighting vessel is 1,000 ft (304 m) from the monopile, visual blockage widths of 59 ft (18 m) and 79 ft (24 m) are estimated if the target vessel is located 500 ft (152 m) and 1,000 ft (304 m) away, respectively.

Overall, it is expected that very limited visual blockage will be created by the presence of the WTG and OSS structures.

The Barnegat Lighthouse is located 8.3 nm (15.4 km) northeast of Lease Area and will be visible within the WTG field. Its visibility may be blocked temporarily in the shadow of WTGs as a vessel transits through the Project. Note that the lighthouse is a PATON and is not a Federal ATON.

6.3 Communications, Radar & Positioning System Impacts

WTGs and OSSs may theoretically distort various types of electromagnetic signals (PIANC 2018) including:

- Radio communications, such as very high frequency (VHF) radio;

- AIS;
- Radar systems; and
- Global Navigation Satellite Systems (GNSS).

The potential effects of the Project on these various systems are discussed in this report section.

6.3.1 VHF Radio and AIS

Marine vessels typically communicate with each other, with shore-based facilities, and with the USCG by means of VHF radio. These radios are required on vessels greater than 65 ft (19.8 m) in length but are very common on smaller vessels for safety reasons. In general, VHF is intended mainly for short range communications ("line of sight", normally 10 to 20 nm [18 to 36 km] at sea), although range is affected by the transmission power, height, and quality of the transmitting and receiving antennae. Marine VHF radio has several uses, including voice and digital/data applications, and there are several pre-designated channels regulated by law (see Table 6.1 for a partial listing).

Table 6.1: U.S. VHF Channel Information

Frequency (MHz)	Channel	Use
156.45	9	Boater calling, commercial and non-commercial
156.6	12	Port operations
156.65	13	Bridge-to-bridge safety
156.8	16	International distress, urgency, and safety priority calls
157.1	22A	USCG Maritime Safety Information Broadcasts
156.525	70	Digital Selective Calling
161.975	87B	Automatic Identification System (AIS1)
162.025	88B	Automatic Identification System (AIS2)
162.4 to 162.55	WX1 to WX 7	NOAA Weather Radio marine forecasts, tide predictions, etc.

Source: https://www.navcen.uscg.gov/?pageName=mtvhf

Importantly, Digital Selective Calling (DSC) operates in the VHF range. DSC uses digital technology to send an automatic distress signal to the nearest USCG station and to all radio-equipped vessels. The signal identifies the vessel, nature of the distress, and provides contact information. If connected to GPS, the radio also transmits the vessel location.

Also, AIS transponders operate on two specific VHF frequencies, channels 87B and 88B.

VHF operates in a relatively low frequency band (for example as compared to marine radar) and is much less affected by WTGs (see for example MCA and QinetiQ 2004). Review of various European studies at sites such as Horns Rev Wind Farm (Elsam Engineering 2004) in Denmark, the Horns Rev 3 Wind Farm (Orbicon 2014), and the North Hoyle Wind Farm (Howard and Brown 2004) indicated that WTGs did not have any significant impact on VHF communications. It was also observed in the Kentish Flat Offshore Wind Farm (BWEA 2007) that AIS-equipped vessels (AIS operates with VHF) did not experience any loss of signal either outside or within the wind farm.

Despite these findings, PIANC (2018) identifies as best practice to carry out a study of radio-communication to the extent possible within the constructed turbine field.

6.3.2 USCG Rescue 21

Rescue 21 is the USCG's advanced communications and direction-finding communications system designed to locate and communicate with mariners in distress. It helps identify the location of callers in distress by means of towers that generate lines of bearing to the source of VHF radio transmissions (radio direction finding) to reduce search time and has a coverage to a minimum of 20 nm (36 km) from the coast. DSC is an important component of this system. The system is presently operational along the entire Atlantic, Pacific, and Gulf coasts of the continental United States as well as along the shores of the Great Lakes, Puerto Rico, Hawaii, and Guam. Figure 6.1 shows the coverage map for the New Jersey area.

The Rescue 21 system is reliant on VHF transmissions and, as such, would be subject to the same effects mentioned in the previous section.

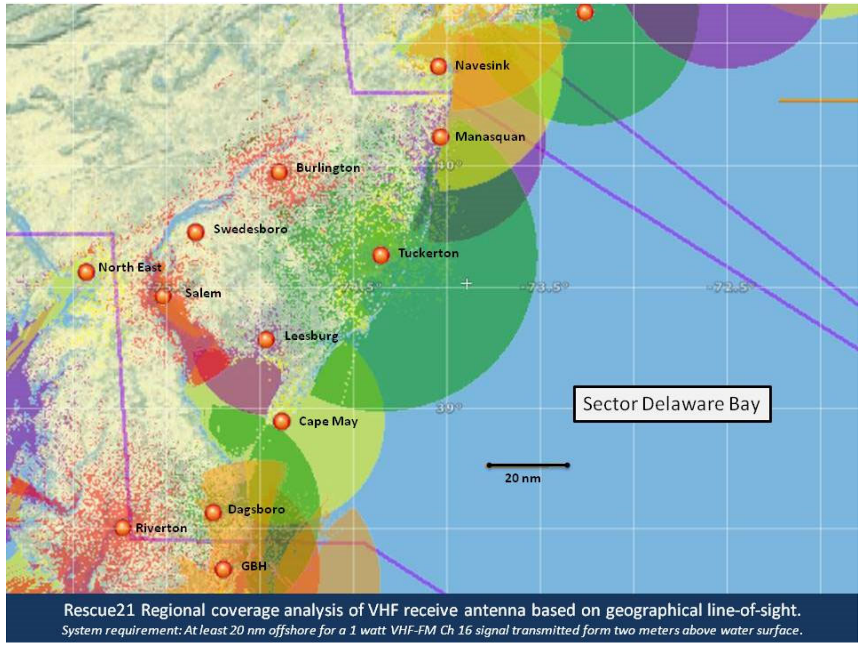

Figure 6.1: Rescue 21 Coverage Map

6.3.3 Global Navigation Satellite Systems

Global navigation satellite systems (GNSSs) use satellites to provide autonomous geo-spatial positioning to a high degree of accuracy. There are several GNSS systems, including the U.S. Global Positioning System (GPS). GNSS use a constellation of satellites spread on geo-synchronous orbits. The positioning is achieved by triangulation using line of sight reception from multiple satellites.

Although large structures can block satellite reception, given the relatively small size of the WTG structures and rotors relative to the corridor spacing, it is unlikely that the WTGs would block signals from all satellites visible in the sky. PIANC (2018) notes that past studies have focused on the potential impacts of WTGs on DGPS systems when the vessel is communicating with a reference station on shore (such as used in hydrographic surveying); however, MCA and Qinetiq (2004) reports on a series of trials using GNSS within a wind farm concluding that there were no issues with GNSS reception or positional accuracy. Thus, Atlantic Shores does not anticipate that the WTGs will adversely affect GNSS.

6.5.4 Marine Radar Systems

Marine radar is an electromagnetic system used for the detection of ships and obstacles at sea, providing the operator with an estimate of the distance and bearing to any object. It consists of a transmitter producing microwaves, a transmitting antenna, a receiving antenna (generally coinciding with the transmitting antenna), and a receiver with a processor to determine the characteristics of the objects detected. Radio waves from the transmitter reflect off the object and return to the receiver, giving information about the object's location and speed. Depending on purpose, marine radars can operate in two different frequency bands termed S-band (2.0 to 4.0 GHz) or X-band (8.0 to 12.0 GHz). X-band is used for accurate navigation and to detect objects around the ship. S-band is used for long distance detection and navigation and is less sensitive to sea and rain clutter (unwanted echoes).

Commercial vessels above 3000 Gross Tons are required to carry both types of radar in order to maintain compliance with international conventions such as the International Convention for the Safety of Life at Sea (SOLAS). Smaller craft, such as fishing and recreational vessels, tend to carry just X-band. As noted in the MARIPARS report (USCG 2020a), fishing vessels are not required to have radar onboard unless they carry 16 or more people, but most do anyway. If equipped with radar, proper use of the system is required as per the International Regulations for Preventing Collisions at Sea 1972 (COLREGS).

There are three potential sources of signal interference between marine radars and turbine fields:

- Side lobe detections – False targets can show up on the radar display that are at the same distance as the actual targets but are located on a different angle relative to the ship.
- Multiple reflections – When the ship’s radar is operating in close proximity to the wind turbines, “ghost” targets and clutter can show on the display due to the interaction of the radar signal with the turbines and ship structure. Re-reflections of the radar signal occur between the ship and turbine.
- Radar shadowing – When structures such as WTGs or OSSs are in the line of sight of the radar, shadowing can occur, which reduces the reflected signal of an object that is behind the turbine.

In addition, wind turbines can mask or shadow weaker signal returns from smaller objects within the turbine field (Angulo et al. 2014). PIANC (2018) noted that at distances less than 1.5 nm (2.8 km) from a wind farm, interference from WTGs can generate false targets.

Comprehensive investigations were conducted by the British Wind Energy Association (BWEA) into marine radar effects at the Kentish Flat Offshore Wind Farm (BWEA 2007). In that study, the effect of an existing wind turbine array on the marine radar systems of various types and sizes of vessels passing near the wind farm were documented. Most of the systems tested (two-thirds) experienced false echoes and clutter; however, the spurious echoes were often generated by the ship’s structures in combination with the reflection characteristics of the turbines. Trained navigators were able to discern these reflection effects and were able to track other vessels near and within the wind farm. If a small vessel operated in close proximity to a WTG, the return signal of the vessel merged with the signal of the WTG itself and rendered the vessel invisible on the radar system. When the detecting ship was traveling within the turbine array, small vessels proved to be less detectable. Adjustment of the gain setting on the radar could improve the detection in these situations but did require a skilled operator. The Kentish study identified that often the radar scanner was installed at a poorly selected location on the ships, accentuating the spurious echoes due to the proximity of the ship structures.

In 2013, researchers at the University of Texas conducted a study of the impact of wind turbines on various electronic systems, including marine radar. The study included a review of the technical literature, stakeholder engagement, and numerical modeling. The modeling showed that vessels operating outside the wind farm could be readily detected but that detection and tracking of boats within the wind farm was made more difficult by the presence of the turbines. It is unclear from the study as to the extent that gain control and other adjustments were applied in the model.

In 2015, a detailed investigation of the potential impact of the Deepwater Block Island Wind Farm on Vessel Radar Systems was carried out (QinetiQ 2015). The Block Island Wind Farm consists of five 6-MW WTGs aligned linearly in an area located southeast of Block Island, Rhode Island. QinetiQ conducted numerical modeling to assess the radar reflection characteristics of the proposed WTGs and the potential effect on X-band and S-band ship radar systems. Two reference vessels were assumed to be present behind the turbines. The radars tested were assumed to be representative of typical small fishing vessels and a larger commercial vessel. It was found that the radar systems, when utilized at maximum sensitivity, would exhibit clutter and false artifacts, but that this clutter could be reduced through reducing the gain on the radar systems without loss of detection of the reference vessels.

The potential effects of the turbines creating shadows were also evaluated in the Block Island study. It was concluded that shadowing would not affect the detection of the reference vessels. The shadowing occurred in 0.05 nm (100 m) wide strips behind the WTGs and would only be significant for detecting small vessels at some distance from the turbine. The shadowing effect did not prevent detection of these vessels due to the movement of the ship with the radar and/or the reference vessel.

It is important to recognize that there have been significant advances in radar technology in recent years, including Frequency Modulated Continuous Wave transmissions, target detection through Doppler effect, and other similar developments.

In recognition of the concerns associated with radar system impacts, the Wind Turbine Radar Interference (WTRIM) Working Group has been established with the support of a number of agency and partners including BOEM, the Department of Energy, the Department of Defense, the FAA, NOAA, and the Department of Homeland Security. The purpose of the group is to mitigate the technical and operational impacts of wind turbine projects on critical radar missions. The goal is to develop near- (5-year), mid- (10-year) and long-term (20-year) mitigation solution recommendations, recognizing that these will be primarily technology driven.

In 2021, at the request of BOEM, the National Academy of Sciences (NAS) conducted a study of the effects of WTGs on marine vessel radar based on a review of technical literature, information gathering sessions held with key stakeholders and analyses of radar data. It was identified that WTGs can affect marine radar systems in a situation-dependent manner. Distinctions were drawn between the older magnetron-based radar systems and the newer solid-state systems that can incorporate more sophisticated processing techniques. It was noted that there have been no field tests in offshore wind farms of these newer systems, and the NAS made recommendations for more comprehensive data collection efforts. A number of possible mitigations were identified including improved operator training, the requirement for smaller vessels to carry radar reflectors to improve detectability, the deployment of reference buoys adjacent to wind farms to give a reference target for appropriate adjustment of the radar gain, and the standardization of radar mounting procedures on vessels. The NAS also encouraged the development of improvements in solid-state radar design by manufacturers, noting that solid-state radar technology allows for signal processing methods and filtering to create WTG-resilient systems.

In summary, it appears likely that the Atlantic Shores Project, as with many other similar facilities around the world, may have an impact on certain marine radar systems. The largest risk with this issue appears to be the shadow effect and the detection of vessels that are located within the turbine field. The issue of radar clutter and false targets when navigating outside the turbine field, as will occur west and east of the Lease Area, is common to wind farms in Europe, some of which are located adjacent to heavily used shipping channels. Vessels do safely navigate outside these wind farms despite the radar impacts. The lighting and marking of the WTGs, OSSs, and Met Tower as well as the use of AIS and MRASS as per USCG requirements will help mitigate potential allision risk due to the presence of Project's structures. Radar operator training and dissemination of information regarding proper installation and adjustment of equipment will reduce effects on use of radar systems. The use of radar reflectors on small craft will be encouraged.

6.3.5 High Frequency Radar for Current Measurement

NOAA maintains a network of high-frequency radar stations along the coastline, which are capable of inferring currents and wave heights offshore in high temporal and spatial resolution, an example of which is shown in Figure 6.2. These radars can measure currents over a large region of the coastal ocean, from a few miles offshore up to about 60 nm (200 km) and can operate under any weather condition. These systems provide data that is used for a variety of purposes, including aiding search and rescue missions, oil spill response, and marine navigation. In particular, the USCG has integrated the data into their Search and Rescue Optimal Planning System (SAROPS).

As noted in the IAMSAR Manual (IMO, 2022), which is the international guidance on SAR, one of the key elements in planning a search is estimating the surface movements of the distressed vessel or individual (if a person in the water) depending on drift due to wind and water currents. The SAROPS is a GIS based platform that integrates information from various environmental data sources, including HF radar, along with various drift algorithms to predict vessel movement and aid in search pattern selection.

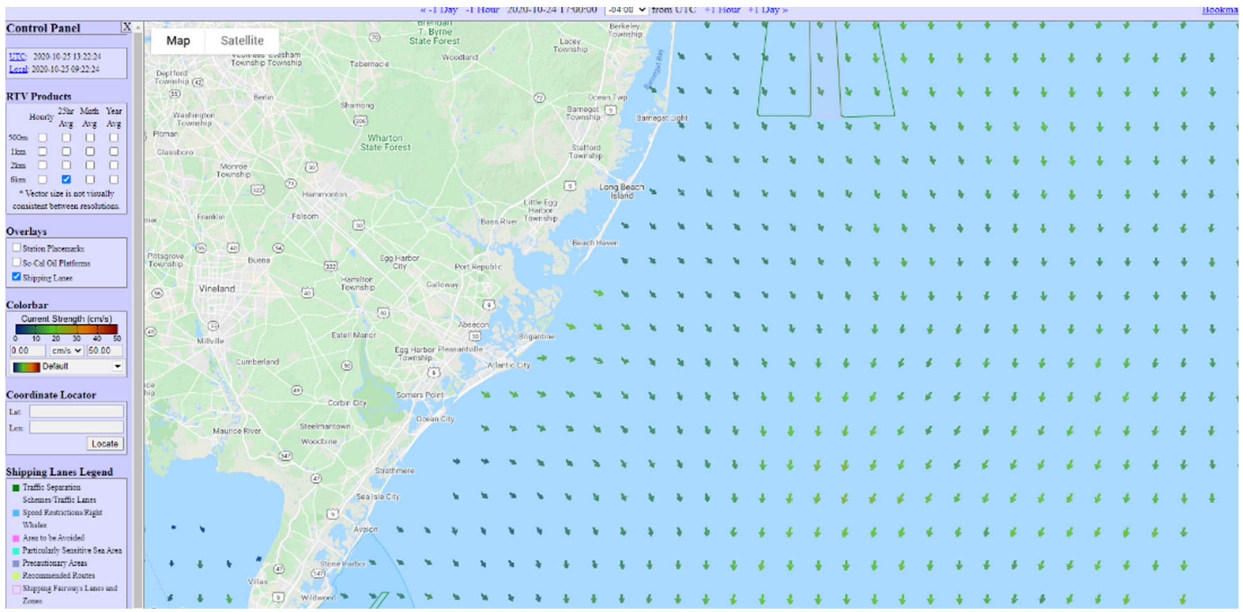

Figure 6.2: Example of Current Fields from HF Radar Output

The system operates on a frequency band of approximately 5 to 12 MHz and uses doppler effects to derive ocean currents. There is a documented effect of offshore wind turbines on the doppler shifts used to measure currents and wave heights (Trockel et al., 2018), which can affect the current estimates and use of HF radar for input to SAROPS. A High Frequency Radar Wind Turbine Interference Community Working Group was established through funding by BOEM (Cahl et al., 2019) to examine potential mitigation strategies including additional signal filtering and various software improvements. Trockel et al. (2021) reported on the development of a wind turbine interference simulation tool that is capable of representing the effects of multiple turbines of different sizes and the testing of software mitigation improvements. A test of these mitigations at the Block Island wind farm showed promise with an 86% reduction in interference.

As is discussed in Section 8.0, Atlantic Shores is considering various potential mitigation measures to support SAR and will continue consultation with the USCG on this issue.

6.4 Noise and Underwater Impacts

6.4.1 Noise

Sounds of different frequencies are emitted by WTGs as they operate, related to both the aerodynamics of the turbine blades as they rotate and the mechanical sounds of the internal mechanism of the turbine. Noise levels at the turbine can be in the range of 100 to 120 decibels (dB) but diminish rapidly with distance. At a distance of 980 ft (300 m), the sound pressure is in the order of 43 dB, an equivalent level to the noise in a typical home. The New York State Energy Research and Development Authority's (NYSERDA's) (2013) literature review of "Wind Turbine-Related Noise" noted that in several measurement studies, the highest recorded sound levels were in the range of 20 to 50 dB at distances of 1,640 ft (500 m).

The noise emitted from WTGs will not interfere with sound signals from ATONs or other vessels. It also will not affect instrumentation or crew on passing vessels.

The noise from WTGs is not expected to interfere with USCG SAR and MER activities.

6.4.2 Sonar

Sonar technology is used by vessels to find fish, determine depth and bathymetric conditions, map the seabed, and identify potential underwater hazards. These instruments use the principle of echolocation to determine the relative position of objects. In active sonar, a sound wave is emitted from a sonar transducer aboard the vessel, which bounces off the object and returns an "echo." The lag time between the emission and response is used in conjunction with the speed of sound underwater to determine distance. In passive sonar, the system does not emit a signal, but only "listens" for signals.

A University of Texas study (Ling et al. 2013) that assessed the effect of offshore wind turbines on various electronic systems noted that wind turbines do not generate noise above background levels at frequencies above 1 kHz. Given that most sonar systems, such as depth sounders, operate at much higher frequencies (25 kHz to 400 kHz typically), it is not expected that the WTGs will affect such equipment.

6.5 Electromagnetic Interference

The WTGs are not anticipated to generate electromagnetic fields (EMFs), but the inter-array cables, inter-link cables (if used), and export cables could potentially create EMFs. These fields could theoretically interfere with ship equipment only if in very close proximity (within a few feet) of the vessel; however, the water depths at the Lease Area and along the ECCs provide a significant physical separation from the vessels. In addition, EMF emissions are greatly reduced due to the effects of cable armor, insulation, bundling, and the cable burial depth of 5 to 6.6 ft (1.5 to 2.0 m) below the seabed.

The effect of EMFs is expected to be negligible.

7. Risk of Collision, Allision or Grounding

A quantitative navigational safety risk assessment was conducted for the Project, including both Lease Area OCS-A 0549 and Lease Area OCS-A 0499 in the analysis. The analysis was carried out for both the pre-construction and operational phases of the Project, to determine the impact and relative change in navigational risk due to the installation of the WTGs and OSSs. This analysis included the WTGs and OSSs from Lease Area OCS-A 0499 which were assumed to have already been developed (i.e., accounting for cumulative impacts of the adjacent lease area). The navigational safety risk assessment was carried out using Baird's proprietary Navigational and Operational Risk Model (NORM); refer to Appendix F for a more detailed outline of the model capabilities and methodology.

7.1 Navigational and Operational Risk Model (NORM)

NORM is a model developed by Baird to assess and quantify navigational risk for both open water and defined waterway conditions. It is a statistically based model that uses raw AIS traffic inputs, metocean conditions, and fixed structure information (i.e., WTGs and OSSs) to calculate the risk of various accident scenarios. NORM can calculate the occurrence frequency of vessel grounding, head-on collisions, overtaking collisions, crossing collisions, powered allisions, and drifting allisions. These calculations can be performed for intra-class, inter-class, and overall traffic risk analyses.

NORM employs a widely adopted and accepted methodology for calculating navigational risk that is described in the below equation:

$$N_a = P_a * n = P_g * P_c * n$$

Where N_a is the number of accidents occurring over a given period (typically one year), P_a is the probability of an accident occurring, n is the number of vessels over a given period, P_g is the geometric probability of an accident occurring, and P_c is the causation probability. The causation probability is the probability that a potential accident will in fact occur once on a potential collision/allision course.

The number of vessels considered (n) was obtained from AIS data, while the geometric and causation probabilities have been derived from literature using raw AIS data as input. For calculating the geometric probability of an accident, a widely adopted methodology outlined in Zhang et al. (2019) is employed, which stems from original work outlined in Pedersen (2010).

Causation probabilities have historically been computed using fault tree analysis, Bayesian networks, or derived from historical accident data. NORM utilizes the base causation factors developed by Fuji and Mizuki (1998), rooted in historical observations. These causation factors have been widely applied in the industry and have been used as default factors for navigational risk models as such IWRAP (IALA n.d.).

Note that causation factors relate to the ability of the vessel to avoid a potential collision or powered allision. Thus, drifting allisions do not make use of causation factors as the vessel is assumed to have lost the ability to maneuver. Instead, a probability (based on Zhang et al. 2019) is used to quantify the frequency of vessels becoming inoperable and being in a potential drifting allision scenario.

The base causation factors may be subsequently modified to account for site-specific conditions, including considerations such as pilotage, tug use, weather conditions, Vessel Traffic Services, and similar.

7.1.1 Accident Scenarios

The navigational safety risk assessment was carried out for three main categories of accident scenarios: vessel grounding, vessel collisions, and vessel-WTG/OSS allisions. Collisions are further divided into head-on, overtaking, and crossing collisions. Allisions are further divided into powered and drifting allisions. Given the bathymetric conditions local to the Lease Area, grounding was determined to not be a significant source of risk and was not included in the NORM analysis. The navigational safety risk assessment resulted in occurrence frequencies and recurrence intervals (return periods) for each potential accident scenario, followed by consideration of the consequences.

7.1.2 Study Area

To perform the navigational safety risk assessment, the study area was carefully chosen (a manual process) to only contain traffic that may be affected by the WTGs and OSSs. If an overly large area is chosen, it may contain a considerable amount of traffic that may never actually experience any impacts due to the WTGs and OSSs, resulting in an underestimation of the change in navigational risk. If an overly small area is chosen, then the resultant effect on vessels that choose to divert around the Lease Areas would not be considered.

The study area used for the navigational safety risk assessment is shown in Figure 7.1, the study area encompasses a 3.8 NM (7 km) region around the extents of Lease Area OCS-A 0499 and Lease Area OCS-A 0549. As mentioned above, this area was chosen to best capture only the vessel traffic that may be appreciably affected by the installation. In this case, the selected region would capture the considerable north-south vessel traffic that occurs to the east and west of the Lease Areas but is not so large as to include the large amount of recreational traffic that travels in shallow water adjacent to the New Jersey shoreline. If the latter were to be included, the overall collision statistics would be significantly altered by this traffic.

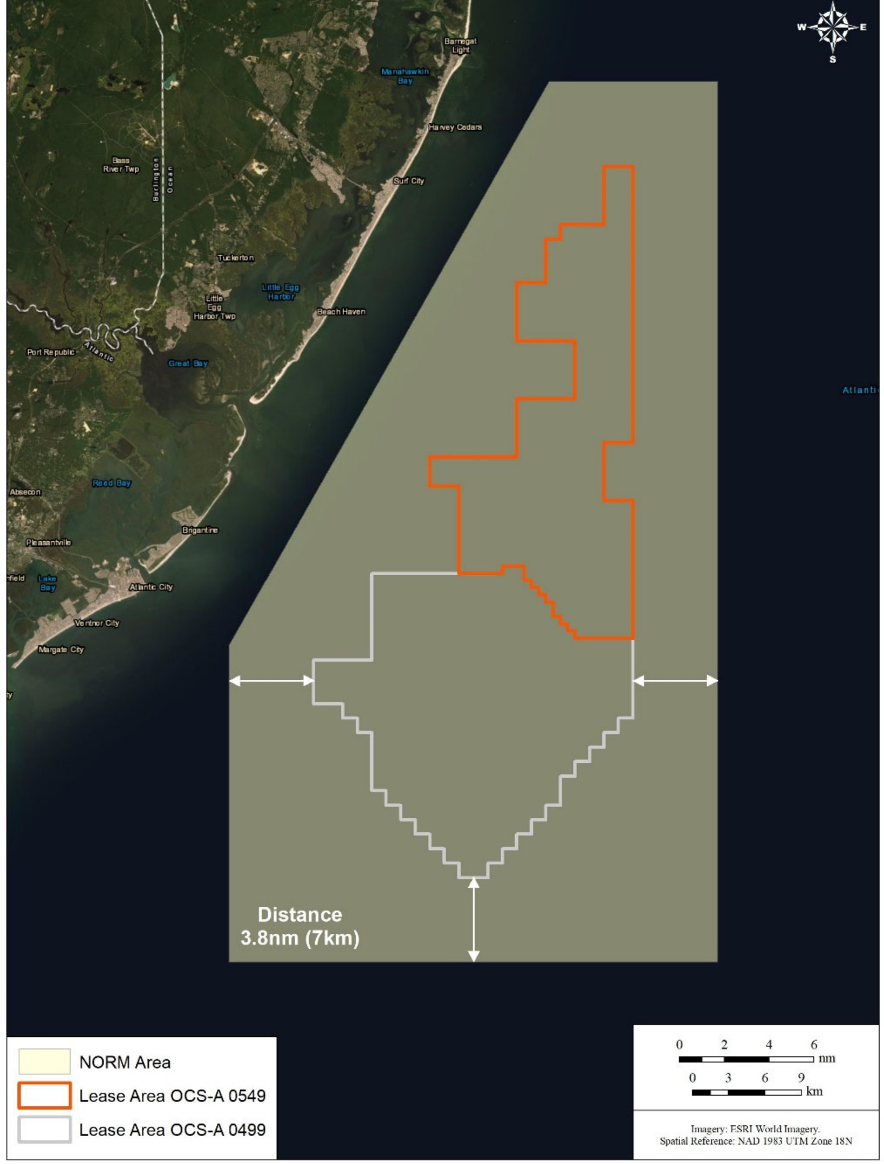

Figure 7.1: Study Area Considered by NORM

7.1.3 AIS Traffic Inputs

NORM makes use of raw AIS inputs to analyze vessel and traffic patterns and characteristics and is also used to develop relationships used for the risk calculations. For this study, the full set of AIS data was used from 2016 through September of 2021, clipped to the extents of the NORM study area. The AIS data was processed and analyzed to determine statistics and distributions of vessel/traffic characteristics within the NORM study area (i.e., LOA, beam, speed, annual volume, etc.) as well as to determine the range and distribution of track characteristics (i.e., lengths, crossing angles, etc.). The AIS data was also used to develop a proximity analysis to assess the frequency of potential ship encounters based on historical data. Appendix F outlines NORM's use of AIS data in further detail.

7.1.4 Metocean Inputs

Wind

Long-term CFSR winds were used as a model input for NORM. The distribution of wind speeds and directions are specifically used for the drifting allision risk calculations, whereby the direction and speed of the drifting vessel are directly correlated with the speed and direction of the winds acting on it. The small magnitude surface currents in the vicinity of the Lease Areas were not considered as a driving factor for determining drifting vessel drift direction.

Visibility

A time series of visibility conditions from Atlantic City International Airport was obtained and analyzed. The distribution of historical conditions revealed that visibility was equal to or less than 0.5 NM (1 km) approximately 2.95% of the time (see Section 5 for more details). Adverse visibility conditions in potential accident scenarios can reduce vessel reaction and response time and lead to increased navigational risk. According to Fujii and Mizuki (1998), the causation factors utilized by NORM were obtained from historical data where visibility was less than 0.5 NM (1 km) approximately 3% of the year. They also state that the influence of adverse visibility conditions on the causation probability (and thus navigational risk) is approximately inversely proportional to visibility. Suggestions are then provided by these researchers to scale the causation factors by a factor of two if the frequency of visibility less than 0.5 NM (1 km) is between 3% to 10%, and by a factor eight if it is between 10 to 30%. Based on the historical visibility data, NORM did not use a modified version of these causation factors and used a causation factor of two.

7.1.5 GIS and Geometric Inputs

To calculate the navigational risk in the presence of the constructed WTG and OSS grid, GIS layers of the Lease Areas and WTG/OSS positioning were used as inputs for NORM. The layout of the grids dictates the geometric characteristics of the corridors through the Lease Areas that can be safely transited, and relative positioning of structures with respect to transiting vessels. This in turn influences all collision and allision scenarios for the operational phase.

WTGs will be placed along east-northeast to west-southwest rows spaced 1.0 NM (1.9 km) apart and along approximately north to south rows spaced 0.6 NM (1.1 km) apart. In addition to the layout, the dimensions of the WTG foundations at the waterline are required. A dimensional range of 39.4 ft (12.0 m) to 98.4 ft (30.0 m) in width was assumed to encompass the range of maximum sizes for the different WTG foundation types. Monopiles, mono-buckets, suction bucket tetrahedron bases, gravity-pad tetrahedron bases, and GBS have a maximum diameter at the waterline of 39.4 ft (12.0 m), whereas piled and suction bucket jackets have a maximum width 98.4 ft (30.0 m) at the waterline. Note that the allision calculations in the model assumed the maximum projected dimension of any jacket-type structure of 139 ft (42 m), which is the diagonal distance between piles spaced 98.4 ft (30.0 m) apart at the waterline. The allision calculations also accounted for the positions and dimensions of up to eight OSS foundations and for the potential Met Tower.

7.1.6 Data Adjustments

While contributing to overall navigational risk, vessels that do not meet AIS requirements may not be equipped with transponders, and thus may not be transmitting data. This can lead to an underestimation of vessel traffic, particularly for recreational and small fishing vessels. An analysis was conducted to understand the proportion of recreational and fishing vessels not equipped with AIS within the surrounding area. This analysis revealed that a scaling factor of two for fishing and recreational traffic volume was appropriate to account for the unequipped vessels.

Fishing vessels typically require a much larger area to operate when their gear is fully extended. In this study, it has been assumed that fishing vessels might utilize outriggers giving the vessel an overall effective beam of five times its usual beam (i.e., outriggers on either side having a length of two times the vessel beam). The gear length extension was based on the gear typically used at the Lease Areas, taking into consideration the water depths present in the Lease Areas.

7.1.7 General Assumptions and Limitations

To compute accident frequencies using NORM, several assumptions were necessary. These assumptions lead to inherent limitations in the modeling approach that are listed and briefly described in this section.

For the vessel characteristics used in the risk calculations (i.e., LOA, beam, speed, etc.), the median value observed in the AIS data within the NORM study area was considered representative. A set of representative vessels for each AIS type was used for all NORM calculations. Note that due to the scaling of the recreational and fishing traffic volumes to account for non-AIS-equipped vessels, which are all less than 65 ft in length, the assumed vessel LOA are representative of the larger vessels in these vessel classes not the overall median.

The metocean conditions were used as inputs for NORM's drifting allision methodology to determine the drift direction following a vessel breakdown. Due to the magnitude of currents in the area, and the relative size of the area of a vessel above the waterline compared to below, it was assumed that windage would be the dominant force driving drifting direction. Thus, it was assumed that the drift direction distribution is equal to the wind direction distribution. Secondly, a constant drift speed was assumed of 1.9 knots (1.0 m/s). While the drift speed will ultimately determine the maximum drift extent during a given time period (and thus how many WTGs and OSSs are within this extent), sensitivity testing of this parameter revealed only the one to two closest sets of WTGs or OSSs surrounding a disabled vessel contribute nearly all of the potential risk.

For collision scenarios during the operational phase, an assumption regarding lane distributions within corridors between WTGs was necessary. While transiting without the presence of other vessels, it is expected (based on experience and discussions with experienced operators) that vessels may tend towards the middle of the corridor. This centered position assumption was used for both powered drifting allisions in the WTG corridors. The standard deviation of the lane distributions was assumed to be one quarter of the corridor width. It was also assumed that mariners would likely go to one side in the presence of other traffic (if known), centered in two "lanes" within a WTG corridor; this assumption was used for the head-on and overtaking collisions within a WTG corridor.

The causation factors used by NORM are derived from historical accident data and have been widely used in many navigational risk studies (Fuji and Mizuki 1998). While they are in general agreement, with causation factors independently determined from different historical datasets (IALA n.d.), all these datasets have the limitation that they were derived from a particular location with particular conditions that may not necessarily be reflective of conditions in another location. The relative uniformity in the spread of causation factors independently determined suggests that the values employed by NORM are generally representative and applicable to this analysis. In addition, the probability of causation was kept consistent between the pre-construction and operational phase scenarios so the relative change in risk could be evaluated.

Track lengths and lane distributions of large commercial vessels re-routing east or west around the Lease Areas were adjusted in the operational case.

While the WTGs/OSSs in Lease Area OCS-A 0499 were included in the modeling (i.e., adjacent effects captured), the reported model output details the risk associated with Lease Area OCS-A 0549 only.

7.2 Navigational Risk Results

This section presents the results of the quantitative navigational safety risk assessment for NORM area. Two scenarios were modeled using NORM: one for the pre-construction (present) conditions, and another for the operational phase conditions. The NORM model was run using AIS data from 2016 to September of 2021. The operational phase was modeled for both 39.4 ft (12.0 m) and 98.4 ft (30.0 m) turbine foundation widths at the waterline. Performing these two scenarios (pre-construction and operational) individually allows for a comparison of the relative change in risk due to construction of WTGs and OSSs in the Lease Area.

7.2.1 Pre-construction

The AIS data used in NORM covers 2016 to 2021 inclusive. The navigational risk calculated using inputs from this period is considered as the reference point for future comparisons. Table 7.1 and Table 7.2 present NORM's output for this pre-construction scenario in terms of average collision frequency per year and as average recurrence intervals. The average recurrence interval, or "return period", is computed as the inverse of the annual frequency. It is a statistical measure of the average time between "events" (i.e., a collision).

As can be seen in Table 7.1, much of the pre-construction navigational risk is associated with fishing, tug/tow, and cargo vessels due to the volume of traffic associated with these vessel categories.

Much of the pre-construction navigational risk is a result of crossing collisions as opposed to head-on or overtaking collisions. Given the current open water conditions and the somewhat random nature of the vessel tracks through the NORM study area, it was expected that the largest proportion of collisions would occur with oblique approach angles, and thus fall under the crossing collision scenario. The tug/tow and cargo vessel traffic have a more defined behavior and tends to have more head-on and overtaking risk than the fishing vessels.

Table 7.1: Estimated Pre-construction Inter-Class Collision Annual Frequencies

Vessel Class	Collisions / Total
Cargo	1.3E-02
Fishing – Transiting	2.1E-02
Fishing – Active	3.2E-02
Passenger	8.4E-04
Recreational	6.8E-03
Tanker	1.1E-03
Tug-Tow	8.4E-03
Other	6.8E-03
All	9.0E-02

Table 7.2: Estimated Pre-construction Inter-Class Collision Average Recurrence Intervals (years)

Vessel Class	Collisions / Total
Cargo	76
Fishing – Transiting	47
Fishing – Active	31
Passenger	1185
Recreational	147
Tanker	918
Tug-Tow	119
Other	147
All	11

1. Average Recurrence Interval refers to the average time in years between collision events.

Overall, the total frequency of all accident scenarios for all vessel classes was calculated to be 0.09 accidents per year (9% annual probability), corresponding to an approximately 11-year average recurrence interval. As will be discussed in Section 8.2, there have been two collisions that occurred on the western boundary of the NORM area within the USCG SAR dataset; this finding from the NORM model and historical data are within the statistical uncertainty associated with the observed collision rate in the vicinity of the Lease Area.

7.2.2 Operational Phase

The operational phase (post-construction) scenario was carried out in NORM using the same inputs as the pre-construction scenario, but with the WTG and OSS layout considered. It was assumed that only fishing and recreational vessels would transit through the Lease Areas, and the rest would re-route around.

In addition, the Project's O&M vessels are expected to transit to and from, as well as within, the Lease Areas. This was accounted for in the NORM model by creating synthetic vessel tracks from Atlantic City to the WTGs. It was assumed that there would be a random distribution of O&M traffic down each corridor. It was assumed that these vessels will consist of CTVs originating from Atlantic City (as use of CTVs produced the largest number of transits). The CTVs were assigned a 98 ft (30 m) LOA, 33 ft (10 m) beam, and an average speed of 15 knots. The volume of O&M traffic was estimated to be up to 4380 round trips per year (equivalent to approximately twelve round trips per day; six in each of the two Lease Areas). It was also assumed that the O&M vessels would return to Atlantic City along the same path that was used to get there, to account for their potential interaction with other vessels along the way.

For travel within or through the Lease Areas, the remaining types of vessels were "routed" through the corridors between the array of WTGs. The algorithm used for this routing isolates vessel tracks that intersect with the Lease Areas and determines the appropriate corridor of travel based on the intersection location and angle. The closest corridor with the greatest directional alignment with the vessel course when it enters the WTG grid is chosen. It is assumed that no turning occurs during transit through the corridors; that is, an optimal route analysis was not performed for this step. This is a simplified routing process used to assess the relative level of traffic in each corridor. The re-routed north to south corridors is shown in Figure 7.2.

For the operational phase, OSSs were also included in select corridors and their impact on allision risk was incorporated into the NORM calculations. For the analysis, the OSS foundations were assumed to be 328 ft

(100 m) by 492 ft (150 m) at the waterline. Met Towers included in the analysis were assumed to be the same dimension as the WTGs. The Map of OSSs and Met Towers included in the model are shown in Figure 4.1.

An important distinction between the pre-construction and operational phase risk calculation methodology is how traffic is handled both inside and outside the Lease Area. For the operational phase calculations, portions of the traffic are both inside and outside of the Lease Area. Vessels within the Lease Area are constrained by the physical geometry of the WTGs and OSSs and are thus likely to have more overlap in vessel lane distributions. Lane distribution refers to the probable distribution of lateral vessel position across the width of a waterway. The layout of the WTGs and OSSs also restricts the direction of travel and potential crossing angles. Therefore, for the operational phase calculations, the risk is calculated individually and summed for vessels both inside and outside the Lease Area.

Outputs from NORM for the operations phase navigational risk calculations are summarized in Table 7.3 and Figure 7.3. Note that results for both the 39.4 ft (12.0 m) and 98.4 ft (30.0) maximum foundation width scenarios are presented with the latter shown in brackets. Table 7.4 presents the same results in terms of average recurrence intervals.

The navigational risk (for both pre-construction and operational phases) is generally dominated by crossing collisions and mostly by fishing, tug/tow, and cargo vessels. The risk from fishing vessels also appears to be mostly from transiting vessels. For the operational phase, there are also the contributions from potential collisions with O&M vessels and potential allisions with the WTGs/OSSs. The allision results suggest that both scenarios are quite low in probability, but that drifting allisions are considerably more likely than powered allisions.

Overall, the total frequency of all operations phase accident scenarios for all vessel classes was calculated to be 0.10 to 0.11 accidents per year (10% to 11% annual probability), corresponding to a return period of approximately 10 and 9 years, respectively.

If one considers the risk to existing vessel traffic (i.e., excluding collisions between O&M vessels themselves or allisions by O&M vessels), the overall frequency drops to 0.098 to 0.107 accidents per year, corresponding to return periods of approximately 10.2 and 9.4 years. This change from the base case represents one additional accident every 59 to 130 years, depending on the foundation type.

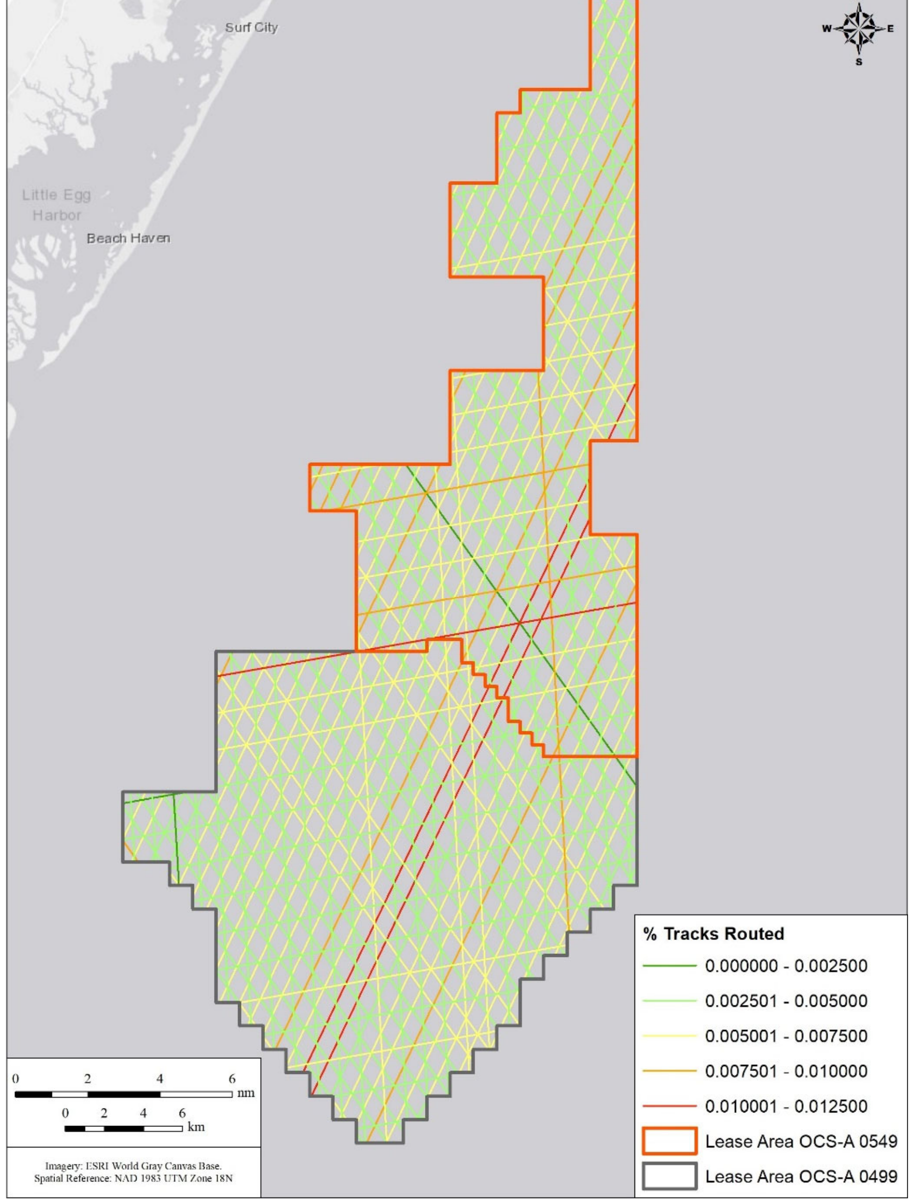

Figure 7.2: Routed Traffic Through Both Lease Areas for Operational Case (Colored by Percent of Traffic Routed)

Table 7.3: Estimated Operational Phase Inter-Class Accident Annual Frequencies

Vessel Class	Collisions	Allisions	Total
Cargo	1.5E-2 (1.5E-2)	-	1.5E-2 (1.5E-2)
Fishing – Transiting	2.0E-2 (2.0E-2)	1.1E-3 (2.2E-3)	2.1E-2 (2.2E-2)
Fishing – Active	3.1E-2 (3.1E-2)	1.2E-3 (2.0E-3)	3.2E-2 (3.3E-2)
Passenger	8.4E-4 (8.4E-4)	-	8.4E-4 (8.4E-4)
Recreational	7.1E-3 (7.1E-3)	4.9E-4 (1.1E-3)	7.6E-3 (8.1E-3)
Tanker	1.1E-3 (1.1E-3)	-	1.1E-3 (1.1E-3)
Tug-Tow	9.5E-3 (9.5E-3)	-	9.5E-3 (9.5E-3)
Other	7.4E-3 (7.4E-3)	-	7.4E-3 (7.4E-3)
O&M	8.1E-3 (8.1E-3)	1.2E-3 (1.9E-3)	9.2E-3 (1.0E-2)
All	9.9E-2 (9.9E-2)	4.0E-3 (7.2E-3)	1.0E-1 (1.1E-1)

Note that results for both the 39.4 ft (12.0 m) and 98.4 ft (30.0) foundation widths are presented. The 39.4 ft (12.0 m) foundation width is associated with the monopile, mono-bucket, suction bucket tetrahedron base, gravity-pad tetrahedron base, and GBS WTG foundation types. The 98.4 ft (30.0) foundation width is associated with the piled jacket and suction bucket jacket WTG foundation types; the results for these foundation types are presented in brackets.

Table 7.4: Estimated Operational Phase Inter-Class Accident Average Recurrence Intervals (years)

Vessel Class	Collisions (years)	Allisions (years)	Total Average Recurrence Interval (years)
Cargo	66 (66)	-	66 (66)
Fishing – Transiting	51 (51)	871 (454)	48 (46)
Fishing – Active	33 (33)	868 (511)	32 (31)
Passenger	1191 (1191)	-	1191 (1191)
Recreational	141 (141)	2030 (949)	132 (123)
Tanker	911 (911)	-	911 (911)
Tug-Tow	105 (105)	-	105 (105)
Other	135 (135)	-	135 (135)
O&M	124 (124)	864 (514)	109 (100)
All	10 (10)	253 (140)	10 (9)

Note that results for both the 39.4 ft (12.0 m) and 98.4 ft (30.0) foundation widths are presented. The 39.4 ft (12.0 m) foundation width is associated with the monopile, mono-bucket, suction bucket tetrahedron base, gravity-pad tetrahedron base, and GBS WTG foundation types. The 98.4 ft (30.0) foundation width is associated with the piled jacket and suction bucket jacket WTG foundation types; the results for these foundation types are presented in paratheses.

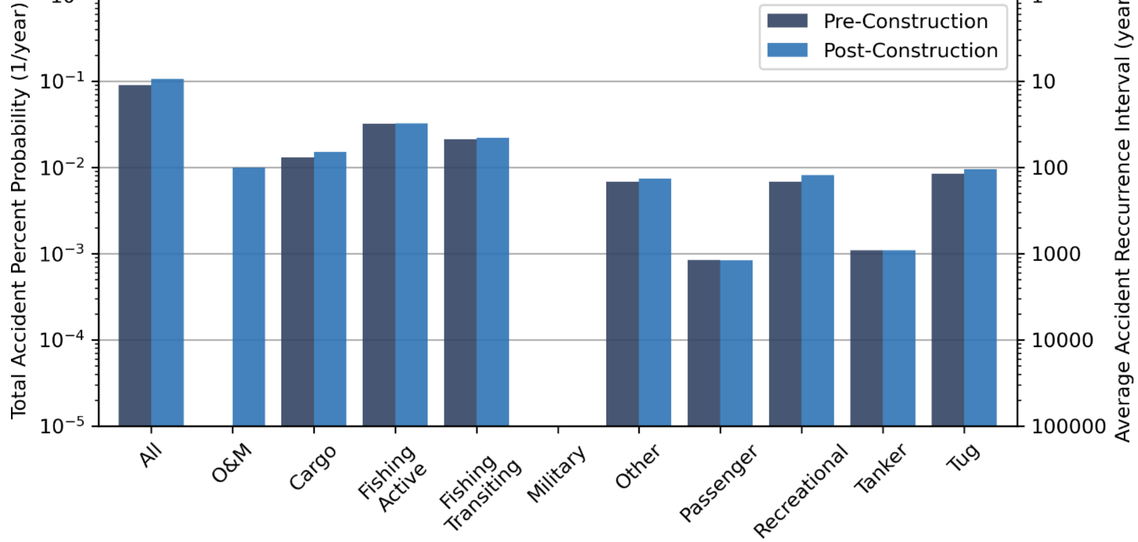

Figure 7.3: Estimated Operational Phase Inter-Class Accident Annual Frequencies

7.2.3 Interpretation of Results

The primary risks for collision under existing conditions occur between the cargo, tug tows, transiting fishing and recreational vessels, as summarized in Table 7.1, as these vessels represent most of the vessel traffic. Cargo, tanker, and passenger vessels have dominant north-south vessel tracks and generally transit to the east of the Lease Area. Atlantic Shores anticipates that a small proportion of this traffic will need to alter their tracks to bypass the Project to the east, as noted in the ACPARS and CPAPARS. This will tend to increase the traffic density to the east by a small amount; this was accounted for in the NORM model.

Based on the relatively small changes in traffic patterns for the large commercial vessels, the number of encounters (crossing of paths) between fishing and recreational craft with the commercial traffic is expected to remain largely the same in the future as with existing conditions, and hence risks of collision are expected to be similar. For example, encounters that occurred between fishing and cargo vessels that took place in the Lease Area will now occur to the east of the site.

Atlantic Shores anticipates that most fishing and recreational craft transiting within the Lease Area will continue to do so after installation of the WTGs; however, now this traffic will tend to follow defined corridors. This was shown in the NORM model to reduce risk slightly as crossing encounters often occur at oblique angles and predictable directions. Countering this risk reduction to some degree is the presence of the WTGs/OSSs and the potential for allisions with these structures. In addition, there is considerable additional traffic associated with the O&M vessels, which creates potential for collisions with existing traffic (both inside and outside WTG corridors) and allision with the structures. Note that the use of CTVs was assumed in the analysis; if some or all of the crew transfer is carried out by SOV, then the number of transits is reduced.

It is important to note that the causation probability for collisions (i.e., essentially the probability that human error will occur) was unchanged between the existing and future cases in the model. Allisions were found to contribute a small percentage of the overall risk, with powered allisions being considerably less likely than drifting.

In general, the change in risk from pre-construction to the operational phase is small and indicates that the construction of WTGs and OSSs would have only a small impact on navigational risk.

8. Emergency Response Considerations

The potential effect of the proposed Lease Area on USCG SAR and Marine Environmental Response (MER) missions has been assessed through analyses of historical data, discussions with a local commercial salvor, and consideration of aerial SAR requirements. Possible mitigations to improve both the search and rescue components of a mission have been considered.

8.1 USCG Assets

The USCG Fifth District operates several response bases in the region as shown in Figure 8.1. The key locations in terms of marine response are:

- Coast Guard Station Atlantic City
- Coast Guard Station Barnegat Light
- Coast Guard Station Manasquan Inlet
- Coast Guard Station Cape May
- Coast Guard Station Beach Haven
- Coast Guard Station Great Egg
- Coast Guard Station Townsend Inlet

Key SAR marine assets include Sentinel class Fast Response Cutters that homeport in Cape May and Protector class patrol Cutters based at the various other stations. The Sentinel and Protector class vessels have overall lengths of 154 ft (46.9 m) and 87 ft (26.5 m), respectively.

Aerial SAR response is provided by Coast Guard Air Station Atlantic City, a USCG Air Station located nine miles northwest of Atlantic City at the Atlantic City International Airport in Egg Harbor Township, New Jersey. It is the northernmost, largest air station within the USCG Fifth District. Air Station Atlantic City consists of 11 MH-65D Dolphin helicopters and maintains two MH-65D helicopters in 30-minute response status. Approximately 250 aviation personnel are staffed at the facility in addition to Coast Guard Reserve personnel and Coast Guard Auxiliary members that augment its Active-Duty forces.

8.2 Search and Rescue (SAR)

Ten years (2011 to 2020) of USCG SAR data were obtained from the USCG Fifth District and have been analyzed and mapped. Data for a total of 169,895 SAR missions starting in fiscal year 2011 to 2020 were extracted and were categorized into 38 incident types.

Figure 8.2 shows SAR sorties in the Project Area. The sorties within the combined Lease Areas are roughly equally distributed between aerial and marine missions.

Figure 8.3 provides a summary of SAR incidents around the Lease Area including an assumed “drift buffer area.” The buffer area extends 2 nm (3.8 km) beyond the lease boundary and is based on an assumed maximum two-hour response time for the USCG and a drift velocity of 1 knot (1.9 kilometer per hour [kph]). A total of 31 SAR missions were found within the confines of the buffer area as summarized in Table 8.1. Of these, six occurred within the Lease Area.

To better understand the conditions occurring during each mission, wind and wave data from a nearby buoy (NOAA Buoy 44009) was obtained, and the wind speed and wave height measured at the time of initial notification to the USCG was identified (last two columns in Table 8.1).

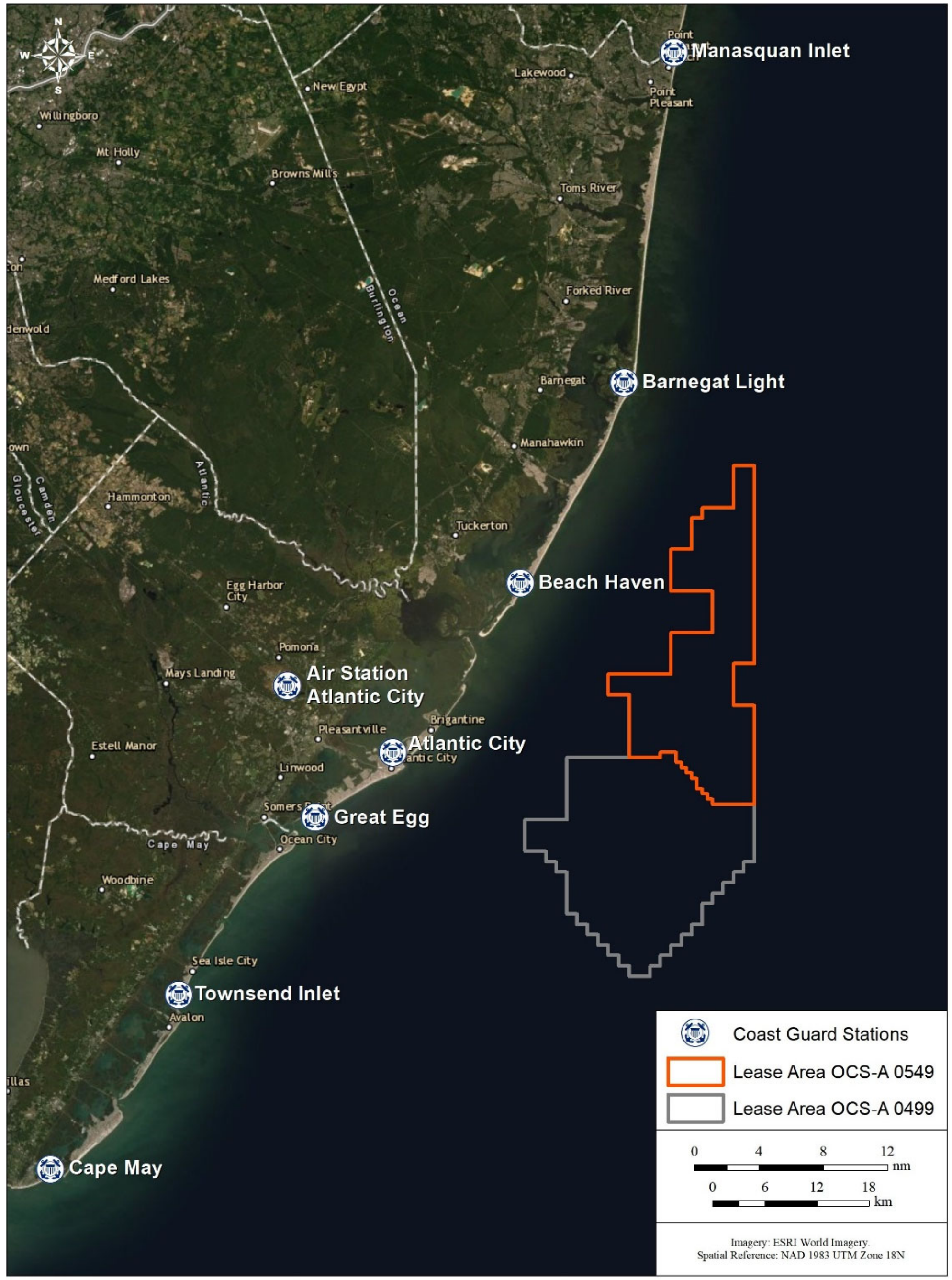

Figure 8.1: USCG Stations

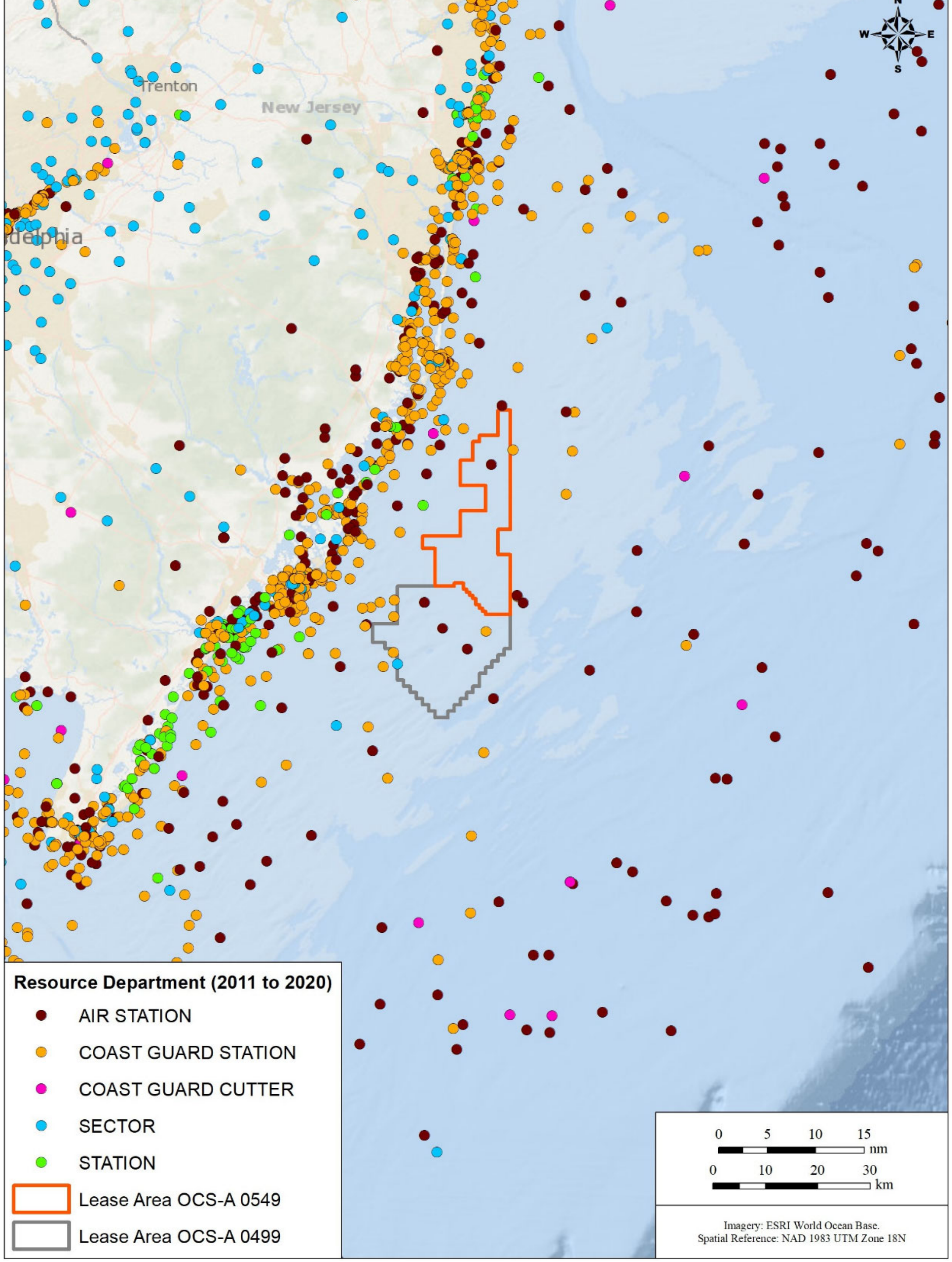

Figure 8.2: SAR Sorties (2011 to 2020) for the New Jersey Coastline

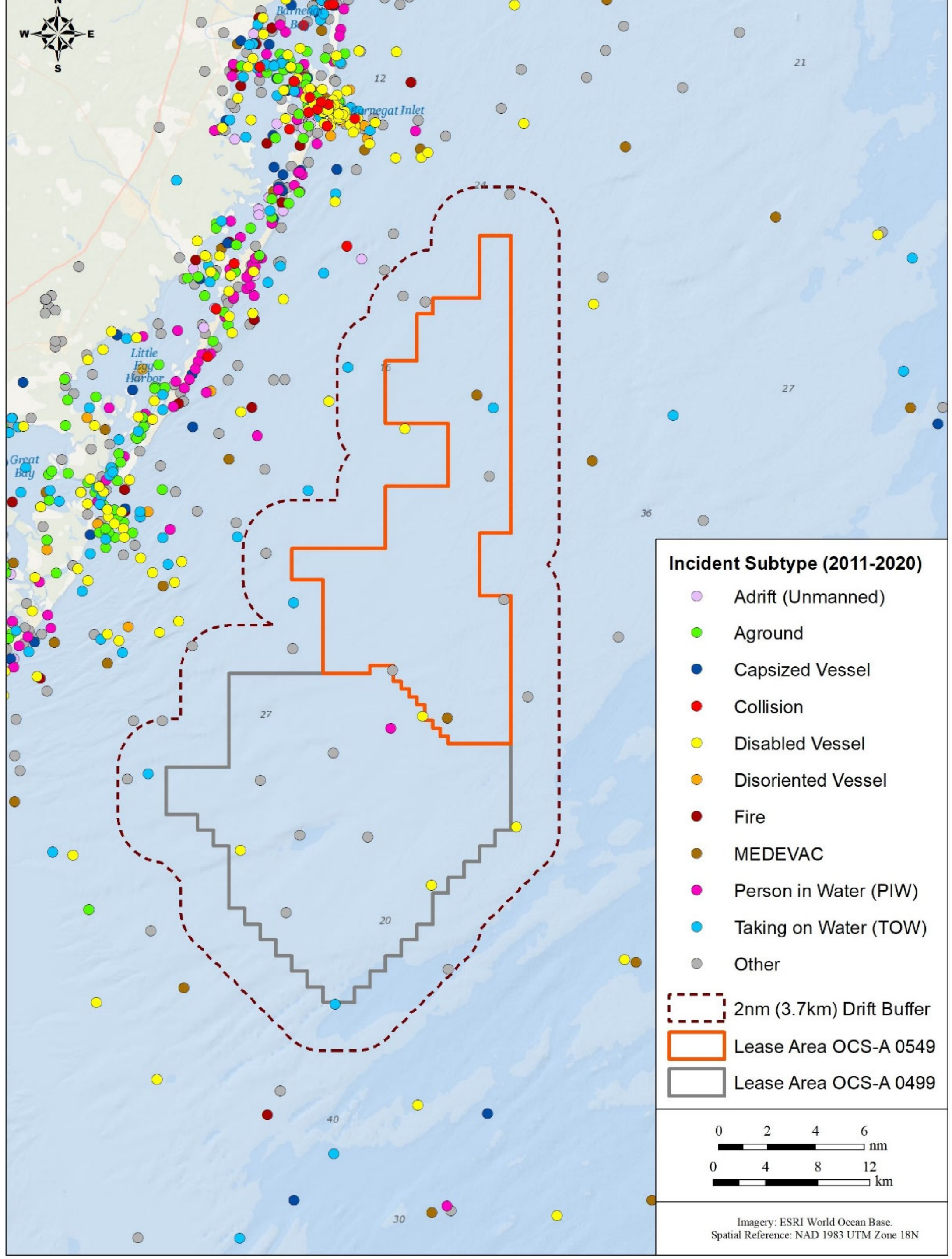

Figure 8.3: SAR Incidents with 2 nm Buffer Shown

le 8.1: Historical SAR Incidents within the Buffer Area (2011-2020)

ase ID	First Notification (UTC)	Season	Day/Night	Originating Department	Incident Type	Wind Speed (knots)	Wave Height (ft)
52354	2011/02/25 14:55	Winter	Day	D5 Operations Div (O) (003558)	Distress Alert – situation unknown	30	9.9
14670	2011/08/13 15:51	Summer	Day	Cg Sta Barnegat Light (000560)	Taking on Water (TOW)	3	1.8
35028	2011/09/04 03:37	Summer	Night	Sector Delaware Bay (007308)	Distress Alert – situation unknown	10	4.4
97715	2011/07/28 20:33	Summer	Day	Sector Delaware Bay (007308)	Overdue Vessel	8	1.8
15070	2011/08/14 16:08	Summer	Day	Sector Delaware Bay (007308)	Uncorrelated MAYDAY	16	4.3
52740	2011/02/25 22:57	Winter	Night	Sector Delaware Bay (007308)	Taking on Water (TOW)	35	10.3
76415	2010/10/24 16:20	Autumn	Day	Sector Delaware Bay (007308)	MEDICO	14	3.0
15218	2012/05/18 21:30	Spring	Day	Sector Delaware Bay (007308)	Disabled Vessel	19	6.0
68900	2013/04/14 21:00	Spring	Day	Cg Sta Barnegat Light (000560)	Disabled Vessel	0	2.8
20974	2013/09/23 11:56	Autumn	Day	Sector Delaware Bay (007308)	Uncorrelated MAYDAY	n/a	5.1
63486	2012/10/14 03:14	Autumn	Night	Sector Delaware Bay (007308)	Disabled Vessel	12	2.7
55193	2013/11/19 03:50	Autumn	Night	Sector Delaware Bay (007308)	Distress Alert – situation unknown	n/a	4.0
25518	2016/07/01 02:48	Summer	Night	Sector Delaware Bay (007308)	Distress Alert – situation unknown	n/a	2.0
96153	2016/01/12 17:43	Winter	Day	Sector Delaware Bay (007308)	Disabled Vessel	26	5.8
94354	2015/10/18 14:50	Winter	Day	Sector Delaware Bay (007308)	Person in Water (PIW)	13	4.0
45145	2015/09/18 14:25	Autumn	Day	Sector Delaware Bay (007308)	Disabled Vessel	4	1.1
93467	n/a	Winter	-	Sta (Sm) Beach Haven (003373)	Uncorrelated MAYDAY	n/a	n/a
03890	2017/07/10 09:53	Summer	Night	D5 Operations Div (O) (003558)	Distress Alert – situation unknown	9	2.0
35336	2017/08/09 15:40	Summer	Day	Sector Delaware Bay (007308)	MEDEVAC	5	2.2
62945	2016/12/27 23:20	Winter	Night	Sector Delaware Bay (007308)	Distress Alert – situation unknown	n/a	n/a

ase ID	First Notification (UTC)	Season	Day/Night	Originating Department	Incident Type	Wind Speed (knots)	Wave Height (ft)
14905	2016/10/03 17:53	Autumn	Day	Sector Delaware Bay (007308)	MEDEVAC	n/a	n/a
23702	2018/08/27 00:26	Summer	Day	Sector Delaware Bay (007308)	Distress Alert – situation unknown	14	2.8
31676	2018/06/01 19:26	Summer	Day	Sector Delaware Bay (007308)	Taking on Water (TOW)	7	2.1
89890	2017/10/18 03:54	Autumn	Night	Sector Delaware Bay (007308)	Distress Alert – situation unknown	1	2.6
23143	2019/09/28 15:00	Autumn	Day	Sector Delaware Bay (007308)	Taking on Water (TOW)	11	2.2
85424	2020/01/08 18:21	Winter	Day	D5 Operations Div (O) (003558)	Distress Alert – situation unknown	26	4.8
64499	2020/09/24 19:47	Autumn	Day	Sector Delaware Bay (007308)	Taking on Water (TOW)	n/a	3.6
68481	2019/12/06 08:20	Winter	Night	Sector Delaware Bay (007308)	Overdue Vessel	11	2.2
67636	2019/12/05 10:19	Winter	Night	Sector Delaware Bay (007308)	Distress Alert – situation unknown	22	3.5
56926	2019/11/16 22:12	Autumn	Night	Sector Delaware Bay (007308)	MAYDAY Broadcast	28	12.3
11698	2020/07/20 21:37	Summer	Day	Cgd One (000341)	Distress Alert – situation unknown	n/a	2.8

The following observations were made from the data:

- The incidents were spread throughout the seasons with the least in spring (2) and most in summer and autumn (10 each).
- Approximately 60% of the incidents occurred during daylight hours.
- The types of incidents varied including 11 distress alerts, four Mayday calls, five disabled vessels, five vessels taking on water, three medical evacuations, two overdue vessels and one person in water.
- Five of the events occurred when wind speeds equaled or exceeded 25 knots and two events occurred with wave heights exceeding 10 ft.

8.3 Marine Environmental Response (MER)

An analysis of a Marine Information for Safety and Law Enforcement (MISLE) database from 2002 to 2021 was carried out to identify potential vessel marine environmental response events in the region. Figure 8.4 shows the historical and recent spill locations. As may be noted in the figure, the majority of the spills have occurred nearshore and there are seven offshore spills. Of the seven spills, three are around Lease Area OCS-A 0549:

- There were two small discharges of oil from cutter/dredger vessels that occurred in July and November 2018.
- A discharge of approximately 500 gallons of bilge slops from a towing vessel occurred in September 2019.

8.4 Commercial Salvors

There are a variety of commercial operators who provide vessel towing facilities along the Atlantic coastline of New Jersey. Discussions were held with the operator TowboatUS of Atlantic City, one of the closest facilities to the proposed Lease Area. Services provided include vessel towing, repair, and salvage. Their service area covers up to 75 nm (139 km) offshore, although many of the rescues are conducted within 10 nm (19 km) of shore. In terms of offshore tows, these tend to occur at popular fishing grounds, including the large artificial reef that is located to the south of Lease Area. TowboatUS's fleet consists of a range of vessels from 26- and 28-ft (7.9- and 8.5-m) small craft for use nearshore to a 100-ft (30-m) former offshore supply vessel for operations farther offshore.

Almost all of the responses are associated with recreational craft, although there have been a few commercial fishing vessels in the past. During a busy summer day, it was noted that there can be 200 to 300 vessels fishing offshore, and that it was typical to perform one or more tows per day. The busy season for recreational craft (and rescue services) starts on Memorial Day weekend and ends on Labor Day (~4 months).

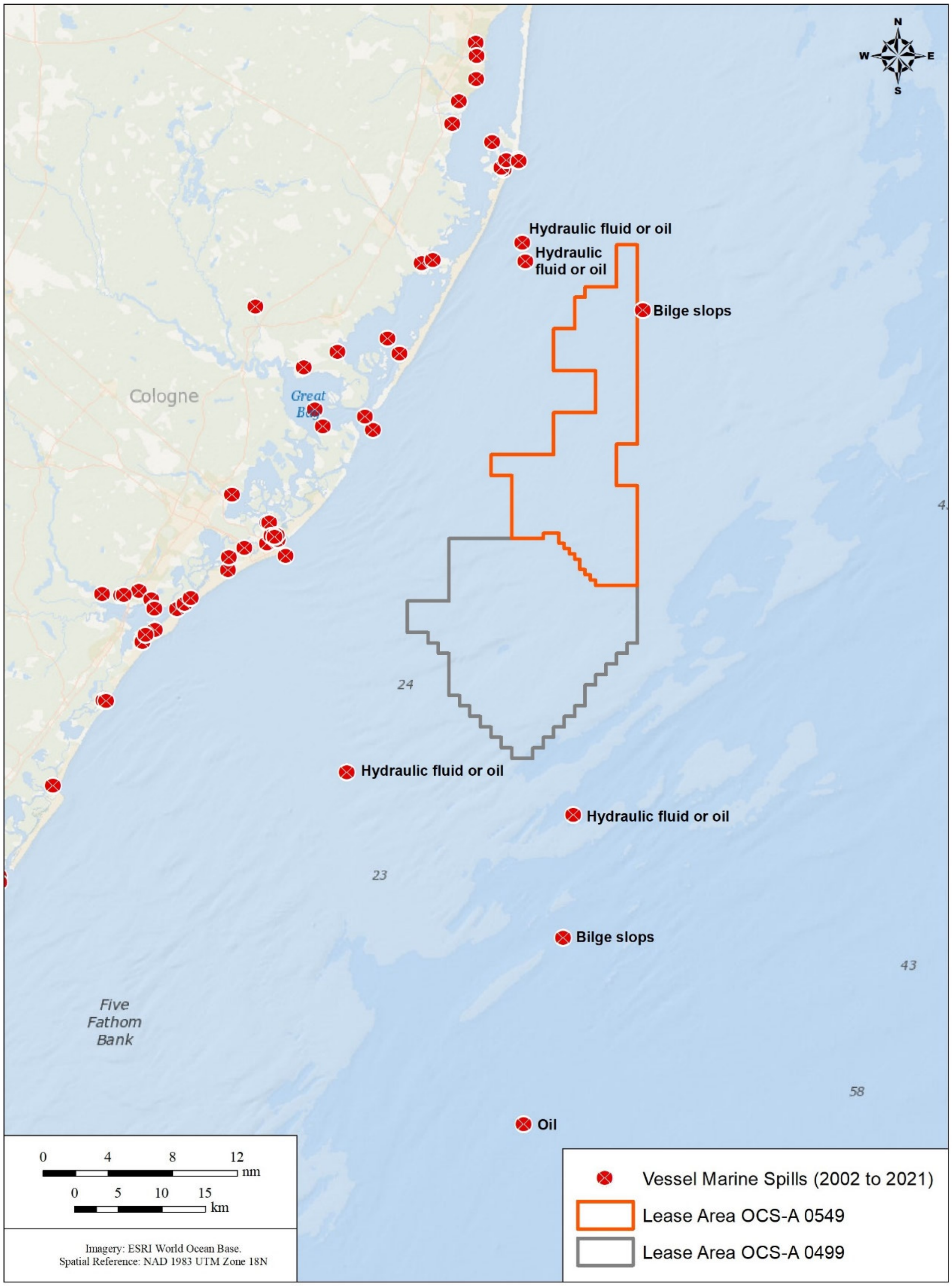

Figure 8.4: Marine Environmental Spill Response Incidents

8.5 Impact of the WTGs on SAR

USCG marine responders are very experienced with the types of conditions that may be encountered within the Lease Area, are well trained in safe navigation, and utilize recent navigational technology. Given the minimum 72.2 ft (22.0 m) clearance between HAT and the blade tips, Atlantic Shores does not expect that there will be an appreciable impact on the ability of USCG SAR vessels in the region to operate in and around the WTGs as the vessel mast heights are less than this clearance. Only if a larger vessel, such as a Medium Endurance class vessel out of Boston or Portsmouth, with an air draft greater than 72 ft, were to participate in the search would there be a possibility of interference between a blade and the vessel mast if the vessel were in very close proximity to a WTG. Atlantic Shores would coordinate directly with USCG during any SAR operations and the WTGs could be fixed in a "bunny ears" position through use of the braking system.

Atlantic Shores does not anticipate that the Project will affect travel times to and within the Lease Area by vessels responding to SAR distress calls. The WTG layout may have some effect on the operation of USCG marine assets (or commercial salvors vessels) that are in use in the area, although and it is expected that these assets will be able to safely navigate and maneuver adequately within the Lease Area. However, search patterns would need to adapt for the presence of the structures and would be constrained by the WTG layout.

To address aerial SAR, a Risk Assessment Workshop was held in July 2021 to methodically review the potential impacts of the proposed offshore wind projects within the Lease Area on USCG SAR operations and to identify safeguards and additional recommended measures to mitigate these measures (Atlantic Shores, 2021). The workshop was held over a two-day period with participation by the USCG, BOEM, Atlantic Shores, and other relevant stakeholders. The workshop team evaluated 13 hazardous scenarios in four hazard categories and identified 16 recommendations to support the reduction of overall risk to USCG aerial SAR missions. Atlantic Shores is reviewing the recommendations in coordination with the USCG and key stakeholders and may elect to implement recommendations that are found to meaningfully reduce risk. As part of this work, various possible mitigations to aid in detection of disabled vessels or persons in water are being considered, as summarized in Section 8.6 below.

Although there will be OSS located within two of the north-south transit corridors, the elevation of these structures is relatively low (maximum 63 m MLLW) as compared to the WTGs.

8.6 Potential Mitigations to Support SAR

Various potential mitigations to assist with SAR are being discussed with the USCG, including:

- Use of a Marine Coordinator to liaise with the USCG as required during SAR activity within Lease Area, particularly with respect to emergency braking of selected WTG rotors.
- Clear alphanumeric marking of WTGs, OSSs, and the Met Tower to assist in communication of location.
- Possible mitigations to assist in search detection, including installation of VHF direction finding equipment, real-time weather measurements (waves, wind, currents), and high-resolution infrared detection systems to assist in location of persons in water and/or vessels.
- Atlantic Shores expects that the access ladders on the WTG and OSS foundations will be designed to allow distressed mariners access to an open refuge area on top of the ladder. The presence of a person on the offshore structure will be detected using cameras and intrusion detectors.

Development of an Emergency Response Plan (ERP) to specify coordination, shutdown, and rescue procedures. The ERP will be reviewed and updated at least annually between Atlantic Shores and the USCG.

9. Facility Characteristics and Design Requirements

9.1 Marine Marking and Lighting

The WTGs will be permitted as a PATON and appropriate markings and lighting will be installed in accordance with USCG's *NC – VA – MD – DE – NJ – Atlantic Ocean – Offshore Structure Paton Marking Guidance* contained in District 5 LNM 23/22. These requirements are also provided in BOEM's Guidelines for the Lighting and Marking of Structures Supporting Renewable Energy Development as published in April 2021.

The PATON will meet USCG availability standards and will be maintained throughout the life of the WTGs, including maintaining procedures to correct any discrepancies. No impact to existing Federally maintained ATONs is anticipated due to the WTG or associated PATONs.

Based on current USCG and BOEM guidance, the following lighting, marking, and signaling requirements are expected; however, they will be marked and lit in accordance with guidance in effect at the time the Project is constructed:

Floating Structure Color:

- The color will be no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey in color.
- The floating foundation center and radial columns shall be painted yellow (RAL 1023) all around from the level of Mean Higher High Water (MHHW) to 50 ft (15.2 m) above MHHW.
- Ladders at the foundation base will be painted in a color that contrasts with the yellow.

Floating Structure Identification Marking:

- The structure will be uniquely lettered and numbered.
- Letter and number labels will be as near to 9.8 ft (3 m) high as possible.
- The bottom of the alphanumeric characters will be located at least 30 ft and no higher than 50 ft above Mean Higher High Water.
- Identification markings will be visible above any servicing platforms.
- Identification markings will be visible throughout a 360-degree arc from the water's surface.
- Identification markings will also be visible at night through the use of retro-reflective paint and lettering/numbering materials.
- The structure will also be labelled below the servicing platform, if feasible.

Structure Lighting:

- Lighting will be visible throughout a 360-degree arc from the water's surface.
- Significant Peripheral Structures (SPS), which are corners and other key points along the wind farm periphery, should be marked with quick flashing yellow lights with an operational range of not less than 5 nm (9.3 km).
- Intermediate Peripheral Structures (IPS), which are those structures along the perimeter of the wind farm between the SPSs, should be marked with 2.5 second flashing yellow lights with an operational range of not less than 3 nm (5.6 km).
- Inner towers would be marked with 6- or 10-second flashing yellow lights with a 2-nmi operational range.
- Lights serving the same function (SPS, IPS, etc.) should be synchronized.

- Temporary structures during construction and installation should be marked with a quick, flashing yellow obstruction lights visible through 360 degrees at a minimum distance of 5 nm (9.3 km).

Sound Signal:

- A sound signal will be provided on all SPS and IPS as long as distance doesn't exceed 3 nm. It will sound every 30 seconds (4 second Blast, 26 seconds off) and will be set to project at a range of 2 nm. The sound signal will be Mariner Radio Activated Sound Signals (MRASS) activated by keying VHF Radio frequency 83A five times within 10 seconds and must continue to sound for 45 minutes.

AIS Transponder:

- An AIS transponder (virtual mark) will be placed on all SPS and at other significant locations and should be capable of transmitting signals marking the locations of all structures within the Project.

Additional guidance is provided in BOEM (2021) with respect to environmental considerations related to potential impacts to birds, bats, marine mammals, turtles, and fish including minimization of direct lighting.

Atlantic Shores will coordinate with the USCG and NOAA on navigational chart updates showing positions of constructed WTGs and OSSs. Similarly, Atlantic Shores will coordinate with the USCG on the issuance of LNMs.

9.2 Aviation Marking and Lighting

Aviation marking and lighting shall be done in accordance with BOEM (2021) guidance, and three documents published by the Federal Aviation Administration (FAA) pertaining to the marking and lighting of offshore WTGs:

- Advisory Circular (AC) No. 70/7460, dated November 16, 2020, provides the FAA's standards for the marking and lighting of structures. Chapter 13 of this document specifically addresses the marking and lighting of wind turbines during the construction and operation phases.
- AC No. 150/5345-43J, dated March 11, 2019, provides specifications for obstruction lighting equipment.
- Engineering Brief No. 98, dated December 18, 2017, provides information about the interaction of LEDs used in obstruction lighting fixtures with Night Vision Imaging Systems (NVIS).

Note that the FAA standards only apply within 12 nm (22.2 km) offshore, which is the jurisdictional limit for the FAA. BOEM (2021) recommendations apply beyond the 12 nm (22.2 km) limit and are consistent with the FAA requirements.

9.3 Turbine Control

The WTGs and transmission systems will be operated from Atlantic Shores operation center. This will include the operations center personnel to fix and maintain the position of the turbine blades, nacelle and any other moving parts.

Methods for safe shutdown of the turbines will be established and agreed to with consultation with the USCG and other emergency support services.

9.4 Nacelle Access

WTG nacelle hatches will be capable of being opened from the outside to permit rescuers to gain access if occupants are unable to assist.

10. Operational Requirements and Procedures

The following summarizes key operational requirements and procedures:

- A Marine Coordinator will manage vessel movements throughout the Offshore Project Area. The Marine Coordinator will be responsible for monitoring daily vessel movements, implementing communication protocols with external vessels, and monitoring safety buffers. The Marine Coordinator will be Atlantic Shores' primary point of contact with USCG, port authorities, state and local law enforcement, marine patrol, port operators, and commercial operators (e.g., ferry, tourist, and fishing boat operators).
- Atlantic Shores will maintain an operations center that monitors the status, production, and health of the Project 24 hours per day by means of a supervisory control and data acquisition (SCADA) system. The SCADA system also provides remote control of the Project's equipment, allowing the operator to override automatic operations, remotely reset the Project's systems, adjust control parameters, and shut down equipment for maintenance or at the request of grid operators, regulators, or search and rescue (SAR).
- Applicable USCG command centers will be advised as contact details for the Marine Coordinator and operations center.
- The WTGs' rotor emergency braking systems will be used to fix and maintain the position of the WTG blades, nacelles, and other appropriate moving parts during a SAR event upon the request of the USCG.
- Direct coordination in SAR missions within the Lease Area by the Marine Coordinator.
- Development of an Emergency Response Plan (ERP) to specify coordination, shutdown, and rescue procedures. The ERP will be reviewed and updated at least annually between Atlantic Shores and the USCG.
- Bi-annual testing of the communication and rotor braking systems.
- The FLO and FIR(s), as part of an overall FCP, will communicate and coordinate with the local commercial and recreational fishing community.

Atlantic Shores is also considering the following to support the USCG in SAR activities within the Lease Area:

- Possible mitigations to assist in search detection, including installation of VHF direction finding equipment, real-time weather measurements (waves, wind, currents), and high-resolution infrared detection systems to assist in location of persons in water and/or vessels.
- Atlantic Shores expects that the access ladders on the WTG and OSS foundations will be designed to allow distressed mariners access to an open refuge area on top of the ladder. The presence of a person on the offshore structure will be detected using cameras and intrusion detectors.

Following an allision with a wind farm structure, Atlantic Shores will submit documentation to the USCG that verifies the structural integrity.

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Appendix A

NVIC 01-19 Checklist

ISSUE	REPORT SECTION	NOTES
1. SITE AND INSTALLATION COORDINATE		
Has the developer ensured that coordinates and subsequent variations of site perimeters and individual structures are made available, upon request, to interested parties at all, relevant project stages?	App. B	Yes, details have been provided.
Has the coordinate data been supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format? Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 datum.	App. B	Coordinates provided in Appendix B; GIS files available upon request.
2. TRAFFIC SURVEY		
Was the traffic survey conducted within 12 months of the NSRA?	3.2.2	Yes, data to September 2021 considered
Does the survey include all vessel types?	3.2.2	Yes
Is the time period of the survey at least 28 days duration?	3.2.2	Yes, 5.75 years of data considered
Does the survey include consultation with recreational vessel organizations?	3.2.1	Extensive consultations have been carried out by Atlantic Shores.
Does the survey include consultation with fishing vessel organizations?	3.2.1	
Does the survey include consultation with pilot organizations?		
Does the survey include consultation with commercial vessel organizations?		
Does the survey include consultation with port authorities?		
Does the survey include proposed structure location relative to areas used by any type of vessel?	3.2.2	Yes
Does the survey include numbers, types, sizes and other characteristics of vessels presently using such areas?	3.2.2	Yes
Does the survey include types of cargo carried by vessels presently using such areas?	3.2.2	Yes
Does the survey identify non-transit uses of the areas (for example, fishing, day cruising of leisure craft, racing, marine regattas and parades, aggregate mining)?	3.2.6.3	Yes
Does the survey include whether these areas contain transit routes used by coastal or deep-draft vessels, ferry routes, and fishing vessel routes?	3.2.6.2	Yes

ISSUE	REPORT SECTION	NOTES
Does the survey include alignment and proximity of the site relative to adjacent shipping routes	3.2.6.2	Yes
Does the survey include whether the nearby area contains prescribed or recommended routing measures or precautionary areas?	3.2.6.2	Yes
Does the survey include whether the site lies on or near a prescribed or conventionally accepted separation zone between two opposing routes or traffic separation scheme?	3.2.6.2	Yes
Does the survey include the proximity of the site to anchorage grounds or areas, safe haven, port approaches, and pilot boarding or landing areas?	3.2.6.2	Yes
Does the survey include the feasibility of allowing vessels to anchor within the vicinity of the structure field?	4.3.2	Yes
Does the survey include the proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds?	3.2.4, 3.2.5, & 3.2.6.3	Yes
Does the survey include whether the site lies within the limits of jurisdiction of a port and/or navigation authority?	3.2.6.2	Yes
Does the survey include the proximity of the site to offshore firing/bombing ranges and areas used for any marine or airborne military purposes?	3.2.6.5	Yes
Does the survey include the proximity of the site to existing or proposed offshore OREi/gas platform or marine aggregate mining?	3.2.6.3	Yes
Does the survey include the proximity of the site to existing or proposed structure developments?	3.2.6.3	Yes
Does the survey include the proximity of the site relative to any designated areas for the disposal of dredging material or ocean disposal site?	3.2.6.3	Yes
Does the survey include the proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon?	3.2.6.2	Yes
Does the survey include a researched opinion using computer simulation techniques with respect to the displacement of traffic, mixing of vessel types that were previously segregated; changes in traffic density and resultant change in vessels encounters; and, in particular, the creation of 'choke points' in areas of high traffic density?	7.0	Yes
Does the survey include whether the site lies in or near areas that will be affected by variations in traffic patterns as a result of changes to vessel emission requirements?	3.4	Yes
Does the survey include seasonal variations in traffic?	3.2.10	Yes

ISSUE	REPORT SECTION	NOTES
3. OFFSHORE ABOVE WATER STRUCTURE		
Does the NSRA denote whether any features of the offshore above water structure, including auxiliary platforms outside the main generator site and cabling to the shore, could pose any type of difficulty or danger to vessels underway, performing normal operations, or anchoring? Such dangers would include clearances of wind turbine blades above the sea surface, the burial depth of cabling, and lateral movement of floating wind turbines.	4.2	Yes
Does the NSRA denote whether minimum safe (air) clearances between sea level conditions at Mean Higher High Water (MHHW) and wind turbine rotors are suitable for the vessel types identified in the traffic survey? Depths, clearances, and similar features of other structure types which might affect navigation safety and other Coast Guard missions should be determined on a case-by-case basis.	4.2.4	Yes
Does the NSRA denote whether any feature of the installation could impede emergency rescue services, including the use of lifeboats, helicopters and emergency towing vessels (ETVs)?	4.2.4, 8.5	Yes
Does the NSRA denote how rotor blade rotation and power transmission, etc., will be controlled by the designated services when this is required in an emergency?	9.3	Yes
Does the NSRAdenote whether any noise or vibrations generated by a structure above and below the water column would impact navigation safety or affect other Coast Guard missions?	6.4.1	Yes
Does the NSRA denote the ability of a structure to withstand collision damage by vessels without toppling for a range of vessel types, speeds, and sizes?	7.3	Yes
4. OFFSHORE UNDER WATER STRUCTURE		
Does the NSRA denote whether minimum safe clearance over underwater devices has been determined for the deepest draft of vessels that could transit the area?	4.3.3	Yes
Has the developer demonstrated an evidence-based, case-by-case approach which will include dynamic draft modeling in relation to charted water depth to ascertain the safe clearance over a device?	n/a	n/a

ISSUE	REPORT SECTION	NOTES
To establish a minimum clearance depth over devices, has the developer identified from the traffic survey the deepest draft of observed traffic? This will then require modeling to assess impacts of all external dynamic influences giving a calculated figure for dynamic draft. A 30% factor of safety for under keel clearance (UKC) should then be applied to the dynamic draft, giving an overall calculated safe clearance depth to be used in calculations.	n/a	n/a
NOTE: The Charted Depth reduced by safe clearance depth gives a maximum height above seabed available from which turbine design height including any design clearance requirements can be established.		
5. ASSESSMENT OF ACCESS TO AND NAVIGATION WITHIN, OR CLOSE TO, A STRUCTURE. Has the developer determined the extent to which navigation would be feasible within the structure site itself by assessing whether:		
Navigation within the site would be safe? • By all vessels or • By specified vessel types, operations and/or sizes? • In all directions or areas; or • In specified directions or areas? • In specified tidal, weather or other conditions; and • At any time, day or night?	4.2.4, 4.5	Addressed
Navigation in and/or near the site should be • Prohibited by specified vessel types, operations and/or sizes; • 'Prohibited in respect to specific activities; • Prohibited in all areas or directions; • Prohibited in specified areas or directions; • Prohibited in specified tidal or weather conditions; • Prohibited during certain times of the day or night; or • Recommended to be avoided?	3.3, 4.2.4, 4.5	Addressed
Does the **NSRA** contain enough information for the Coast Guard to determine whether or not exclusion from the site could cause navigation, safety, or transiting problems for vessels operating in the area?	3.3, 4.2.4, 4.5	Yes

ISSUE	REPORT SECTION	NOTES
6. THE EFFECT OF TIDES, TIDAL STREAMS, AND CURRENTS. Does the NSRA contain enough information for the Coast Guard to determine whether or not:		
Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed structure is situated at various states of the tide, that is, whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa?	5.3.3	Water depths greater than deepest draft vessel.
Current maritime traffic flows and operations in the general area are affected by existing currents in the area in which the proposed structure is situated?	5.3	Traffic not affected appreciably by existing currents.
The set and rate of the tidal stream, at any state of the tide, would have a significant effect on vessels in the area of the structure site?	5.3.2	Vessels not affected appreciably by existing currents.
Current directions/velocities might aggravate or mitigate the likelihood of allision with the structure?	5.3.2	Allision estimates consider drift due to tidal currents.
The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect?	5.3.4	Addressed
The set is across the major axis of the layout at any time, and, if so, at what rate?	5.3	Tidal current roses provided.
In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream or currents?	5.3.2, 7.1.2	Allision risk due to vessel drift has been considered in the modeling.
Structures themselves could cause changes in the set and rate of the tidal stream or direction and rate of the currents?	5.3.2	Addressed
Structures in the tidal stream could produce siltation, deposition of sediment or scouring, any other suction or discharge aspects, which could affect navigable water depths in the structure area or adjacent to the area?	5.3.2	Water depths are much greater than largest vessel drafts and would not be affected by siltation or scour.
Structures would cause danger and/or severely affect the air column, water column, seabed and sub-seabed in the general vicinity of the structure?	5.3.2	No anticipated effect on air column, water column, seabed or sub-seabed in general vicinity.
7. WEATHER. Does the NSRA contain a sufficient analysis of expected weather conditions, water depths and sea states that might aggravate or mitigate the likelihood of allision with the structure, so that Coast Guard can properly assess the applicant's determinations of whether:		
The site, in all weather conditions, could present difficulties or dangers to vessels, which might pass in close proximity to the structure?	5.4.3	Addressed
The structures could create problems in the area for vessels under sail, such as wind masking, turbulence, or sheer?	5.4.4	Addressed

ISSUE	REPORT SECTION	NOTES
In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred above?	7.1.2	Allision risk due to vessel drift has been considered in the modeling.
Depending on the location of the structure and the presence of cold weather, sea ice and/or icing of the structure may cause problems? A thorough analysis of how the presence of the structure would mitigate or exacerbate icing?	5.4.2	Rotor icing addressed
An analysis of the likelihood that ice may form on the structure, especially those types that have rotating blades such as a Wind Turbine Generator (WTG), should be conducted by the applicant, and should include an analysis of the ability of the structure to withstand anticipated ice accumulation on the structures, and potential for ice to be thrown from the blades, and the likely consequences of that happening and possible actions to mitigate that occurrence?	5.4.2	Rotor icing addressed
8. CONFIGURATION AND COLLISION AVOIDANCE		
The Coast Guard will provide Search and Rescue **(SAR)** services in and around OREis in US waters. Layout designs should allow for safe transit by SAR helicopters operating at low altitude in bad weather, and those vessels (including rescue craft) that decide to transit through them. Has the developer conducted additional site-specific assessments, if necessary, to build on any previous assessments to assess the proposed locations of individual turbine devices, substations, platforms and any other structure within OREi such as a wind farm or tidal/wave array? Any assessment should include the potential impacts the site may have on navigation and SAR activities. Liaison with the USCG is encouraged as early as possible following this assessment which should aim to show that risks to vessels and/or SAR helicopters are minimized and include proposed mitigation measures.	8.5	The effect of the Project on aerial and marine SAR has been discussed. A risk assessment workshop was held with the USCG with regard to aerial SAR.
Each OREi layout design will be assessed on a case-by-case basis.		Understood

ISSUE	REPORT SECTION	NOTES
Risk assessments should build on any earlier work conducted as part of the NSRA and the mitigations identified as part of that process. Where possible, an original assessment should be referenced to confirm where information or the assessment remains the same or can be further refined due to the later stages of project development. Risk assessments should present information to enable the USCG to adequately understand how the risks associated with the proposed layout have been reduced to As Low As Reasonably Practicable (ALARP).	7	A quantitative risk model has been applied.
Packed boundaries will be considered on a case-by-case basis as part of the risk assessment process. For opposite boundaries of adjacent sites due consideration should be given to the requirement for lines of orientation which allow a continuous passage of vessels and/or SAR helicopters through both sites. Where there are packed boundaries, this will affect layout decisions for any possible future adjacent sites. The definition of 'adjacent' will be assessed on a case-by-case basis.	2	Packed boundaries are not planned. Layout is consistent with the adjacent Lease Area OCS-A 0499.
9. VISUAL NAVIGATION. Does the NSRA contain an assessment of the extent to which:		
Structures could block or hinder the view of other vessels underway on any route?	6.2	Addressed
Structures could block or hinder the view of the coastline or of any other navigational feature such as aids to navigation, landmarks, promontories?	6.2	Addressed
Structures and locations could limit the ability of vessels to maneuver in order to avoid collisions?	3.3	Addressed
10. COMMUNICATIONS, RADAR AND POSITIONING SYSTEMS. Does the NSRA provide researched opinion of a generic and, where appropriate, site-specific nature concerning whether or not:		
Structures could produce interference such as shadowing, reflections or phase changes, with marine positioning, navigation, or communications, including Automatic Identification Systems **(AIS),** whether ship borne, ashore, or fitted to any of the proposed structures?	6.3	Addressed
Structures could produce radar reflections, blind spots, shadow areas or other adverse effects in the following interrelationships: • Vessel to vessel; • Vessel to shore; • Vessel Traffic Service radar to vessel; • Radio Beacons (RACONS) to/from vessel; and • Aircraft and Air Traffic Control?	6.3.4	Addressed

ISSUE	REPORT SECTION	NOTES
Structures, in general, would comply with current recommendations concerning electromagnetic interference?	6.5	Addressed
Structures might produce acoustic noise or noise absorption or reflections which could mask or interfere with prescribed sound signals from other vessels or aids to navigation?	6.4	Addressed
Structures, generators, and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems?	6.5	Addressed
The power and noise generated by structures above or below the water would create physical risks that would affect the health of vessel crews?	6.4	Addressed
11. RISK OF COLLISION, ALLISION, OR GROUNDING. Does the NSRA, based on the data collected per paragraph 2 above, provide an evaluation that was conducted to determine the risk of collision between vessels, risk of allisions with structures, or grounding because of the establishment of a structure, including, but not limited to:		
• Likely frequency of collision (vessel to vessel); • Likely consequences of collision ("What if" analysis); • Likely location of collision; • Likely type of collision; • Likely vessel type involved in collision; • Likely frequency of allision (vessel to structure) • Likely consequences of allision ("What if" analysis); • Likely location of allision; • Likely vessel type involved in allision; • Likely frequency of grounding; • Likely consequences of grounding ("What if" analysis); • Likely location of grounding; and • Likely vessel type involved in grounding?	7	Quantitative risk modeling performed
12. EMERGENCY RESPONSE CONSIDERATIONS. In order to determine the impact on Coast Guard and other emergency responder missions, has the developer conducted assessments on the Search and Rescue and the Marine Environmental Protection emergency response missions?		
Marine Environmental Protection/Response: • How many marine environmental/pollution response cases has the USCG conducted in the proposed structure region over the last ten years? • What type of pollution cases were they? • What type and how many assets responded? • How many additional pollution cases are projected due to allisions with the structures?	8.3	Historical MER is addressed

ISSUE	REPORT SECTION	NOTES
13. FACILITY CHARACTERISTICS. In addition to addressing the risk factors detailed above, does the developer's NSRA include a description of the following characteristics related to the proposed structure:		
Marine Navigational Marking?	9.1	Addressed. Marking and lighting as per USCG and BOEM guidance.
How the overall site would be marked by day and by night, taking into account that there may be an ongoing requirement for marking on completion of decommissioning, depending on individual circumstances?	9.1	Addressed. Marking and lighting as per USCG and BOEM guidance.
How individual structures on the perimeter of and within the site, both above and below the sea surface, would be marked by day and by night?	9.1	Addressed, Marking and lighting as per USCG and BOEM guidance.
If the site would be marked by one or more Radar Beacons (RACONS) or, an Automatic Identification System (AIS) transceiver, or both and if so, the AIS data it would transmit?	9.1	AIS marking of turbine positions will be provided.
If the site would be fitted with a sound signal, the characteristics of the sound signal, and where the signal or signals would be sited?	9.1	MRASS as per USCG requirements.
If the structure(s) are to be fitted with aviation marks, how would they be screened from mariners or potential confusion with other navigational marks and lights be resolved?	9.2	Aviation marking and lighting as per FAA requirements.
Whether the proposed site and/or its individual generators would comply in general with markings for such structures, as required by the Coast Guard?	9.1	Addressed. Marking and lighting as per USCG and BOEM guidance.
Whether its plans to maintain its aids to navigation are such that the Coast Guard's availability standards are met at all times. Separate detailed guidance to meet any unique characteristics of a particular structure proposal should be addressed by the respective District Waterways Management Branch?	9.1	Maintenance will meet USCG requirements.
The procedures that need to be put in place to respond to and correct discrepancies to the aids to navigation, within the timeframes specified by the Coast Guard?	9.1, 10	Addressed
How will the marking of the structure impact existing Federal aids to navigation in the vicinity of the structure?	3.2.5.1	No existing Federal ATONS near the Project.

ISSUE	REPORT SECTION	NOTES
14. DESIGN REQUIREMENTS. Is the structure designed and constructed to satisfy the following recommended design requirements for emergency shutdown in the event of a search and rescue, pollution response, or salvage operation in or around a structure?		
All above surface structure individual structures should be marked with clearly visible unique identification characters (for example, alpha-numeric labels such as "Al," "B2."). The identification characters should each be illuminated by a low-intensity light visible from a vessel, or be coated with a phosphorescent material, thus enabling the structure to be detected at a suitable distance to avoid a collision with it. The size of the identification characters in combination with the lighting or phosphorescence should be such that, under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer, and at a distance of at least 150 yards from the structure. It is recommended that, if lighted, the lighting for this purpose be hooded or baffled so as to avoid unnecessary light pollution or confusion with navigation aids. (Precise dimensions to be determined by the height of lights and necessary range of visibility of the identification numbers).	9.1	Addressed. Marking and lighting as per USCG and BOEM guidance.
All generators and transmission systems should be equipped with control mechanisms that can be operated from an operations center of the installation.	9.3	Will be provided.
Throughout the design process, appropriate assessments and methods for safe shutdown should be established and agreed to through consultation with the Coast Guard and other emergency support services.	10	Emergency plan to be developed in consultation with USCG.
The control mechanisms should allow the operations center personnel to fix and maintain the position of the WTG blades, nacelles and other appropriate moving parts as determined by the applicable Coast Guard command center. Enclosed spaces such as nacelle hatches in which personnel are working should be capable of being opened from the outside. This would allow rescuers (for example, helicopter winch-man) to gain access if occupants are unable to assist or when sea-borne approach is not possible.	9.4	Nacelle access provided

ISSUE	REPORT SECTION	NOTES
15. OPERATIONAL REQUIREMENTS. Will the operations be continuously monitored by the facility's owners or operators, ostensibly in an operations center? Does the NSRA identify recommended minimum requirements for an operations center such as:		
The operations center should be manned 24 hours a day?	10	24 hour per day coordination will be provided
The operations center personnel should have a chart indicating the Global Positioning System (GPS) position and unique identification numbers of each of the structure?	10	This will be available.
All applicable Coast Guard command centers (District and Sector) will be advised of the contact telephone number of the operations center?	10	Contact details of the Marine Coordinator will be provided
All applicable Coast Guard command centers will have a chart indicating the position and unique identification number of each of the structures?	10	This will be available.
16. OPERATIONAL PROCEDURES. Does the NSRA provide for the following operational procedures?		
Upon receiving a distress call or other emergency alert from a vessel that is concerned about a possible allision with a structure or is already close to or within the installation, the Coast Guard Search and Rescue Mission Coordinator (SMC) will establish the position of the vessel and the identification numbers of any structures visible to the vessel. The position of the vessel and identification numbers of the structures will be passed immediately to the operations center by the SMC.	10	Addressed. Various mitigations to support SAR proposed.
The operations center should immediately initiate the shut-down procedure for those structures as requested by the SMC, and maintain the structure in the appropriate shut-down position, again as requested by the SMC, until receiving notification from the SMC that it is safe to restart the structure.	10	Emergency plan to be developed in consultation with USCG.
Communication and shutdown procedures should be tested satisfactorily at least twice each year.	10	Agreed.
After an allision, the applicant should submit documentation that verifies the structural integrity of the structure	10	Agreed.

Appendix B

WTG Coordinates

B.1 Wind Turbine Generator Approximate Coordinates

All coordinates are provided in Universal Trans-Mercator (UTM) Zone 18 and North American 1983 (NAD83).

Identifier	Easting (m)	Northing (m)	Longitude (degrees)	Latitude (degrees)
1	4359432	577454.9	-74.1007	39.3809
2	4363156	577249.4	-74.1026	39.41448
3	4361294	577352.1	-74.1017	39.39769
4	4365212	578241	-74.0909	39.43291
5	4363349	578343.7	-74.0899	39.41612
6	4361487	578446.5	-74.0889	39.39933
7	4365405	579335.3	-74.0781	39.43454
8	4363542	579438	-74.0772	39.41776
9	4361680	579540.8	-74.0762	39.40097
10	4365598	580429.6	-74.0654	39.43618
11	4363735	580532.4	-74.0644	39.41939
12	4361873	580635.1	-74.0635	39.4026
13	4365791	581523.9	-74.0527	39.43782
14	4363928	581626.7	-74.0517	39.42103
15	4362066	581729.4	-74.0507	39.40424
16	4360203	581832.1	-74.0498	39.38745
17	4365984	582618.3	-74.0399	39.43945
18	4364121	582721	-74.039	39.42266
19	4362259	582823.7	-74.038	39.40587
20	4360396	582926.5	-74.037	39.38908
21	4366177	583712.6	-74.0272	39.44108
22	4364314	583815.3	-74.0262	39.42429
23	4362452	583918.1	-74.0253	39.40751
24	4360589	584020.8	-74.0243	39.39072
25	4366370	584806.9	-74.0145	39.44272
26	4364507	584909.6	-74.0135	39.42593
27	4362645	585012.4	-74.0125	39.40914
28	4360782	585115.1	-74.0116	39.39235
29	4366563	585901.2	-74.0017	39.44435

Identifier	Easting (m)	Northing (m)	Longitude (degrees)	Latitude (degrees)
30	4364700	586004	-74.0008	39.42756
31	4362838	586106.7	-73.9998	39.41077
32	4360975	586209.4	-73.9989	39.39398
33	4366756	586995.5	-73.989	39.44597
34	4364893	587098.3	-73.988	39.42918
35	4363031	587201	-73.9871	39.41239
36	4361168	587303.7	-73.9861	39.3956
37	4365019	577146.7	-74.1036	39.43127
38	4359625	578549.2	-74.088	39.38254
39	4359817	579643.5	-74.0752	39.38418
40	4360010	580737.8	-74.0625	39.38581
41	4358727	584123.5	-74.0234	39.37393
42	4358920	585217.8	-74.0106	39.37556
43	4359113	586312.2	-73.9979	39.37719
44	4359306	587406.5	-73.9852	39.37882
45	4359499	588500.8	-73.9724	39.38044
46	4359692	589595.1	-73.9597	39.38207
47	4363224	588295.3	-73.9743	39.41402
48	4361361	588398.1	-73.9734	39.39723
49	4357636	588603.5	-73.9715	39.36365
50	4355774	588706.3	-73.9705	39.34686
51	4353911	588809	-73.9696	39.33007
52	4363417	589389.6	-73.9616	39.41565
53	4361554	589492.4	-73.9607	39.39886
54	4357829	589697.8	-73.9588	39.36528
55	4355967	589800.6	-73.9578	39.34849
56	4354104	589903.3	-73.9569	39.3317
57	4363609	590484	-73.9489	39.41727
58	4361747	590586.7	-73.9479	39.40048
59	4359885	590689.4	-73.947	39.38369
60	4358022	590792.2	-73.946	39.3669
61	4356160	590894.9	-73.9451	39.35011
62	4354297	590997.6	-73.9442	39.33332
63	4358534	583029.2	-74.0361	39.37229

Identifier	Easting (m)	Northing (m)	Longitude (degrees)	Latitude (degrees)
64	4356864	584226.2	-74.0224	39.35714
65	4357057	585320.6	-74.0097	39.35877
66	4357250	586414.9	-73.9969	39.3604
67	4357443	587509.2	-73.9842	39.36203
68	4355195	585423.3	-74.0087	39.34198
69	4355388	586517.6	-73.996	39.34361
70	4355581	587611.9	-73.9833	39.34524
71	4353525	586620.4	-73.995	39.32682
72	4353718	587714.7	-73.9823	39.32845
73	4366495	574855.3	-74.1301	39.44477
74	4366688	575949.6	-74.1173	39.44641
75	4366881	577043.9	-74.1046	39.44806
76	4367074	578138.3	-74.0919	39.4497
77	4367267	579232.6	-74.0791	39.45133
78	4367460	580326.9	-74.0664	39.45297
79	4367653	581421.2	-74.0536	39.45461
80	4367846	582515.5	-74.0409	39.45624
81	4371571	582310.1	-74.0428	39.48982
82	4369709	582412.8	-74.0419	39.47303
83	4369902	583507.1	-74.0291	39.47466
84	4368039	583609.9	-74.0282	39.45787
85	4371957	584498.7	-74.0173	39.49308
86	4370095	584601.4	-74.0164	39.47629
87	4368232	584704.2	-74.0154	39.45951
88	4372150	585593	-74.0046	39.49471
89	4370287	585695.8	-74.0036	39.47792
90	4368425	585798.5	-74.0027	39.46114
91	4372343	586687.3	-73.9918	39.49634
92	4370480	586790.1	-73.9909	39.47955
93	4368618	586892.8	-73.9899	39.46276
94	4370673	587884.4	-73.9781	39.48118
95	4368811	587987.1	-73.9772	39.46439
96	4366948	588089.9	-73.9762	39.4476
97	4365086	588192.6	-73.9753	39.43081

Identifier	Easting (m)	Northing (m)	Longitude (degrees)	Latitude (degrees)
98	4371764	583404	-74.0301	39.49145
99	4376261	587576.2	-73.981	39.53155
100	4372536	587781.7	-73.9791	39.49797
101	4385766	588156.8	-73.973	39.61712
102	4383904	588259.6	-73.972	39.60033
103	4382041	588362.3	-73.9711	39.58354
104	4380179	588465	-73.9701	39.56675
105	4378316	588567.8	-73.9692	39.54997
106	4376454	588670.5	-73.9682	39.53318
107	4374591	588773.2	-73.9673	39.51639
108	4372729	588876	-73.9663	39.4996
109	4370866	588978.7	-73.9654	39.48281
110	4385959	589251.2	-73.9602	39.61875
111	4384097	589353.9	-73.9592	39.60196
112	4382234	589456.6	-73.9583	39.58517
113	4380372	589559.4	-73.9573	39.56838
114	4378509	589662.1	-73.9564	39.55159
115	4376647	589764.8	-73.9555	39.5348
116	4374784	589867.6	-73.9545	39.51801
117	4372922	589970.3	-73.9536	39.50122
118	4371059	590073	-73.9526	39.48443
119	4386152	590345.5	-73.9474	39.62037
120	4384289	590448.2	-73.9465	39.60358
121	4382427	590551	-73.9455	39.58679
122	4380565	590653.7	-73.9446	39.57
123	4378702	590756.4	-73.9436	39.55321
124	4376840	590859.2	-73.9427	39.53642
125	4374977	590961.9	-73.9418	39.51963
126	4373115	591064.6	-73.9408	39.50284
127	4374398	587678.9	-73.98	39.51476
128	4385187	584873.9	-74.0113	39.61224
129	4383325	584976.6	-74.0103	39.59545
130	4381462	585079.4	-74.0094	39.57866
131	4379600	585182.1	-74.0084	39.56187

Identifier	Easting (m)	Northing (m)	Longitude (degrees)	Latitude (degrees)
132	4385380	585968.2	-73.9985	39.61387
133	4383518	586070.9	-73.9975	39.59708
134	4381655	586173.7	-73.9966	39.58029
135	4379793	586276.4	-73.9956	39.5635
136	4385573	587062.5	-73.9857	39.6155
137	4383711	587165.3	-73.9848	39.59871
138	4381848	587268	-73.9838	39.58192
139	4379986	587370.7	-73.9829	39.56513
140	4377930	586379.1	-73.9947	39.54671
141	4377737	585284.8	-74.0074	39.54508
142	4378123	587473.5	-73.9819	39.54834
143	4376068	586481.9	-73.9937	39.52992
144	4374205	586584.6	-73.9928	39.51313
145	4380883	581796.4	-74.0476	39.57377
146	4379021	581899.1	-74.0467	39.55698
147	4381076	582890.7	-74.0349	39.5754
148	4379214	582993.5	-74.0339	39.55861
149	4381269	583985	-74.0221	39.57703
150	4379407	584087.8	-74.0212	39.56024
151	4389684	589045.7	-73.9621	39.65233
152	4387821	589148.4	-73.9611	39.63554
153	4391739	590037.3	-73.9502	39.67074
154	4389877	590140	-73.9493	39.65395
155	4388014	590242.8	-73.9484	39.63716
156	4391546	588943	-73.963	39.66912
157	4391932	591131.6	-73.9375	39.67236

Appendix C

AIS Data Analyses

C.1 Methodology

For this study, USCG Marine Cadastre AIS data for the period from January 1, 2016 to September 30, 2021 were compiled (note that data after September 30, 2021 were not available at the time of report preparation). The data were clipped to the region of interest, and vessel tracks developed from the AIS transmissions ("pings") using an automated algorithm. The tracks were then clipped to the Lease Area and ECCs, and plots and statistics created by means of proprietary software.

All top 10 vessels were reviewed using the USCG Port State Information Exchange system (PSIX). In the event of differences between PSIX and the AIS data, the PSIX data was prioritized. As AIS is not always accurately reported; therefore, there may be some variation between the analyzed data and reality.

C.2 Overall Traffic Summary

Unique Tracks and Vessels within the Lease Area

	Unique Tracks		Unique Vessels	
Vessel Type	Number	Percentage	Number	Percentage
Dry Cargo	4,506	19%	1,072	21%
Tankers	447	2%	264	5%
Passenger	501	2%	107	2%
Tug Tows	1,770	8%	243	5%
Recreational	3,963	17%	2,179	43%
Fishing	9,398	40%	522	10%
Other Vessels	1,011	4%	172	3%
Unspecified AIS	1,841	8%	515	10%
Total (2016-2021)	23,437	100%	5,074	100%
Annual Average	4,076.0		882.4	

nmary of AIS Vessel Traffic through the Lease Area by Year

essel Traffic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annua
016													
umber of Unique essels	106	127	145	156	278	343	265	237	268	230	164	144	1,356
umber of Unique essel Tracks	146	171	208	294	565	607	431	398	374	333	232	207	3,966
017													
umber of Unique essels	134	123	155	172	241	304	278	235	266	311	181	148	1,413
umber of Unique essel Tracks	186	177	230	338	315	433	421	337	355	422	279	228	3,721
018													
umber of Unique essels	132	130	140	178	270	353	303	269	280	270	208	143	1,481
umber of Unique essel Tracks	190	202	225	271	546	575	491	500	403	431	317	245	4,396
019													
umber of Unique essels	119	108	146	169	272	345	283	256	3,099	306	202	148	1,473
umber of Unique essel Tracks	177	177	231	296	488	540	505	515	629	632	296	215	4,701

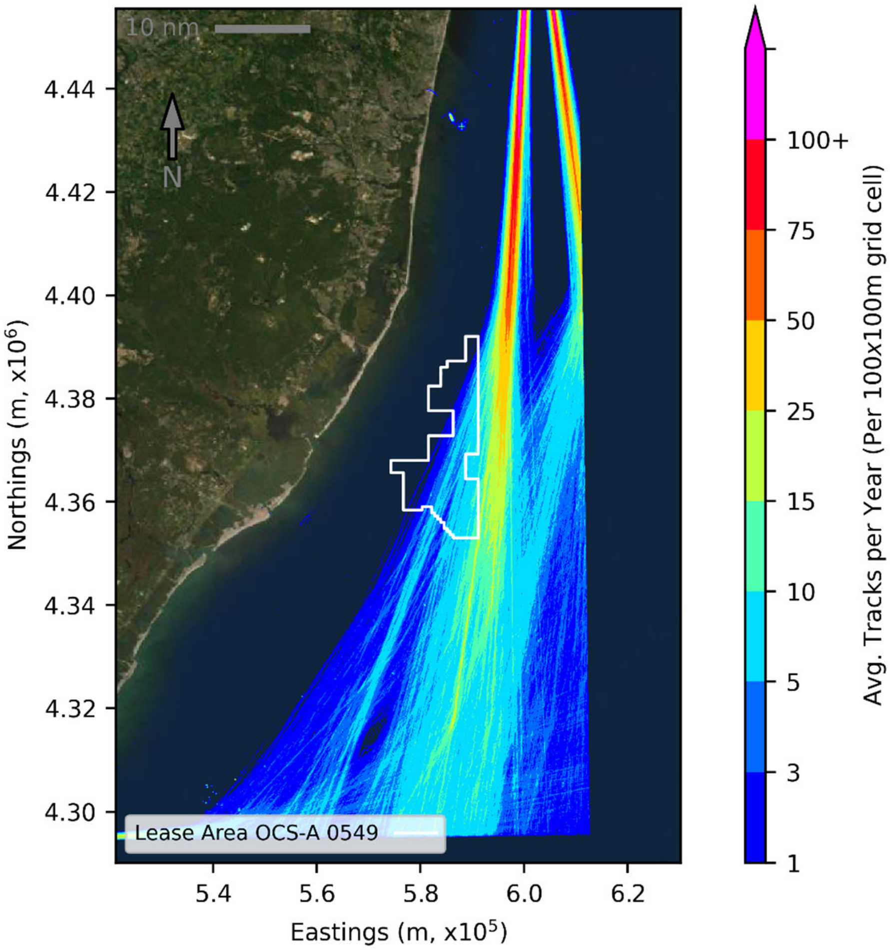
020													
umber of Unique essels	150	145	169	157	229	299	268	214	264	315	203	157	1,432
umber of Unique essel Tracks	218	230	251	201	372	548	430	341	370	416	304	216	3,897
021													
umber of Unique essels	114	104	151	164	260	317	292	241	263				1,241
umber of Unique essel Tracks	185	135	227	249	358	418	443	368	373				2,756

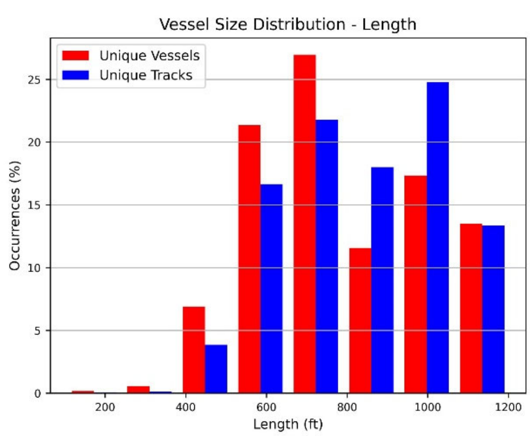
mmary of AIS Vessel Traffic Through the Lease Area

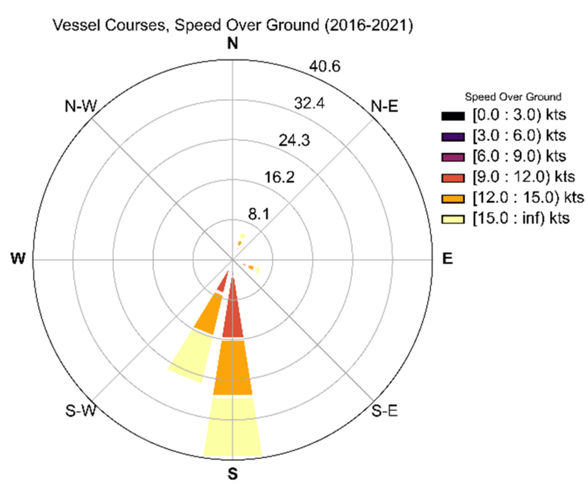
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
otal Number of Tracks 016-21)	1,111	1,102	1,092	1,372	1,649	2,644	3,121	2,721	2,459	2,504	2,234	1,42
verage Tracks per onth (2016-21)	224	185	183	228	271	431	516	443	389	375	401	283
verage Tracks per Day	7.2	6.0	6.5	7.4	9.0	13.9	17.2	14.3	12.5	12.5	12.9	9.4
	Winter			Spring			Summer			Autumn		
easonal Average acks per Day	6.6			10.1			14.7			11.6		

C.3 Traffic by Vessel Category

Location: Atlantic Shores Lease Area 0549
Vessel Type: Cargo







Number of Unique Transits

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	64	75	67	61	76	77	71	65	74	63	68	67	828
2017	75	66	70	66	61	61	68	62	78	64	66	69	806
2018	66	69	72	70	75	68	59	85	58	74	64	52	812
2019	63	53	66	62	68	72	67	65	64	89	71	71	811
2020	71	70	81	60	58	69	61	66	60	66	58	73	793
2021	48	52	55	54	49	50	49	51	48				456
Avg.	64.5	64.2	68.5	62.2	64.5	66.2	62.5	65.7	63.7	71.2	65.4	66.4	783.7

Number of Unique Vessels

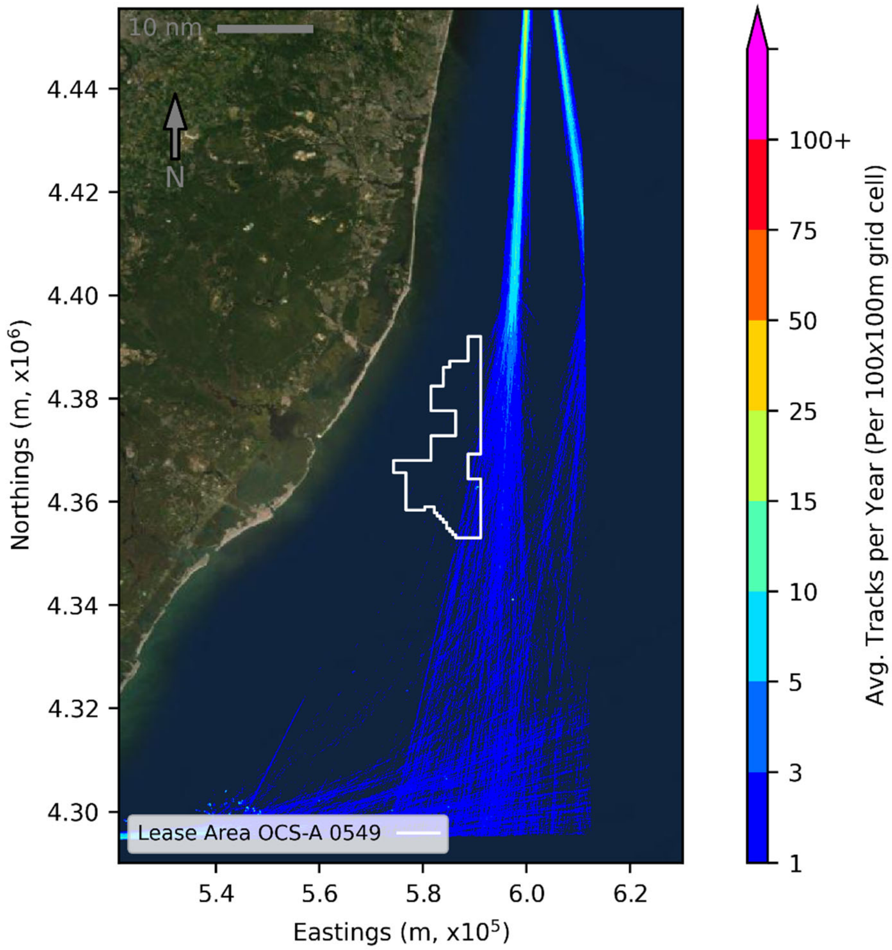
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	58	70	62	59	73	72	66	61	68	59	62	64	344
2017	67	62	65	64	56	59	62	59	74	59	60	64	307
2018	57	66	66	67	68	62	54	80	53	67	56	50	315
2019	53	50	59	56	62	63	58	58	51	64	59	65	290
2020	65	58	72	55	52	64	53	65	54	65	52	67	316
2021	46	48	51	50	48	48	47	47	44				211
Avg.	57.7	59.0	62.5	58.5	59.8	61.3	56.7	61.7	57.3	62.8	57.8	62.0	310.1

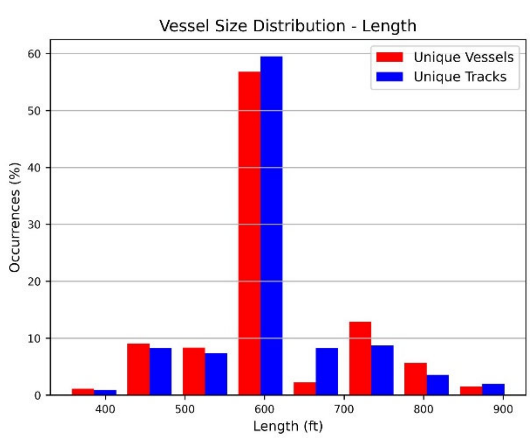
Ten Largest Vessels

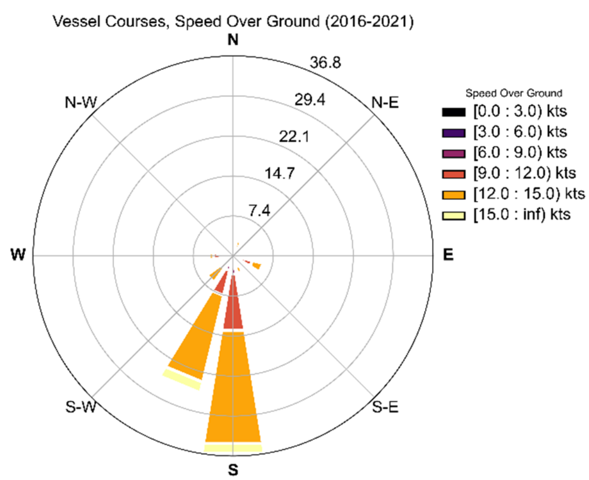
Vessel Name	MMSI Number	LOA (m)	LOA (ft)	Breadth (m)	Breadth (ft)	Depth (m)	Depth (ft)
GRETE MAERSK	220397000	367	1,203.80	43	140.40	24.4	80.10
GUNVOR MAERSK	220413000	367	1,203.80	43	140.40	21.5	70.40
HYUNDAI SPEED	241313000	367	1,202.50	48	158.10	29.8	97.90
OOCL BERLIN	477203100	366	1,202.33	n/a	n/a	n/a	n/a
COSCO FAITH	477108100	366	1,202.30	48	158.10	29.8	97.90
COSCO HARMONY	477397800	366	1,202.20	48	158.10	29.8	97.90
HYUNDAI SMART	241312000	366	1,200.80	48	158.10	29.8	97.90
ERVING	235084298	366	1,200.70	48	158.00	29.8	97.80
OOCL SINGAPORE	477293200	365	1,199.00	n/a	n/a	n/a	n/a
OOCL MALAYSIA	477220100	353	1,157.60	48	158.10	23.8	78.00

Note: Vessel dimensions updated based on dimensions registered on USGS Port State Information Exchange system (PSIX).

Location: Atlantic Shores Lease Area 0549
Vessel Type: Tankers







Number of Unique Transits

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	5	8	11	12	8	10	5	8	11	6	7	13	104
2017	12	7	11	3	7	10	6	6	10	8	8	8	96
2018	7	2	8	9	6	10	3	5	8	6	6	6	76
2019	7	5	4	10	5	7	5	3	10	4	7	3	70
2020	7	4	7	5	11	8	7	2	7	6	4	2	70
2021	4	6	6	2	4	1	3	3	2				31
Avg.	7.0	5.3	7.8	6.8	6.8	7.7	4.8	4.5	8.0	6.0	6.4	6.4	77.7

Number of Unique Vessels

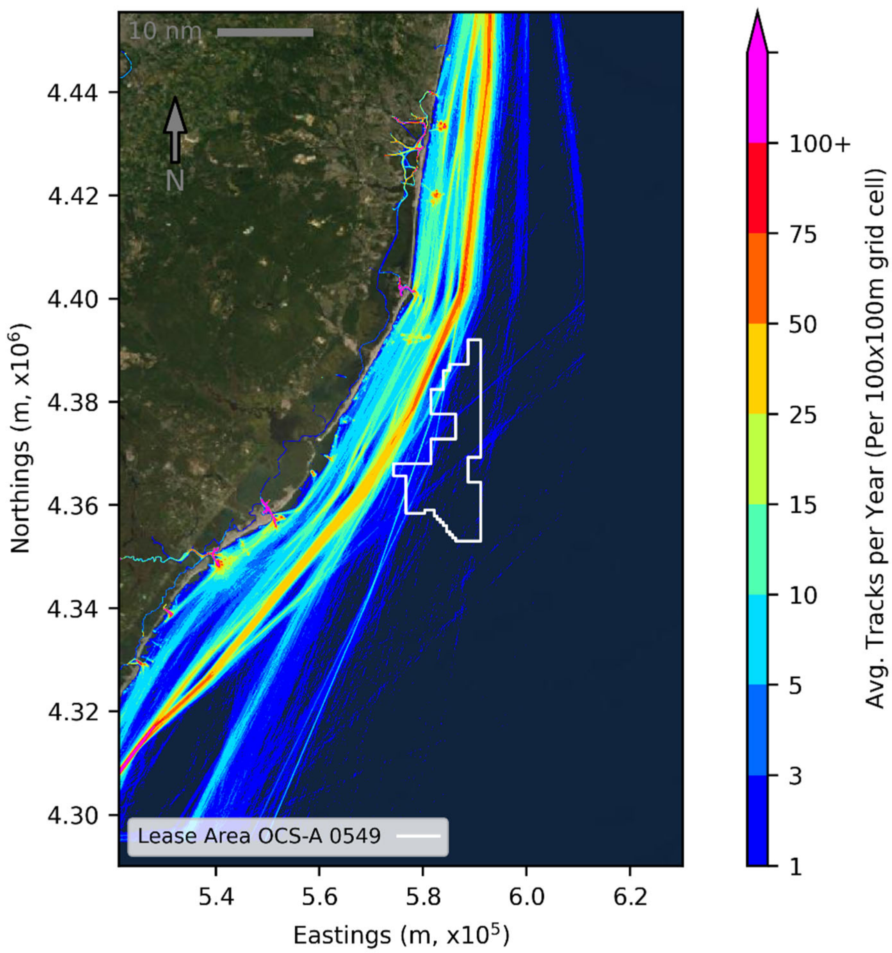
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	5	7	10	9	8	10	5	8	10	6	7	12	84
2017	11	7	9	3	6	10	6	6	10	7	7	8	73
2018	7	2	7	9	5	9	3	5	6	8	6	6	55
2019	6	4	4	10	5	6	4	3	6	2	7	3	43
2020	6	4	7	5	11	8	7	2	6	6	4	2	47
2021	4	6	6	2	4	1	3	3	2				23
Avg.	6.5	5.0	7.2	6.3	6.5	7.3	4.7	4.5	6.7	5.8	6.2	6.2	56.5

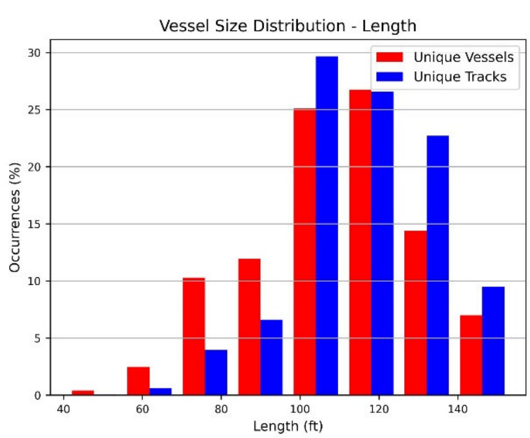
Ten Largest Vessels

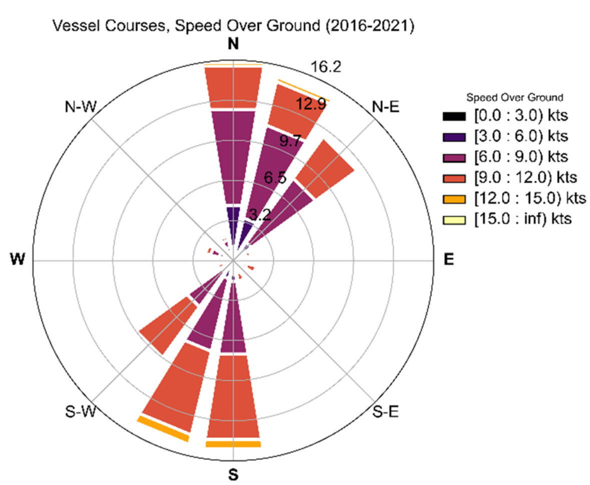
Vessel Name	MMSI Number	LOA (m)	LOA (ft)	Breadth (m)	Breadth (ft)	Depth (m)	Depth (ft)
SK SUMMIT	357357000	277	908.80	43	142.40	26.0	85.30
FRONT ULL	538005567	275	900.60	48	157.50	23.2	76.10
LOS ANGELES SPIRIT	311000436	274	899.80	48	157.50	23.1	75.80
EAGLE FORD	369790000	253	831.50	41	136.00	21.9	71.70
DHT CATHY	538001836	250	820.80	44	144.40	21.0	68.90
DUBAI ANGEL	538003882	250	820.20	44	144.40	21.3	70.00
ELIAS TSAKOS	241455000	250	819.90	44	144.40	21.2	69.60
SEAMAGIC	249266000	250	819.70	44	144.40	22.7	74.50
MINERVA KYTHNOS	241132000	249	816.80	44	143.70	21.0	68.90
ASTRO ARCTURUS	237921000	248	813.60	43	141.80	19.8	65.00

Note : Vessel dimensions updated based on dimensions registered on USGS Port State Information Exchange system (PSIX).

Location: Atlantic Shores Lease Area 0549
Vessel Type: Tug Tows







Number of Unique Transits

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	33	25	37	40	50	44	42	51	41	31	30	40	464
2017	33	27	23	26	28	40	51	37	36	33	32	25	391
2018	38	22	36	26	28	27	35	26	25	17	23	15	318
2019	23	15	25	22	20	27	23	26	43	26	23	22	295
2020	23	20	20	8	22	11	8	9	14	10	13	15	173
2021	12	7	13	21	14	13	12	22	15				129
Avg.	27.0	19.3	25.7	23.8	27.0	27.0	28.5	28.5	29.0	23.4	24.2	23.4	307.8

Number of Unique Vessels

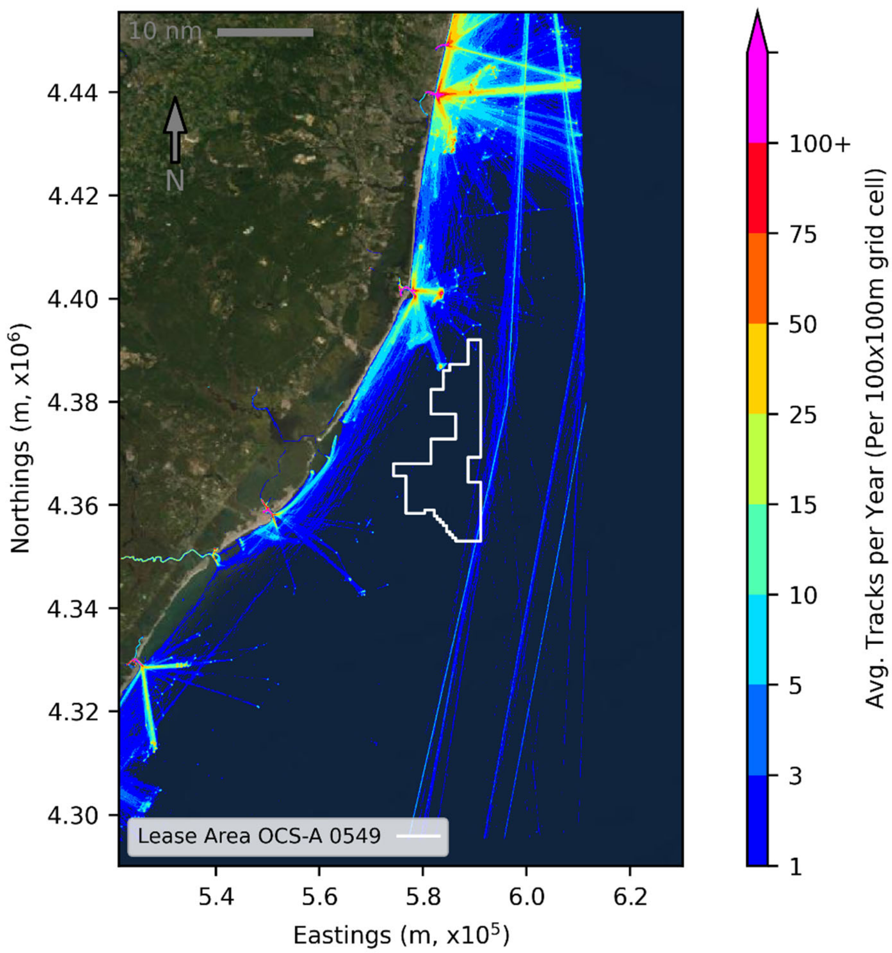
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	19	18	24	21	31	24	28	33	27	21	23	23	109
2017	23	19	17	19	22	25	35	23	26	23	24	20	120
2018	25	17	20	22	20	18	22	17	20	11	18	12	96
2019	18	10	16	15	14	20	12	14	20	15	18	15	88
2020	17	14	12	8	10	8	7	7	12	7	10	12	64
2021	9	6	11	12	13	7	9	16	11				57
Avg.	18.5	14.0	16.7	16.2	18.3	17.0	18.8	18.3	19.3	15.4	18.6	16.4	92.9

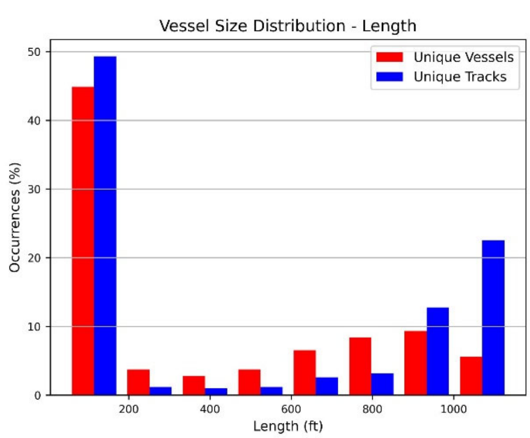
Ten Largest Vessels

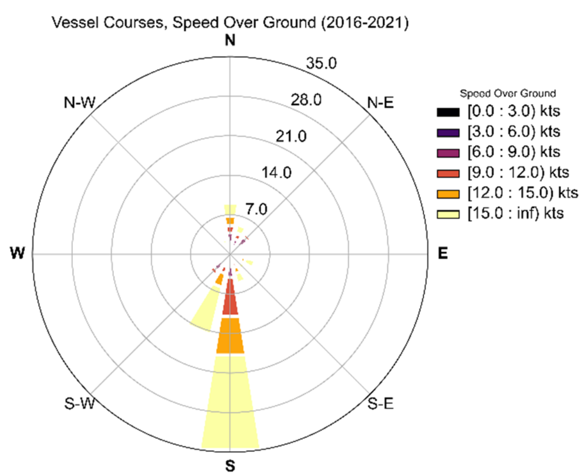
Vessel Name	MMSI Number	LOA (m)	LOA (ft)	Breadth (m)	Breadth (ft)	Depth (m)	Depth (ft)
OSG VISION	369235000	44	144.90	16	51.00	11	37.70
GALVESTON	367337960	44	144.00	14	46.00	8	27.00
FREEPORT	367690000	44	144.00	14	46.00	8	27.00
CORPUS CHRISTI	367362010	44	144.00	14	46.00	8	27.00
BROWNSVILLE	367361960	44	144.00	14	46.00	8	27.00
LEGACY	338504000	43	142.10	18	60.00	9	30.00
LAUREN FOSS	303350200	43	141.40	12	40.00	6	19.50
ATLANTIC SALVOR	366744010	43	140.70	12	40.00	7	22.00
YANKEE	338231000	42	138.00	14	46.00	4	13.90
PENN NO 6	366920970	42	136.50	11	35.00	4	13.90

Note : Vessel dimensions updated based on dimensions registered on USGS Port State Information Exchange system (PSIX).

Location: Atlantic Shores Lease Area 0549
Vessel Type: Passenger







Number of Unique Transits

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	2	4	4	6	9	18	16	14	6	28	8	4	119
2017		3	7	10	7	13	4	6	11	31	13	5	110
2018	5	3	3	9	11	13	9	13	5	18	13	4	106
2019	6	6	9	4	9	8	7	9	9	22	10	3	102
2020	3	1	4	2	2	4	7	4	5	6	3	2	43
2021	1			1		7	1	5	6				21
Avg.	3.4	3.4	5.4	5.3	7.6	10.5	7.3	8.5	7.0	21.0	9.4	3.6	87.1

Number of Unique Vessels

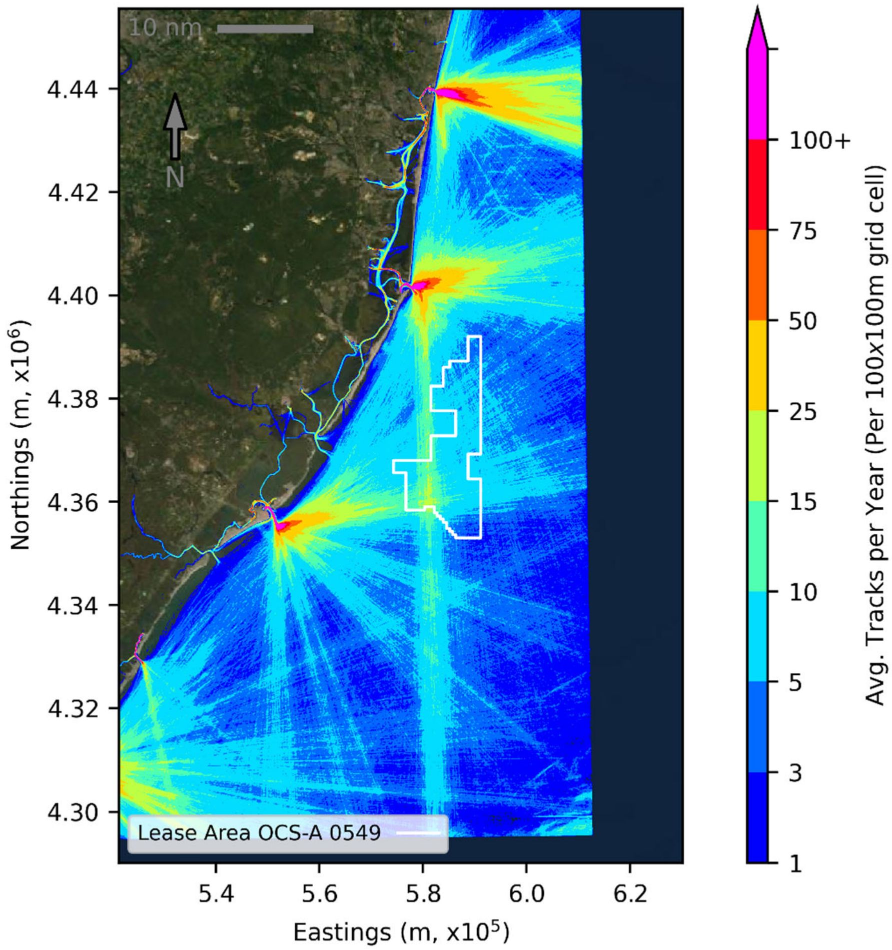
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	2	2	2	4	6	8	3	5	5	23	6	2	40
2017		2	2	8	6	10	4	6	7	20	8	2	53
2018	4	2	2	4	6	6	5	7	5	13	8	2	37
2019	4	3	3	4	8	5	3	5	5	12	5	3	34
2020	2	1	2	2	2	4	4	2	4	5	3	1	21
2021	1			1		6	1	4	4				15
Avg.	2.6	2.0	2.2	3.8	5.6	6.5	3.3	4.8	5.0	14.6	6.0	2.0	34.8

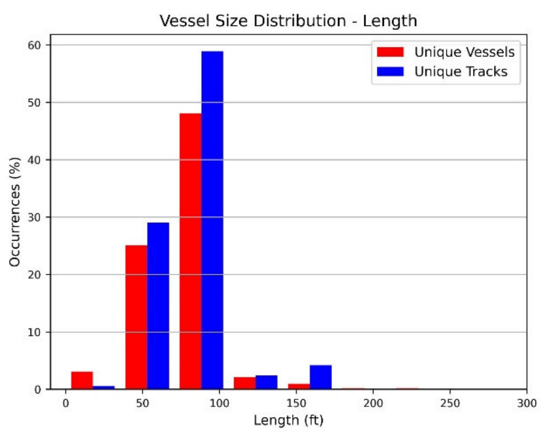
Ten Largest Vessels

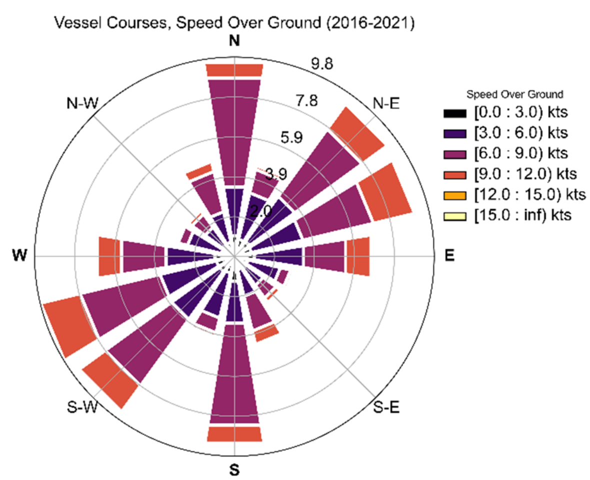
Vessel Name	MMSI Number	LOA (m)	LOA (ft)	Breadth (m)	Breadth (ft)	Depth (m)	Depth (ft)
ANTHEM OF THE SEAS	311000274	350	1,149.90	41	135.80	14	46.40
NORWEGIAN ESCAPE	311000341	335	1,098.00	n/a	n/a	n/a	n/a
ROYAL PRINCESS	310661000	330	1,082.30	38	126.00	11	37.20
NORWEGIAN BREAKAWAY	311050800	326	1,068.30	40	130.20	8	27.30
ADVENTURE OF THE SEAS	311263000	311	1,021.00	39	126.60	21	69.90
QUEEN MARY 2	310627000	303	992.90	41	134.50	45	147.60
NORWEGIAN GEM	309951000	294	965.00	38	125.00	11	37.70
NORWEGIAN DAWN	311307000	294	964.70	32	105.60	11	37.70
CELEBRITY SUMMIT	249047000	294	964.60	32	105.60	10	32.40
DISNEY MAGIC	308516000	264	864.90	32	105.80	14	45.40

Note : Vessel dimensions updated based on dimensions registered on USGS Port State Information Exchange system (PSIX).

Location: Atlantic Shores Lease Area 0549
Vessel Type: Fishing when Transiting







Number of Unique Transits

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	32	50	75	158	300	264	187	172	138	113	88	73	1,650
2017	57	68	101	194	113	146	147	116	110	129	112	95	1,388
2018	55	85	81	120	293	231	196	216	135	183	139	134	1,868
2019	60	82	94	156	235	195	210	258	254	130	97	75	1,846
2020	87	101	98	88	169	240	173	144	134	143	129	82	1,588
2021	86	46	122	121	130	104	136	124	131				1,000
Avg.	62.8	72.0	95.2	139.5	206.7	196.7	174.8	171.7	150.3	139.6	113.0	91.8	1,624.3

Number of Unique Vessels

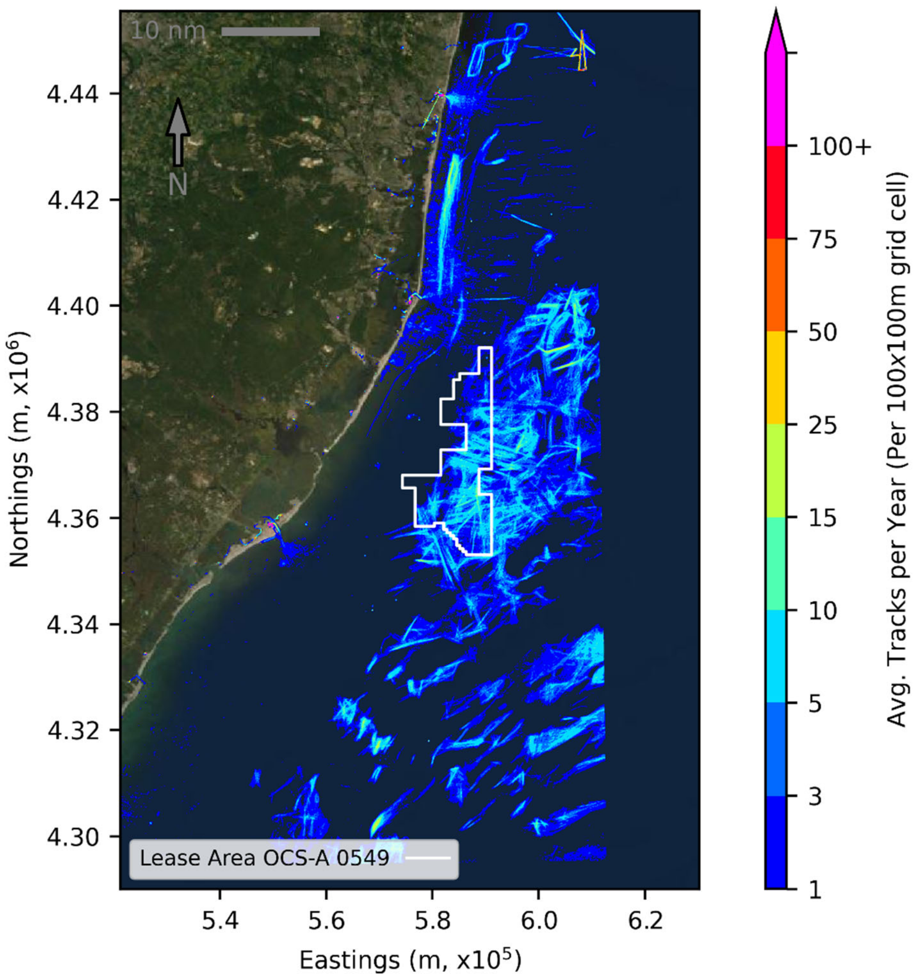
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	12	21	35	49	71	82	70	56	59	43	35	36	264
2017	25	27	48	50	57	56	53	47	52	62	42	40	226
2018	28	32	29	47	55	68	67	51	45	51	56	50	230
2019	27	31	40	50	53	53	47	59	71	65	44	30	218
2020	38	41	45	53	60	54	57	47	59	58	48	37	244
2021	26	22	54	55	50	34	42	44	49				184
Avg.	26.0	29.0	41.8	50.7	57.7	57.8	56.0	50.7	55.8	55.8	45.0	38.6	237.6

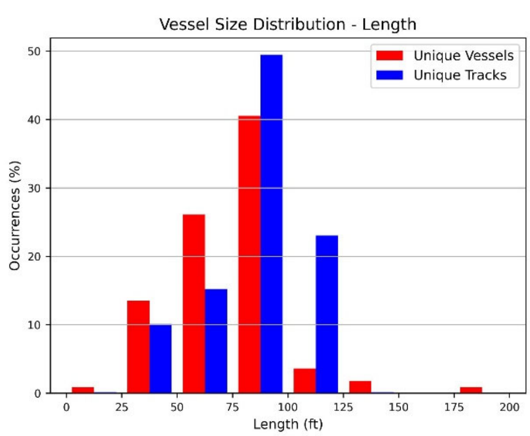
Ten Largest Vessels

Vessel Name	MMSI Number	LOA (m)	LOA (ft)	Breadth (m)	Breadth (ft)	Depth (m)	Depth (ft)
TIDELANDS	367108820	61	200.30	n/a	n/a	n/a	n/a
MELISSA K	366975990	48	158.50	n/a	n/a	n/a	n/a
DYRSTEN	367016390	44	145.90	9	30.00	7	23.80
E S S PURSUIT	367411970	44	145.50	13	42.80	4	13.90
ESS ENDEAVOR	367411920	44	145.00	13	42.80	4	13.90
E S S PRIDE	367411950	44	145.00	13	42.80	4	13.90
CHRISTI-CAROLINE	368035140	39	127.20	11	36.00	4	14.00
SEA WATCHER I	367010820	37	120.80	10	34.00	5	15.00
ENTERPRISE	367658950	36	117.00	9	28.00	4	13.50
STARLIGHT	367674070	34	110.50	9	30.00	4	13.00

Note : Vessel dimensions updated based on dimensions registered on USGS Port State Information Exchange system (PSIX).

Location: Atlantic Shores Lease Area 0549
Vessel Type: Fishing when Actively Fishing





Number of Unique Transits

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	9	8	13	33	27	19	28	28	21	41	23	20	270
2017	20	24	22	17	16	12	14	15	34	38	23	23	258
2018	14	16	23	23	16	22	7	25	16	15	15	18	210
2019	6	13	12	21	35	15	18	16	16	15	12	10	189
2020	11	5	12	7	8	12	7	14	13	16	23	24	152
2021	21	11	19	15	15	8	15	13	19				136
Avg.	13.5	12.8	16.8	19.3	19.5	14.7	14.8	18.5	19.8	25.0	19.2	19.0	211.3

Number of Unique Vessels

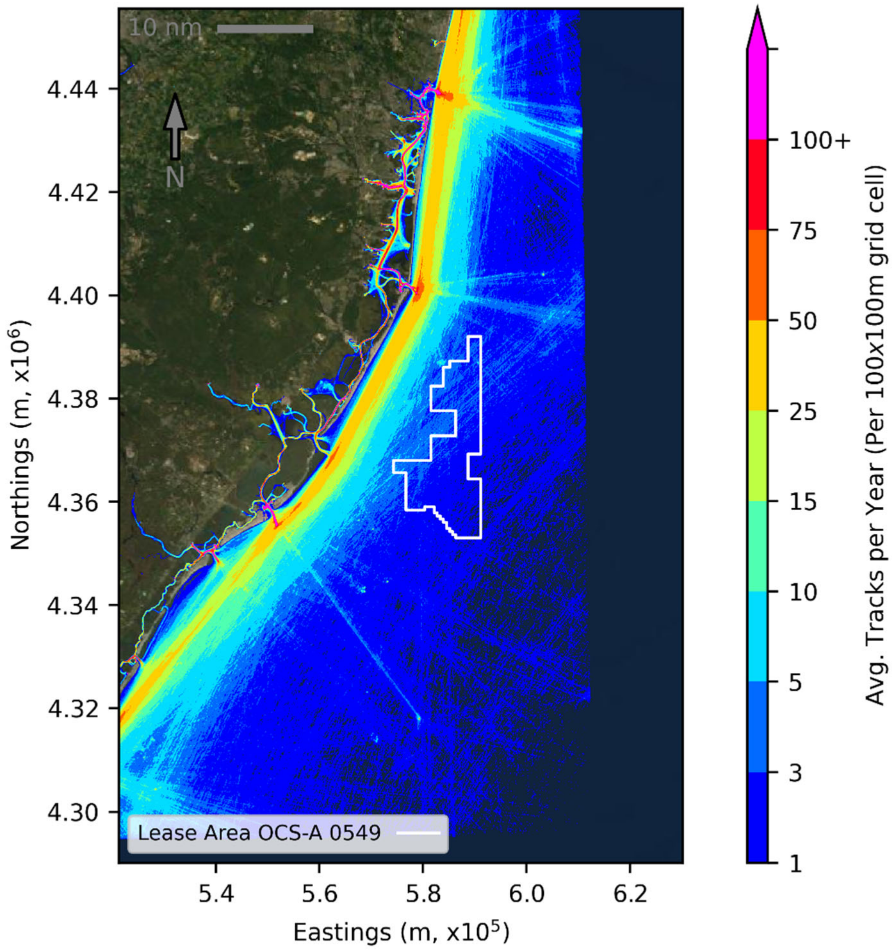
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	2	3	6	11	9	10	10	6	8	10	11	9	32
2017	8	10	12	9	10	9	8	7	15	13	10	10	41
2018	8	10	8	8	10	15	6	14	7	10	8	5	38
2019	4	6	4	6	10	9	10	8	6	10	6	5	33
2020	9	3	5	4	5	6	5	4	6	8	7	7	28
2021	4	4	7	5	4	3	5	4	6				16
Avg.	5.8	6.0	7.0	7.2	8.0	8.7	7.3	7.2	8.0	10.2	8.4	7.2	32.7

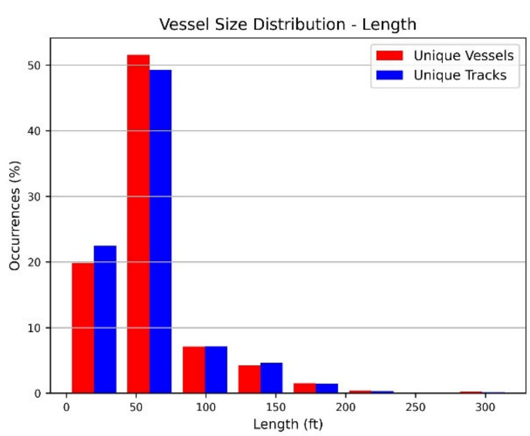
Ten Largest Vessels [1]

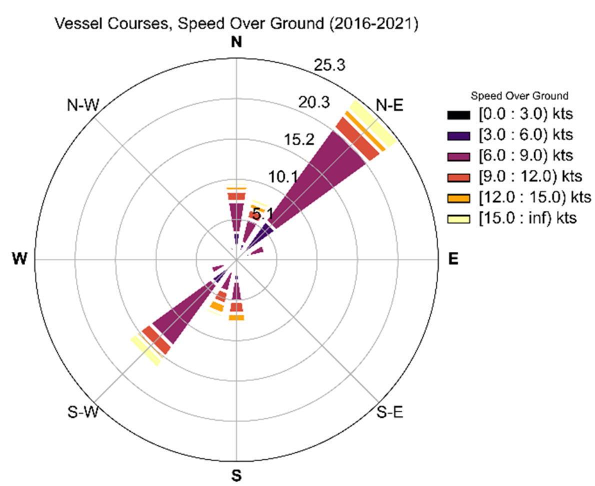
Vessel Name	MMSI Number	LOA (m)	LOA (ft)	Breadth (m)	Breadth (ft)	Depth (m)	Depth (ft)
TIDELANDS	367108820	61	200.30	n/a	n/a	n/a	n/a
E S S PURSUIT	367411970	44	145.50	13	42.80	4	13.90
ESS ENDEAVOR	367411920	44	145.00	13	42.80	4	13.90
CHRISTI-CAROLINE	368035140	39	127.20	11	36.00	4	14.00
RETRIEVER	367324660	38	125.80	8	26.00	4	14.30
JOHN N	367662110	31	100.70	8	27.50	2	7.10
NICOLE DANIELLE	367345330	30	98.80	n/a	n/a	n/a	n/a
VIKING POWER	368111960	29	96.50	9	29.60	5	14.90
JERSEY DEVIL	366798160	28	91.30	n/a	n/a	n/a	n/a
JOEY D	368150450	24	78.80	9	28.00	4	12.50

Note : Vessel dimensions updated based on dimensions registered on USGS Port State Information Exchange system (PSIX).

Location: Atlantic Shores Lease Area 0549
Vessel Type: Recreational







Number of Unique Transits

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	1		1	6	62	116	76	51	90	62	26	1	492
2017				16	64	98	96	60	68	99	17	2	520
2018			3	11	79	152	119	90	117	92	43	6	712
2019	1		1	16	96	159	115	82	130	115	38	7	760
2020			2	11	73	167	134	75	92	129	50	4	737
2021	1		5	18	104	196	187	108	123				742
Avg.	1.0	0	2.4	13.0	79.7	148.0	121.2	77.7	103.3	99.4	34.8	4.0	689.2

Number of Unique Vessels

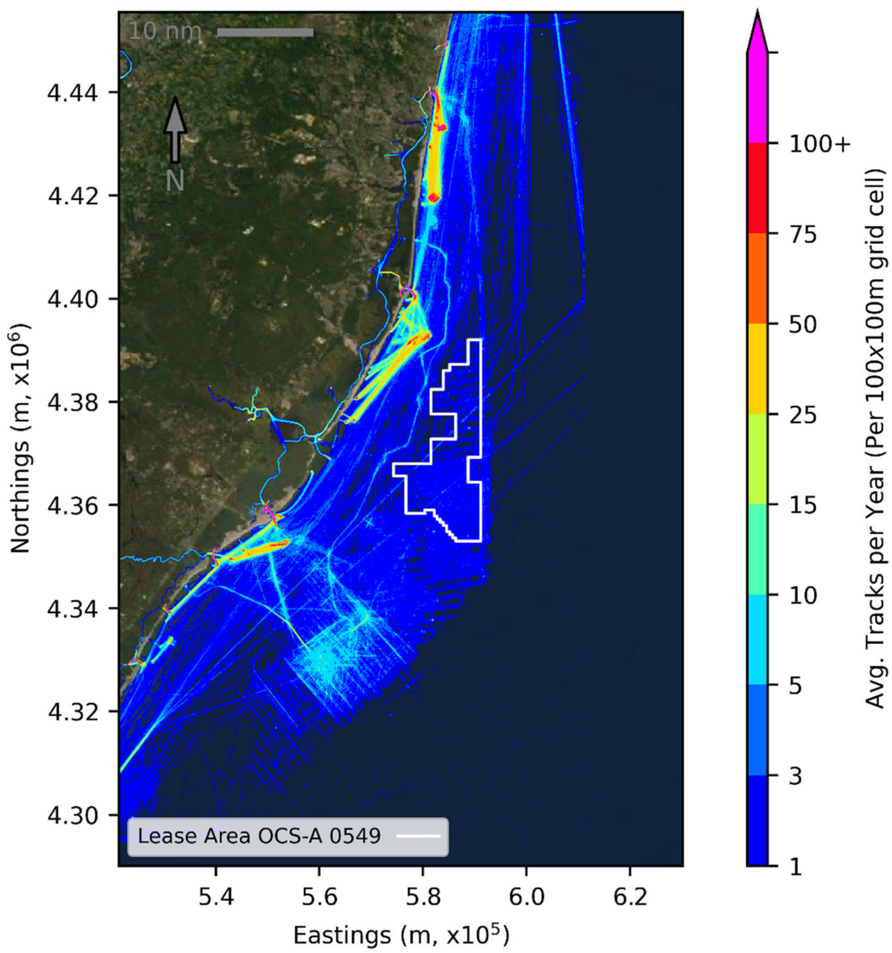
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	1		1	6	62	108	65	48	86	62	26	1	391
2017				16	64	90	79	58	65	98	17	2	410
2018			3	11	78	140	104	70	110	90	43	6	541
2019	1		1	14	93	143	106	74	115	106	37	7	591
2020			2	10	67	122	105	57	80	126	48	4	513
2021	1		5	17	101	179	156	91	117				586
Avg.	1.0	0	2.4	12.3	77.5	130.3	102.5	66.3	95.5	96.4	34.2	4.0	527.3

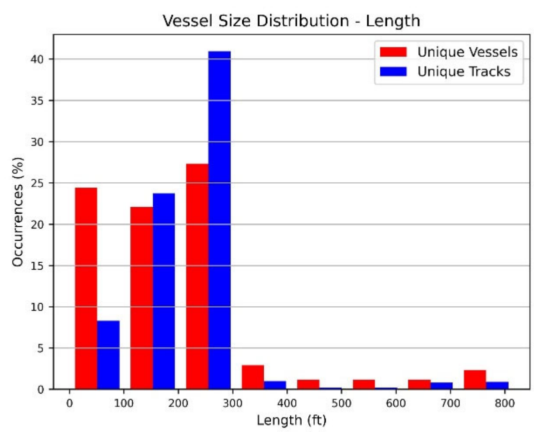
Ten Largest Vessels

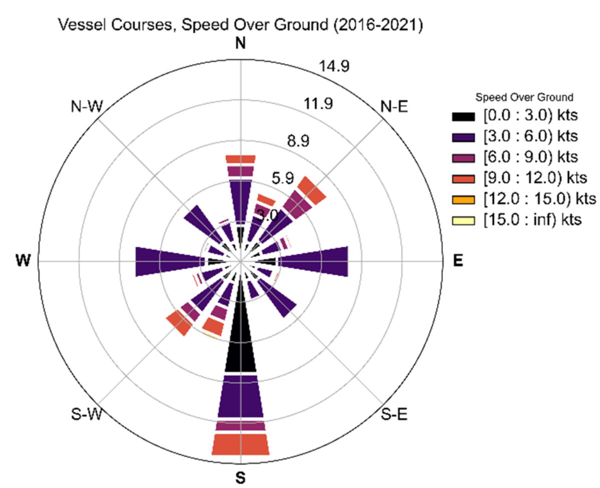
Vessel Name	MMSI Number	LOA (m)	LOA (ft)	Breadth (m)	Breadth (ft)	Depth (m)	Depth (ft)
LIMITLESS	368444000	96	315.80	12	39.40	8	25.30
VAVA II	319808000	96	314.90	17	55.70	5.0	16.40
VIBRANT CURIOSITY	235068366	85	280.28	14	45.28	n/a	n/a
FOUNTAINHEAD	319028100	76	250.30	14	44.30	7	23.30
LADY LARA	319082300	76	249.70	14	47.00	4	12.80
SAINT NICOLAS	319762000	70	229.66	13	42.65	n/a	n/a
HUNTRESS	319008900	65	214.70	14	44.30	n/a	n/a
ARCHIMEDES	310563000	61	198.70	12	38.70	6	20.50
HAMPSHIRE	319092100	58	190.80	11	37.40	6	20.00
SYCARA V	319035600	58	190.10	12	39.30	7	21.60

Note : Vessel dimensions updated based on dimensions registered on USGS Port State Information Exchange system (PSIX).

Location: Atlantic Shores Lease Area 0549
Vessel Type: Other







Number of Unique Transits

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	4	3	4	5	13	21	21	25	6	5	1	2	110
2017	4	3	5	4	13	23	15	22	4	10	7	8	118
2018	2	3	4	2	18	23	28	26	13	9	10	6	144
2019	1	1	13	5	16	23	27	30	67	171	24	11	389
2020	8	5	6	2	15	15	10	11	16	6	6	6	106
2021	7	2	6	9	24	18	27	28	23				144
Avg.	4.3	2.8	6.3	4.5	16.5	20.5	21.3	23.7	21.5	40.2	9.6	6.6	175.8

Number of Unique Vessels

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	4	3	3	5	8	14	17	15	6	5	1	2	48
2017	3	3	5	4	9	15	11	12	4	10	7	4	51
2018	2	3	3	2	13	18	20	17	10	8	10	5	66
2019	1	1	11	5	12	18	18	16	10	7	10	6	60
2020	6	3	5	1	9	10	9	8	13	5	4	4	51
2021	4	2	5	7	14	14	11	13	13				50
Avg.	3.3	2.5	5.3	4.0	10.8	14.8	14.3	13.5	9.3	7.0	6.4	4.2	56.7

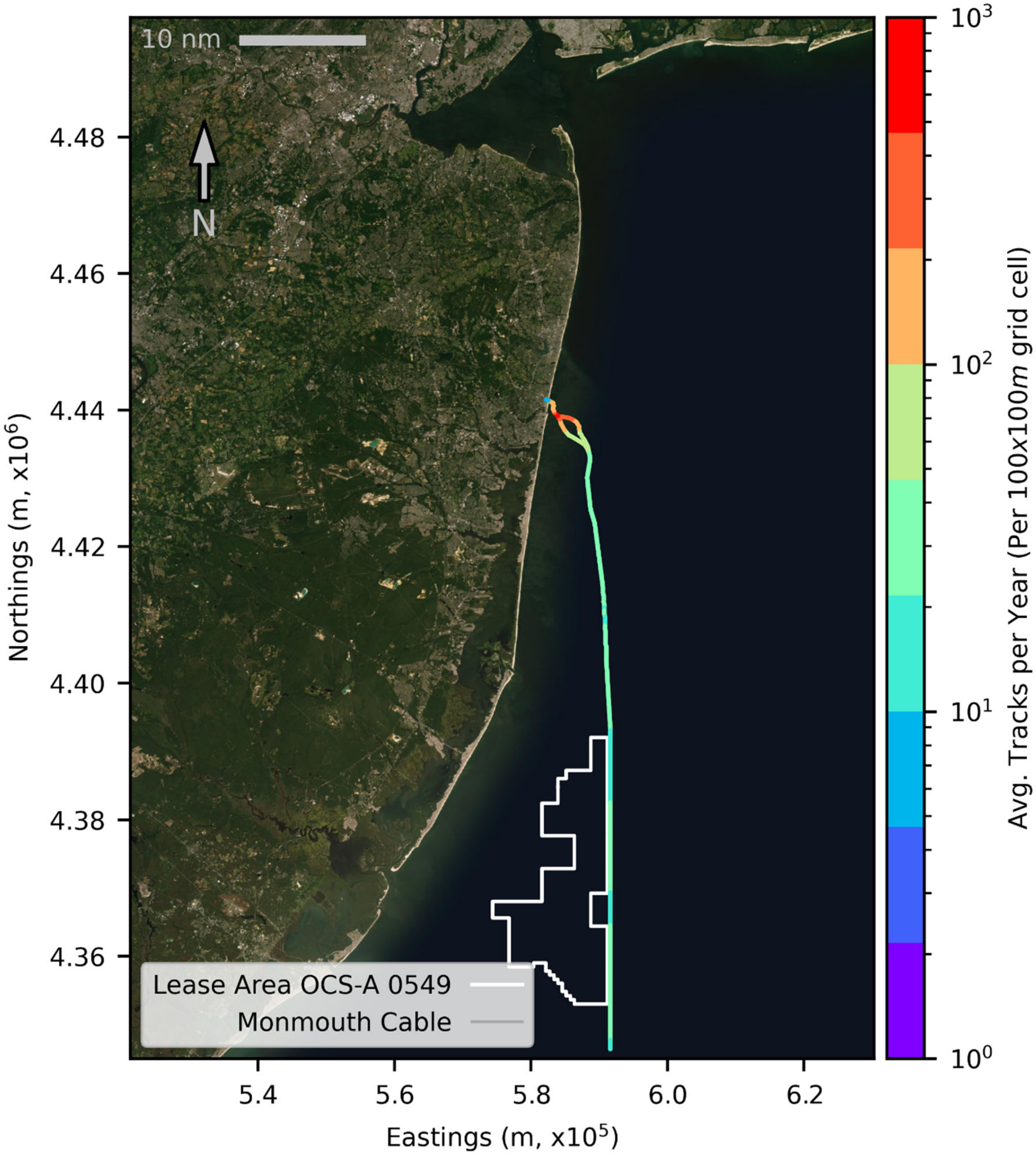
Ten Largest Vessels [1]

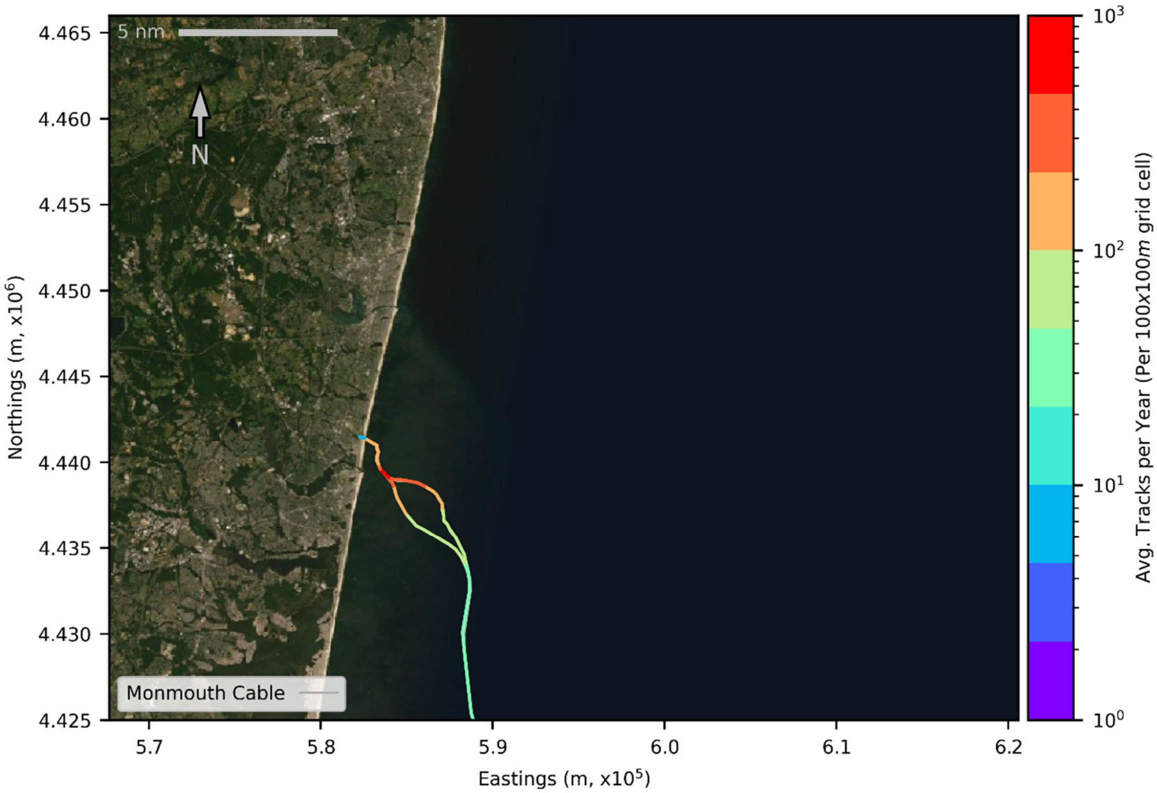
Vessel Name	MMSI Number	LOA (m)	LOA (ft)	Breadth (m)	Breadth (ft)	Depth (m)	Depth (ft)
USS KEARSARGE	368702000	250	819.70	32	106.00	19	60.80
USS ARCTIC	338995000	219	719.60	33	107.00	20	66.60
USS SUPPLY	338947000	218	715.10	33	107.00	17	56.00
USNS ROBERT E PEARY	369886000	210	689.00	n/a	n/a	n/a	n/a
WILLIAM MCLEAN	367852000	201	659.90	32	105.60	19	60.90
USS OAK HILL	368928000	173	568.80	n/a	n/a	n/a	n/a
USS CARTER HALL	368940000	173	568.80	n/a	n/a	n/a	n/a
HMCS ATHABASKAN	316136000	130	421.53	n/a	n/a	n/a	n/a
GLENN EDWARDS	367087140	112	368.00	23	76.00	13	42.00
USCGC HAMILTON	368883000	110	362.00	n/a	n/a	n/a	n/a

Note : Vessel dimensions updated based on dimensions registered on USGS Port State Information Exchange system (PSIX).

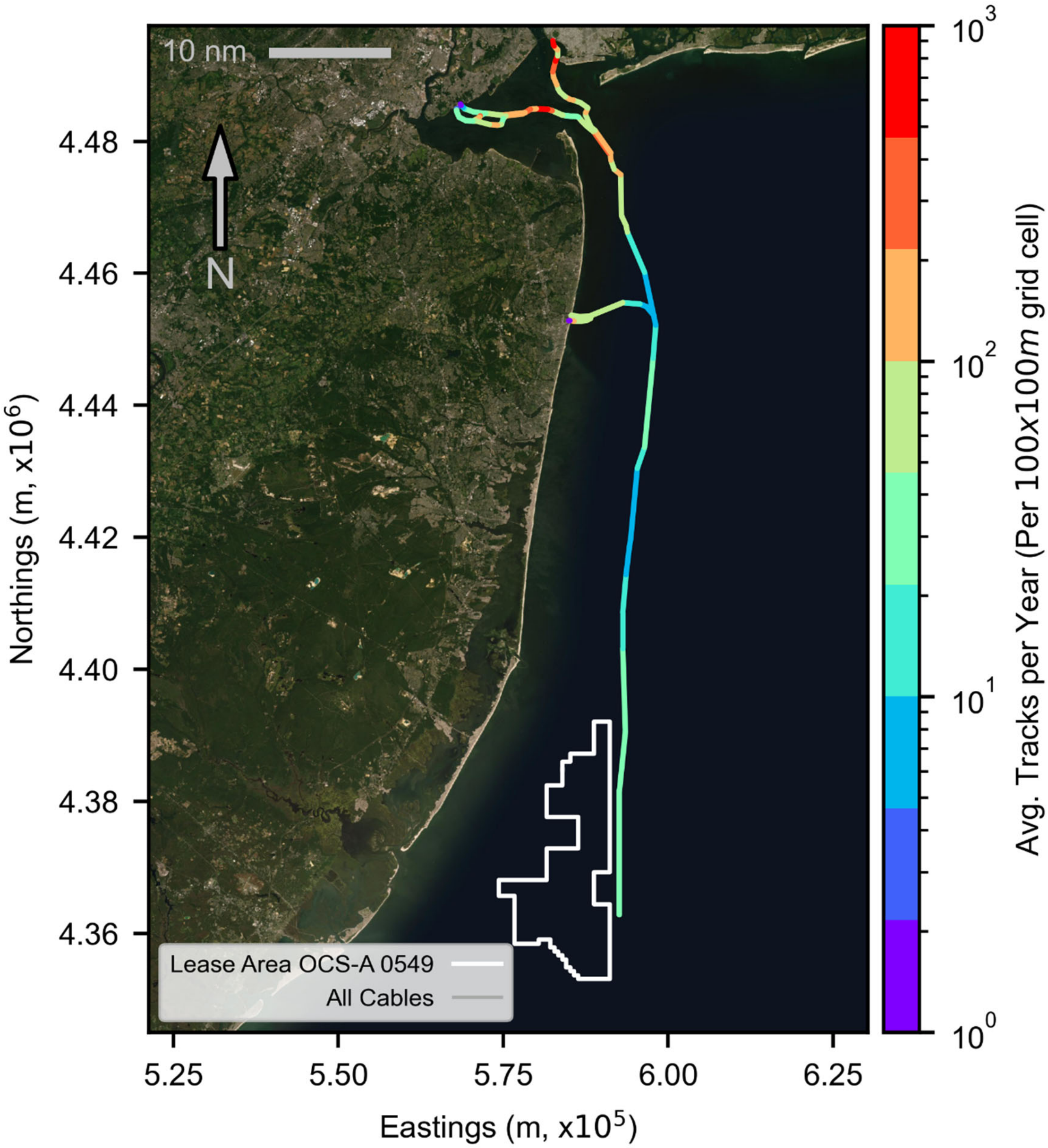
C.4 Export Cable Corridors

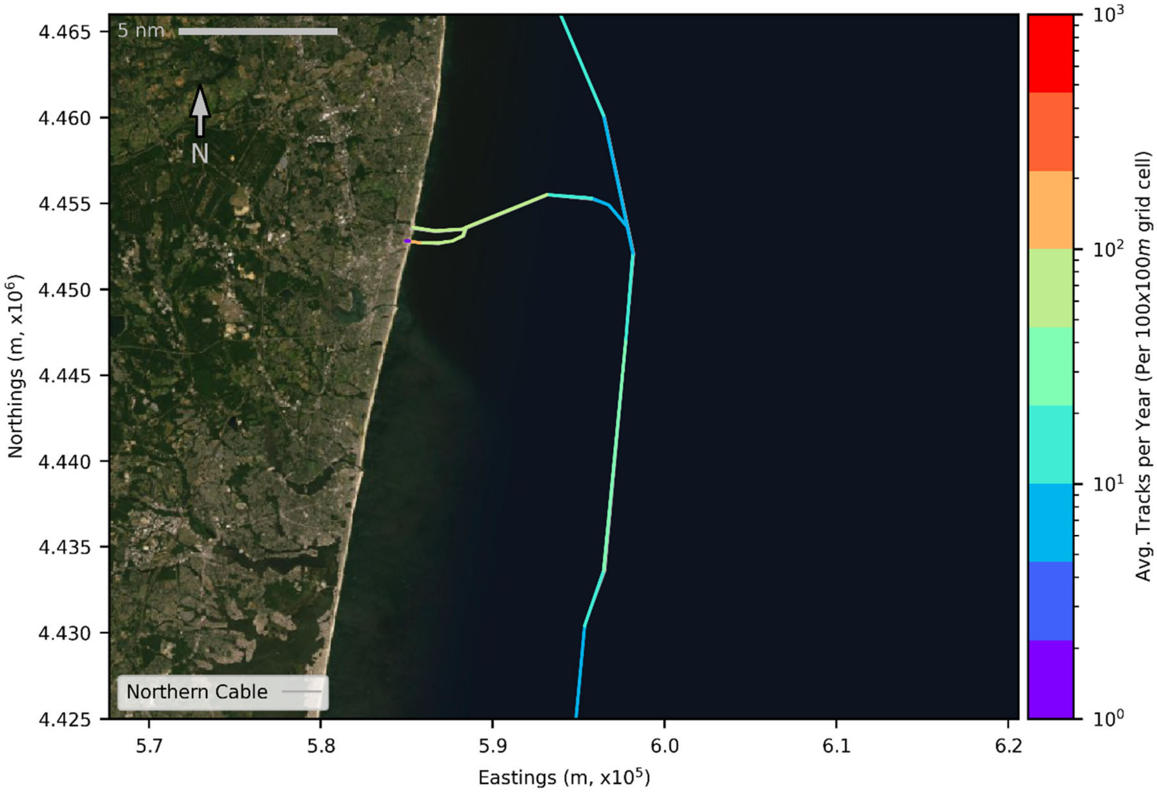
C.4.1 Monmouth Corridor

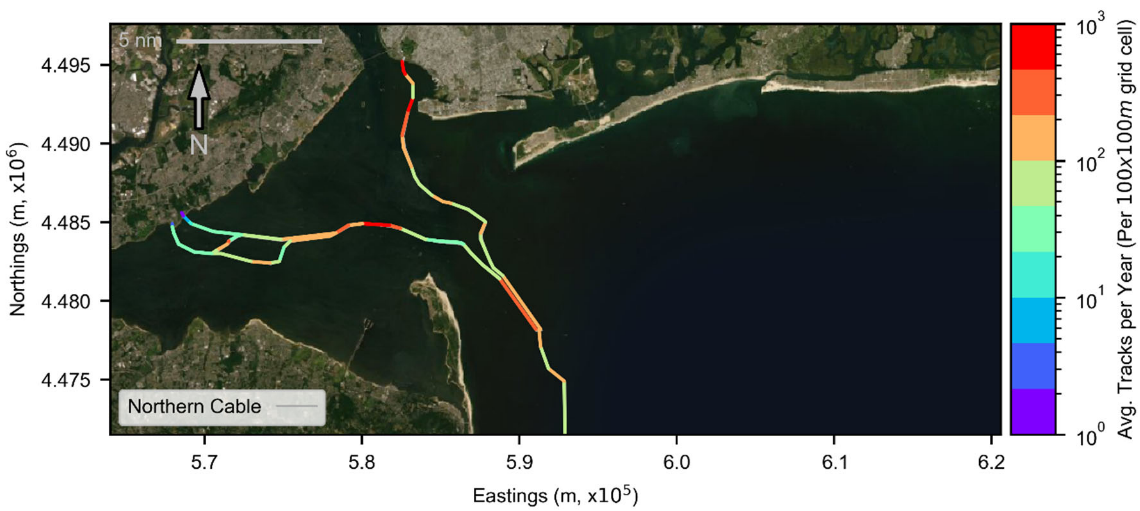



5 nm
N
Monmouth Cable
Northings (m, x10^6)
4.465
4.460
4.455
4.450
4.445
4.440
4.435
4.430
4.425
Eastings (m, x10^5)
5.7
5.8
5.9
6.0
6.1
6.2
Avg. Tracks per Year (Per 100x100m grid cell)
10^3
10^2
10^1
10^0

C.4.2 North Export Corridor




5 nm
N
Northern Cable
4.465
4.460
4.455
4.450
4.445
4.440
4.435
4.430
4.425
Northings (m, x10^6)
5.7
5.8
5.9
6.0
6.1
6.2
Eastings (m, x10^5)
10^3
10^2
10^1
10^0
Avg. Tracks per Year (Per 100x100m grid cell)


5 nm
N
Northern Cable
4.495
4.490
4.485
4.480
4.475
Northings (m, x10^6)
5.7
5.8
5.9
6.0
6.1
6.2
Eastings (m, x10^5)
10^3
10^2
10^1
10^0
Avg. Tracks per Year (Per 100x100m grid cell)

Appendix D

VMS and VTR Data Maps and Polar Histograms

D.1 VMS Fishing Density Maps

The National Marine Fisheries Service (NMFS) Office of Law Enforcement VMS data comes from transponders on vessels carrying permits for regulated fisheries. Each transponder allows the fisherman to "declare" which fishery they are currently participating in, declare that they are not participating in a VMS monitored fishery, or indicate that they are powered down at dock. Each transponder will broadcast a position report hourly (excepting when declared for SES/Atlantic Sea Scallop, which are broadcast every 30 minutes). BOEM received VMS raw position reports from NMFS Office of Law Enforcement for the period from January 1, 2014 to August 21, 2019. These data were processed by BOEM to extract the position reports for those vessels that operated within the combined Lease Area OCS-A 0499 and 0549. The following Appendix subsection will present the Fishing Density plots for Lease Area OCS-A 0549.

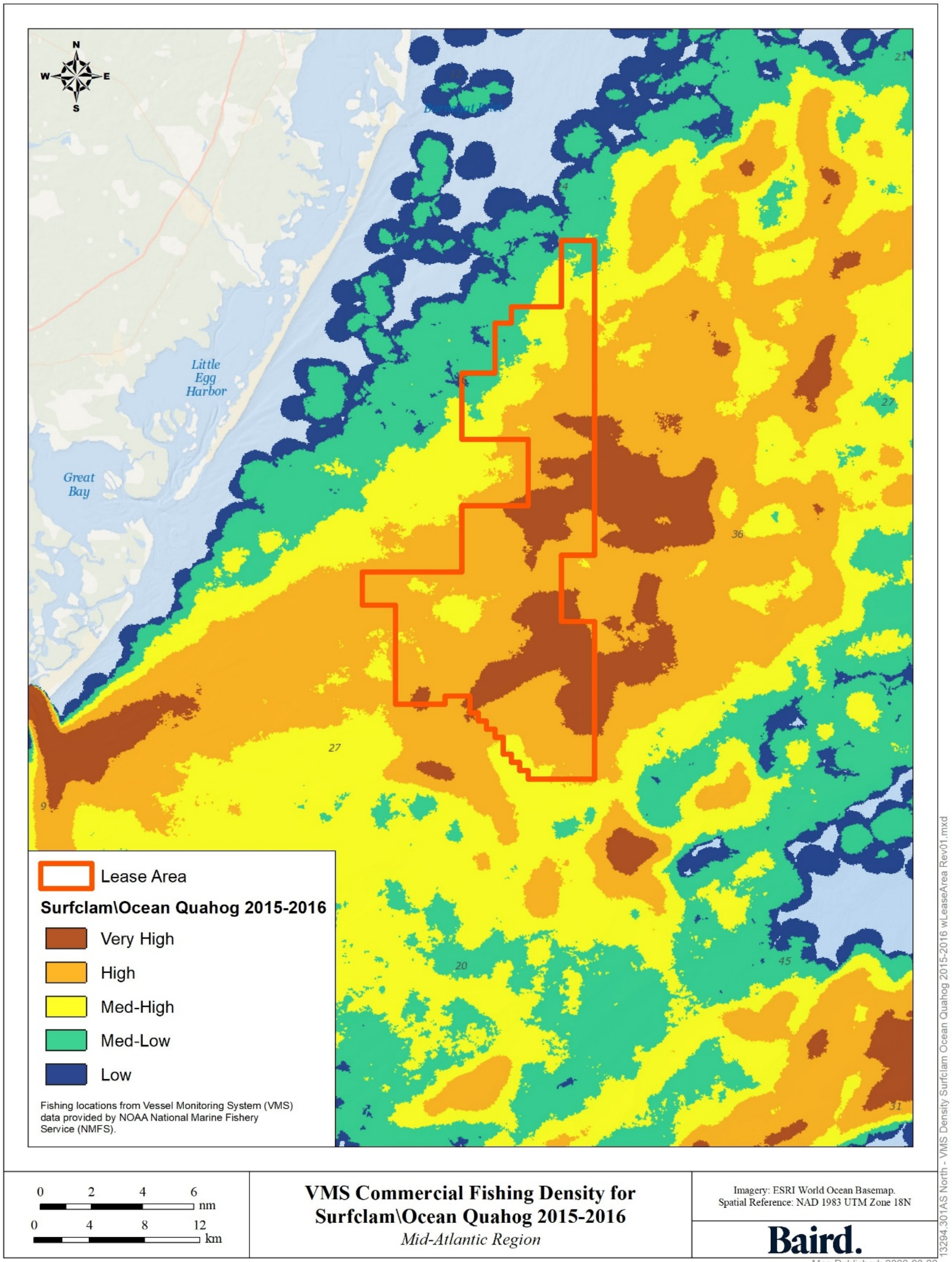


Figure D.1: VMS Commercial Fishing Density for Surf clam\Ocean Quahog 2015-2016

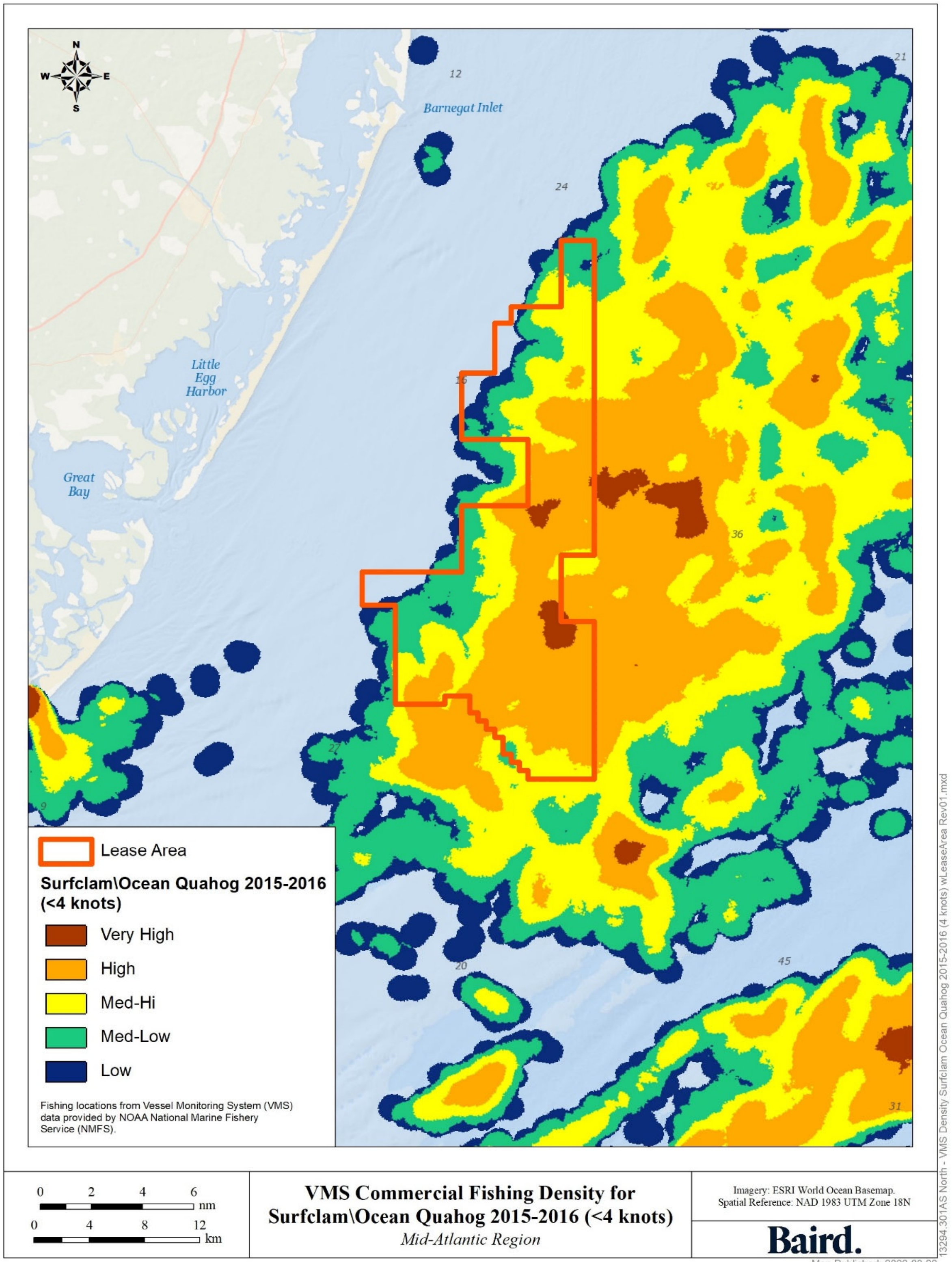


Figure D.2: VMS Commercial Fishing Density for Surf clam\Ocean Quahog 2015-2016 (<4 knots)

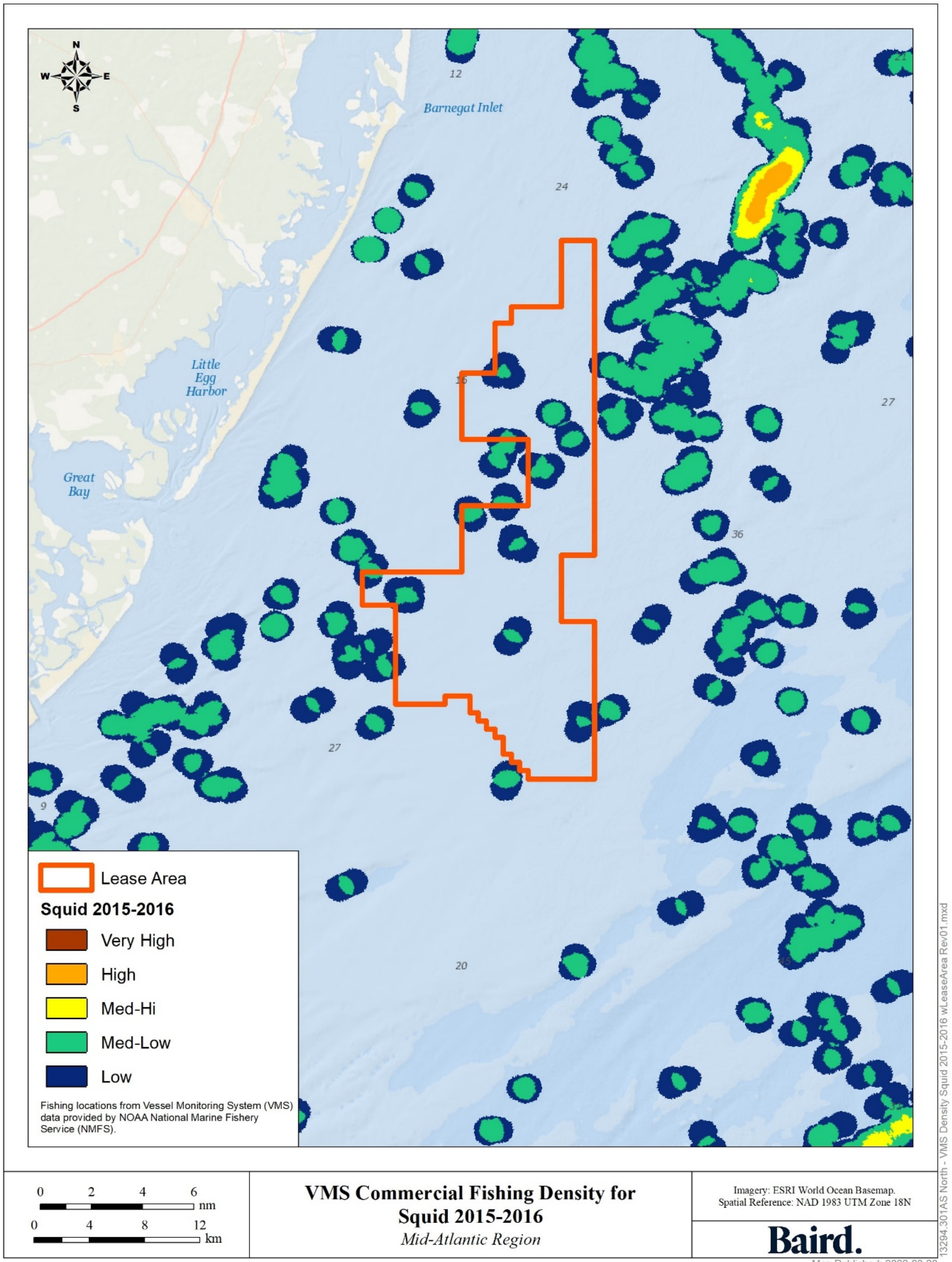


Figure D.3: VMS Commercial Fishing Density for Squid 2015-2016

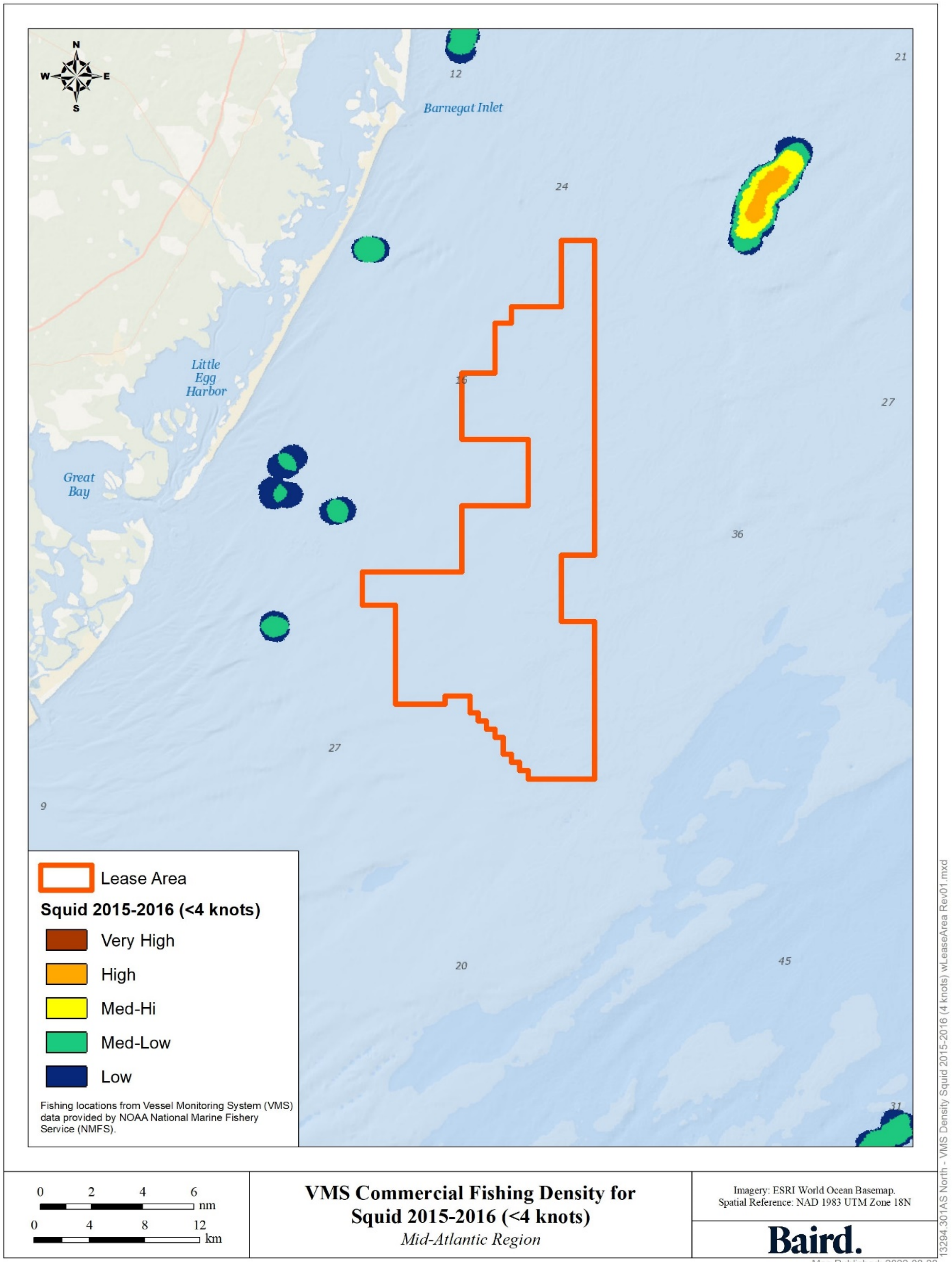


Figure D.4: VMS Commercial Fishing Density for Squid 2015-2016 (<4 knots)

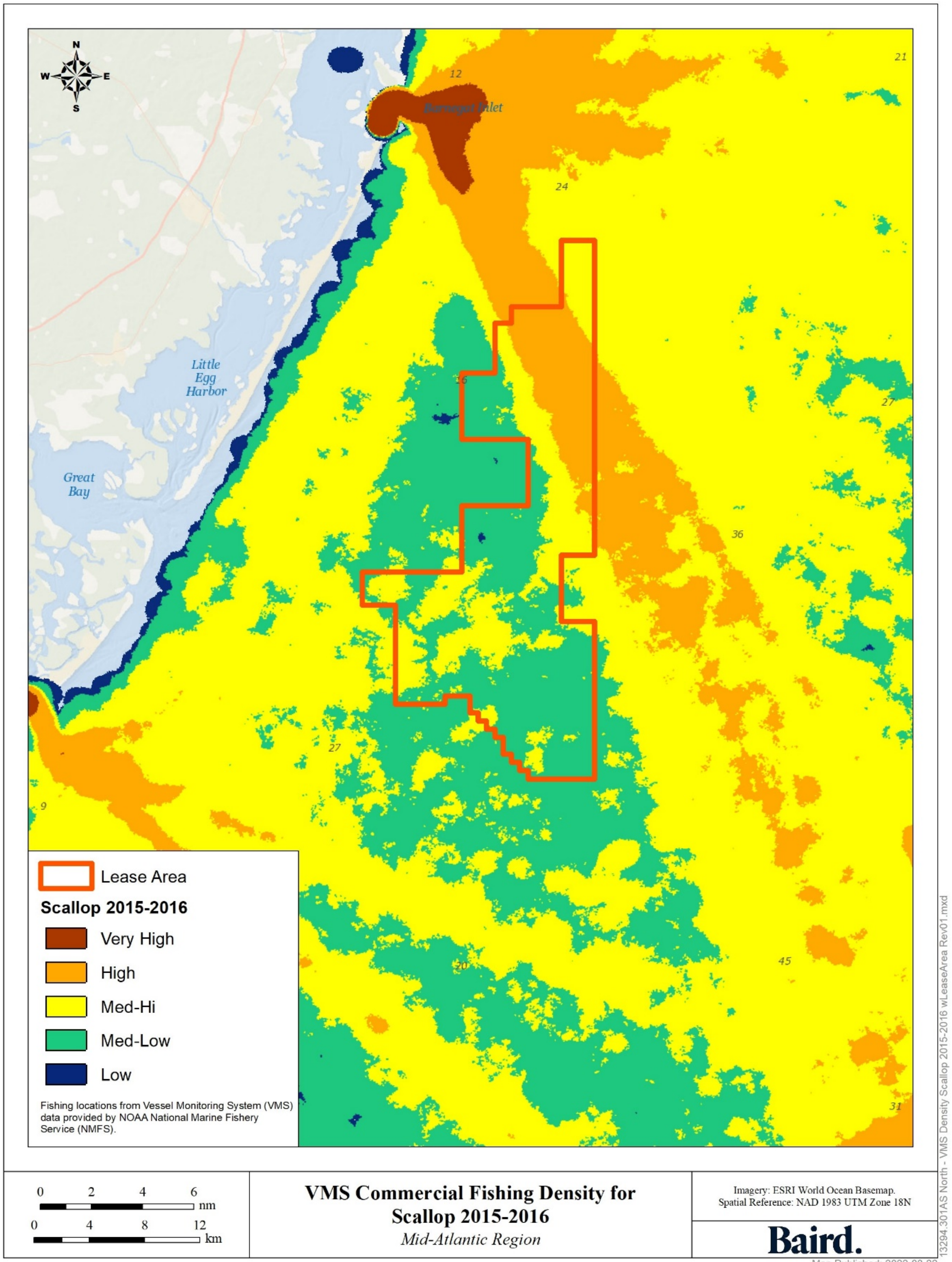


Figure D.5: VMS Commercial Fishing Density for Scallop 2015-2016

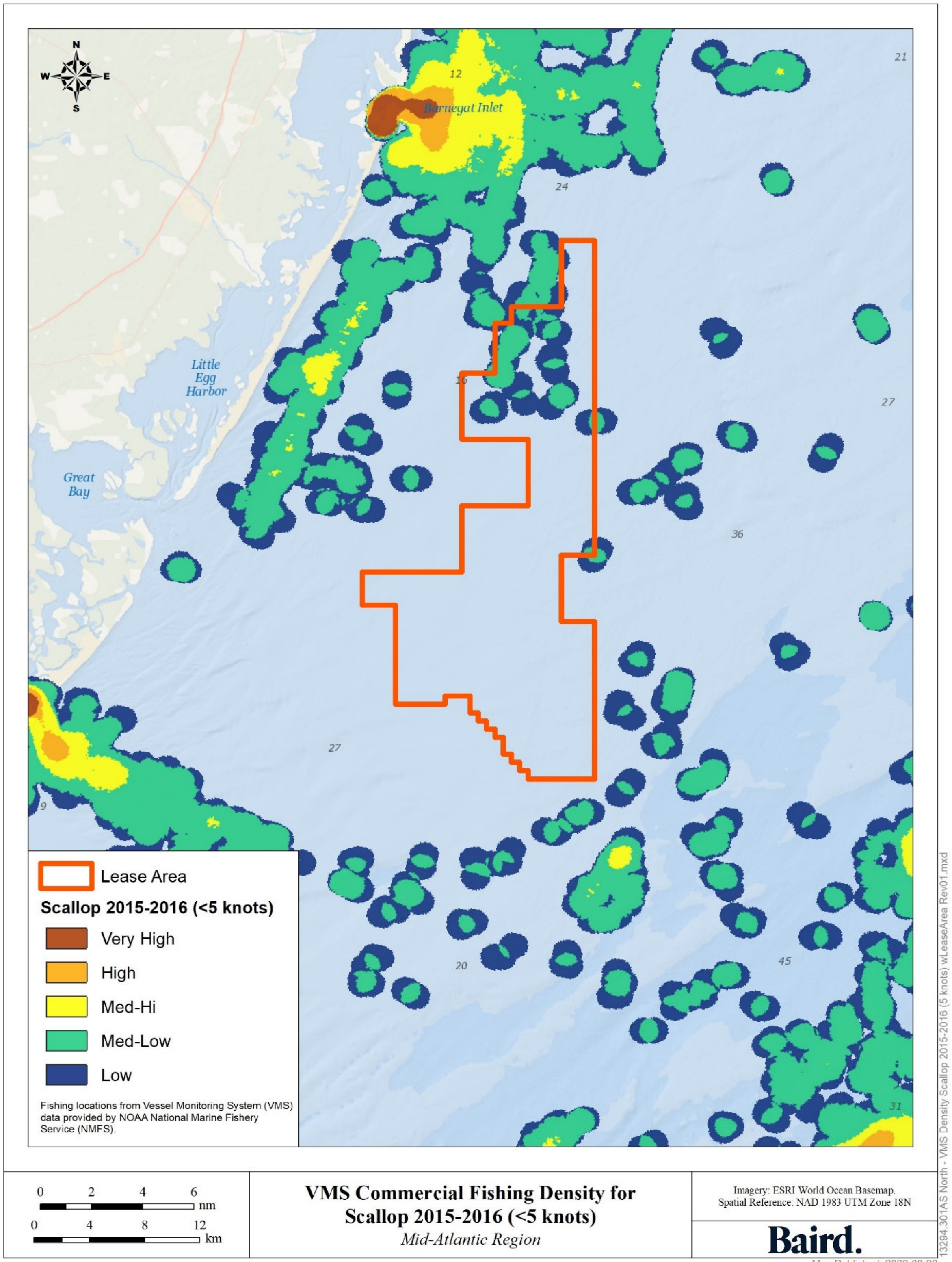


Figure D.6: VMS Commercial Fishing Density for Scallop 2015-2016 (<5 knots)

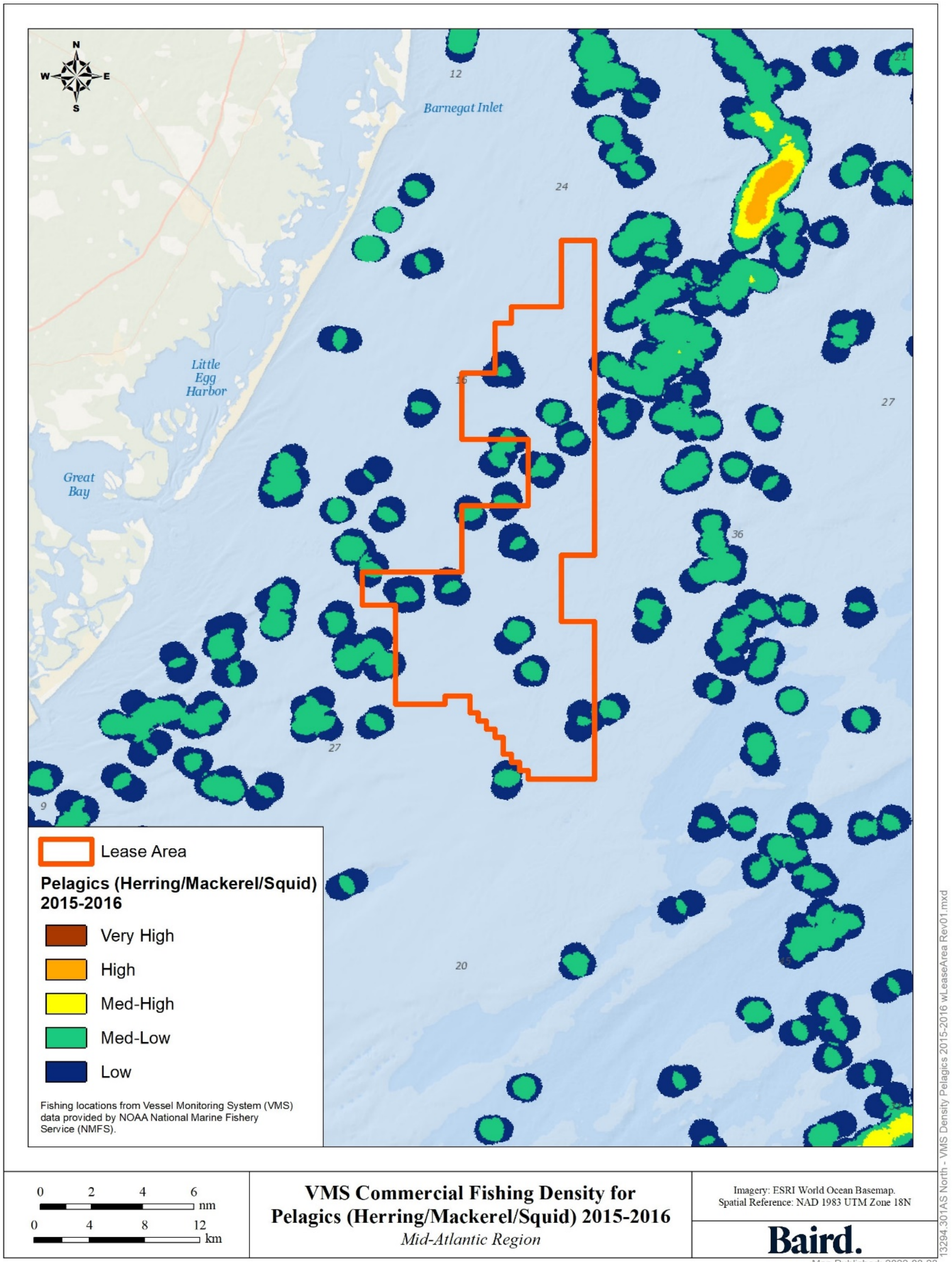


Figure D.7: VMS Commercial Fishing Density for Pelagics (Herring/Mackerel/Squid) 2015-2016

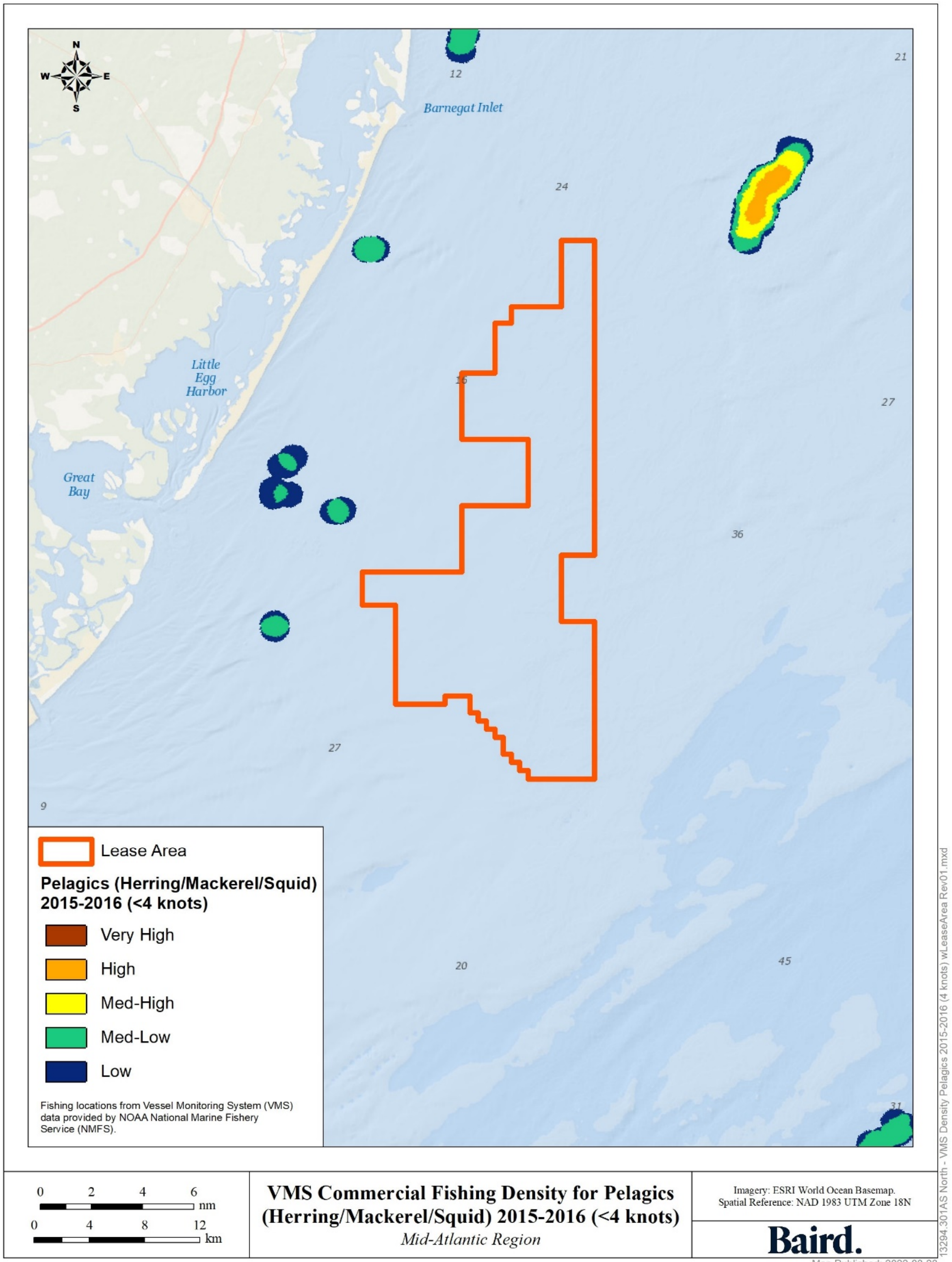


Figure D.8: VMS Commercial Fishing Density for Pelagics (Herring/Mackerel/Squid) 2015-2016 (<4 knots)

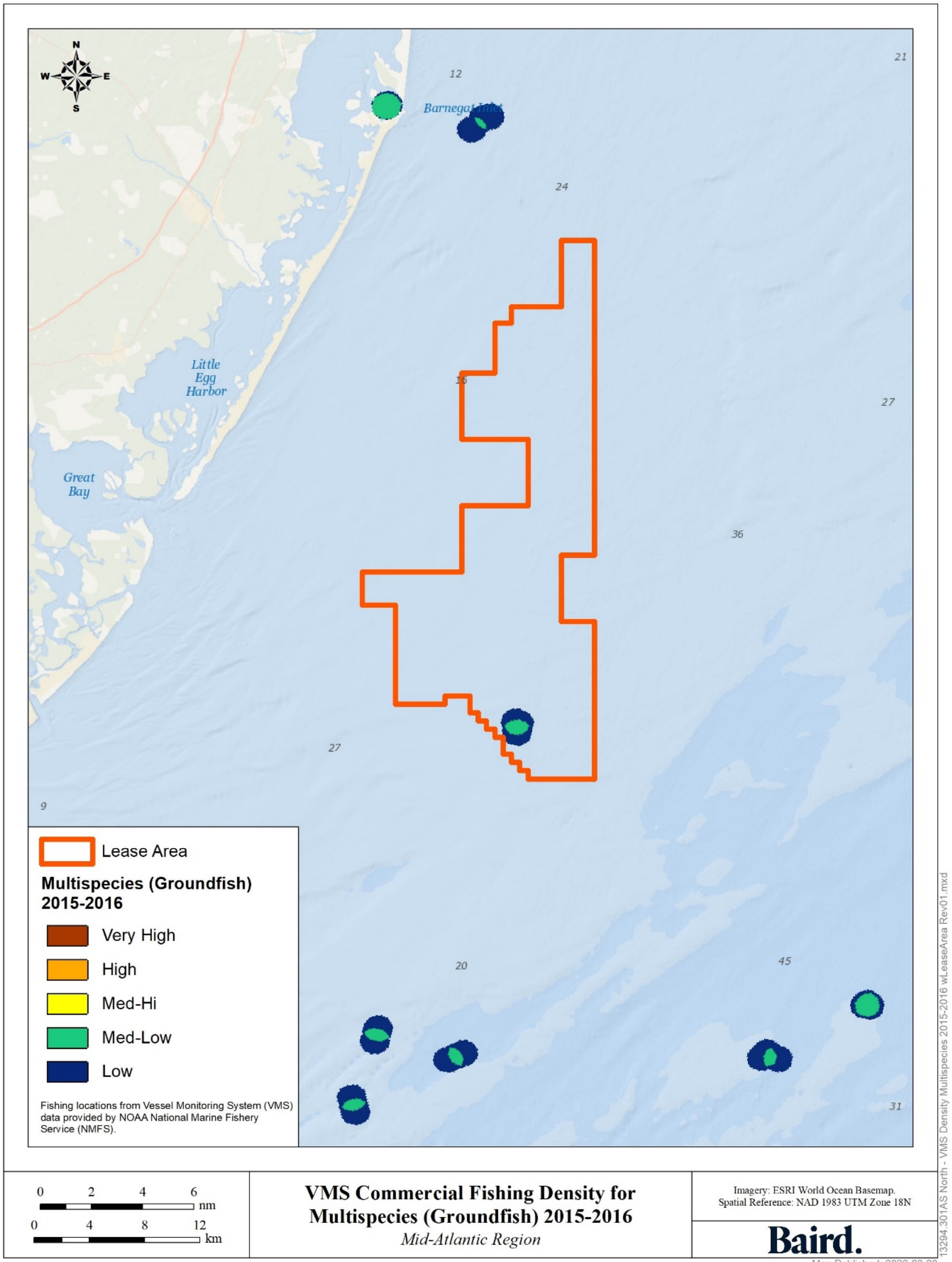


Figure D.9: VMS Commercial Fishing Density for Multispecies (Groundfish) 2015-2016

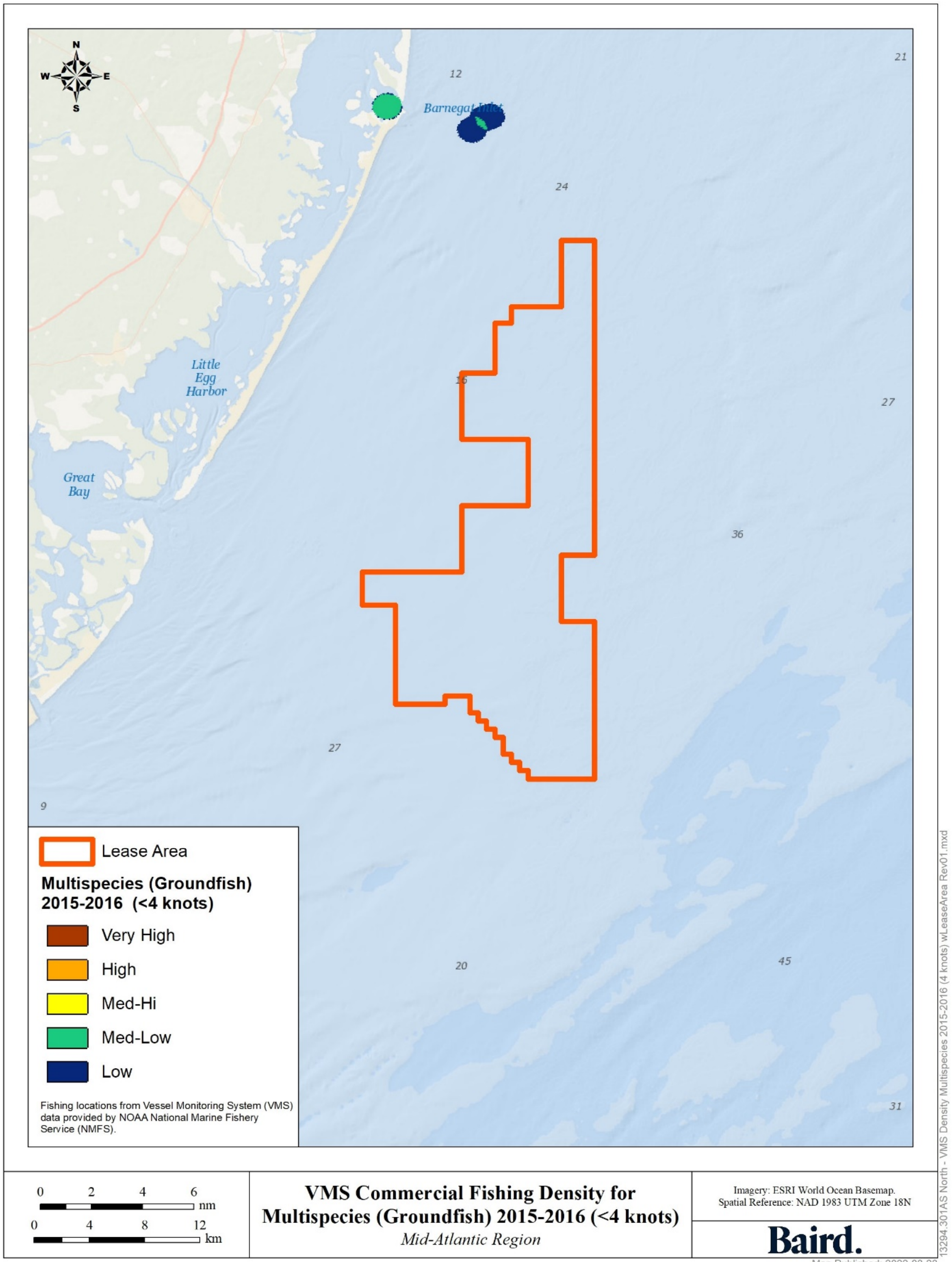


Figure D.10: VMS Commercial Fishing Density for Multispecies (Groundfish) 2015-2016 (<4 knots)

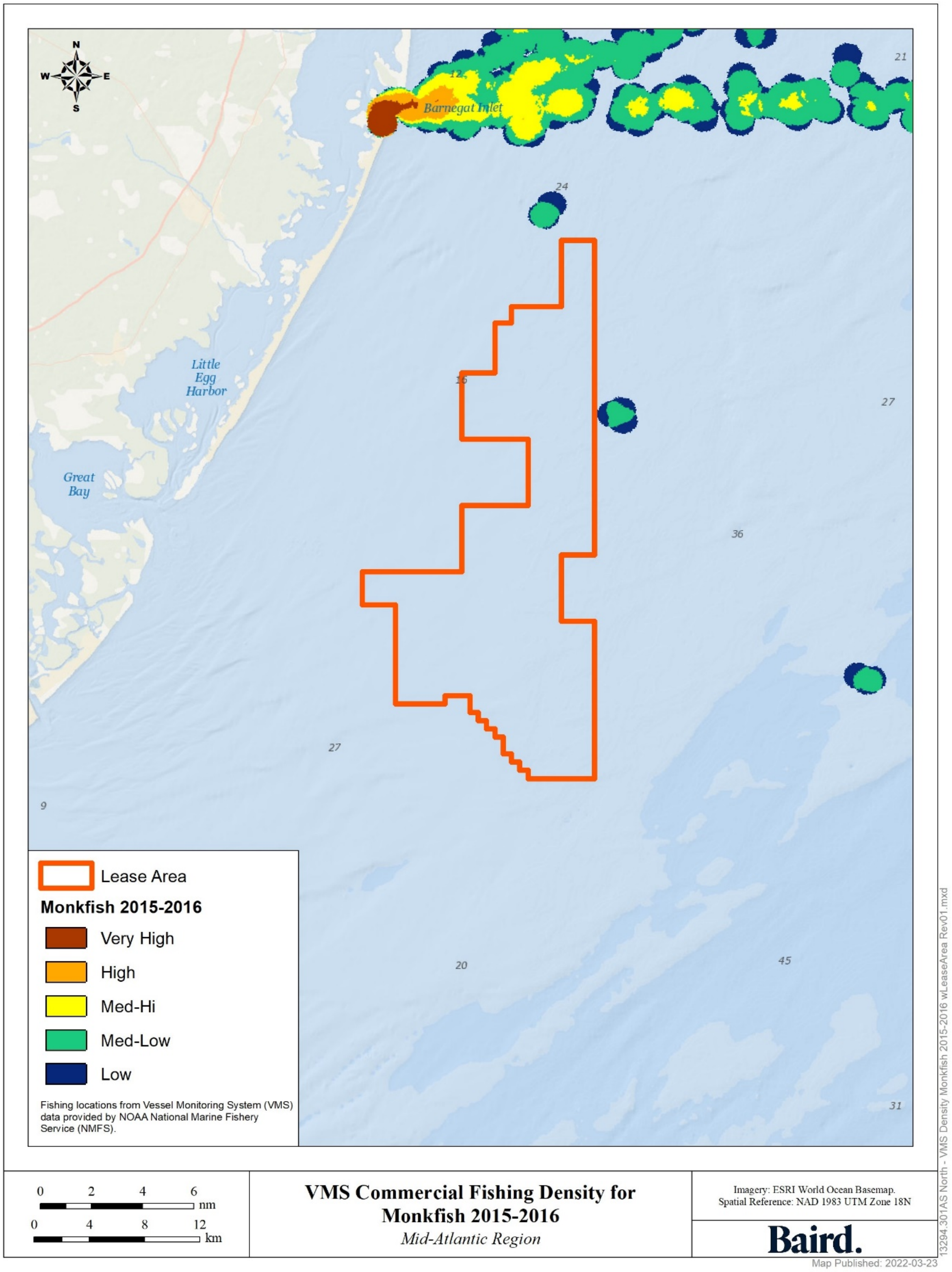


Figure D.11: VMS Commercial Fishing Density for Monkfish 2015-2016

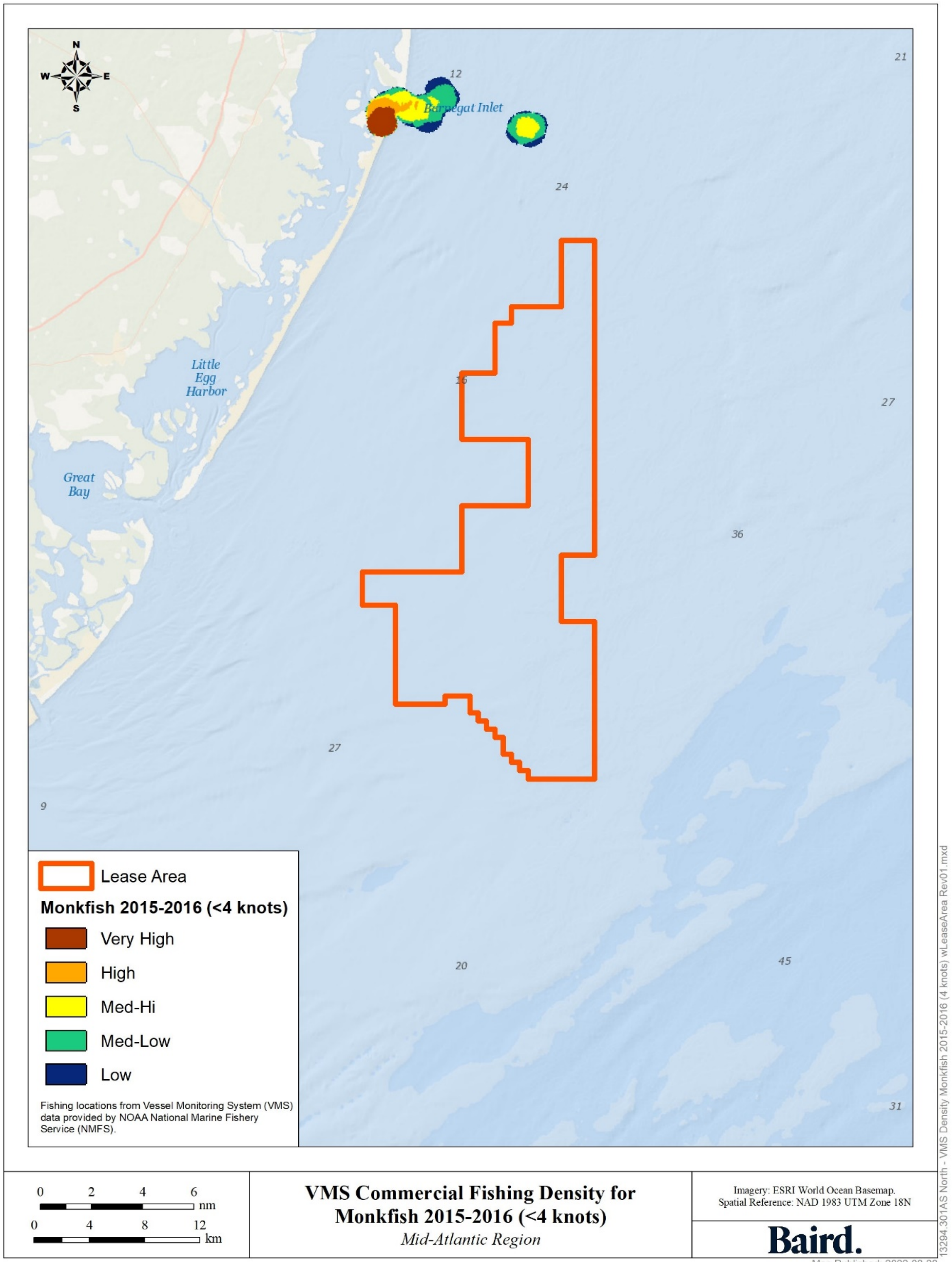


Figure D.12: VMS Commercial Fishing Density for Monkfish 2015-2016 (<4 knots)

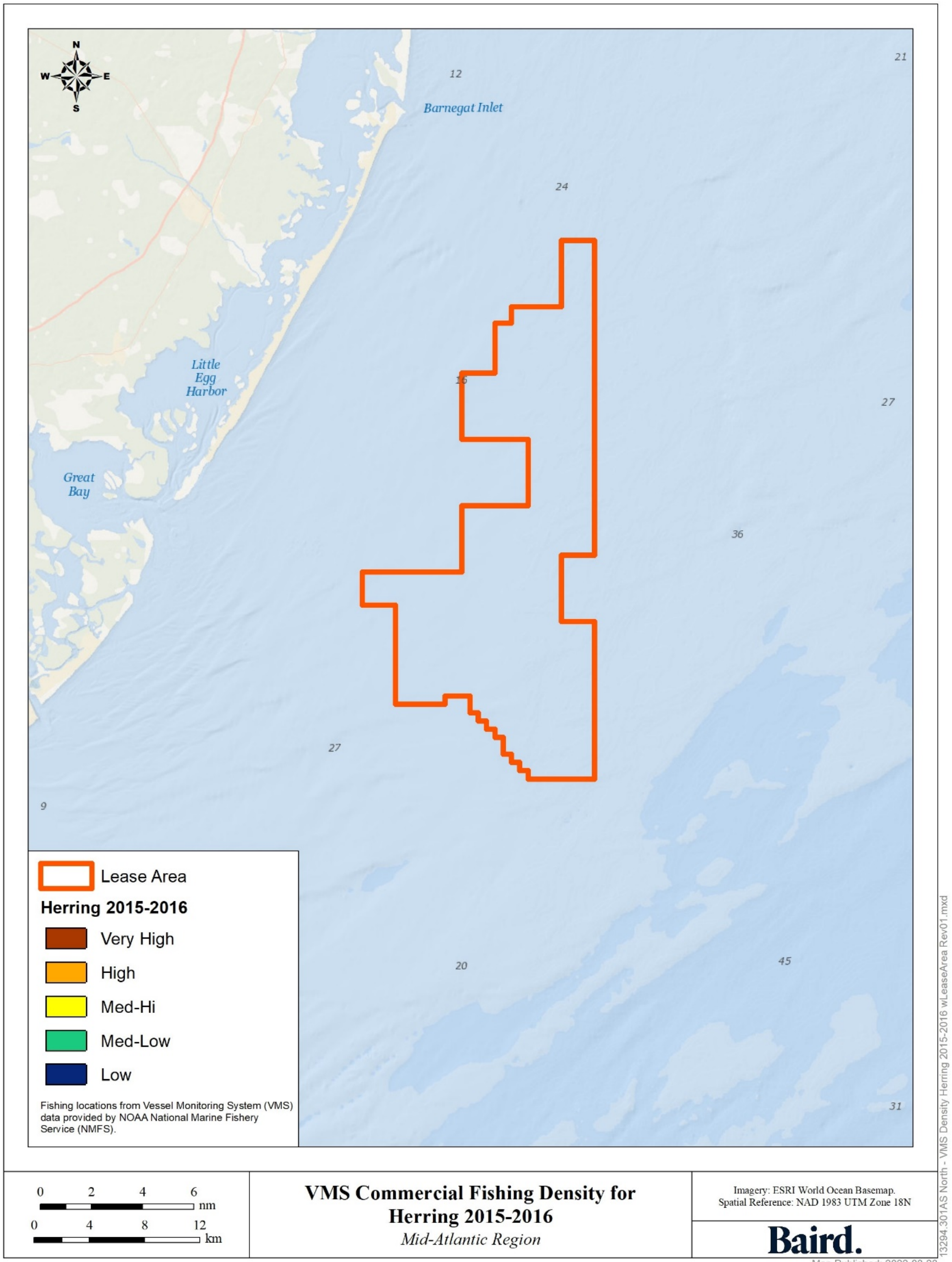
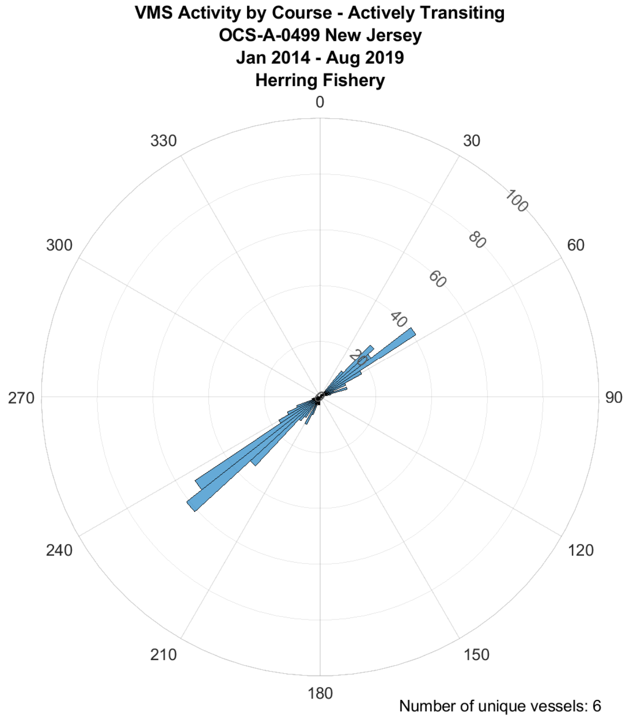


Figure D.13: VMS Commercial Fishing Density for Herring 2015-2016

D.2 VMS Polar Histograms

From the data processed by BOEM, polar histogram plots and vessel count data were developed by BOEM and provided to Atlantic Shores. This appendix section presents the polar histogram plots for the combined Lease Area OCS-A 0499 and 0549.



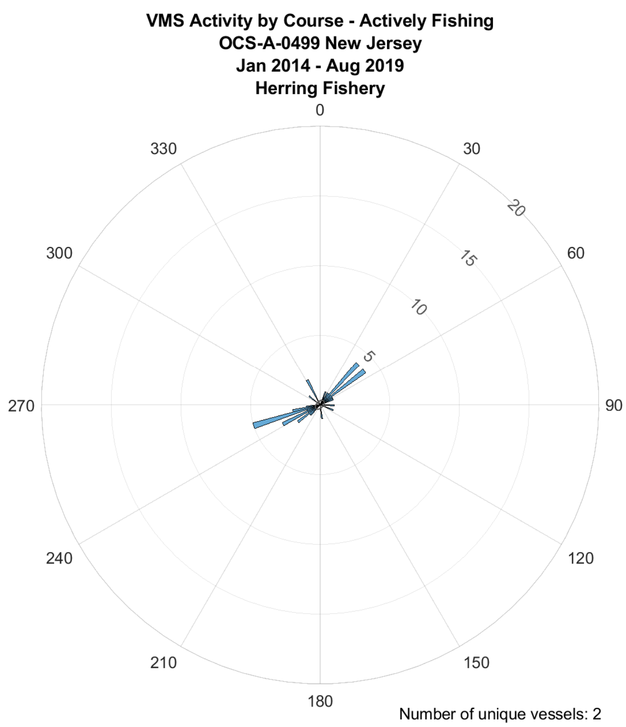
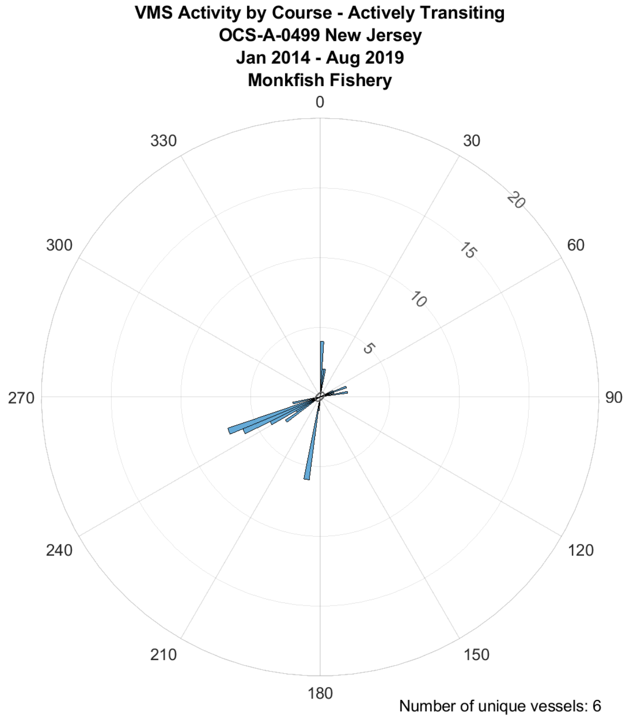


Figure D.14 Polar Histogram for Herring Fishing When Transiting (top) and Actively Fishing (bottom)



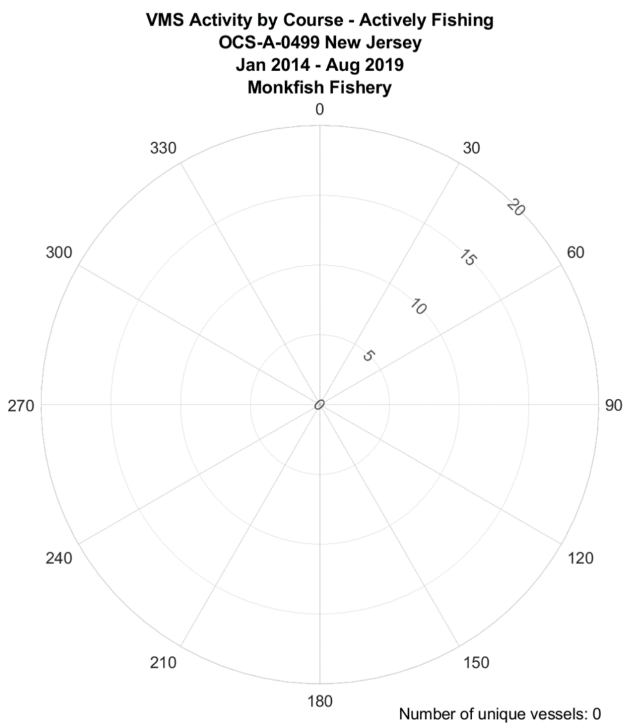
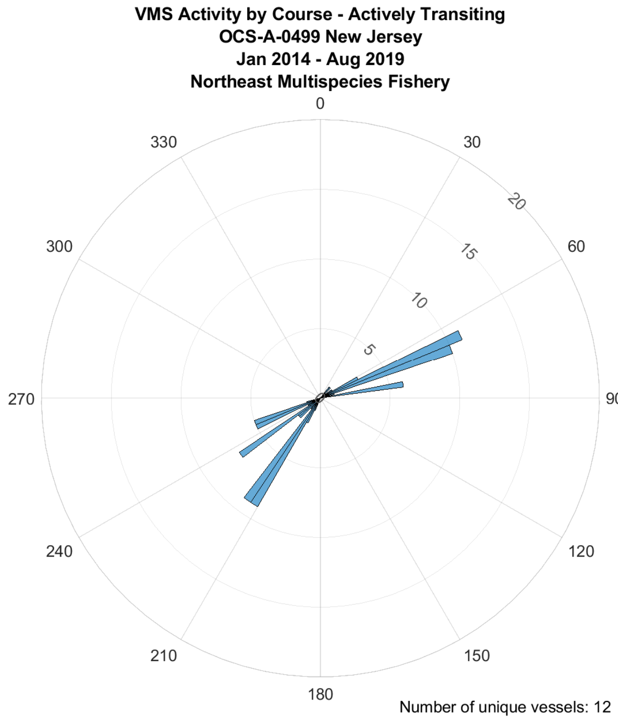


Figure D.15 Polar Histogram for Monkfish Fishing When Transiting (top) and Actively Fishing (bottom)



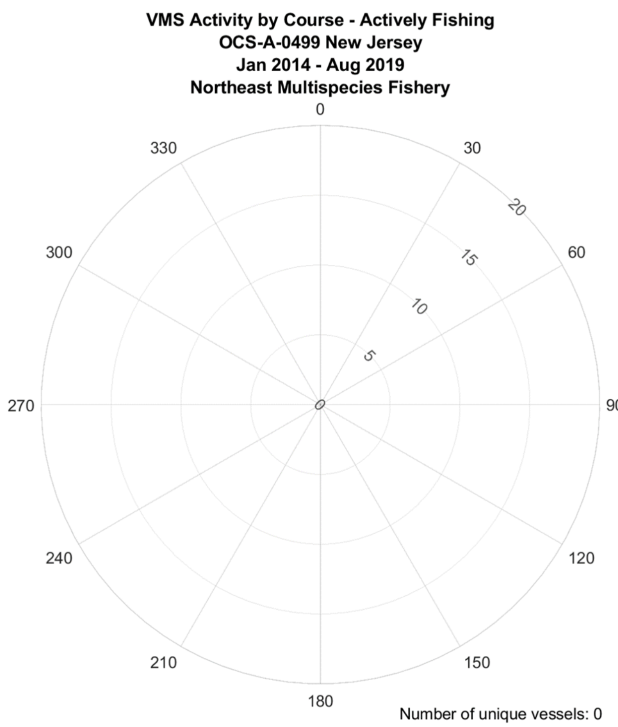


Figure D.16 Polar Histogram for Multispecies Fishing When Transiting (top) and Actively Fishing (bottom)

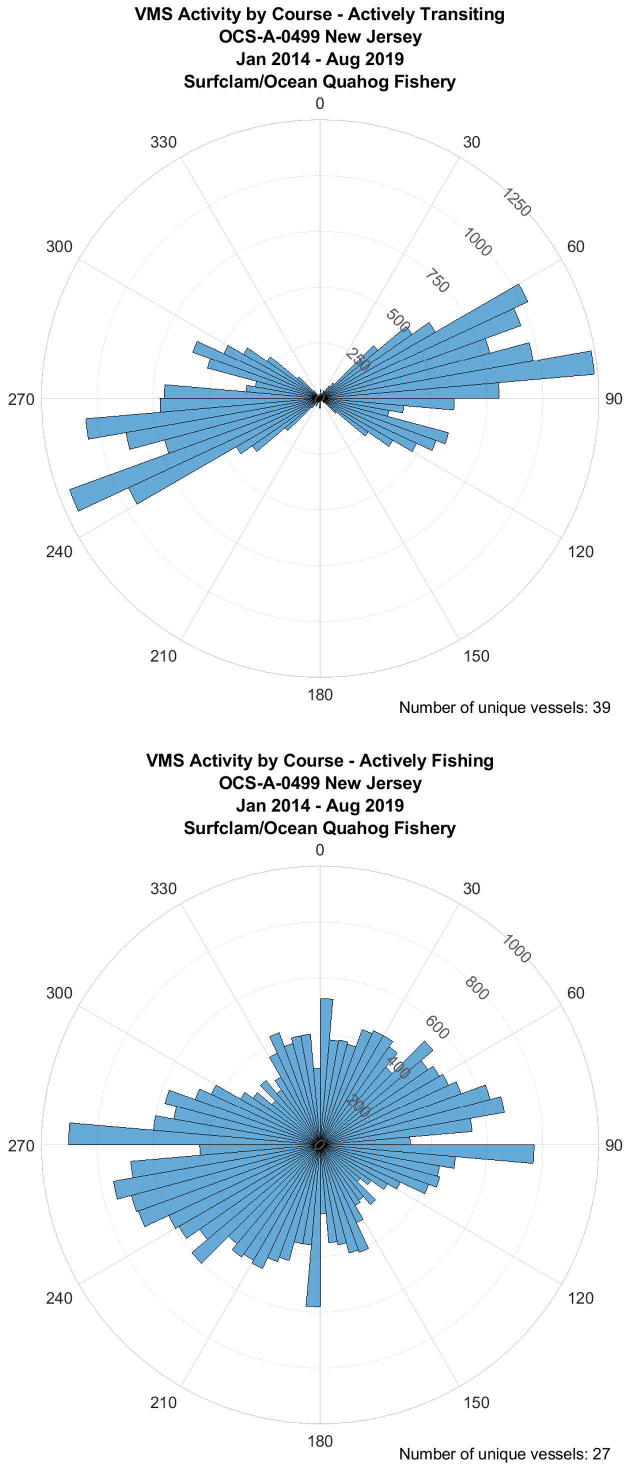
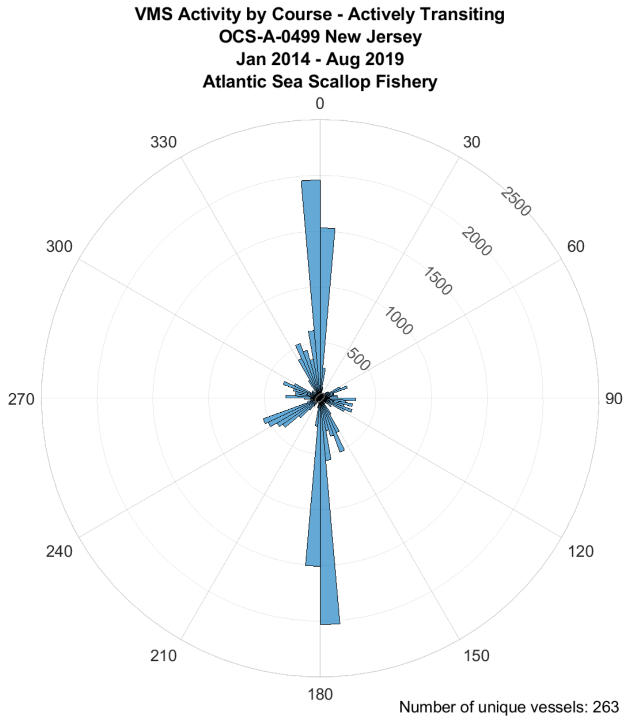


Figure D.17 Polar Histogram for Surf clam/Quahog Fishing When Transiting (top) and Actively Fishing (bottom)



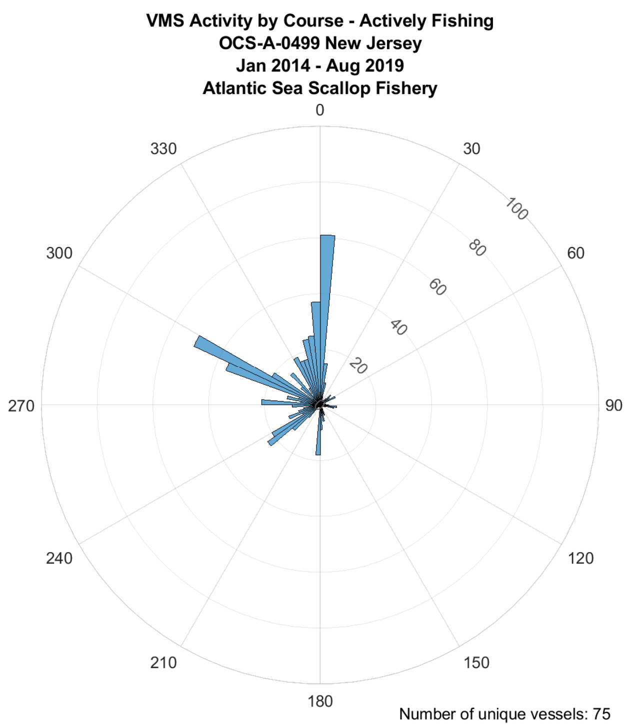
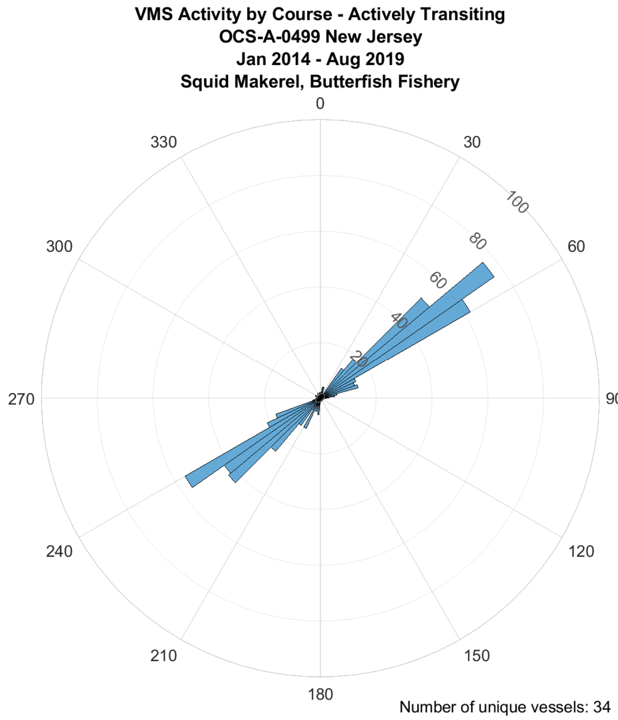


Figure D.18 Polar Histogram for Scallop Fishing When Transiting (top) and Actively Fishing (bottom)



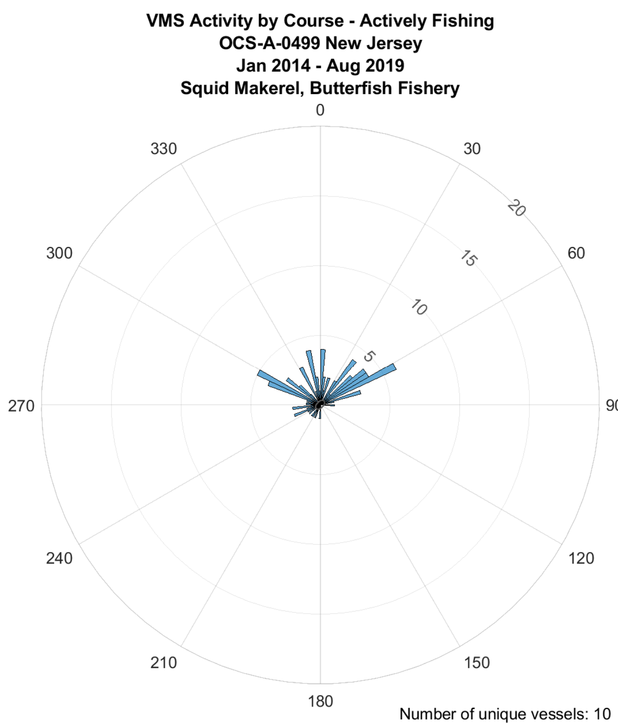
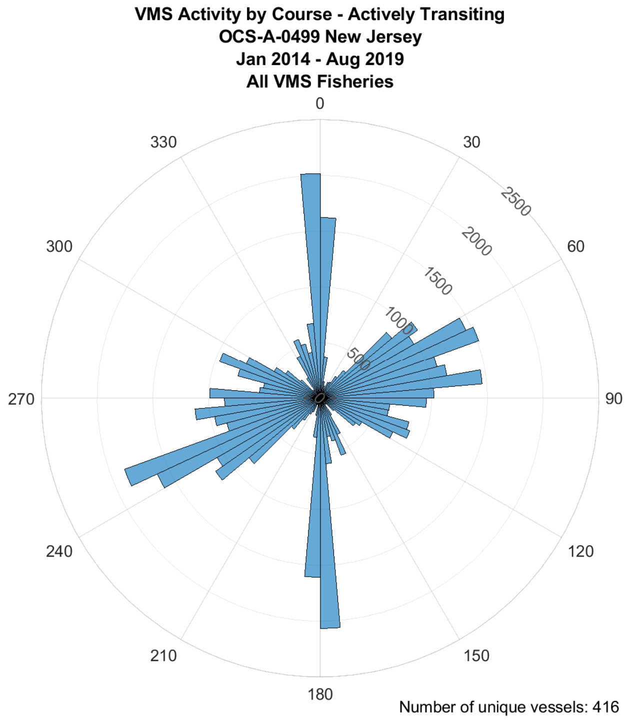


Figure D.19 Polar Histogram for Squid, Mackerel and Butterfish Fishing When Transiting (top) and Actively Fishing (bottom)



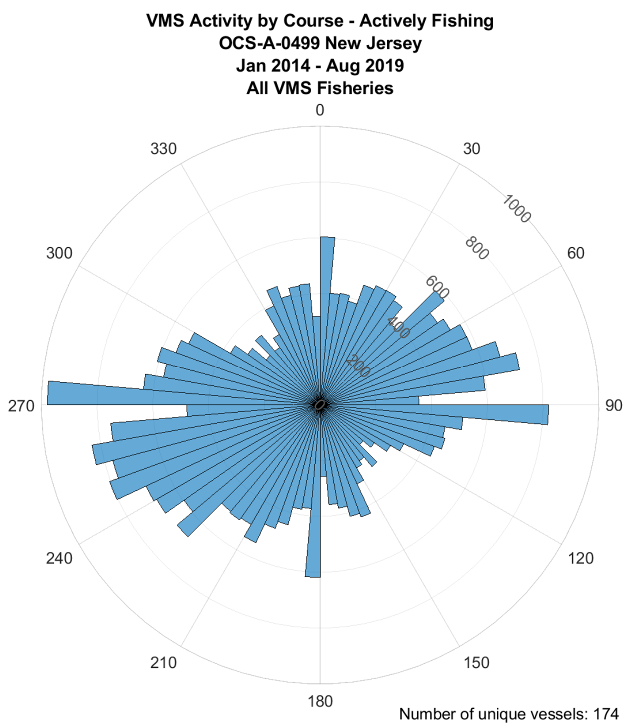
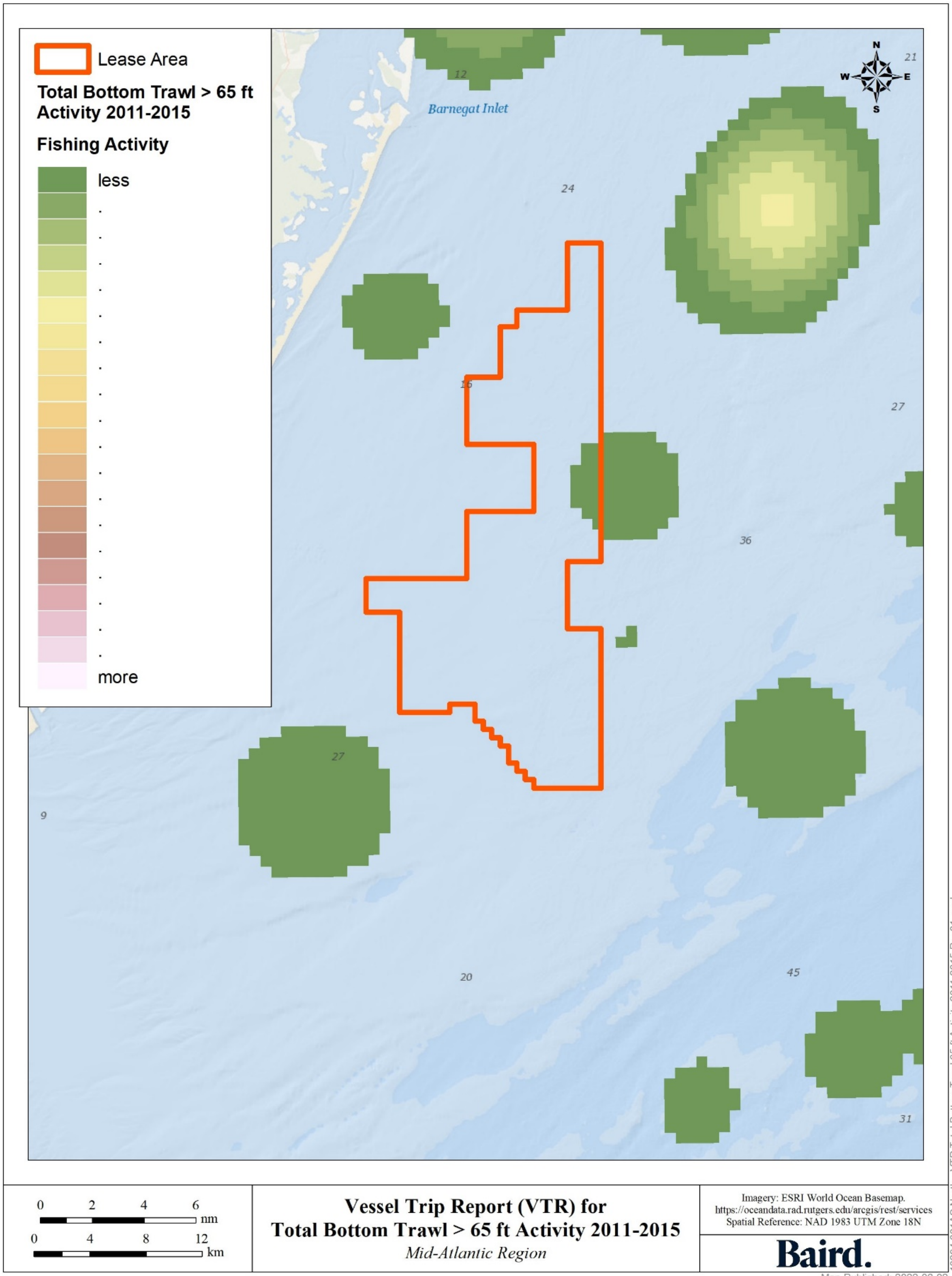


Figure D.20 Polar Histogram for All Vessels When Transiting (top) and Actively Fishing (bottom)

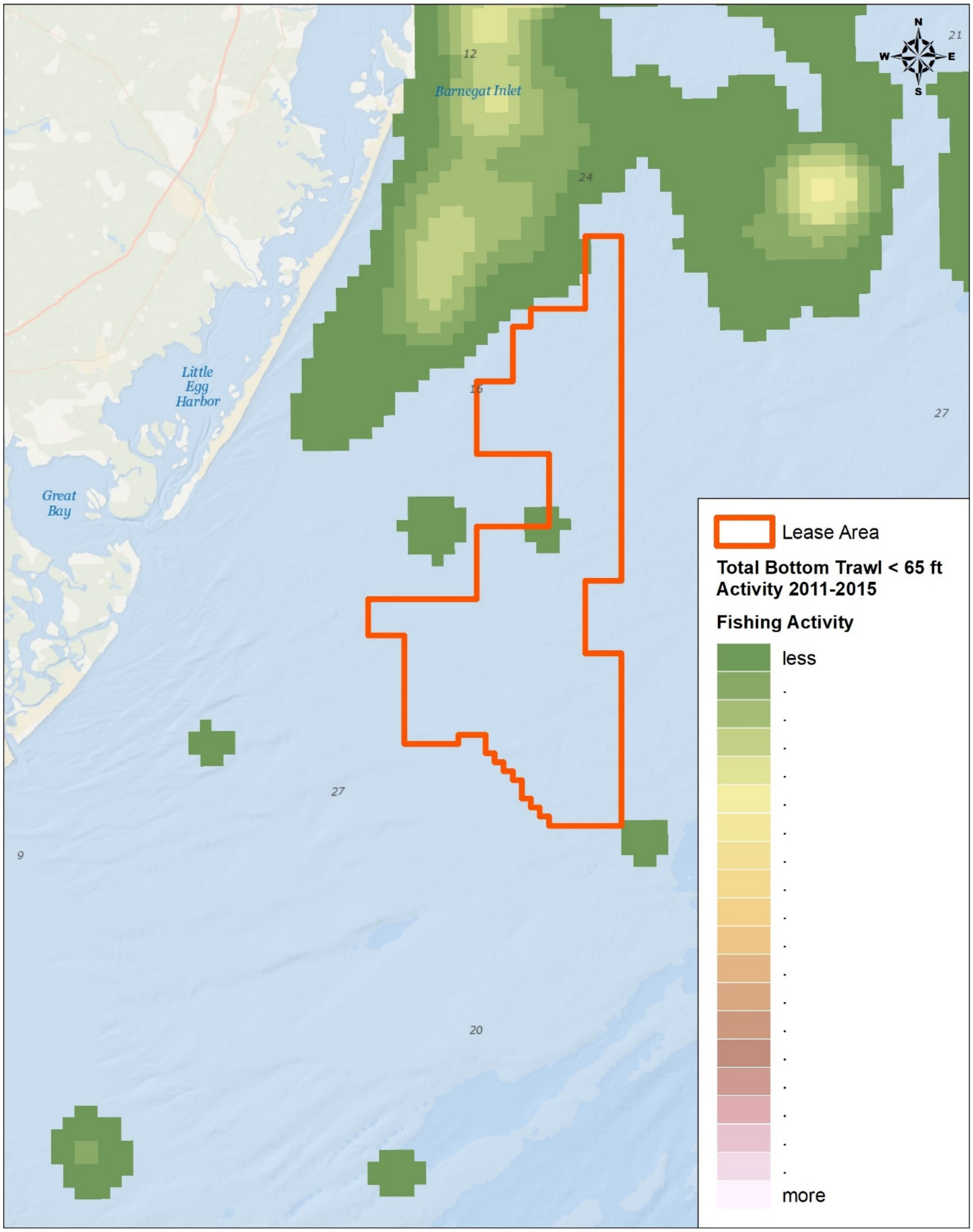
D.3 Vessel Trip Report (VTR) Maps

NOAA collects fishery data by means of Vessel Trip Reports (VTR) in which commercial fishing vessels report the details of each individual trip including vessel details, type of gear used, location, and type of catch. These data have been analyzed and mapped by NOAA and are available online as GIS mapping files broken out by type of fishing activity and time period. The following are maps of the most recent data available (2011 to 2015).



Vessel Trip Report (VTR) for Total Bottom Trawl > 65 ft Activity 2011-2015

Mid-Atlantic Region



0 2 4 6 nm
0 4 8 12 km

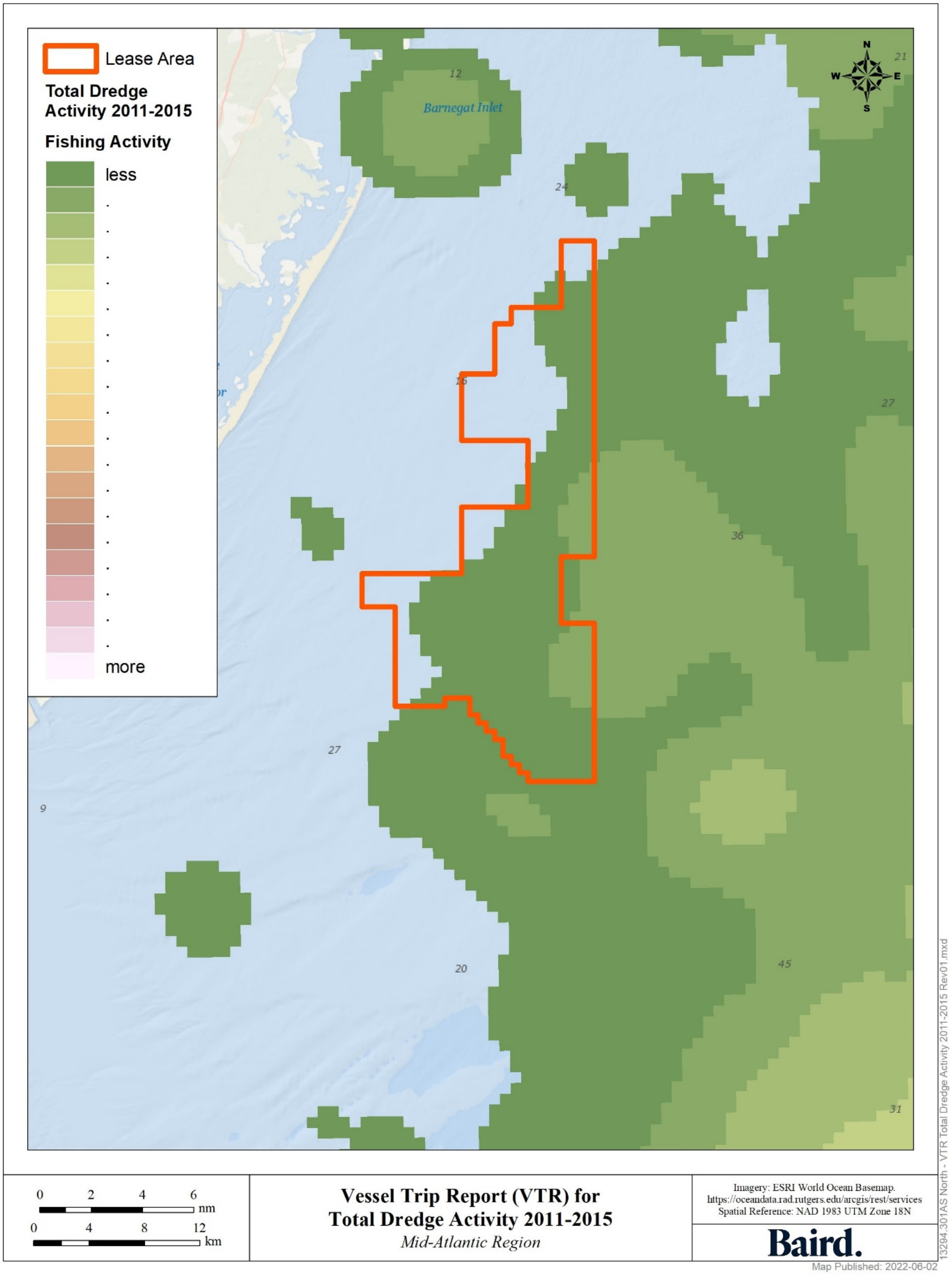
Vessel Trip Report (VTR) for
Total Bottom Trawl < 65 ft Activity 2011-2015
Mid-Atlantic Region

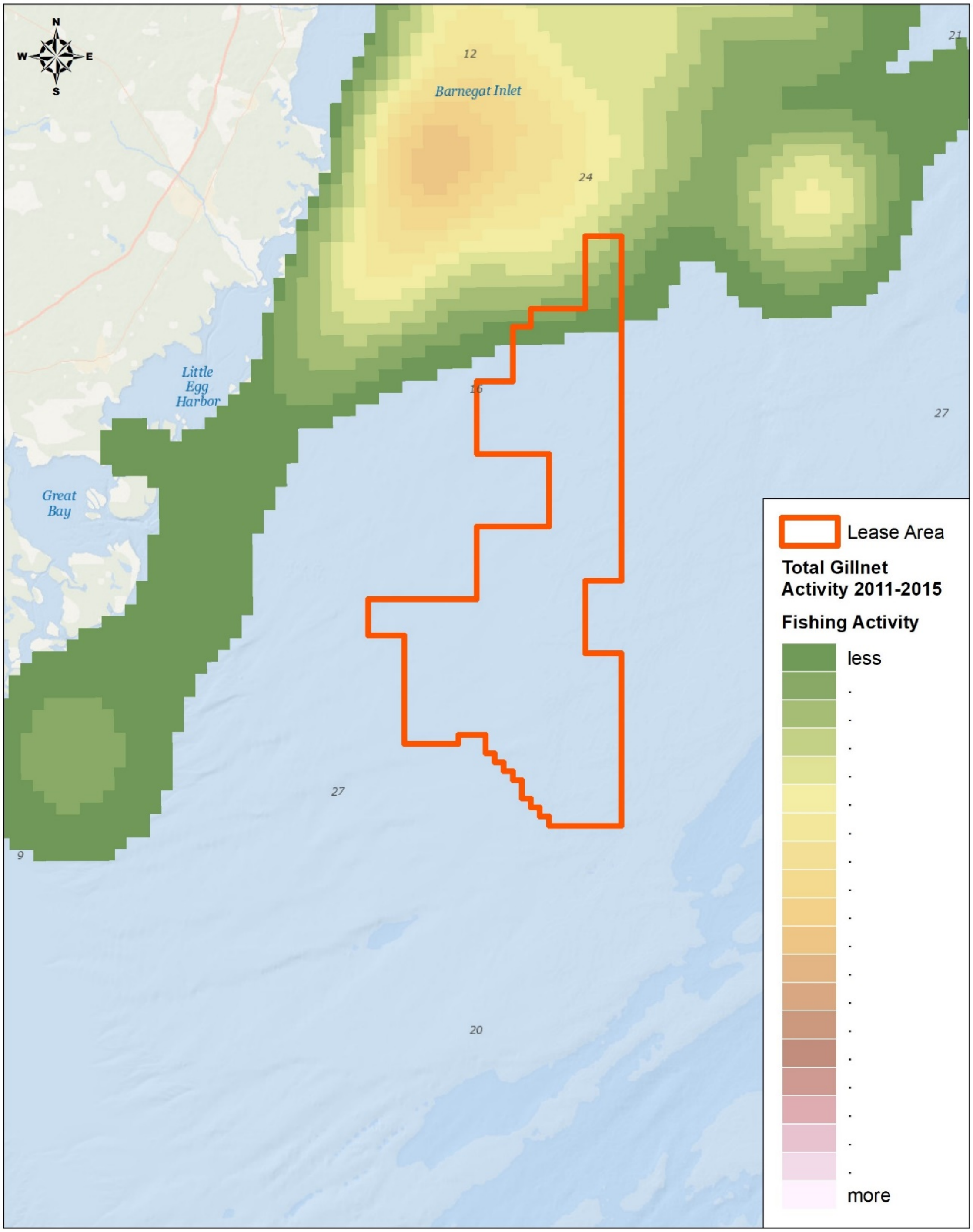
Imagery: ESRI World Ocean Basemap.
https://oceandata.rad.rutgers.edu/arcgis/rest/services
Spatial Reference: NAD 1983 UTM Zone 18N

Baird.

13294.301AS North - VTR Total Bottom Trawl Greater 65 ft Activity 2011-2015 Rev01.mxd

Map Published: 2022-06-02


Lease Area
Total Dredge Activity 2011-2015
Fishing Activity
less
more
N
S
E
W
Barnegat Inlet
12
24
21
16
27
36
27
9
20
45
31
0
2
4
6
nm
0
4
8
12
km
Vessel Trip Report (VTR) for
Total Dredge Activity 2011-2015
Mid-Atlantic Region
Imagery: ESRI World Ocean Basemap.
https://oceandata.rad.rutgers.edu/arcgis/rest/services
Spatial Reference: NAD 1983 UTM Zone 18N
Baird.
13294.301AS North - VTR Total Dredge Activity 2011-2015 Rev01.mxd
Map Published: 2022-06-02



0 2 4 6 nm

0 4 8 12 km

Vessel Trip Report (VTR) for Total Gillnet Activity 2011-2015

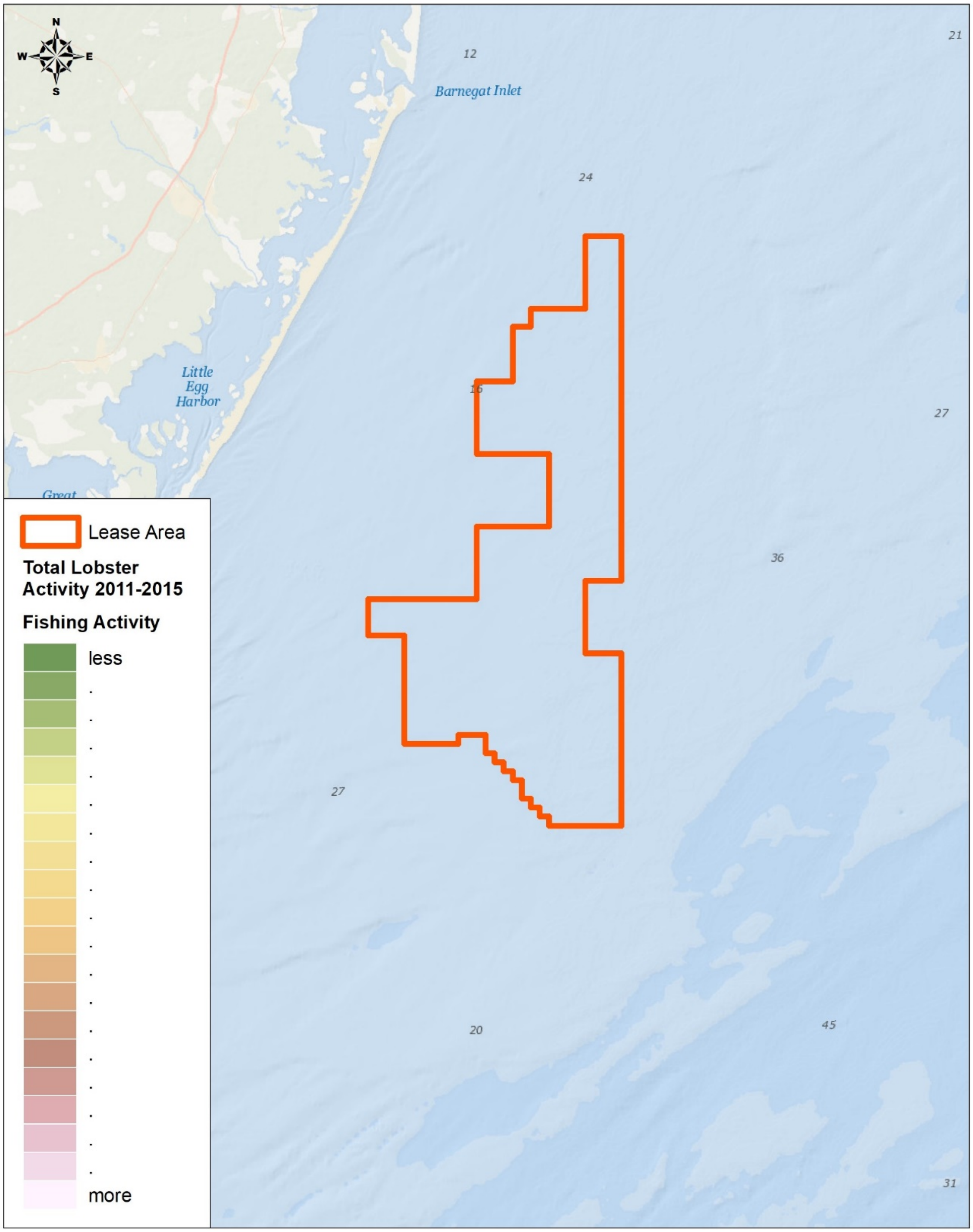
Mid-Atlantic Region

Imagery: ESRI World Ocean Basemap. https://oceandata.rad.rutgers.edu/arcgis/rest/services Spatial Reference: NAD 1983 UTM Zone 18N

Baird.

13294.301AS North - VTR Total Gillnet Activity 2011-2015 Rev01.mxd

Map Published: 2022-06-02



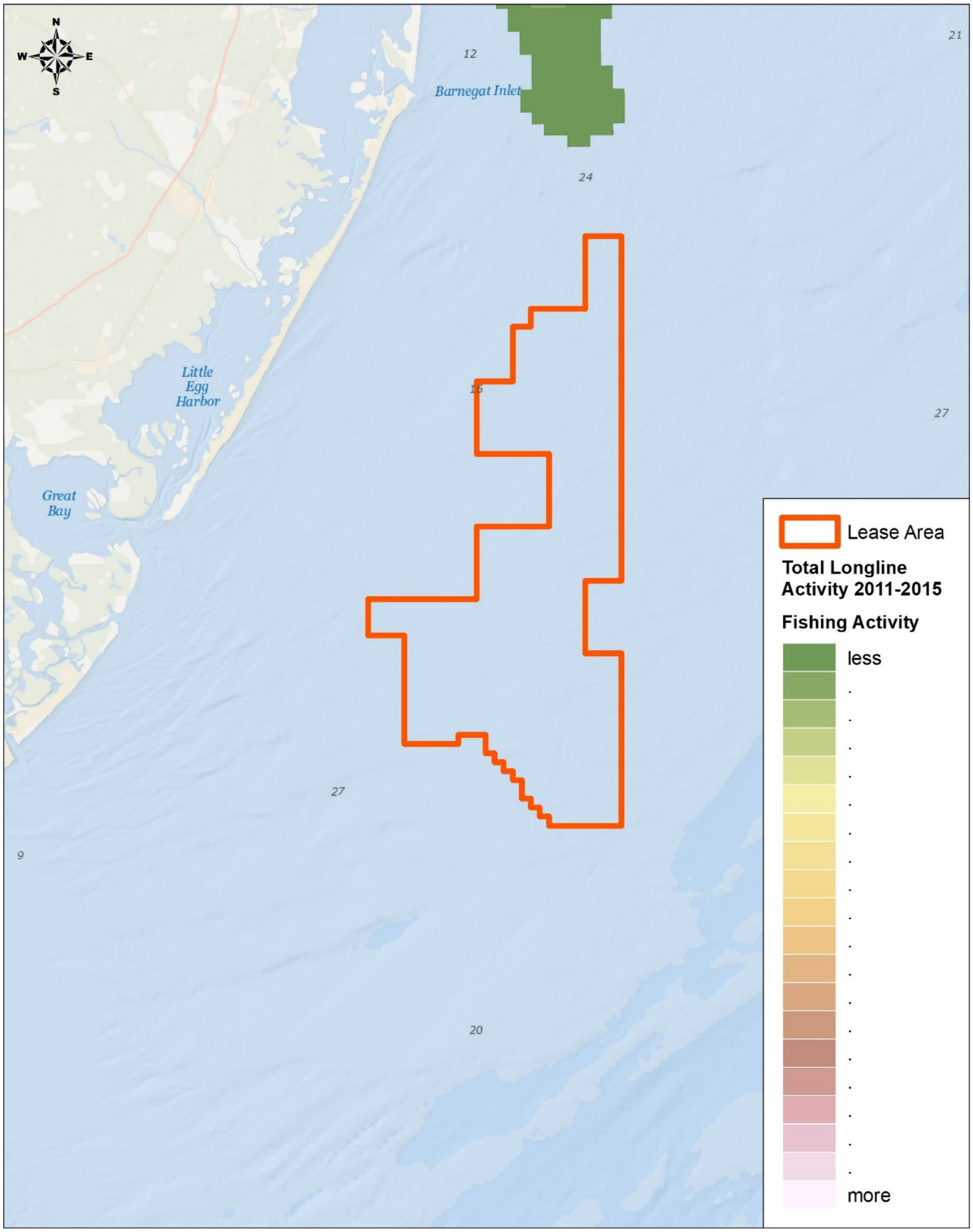
0 2 4 6 nm
0 4 8 12 km

Vessel Trip Report (VTR) for Total Lobster Activity 2011-2015
Mid-Atlantic Region

Imagery: ESRI World Ocean Basemap.
https://oceandata.rad.rutgers.edu/arcgis/rest/services
Spatial Reference: NAD 1983 UTM Zone 18N

Baird.

Map Published: 2022-06-02



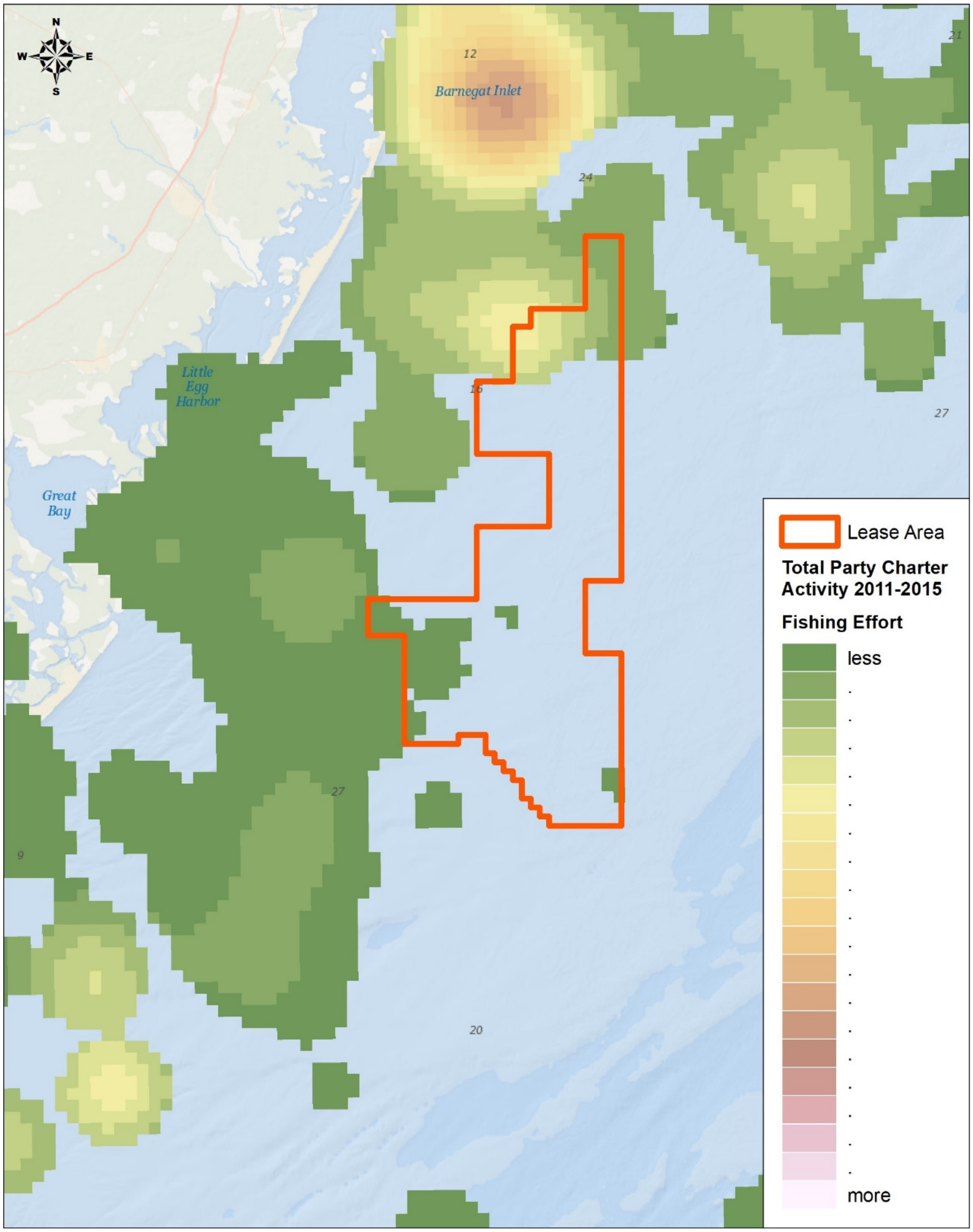
Vessel Trip Report (VTR) for Total Longline Activity 2011-2015
Mid-Atlantic Region

Imagery: ESRI World Ocean Basemap. https://oceandata.rad.rutgers.edu/arcgis/rest/services
Spatial Reference: NAD 1983 UTM Zone 18N

Baird.

Map Published: 2022-06-02

13294.301AS North - VTR Total Longline Activity 2011-2015 Rev01.mxd



Vessel Trip Report (VTR) for Total Party Charter Activity 2011-2015

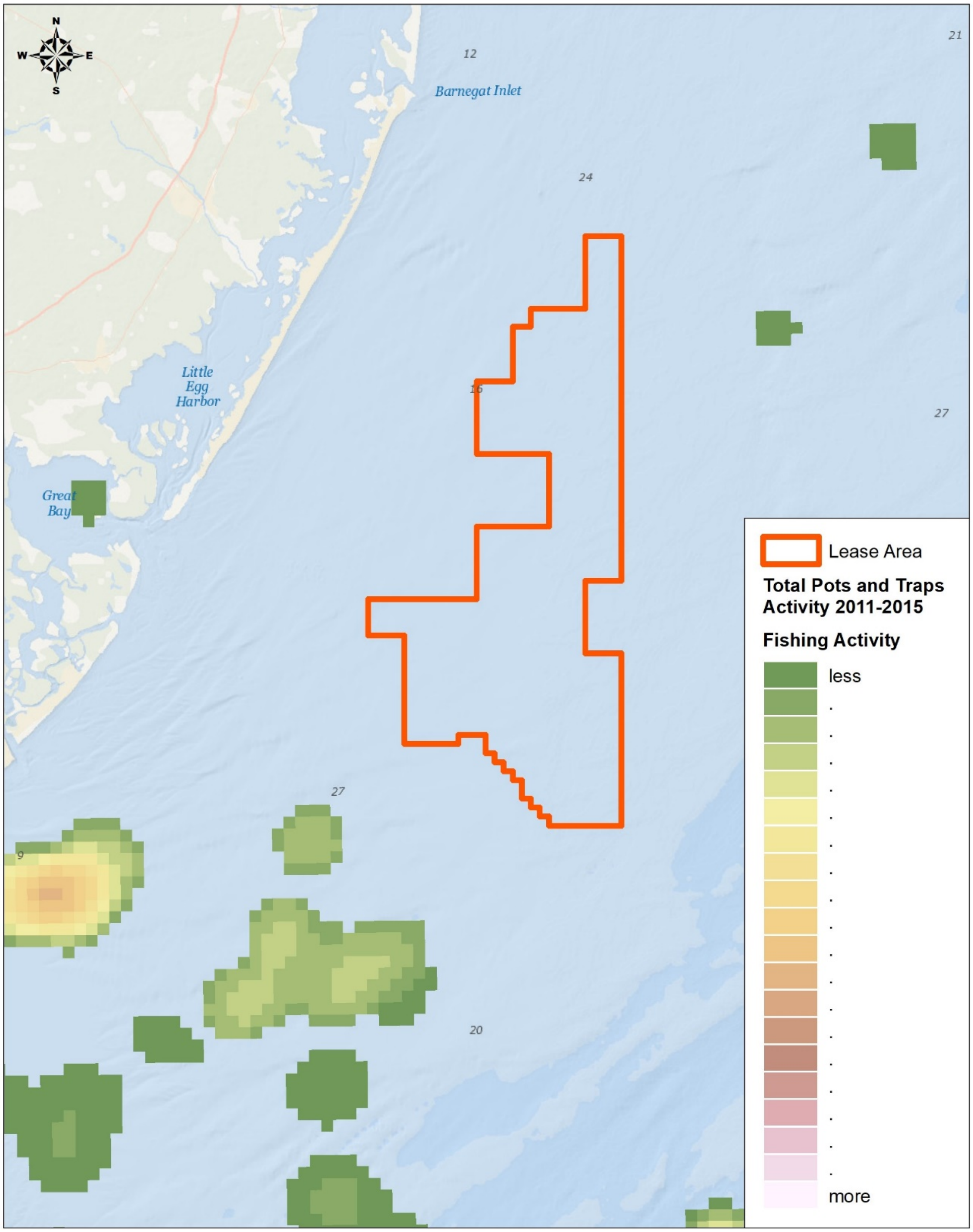
Mid-Atlantic Region

Imagery: ESRI World Ocean Basemap. https://oceandata.rad.rutgers.edu/arcgis/rest/services
Spatial Reference: NAD 1983 UTM Zone 18N

Baird.

13294.301AS North - VTR Total Party Charter Activity 2011-2015 Rev01.mxd

Map Published: 2022-06-02



Vessel Trip Report (VTR) for Total Pots and Traps Activity 2011-2015

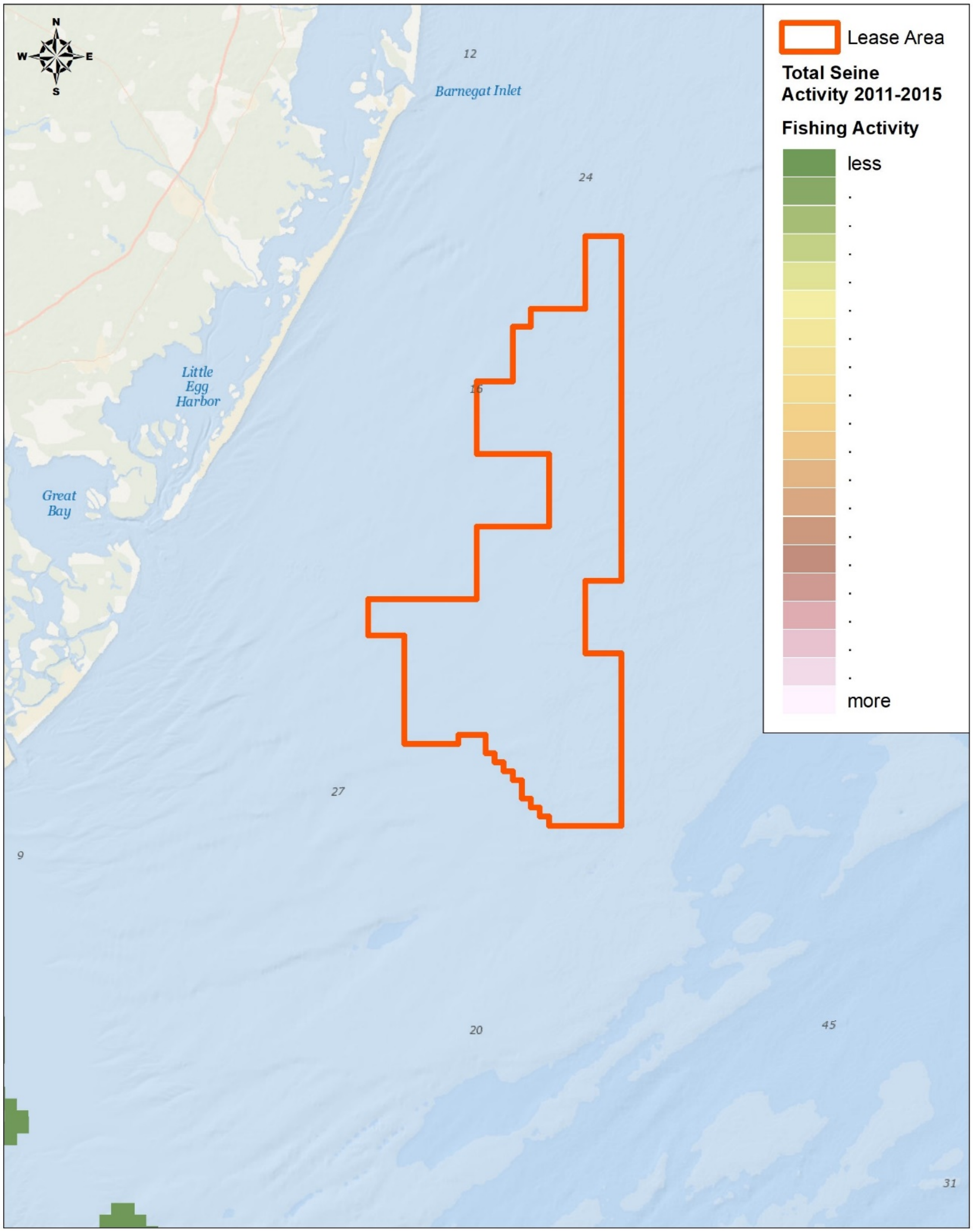
Mid-Atlantic Region

Imagery: ESRI World Ocean Basemap. https://oceandata.rad.rutgers.edu/arcgis/rest/services
Spatial Reference: NAD 1983 UTM Zone 18N

Baird.

Map Published: 2022-06-01

13294.301AS North -VTR Total Pots and Traps Activity 2011-2015 Rev01.mxd



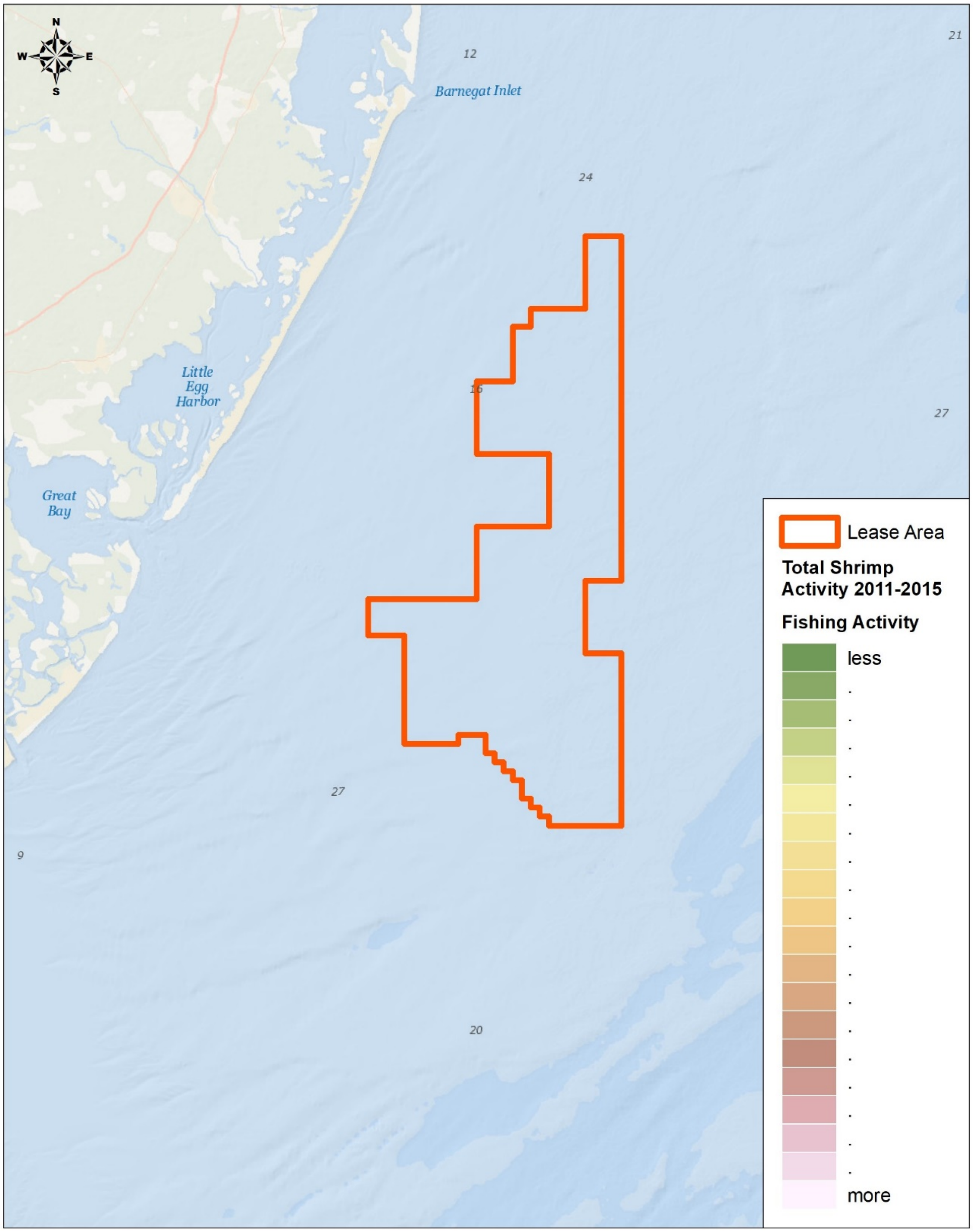
0 2 4 6 nm
0 4 8 12 km

Vessel Trip Report (VTR) for Total Seine Activity 2011-2015
Mid-Atlantic Region

Imagery: ESRI World Ocean Basemap.
https://oceandata.rad.rutgers.edu/arcgis/rest/services
Spatial Reference: NAD 1983 UTM Zone 18N

Baird.

13294.301AS North - VTR Total Seine Activity 2011-2015 Rev01.mxd
Map Published: 2022-06-02



0 2 4 6 nm
0 4 8 12 km

Vessel Trip Report (VTR) for Total Shrimp Activity 2011-2015

Mid-Atlantic Region

Imagery: ESRI World Ocean Basemap. https://oceandata.rad.rutgers.edu/arcgis/rest/services
Spatial Reference: NAD 1983 UTM Zone 18N

Baird.

Map Published: 2022-06-02

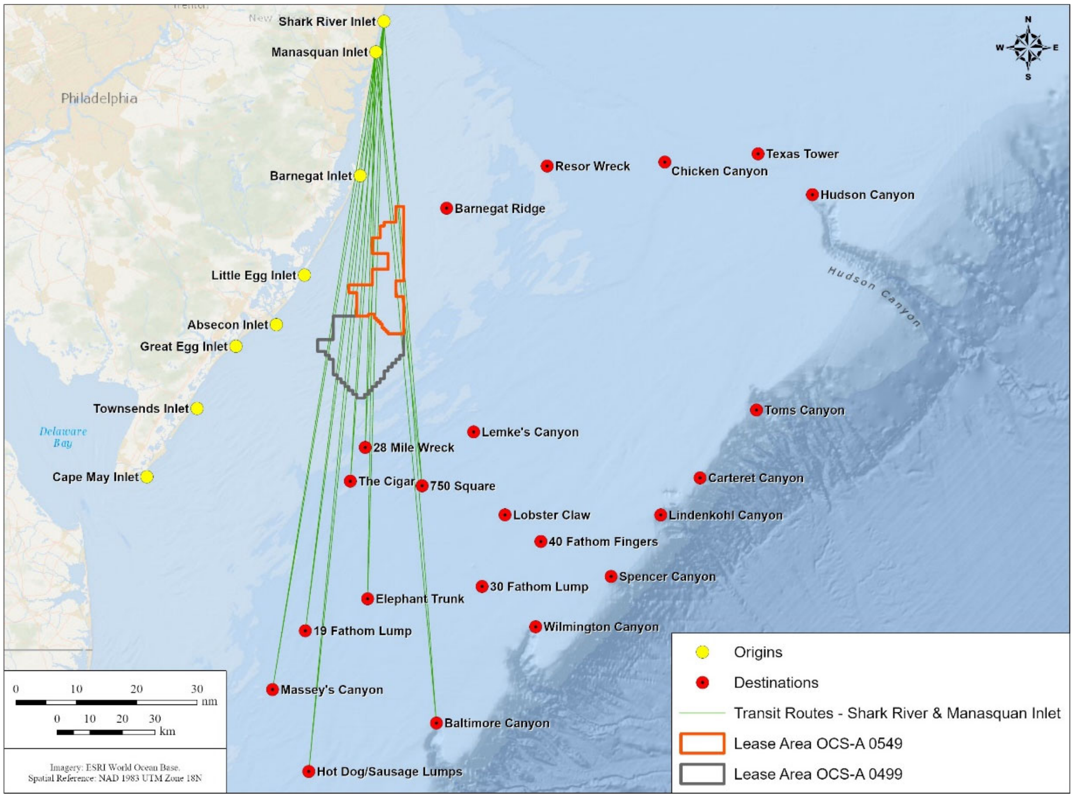
Appendix E

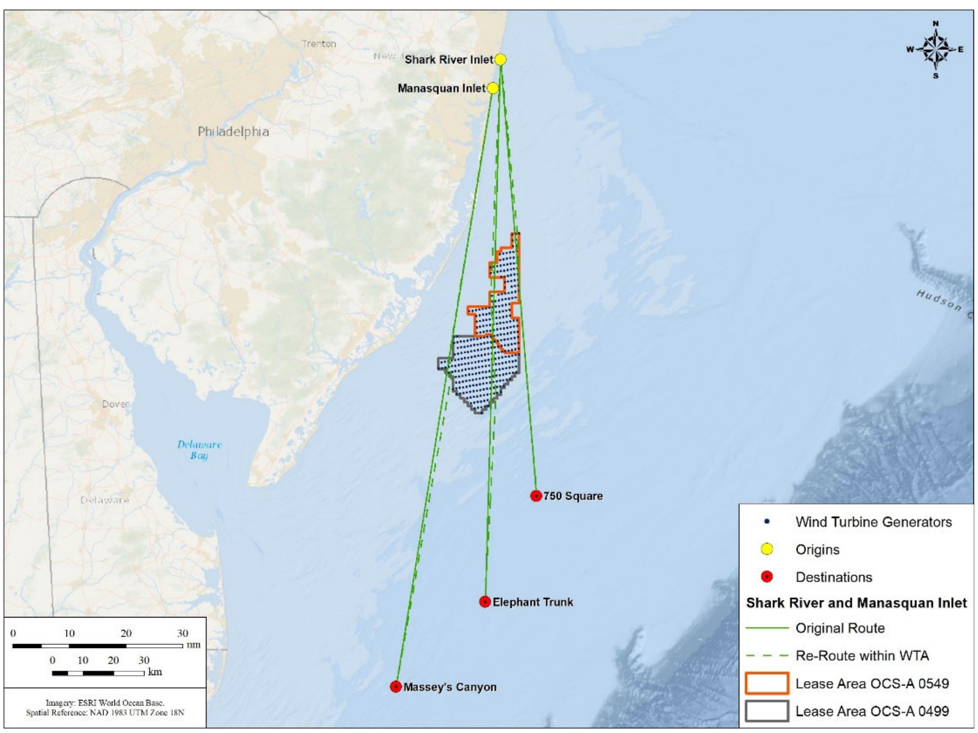
Recreational Fishing Vessel Rerouting

E.1 Introduction

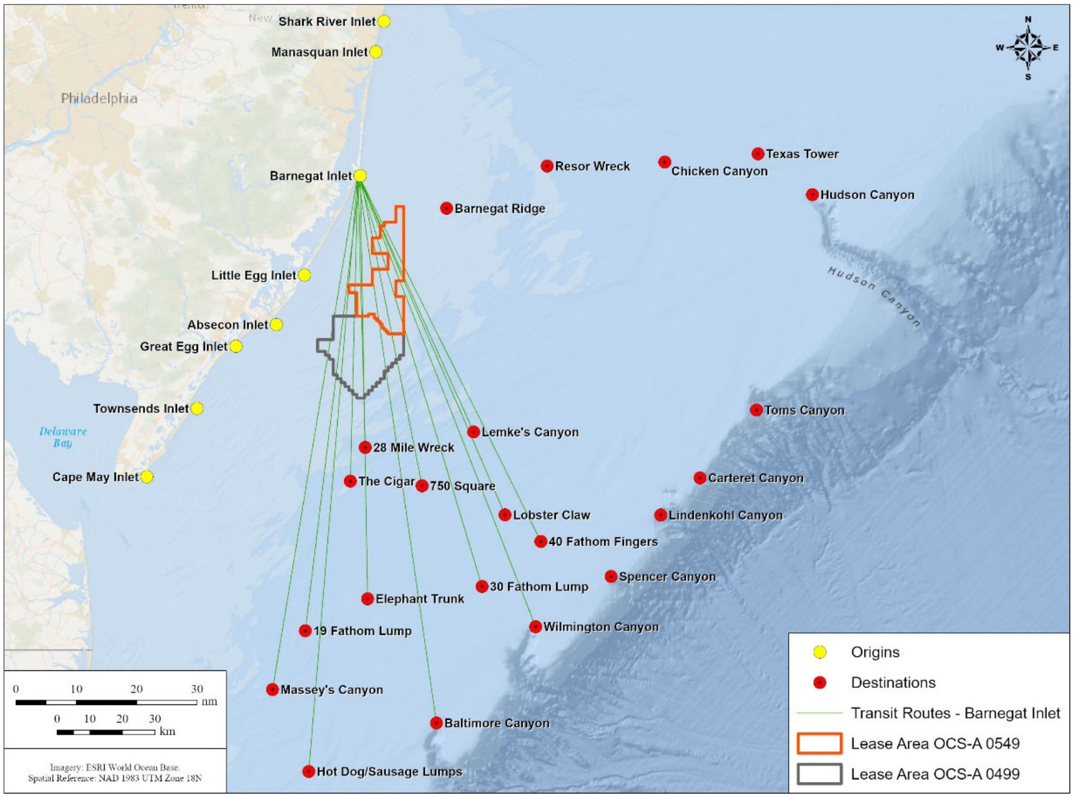
This appendix provides a series of maps the potential straight-line transit routes to popular fishing destinations from each harbor of origin for recreational fishing vessels. Also shown in a companion map are possible routing options through the Lease Area.

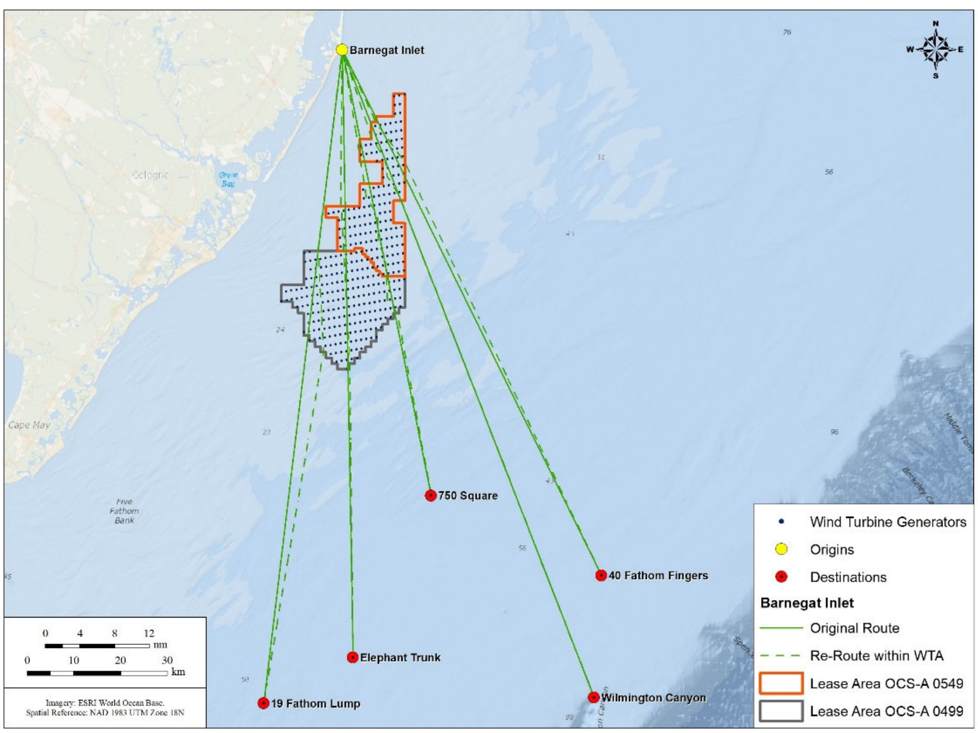
Shark River Inlet / Manasquan Inlet



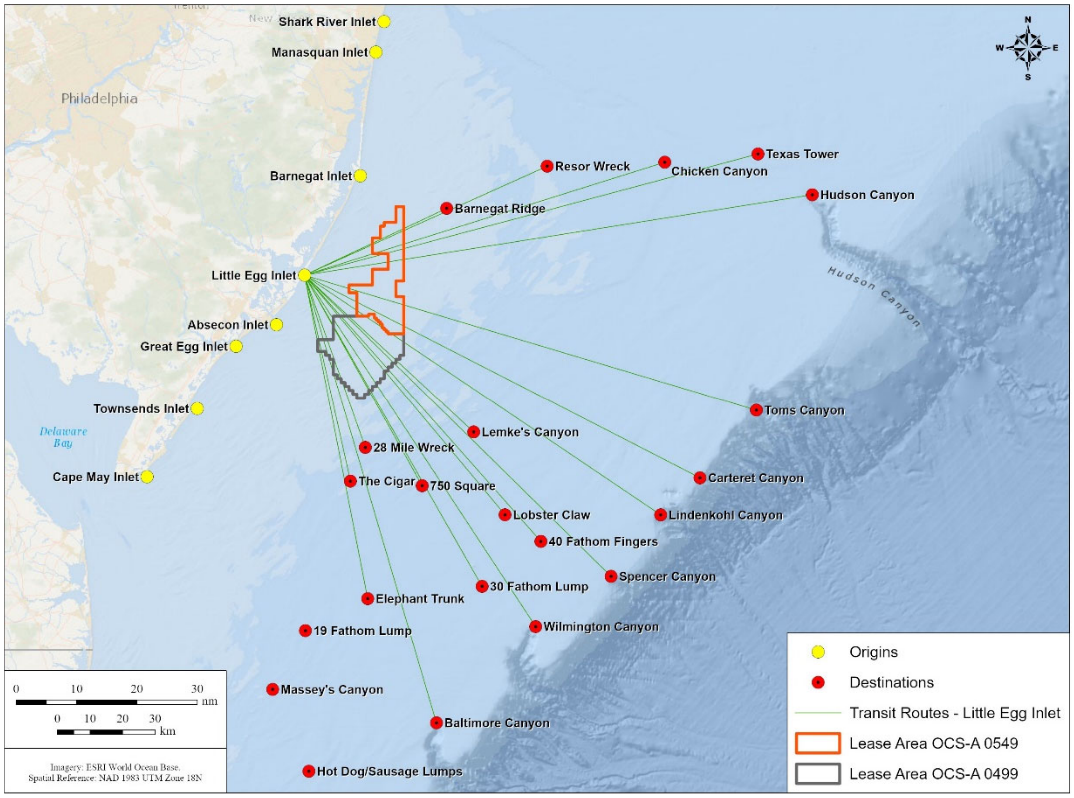


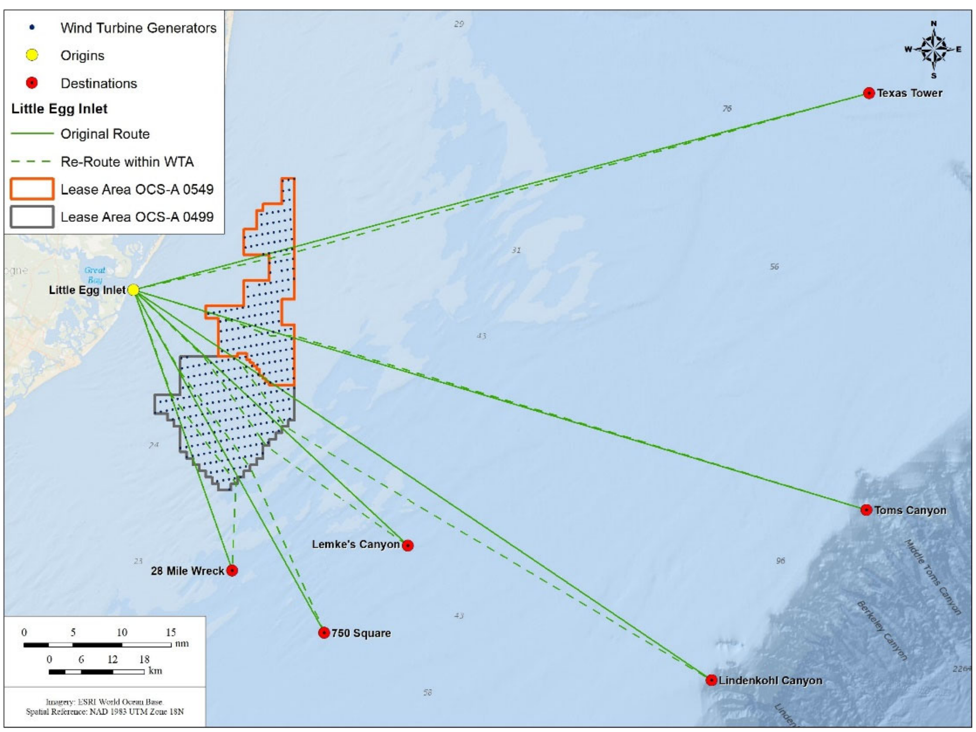
Barnegat Inlet



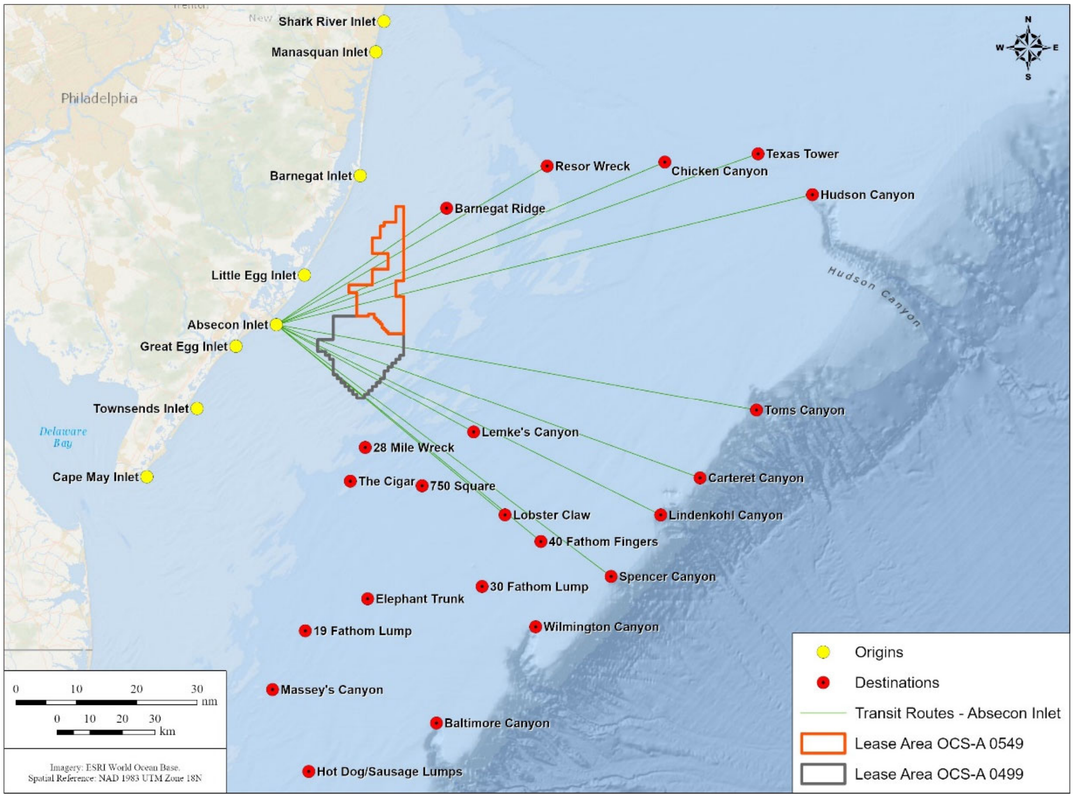


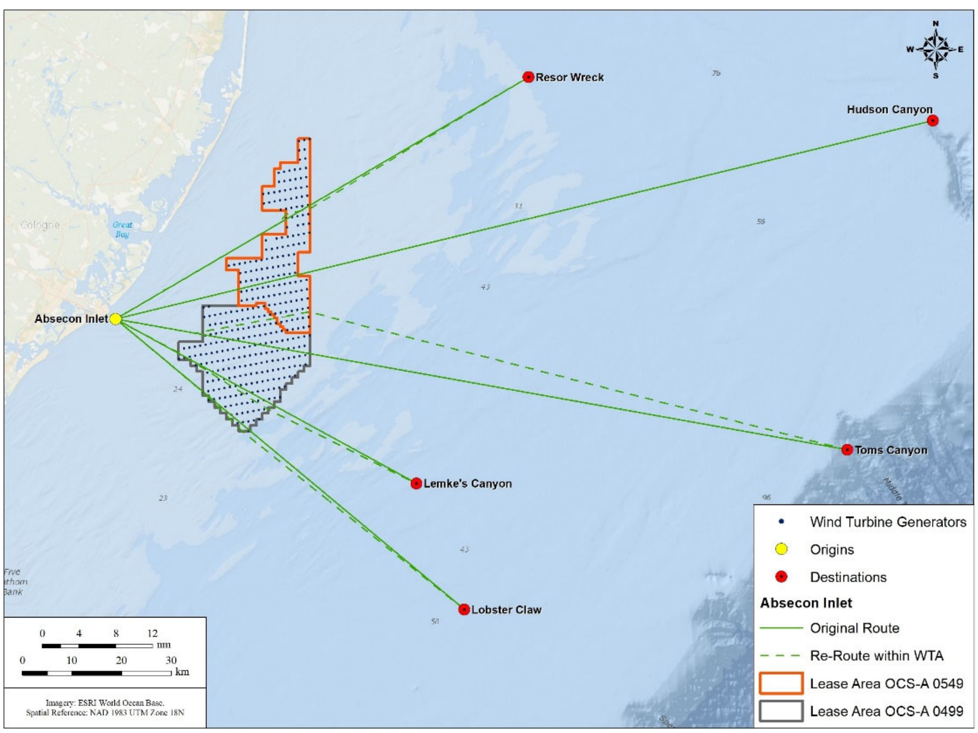
Little Egg Inlet



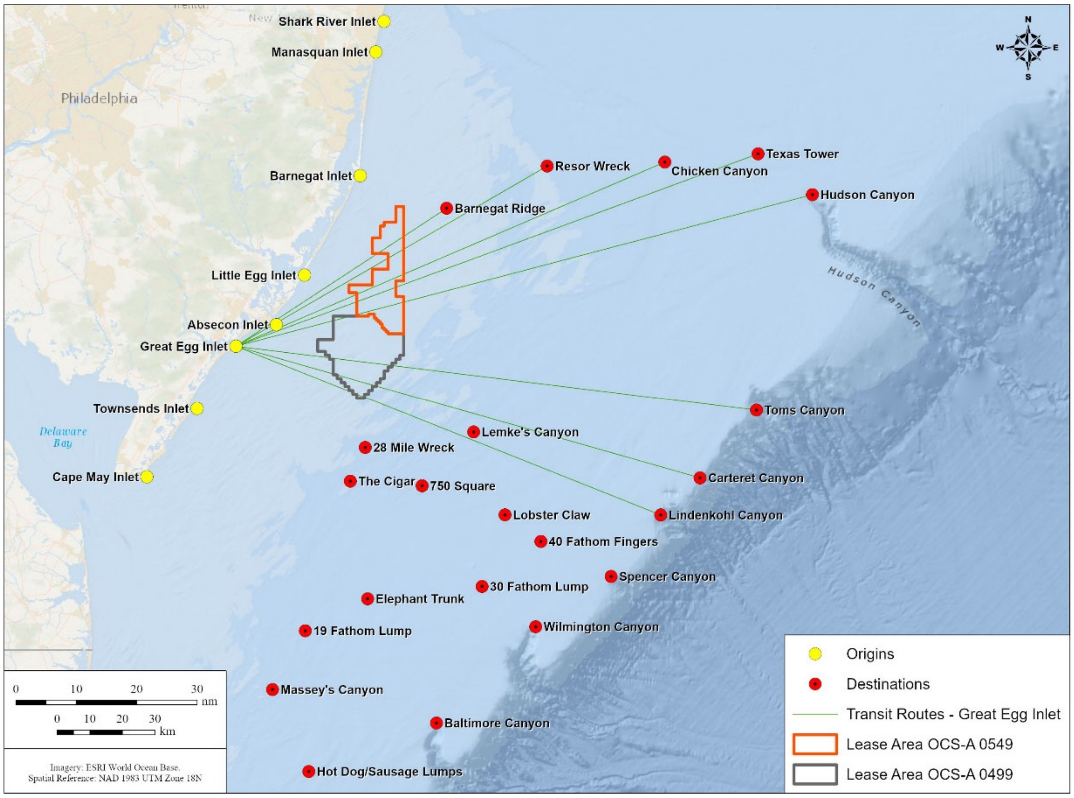


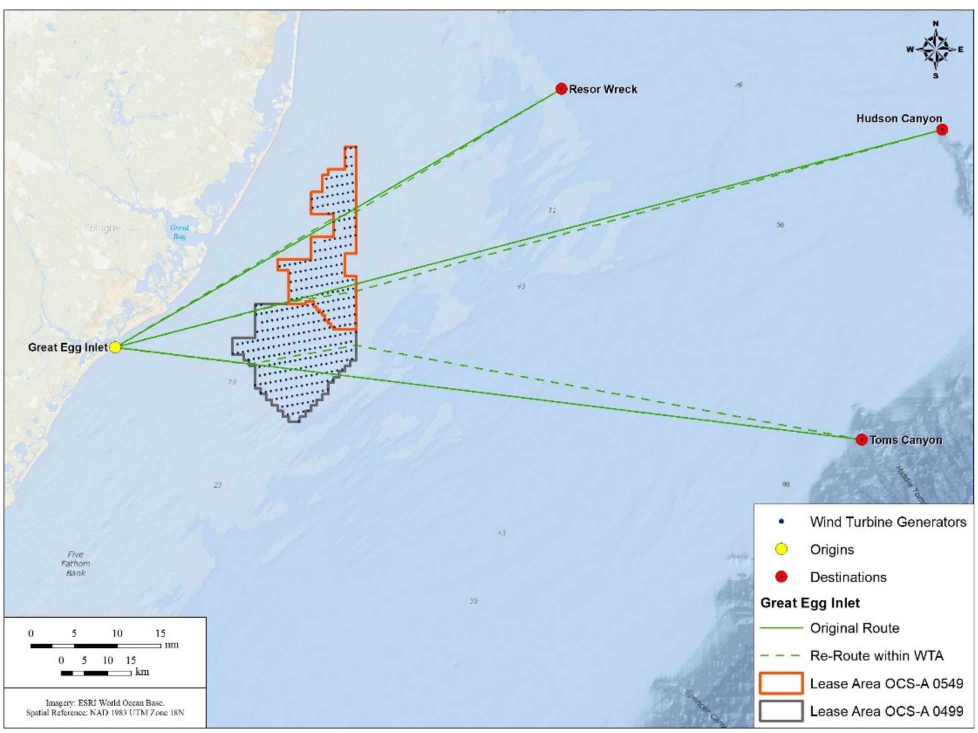
Absecon Inlet



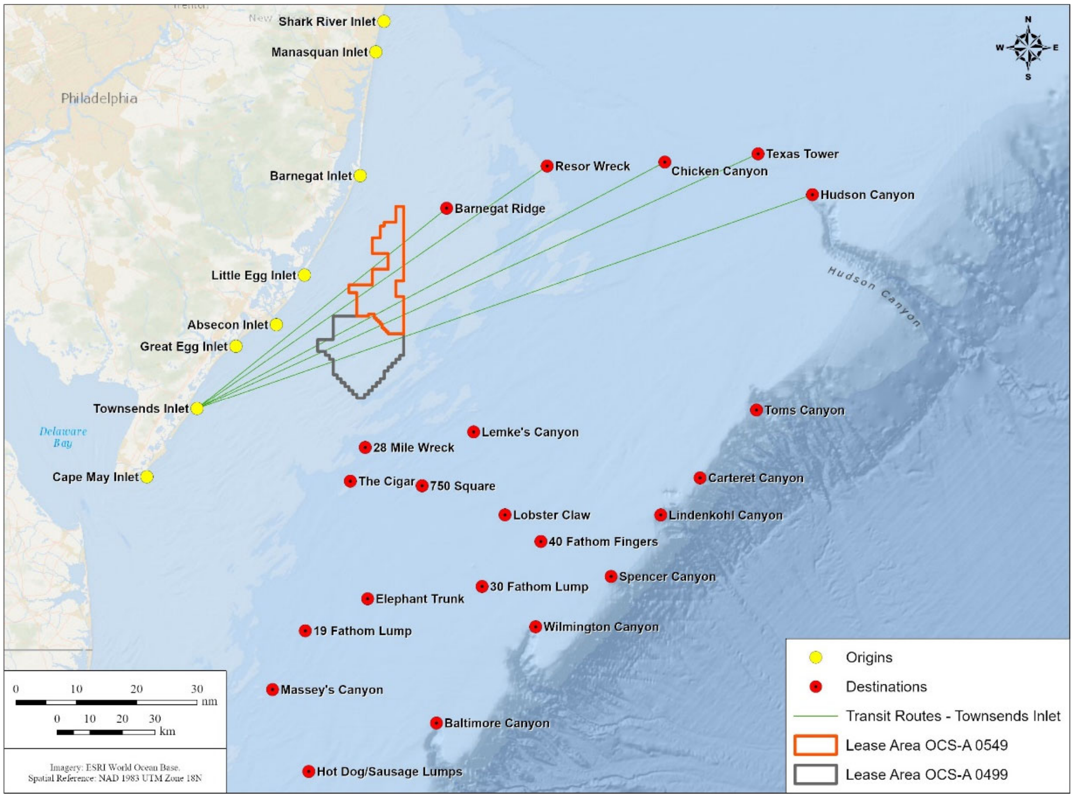


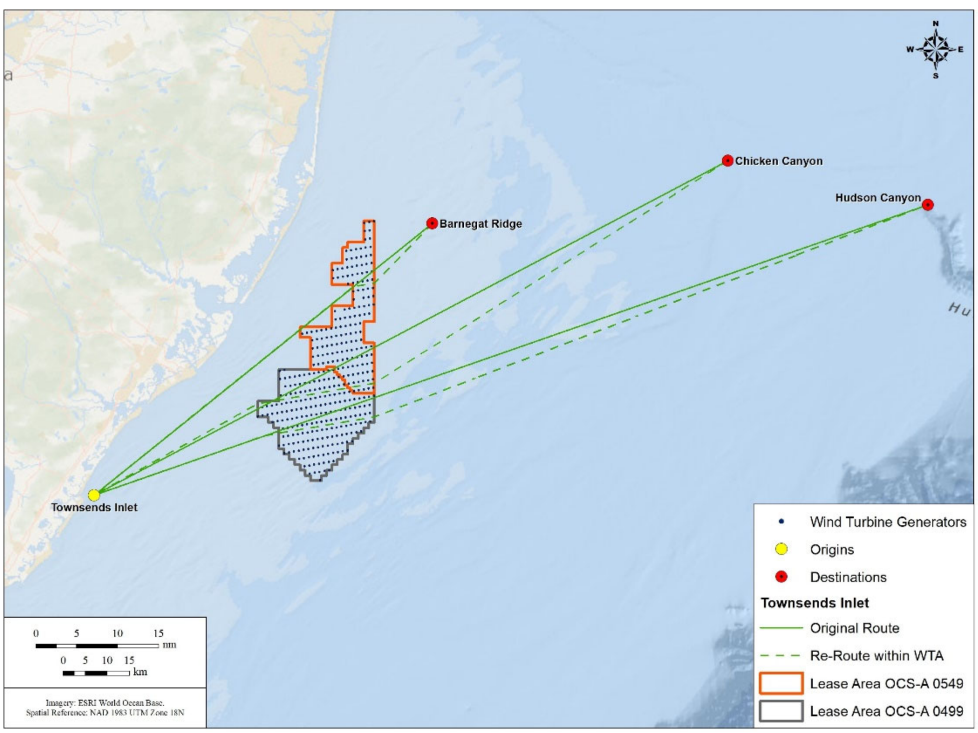
Great Egg Inlet



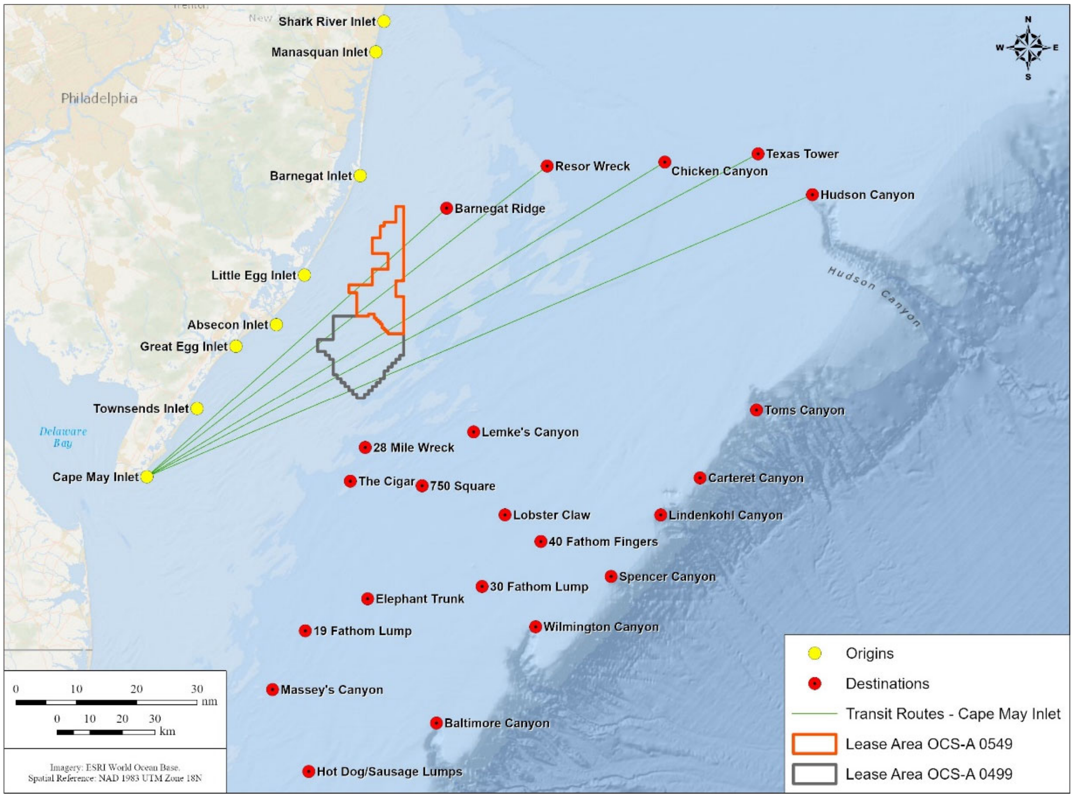


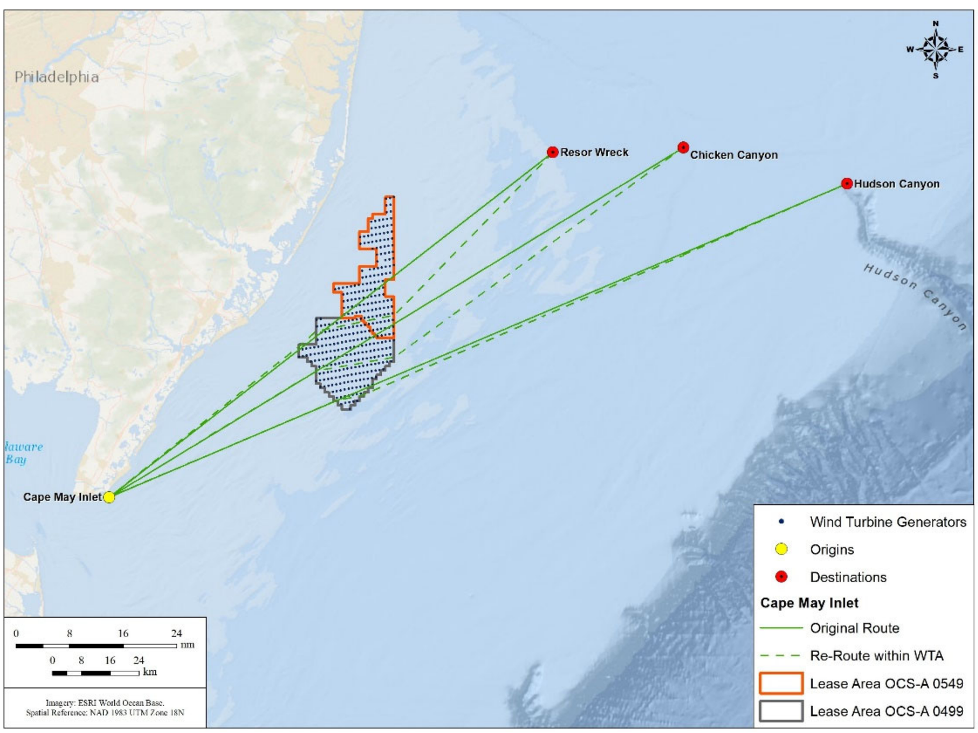
Townsends Inlet





Cape May


Shark River Inlet
Manasquan Inlet
Philadelphia
Barnegat Inlet
Resor Wreck
Chicken Canyon
Texas Tower
Hudson Canyon
Barnegat Ridge
Little Egg Inlet
Absecon Inlet
Great Egg Inlet
Townsends Inlet
Delaware Bay
Cape May Inlet
Hudson Canyon
Toms Canyon
Lemke's Canyon
28 Mile Wreck
The Cigar
750 Square
Carteret Canyon
Lobster Claw
Lindenkohl Canyon
40 Fathom Fingers
30 Fathom Lump
Spencer Canyon
Elephant Trunk
19 Fathom Lump
Wilmington Canyon
Massey's Canyon
Baltimore Canyon
Hot Dog/Sausage Lumps
0 10 20 30 nm
0 10 20 30 km
Imagery: ESRI World Ocean Base.
Spatial Reference: NAD 1983 UTM Zone 18N
Origins
Destinations
Transit Routes - Cape May Inlet
Lease Area OCS-A 0549
Lease Area OCS-A 0499


Philadelphia
Resor Wreck
Chicken Canyon
Hudson Canyon
Hudson Canyon
Cape May Inlet
0 8 16 24 nm
0 8 16 24 km
Imagery: ESRI World Ocean Base.
Spatial Reference: NAD 1983 UTM Zone 18N
Wind Turbine Generators
Origins
Destinations
Cape May Inlet
Original Route
Re-Route within WTA
Lease Area OCS-A 0549
Lease Area OCS-A 0499

Appendix F

NORM Model Summary

F.1.1 Introduction

NORM is a model developed by Baird to assess and quantify navigational risk for both open-water and defined waterway conditions. NORM is capable of calculating navigational risk in both situations and is mainly geared towards quantifying the change in risk due to potential installations, or changes in waterway conditions. NORM is written in Python and is a statistical based navigational risk model that uses a theoretical framework derived from well-established literature as its base. NORM uses raw AIS traffic inputs, bathymetric data, navigational charts, metocean conditions, and fixed structure information to calculate the risk of various accident scenarios. NORM can calculate the occurrence frequency of groundings, head-on collisions, overtaking collisions, crossing collisions, powered allisions, and drifting allisions. These calculations can be performed for intra-class, inter-class, and overall traffic risk analyses.

NORM consists of three main steps, as outlined in Figure F.1. These include an input step (where all relevant input data is collected), a pre-processing step (where the input data is processed into meaningful inputs for the risk calculations), and the actual risk calculation step.

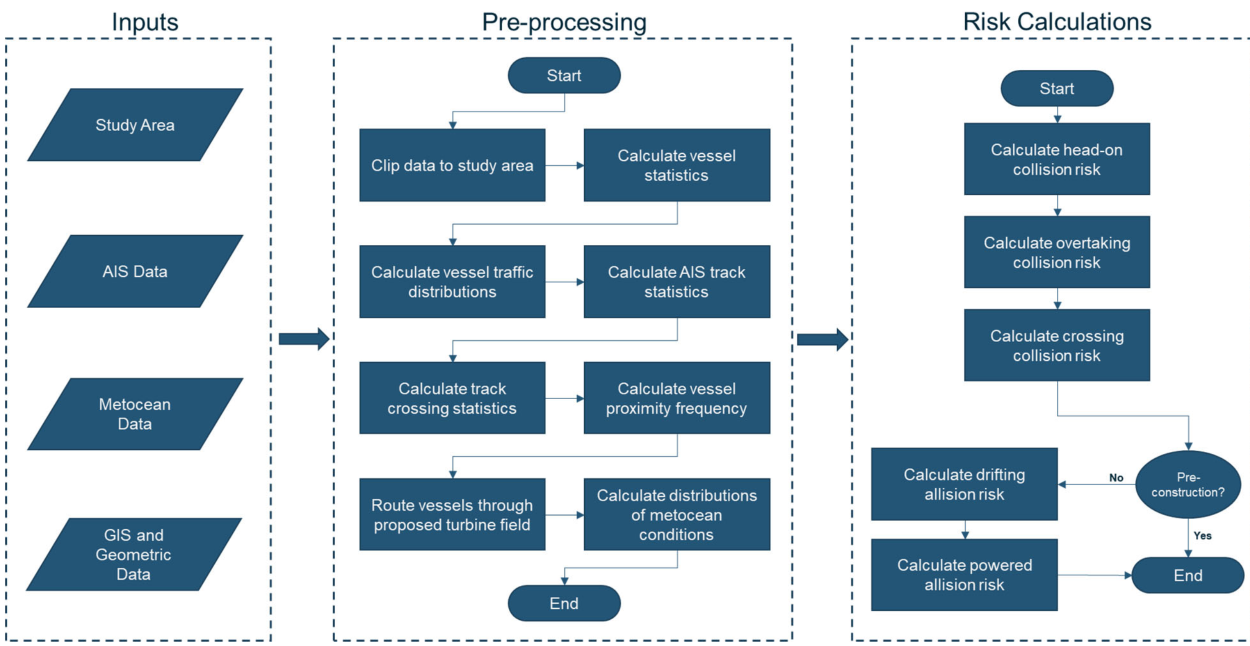


Figure F.1: Overview of NORM Modeling Procedure

F.1.2 Inputs

F.1.2.1 Study Area

The study area for the navigational safety risk assessment must be carefully selected to only contain the traffic that may be appreciably affected by the project of interest. If too large an area is chosen, it may contain a considerable amount of traffic that may never actually experience any impacts due to an offshore installation resulting in an underestimation of the relative change in navigational risk. If too small an area is chosen, the changes to regional traffic patterns may potentially be underestimated. This study area is used to clip all AIS data (often retrieved for a larger area) to contain the analysis only to the study area.

F.1.2.2 AIS Data

NORM uses raw AIS data as inputs into the model, mainly for the pre-processing steps outlined in Appendix C. Multi-year datasets can be used by NORM to understand the distribution of vessel characteristics that are common to the study area and for determination of design vessel characteristics used in the risk calculations. This data is also used for various analyses to determine traffic characteristics such as heading distributions, crossing angle distributions, proximity frequencies, etc.

F.1.2.3 Metocean Data

Wind and/or current conditions local to the chosen study area are used as a model input for NORM. NORM considers long-term historical or hindcast datasets to understand the conditions local to the chosen study area. The wind and current conditions are specifically used for the drifting allision risk calculations, whereby the direction and speed of the drifting vessel is directly correlated with the speed and direction of the winds acting on it as well as oceanographic and/or tidal current.

For North America, NORM can search multiple databases to identify datasets with information on visibility conditions in the chosen study area. Outside of North America visibility data may be manually input. Visibility is a critical component that affects mariner's ability to safely travel and is used by NORM to modify the various causation factors as outlined in Section F.1.4.1.

F.1.2.4 GIS and Geometric Inputs

NORM has the capability to incorporate arbitrarily shaped and positioned objects in the form of GIS shapefiles. These can be used to represent turbine locations, offshore oil rigs, or any other offshore installation, and their respective geometry. These inputs are mainly used to calculate collisions with fixed offshore objects, i.e., allisions. When using NORM to calculate navigational risk in the presence of a turbine field, the layout of the grid dictates the geometric characteristics of the corridors that can be safely transited, and relative positioning of turbines with respect to transiting vessels. NORM uses the GIS and geometric inputs to automatically determine the appropriate corridor geometry and assumed traffic distribution through these corridors in the presence of a turbine field or other fixed objects.

F.1.3 Pre-processing

NORM includes a pre-processing step, whereby all the raw inputs are processed to obtain meaningful relationships and inputs for the risk calculations. This includes pre-processing of the raw AIS data, metocean data, and GIS/geometric data. As part of this pre-processing step, NORM calculates the following:

3. Vessel characteristics and traffic statistics
   - Distribution of vessel LOA, beam, speed, annual/seasonal volume for each vessel class
4. Vessel traffic distributions
   - Spatial distribution of traffic concentration (see Figure F.2)
   - Spatial distribution of vessels with respect to one another in concentrated areas, done on an inter-class and intra-class basis (see Figure F.3)

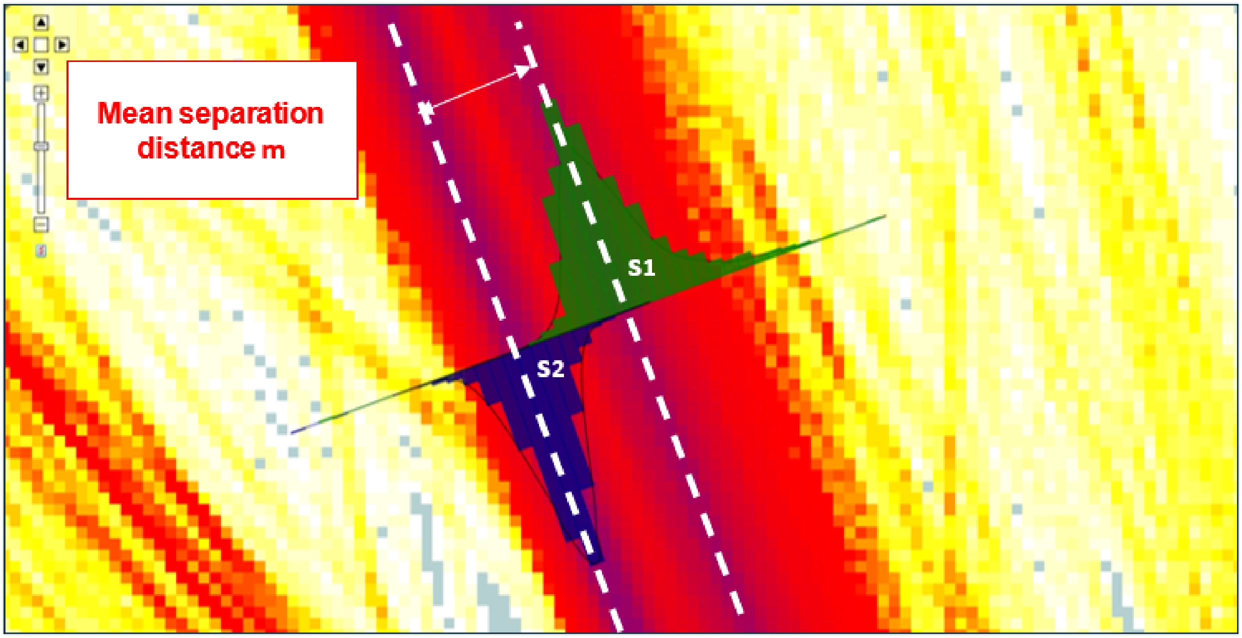


Figure F.2: Spatial Distribution of Traffic Concentration and Vessel Traffic Distribution

5. AIS track statistics
   - AIS ping data is used to make AIS tracks.
   - Individual tracks analyzed to get track length and heading distributions, done on an inter-class and intra-class basis (see Figure F.3)

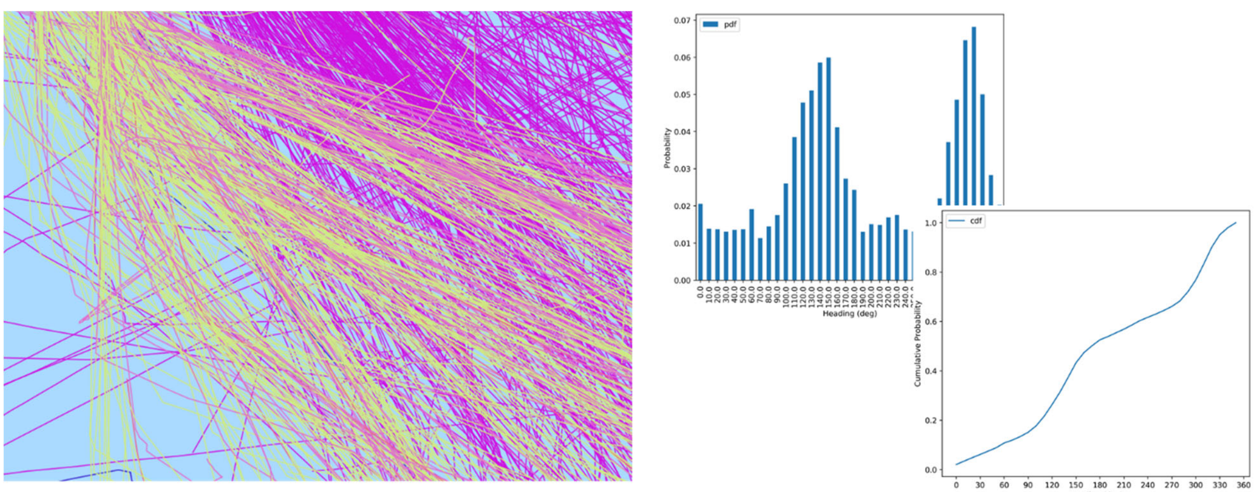


Figure F.3: AIS tracks, and Track Length and Heading Distributions

6. Track crossing statistics
   - AIS tracks used to determine potential crossing locations and distribution of crossing angles, done on an inter-class and intra-class basis (see Figure F.4)

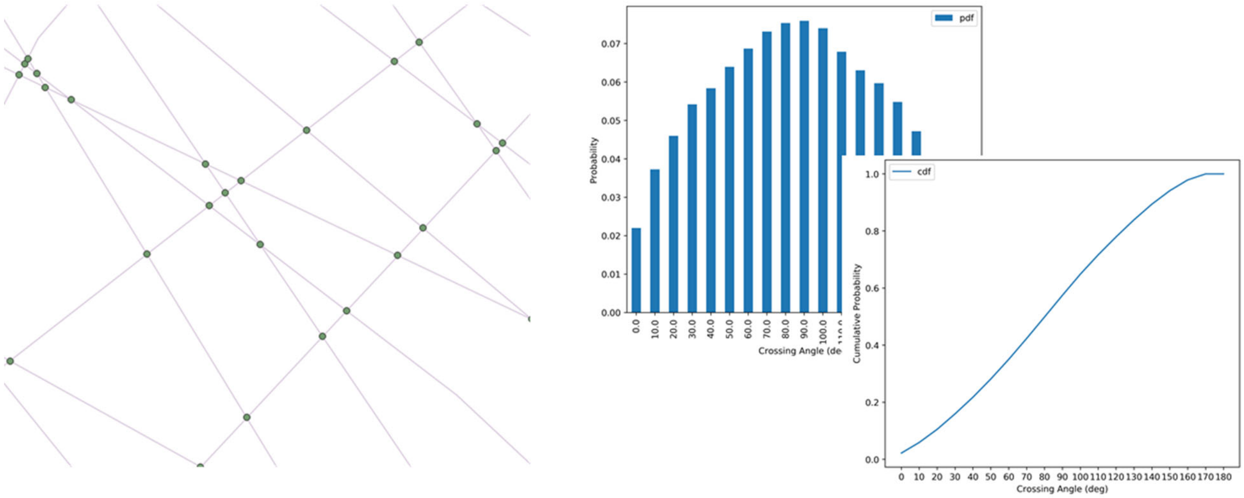


Figure F.4: AIS Tracks, and Track Intersection Angle Distribution

7. Vessel proximity frequencies
   - AIS tracks are used to establish a relationship between vessel proximity and recurrence interval, done on an inter-class and intra-class basis.
8. Route vessels through/around turbine(s)
   - NORM utilizes a simple algorithm (based on existing traffic patterns, turbine field footprint, and turbine placement) to route traffic down future corridors between turbine rows, establishing future traffic conditions within the turbine field used for risk calculations (see Figure F.5).

Figure F.5: Traffic Routed Through Turbine Field (left), Assumed Future Traffic (right)

- NORM also has the capability to divert traffic around fixed objects. This is done by intelligently and dynamically producing options for changes in course to avoid an obstacle and determining the path with the least change in overall travel length (see Figure F.6).

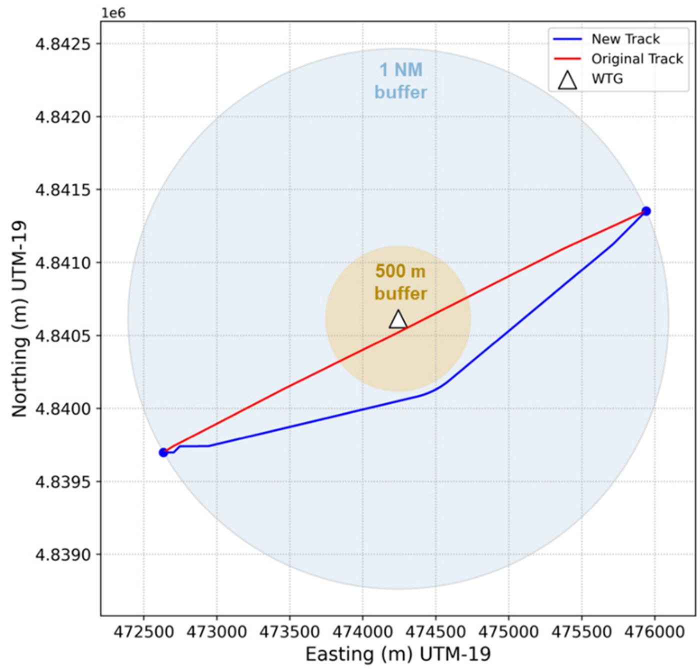


Figure F.6: Traffic Routed Around Turbine

F.1.4 Risk Calculations

NORM employs a widely adopted and accepted methodology for calculating navigational risk for various collision/allision scenarios that is described in the below equation:

$$N_a = P_a * n \;=\; P_g * P_c * n$$

Where N_a is the number of accidents occurring over a given time period (typically one year), P_a is the probability of an accident occurring, n is the number of vessels over a given time period, P_g is the geometric probability of an accident occurring, and P_c is the causation probability. The causation probability is the probability that a potential accident will in fact occur once on a potential collision/allision course.

The number of vessels considered (n) is obtained from AIS data. The methodology outlined in Zhang et al. (2019) is employed to calculate the geometric probability (P_g); this methodology stems from original work outlined in Pedersen (2010). NORM also employs causation factors (P_c) developed by Fuji and Mizuki (1998).

F.1.4.1 Causation Factors

Causation factors are defined as the probability that an accident will in fact occur, given that one (or more) vessel(s) is on a potential collision/allision course. It is the factor meant to capture human error in the collision or allision process, whereby it acts as a reduction factor for all the possible collisions/allisions that could occur under blind navigation conditions.

Causation factors have historically been computed using fault tree analysis, Bayesian networks, or derived from historical accident data. In general, they are dependent on human and vessel response, environmental conditions, use of navigational and communication equipment (i.e., AIS, VTS), etc. NORM utilizes the causation factors developed by Fuji and Mizuki (1998), rooted in historical observations. These causation factors have been widely applied in the industry and have been used as default factors for navigational risk models as such IWRAP (IALA, n.d.); the causation factors are summarized in Table E.1.

Table F.1: Accident causation factors used in NORM

Accident Scenario	Causation Factor
Head-on Collision	0.5E-04
Overtaking Collision	1.1E-04
Crossing Collision	1.3E-04
Grounding	1.6E-04
Powered Allision	1.86E-04

Adverse visibility conditions in potential accident scenarios can reduce vessel reaction and response time and lead to increased navigational risk. According to Fujii and Mizuki (1998), the causation factors they generated were obtained from historical data where visibility was less than 1 km approximately 3% of the year. They also state that the causation probability (and thus navigational risk) is approximately inversely proportional to the visibility. Suggestions are then provided to scale the causation factors by a factor of two if the frequency of visibility less than 1 km is between 3% to 10%, and by a factor eight if it is between 10 to 30%. NORM makes this adjustment based on visibility conditions.

F.1.4.2 Collision Scenarios

Collisions are defined as the event of one vessel striking or contacting another vessel. NORM considers three different collision scenarios as part of the navigational safety risk assessment procedure: head-on, overtaking, and crossing. These collision scenarios are depicted in Figure F.7.

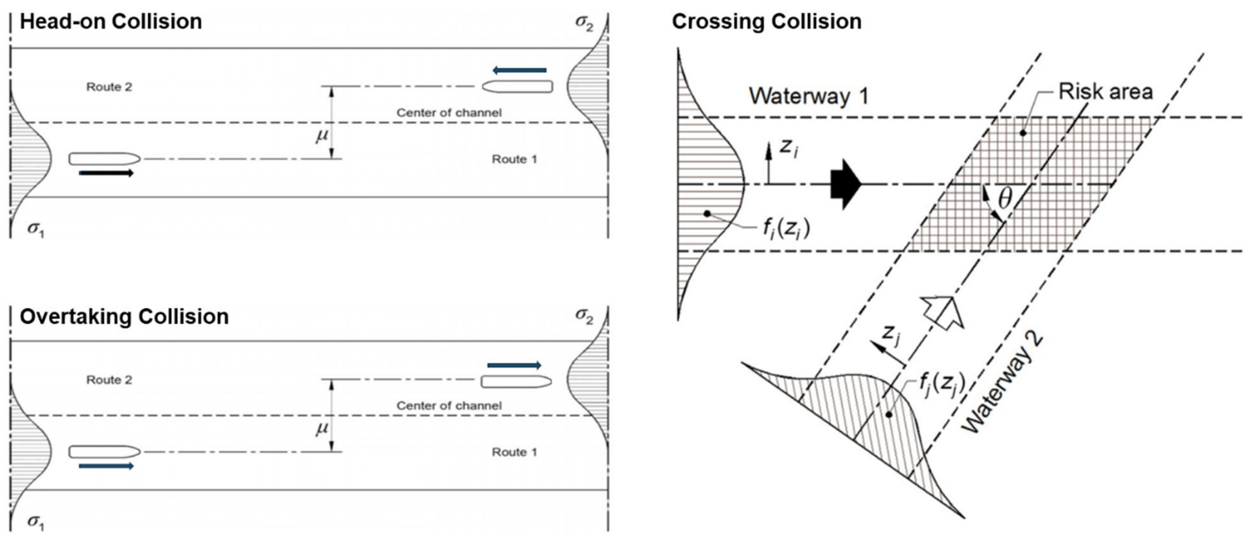


Figure F.7: Collision Scenarios Considered by NORM (images adopted from Zhang et al., 2019)

Head-on collisions occur when vessels are approaching from parallel but opposite directions. Overtaking collisions are similar to head-on collisions but occur when two vessels are traveling in the same direction at different speeds. Crossing collisions can occur when two vessel tracks intersect at a significantly non-parallel angle (assumed >10 degrees in the NORM model). NORM utilizes the applicable methodology (from Zhang et al. [2019]) to calculate the navigational risk for each of these scenarios, with outputs from the pre-processing step used as the inputs for the risk calculations. In particular, NORM utilizes the full distribution of vessel track orientations, and the observed probabilities of vessels approaching head-on, overtaking or at a crossing angle within the study area.

Navigational risk for each of the collision scenarios is highly dependent on the vessel characteristics, track characteristics, and traffic distributions calculated during the pre-processing step. NORM has the capability to use the full range of vessel and track characteristics for risk calculations, or single statistical values, i.e., mean/median vessel LOA, beam, speed, etc. Collision risk due to head-on, overtaking, and crossing collisions is calculated by NORM for all inter-class and intra-class combinations, as well as overall traffic for all vessel classes.

As the methodology outlined in Zhang et al. (2019) is mainly geared towards defined navigational channels, for open-water conditions NORM considers the true level of interaction of vessels (through the frequency-proximity pre-processing analysis) as part of the calculation to overcome inherent limitations in the formulation for this type of application.

F.1.4.3 Allision Scenarios

Allisions are defined as the event of a vessel striking or contacting a fixed structure. NORM considers both powered and drifting allisions as part of the navigational safety risk assessment procedure. Powered allisions occur when there is still power to the vessel and operable steering, whereas drifting allisions occur after a vessel experiences either loss of propulsion or rudder failure, a combination of the two, or some other form of damage that renders the vessel inoperable. Both powered and drifting allisions are depicted in Figure F.8.

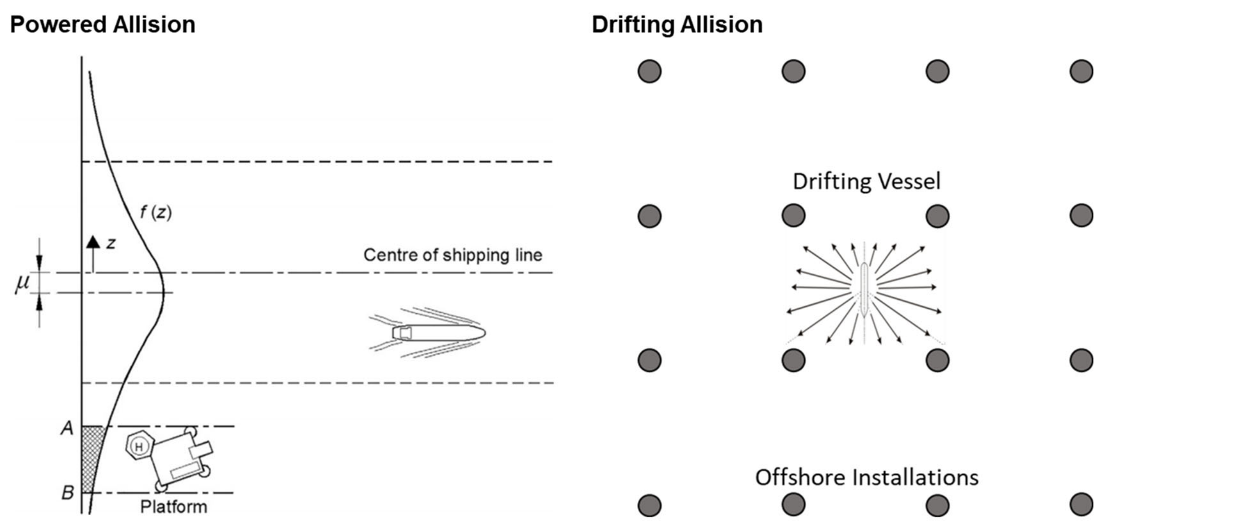


Figure F.8: Allision Scenarios Considered by NORM (powered allision image adopted from Zhang et al., 2019)

Powered allisions are like head-on collisions in that they generally depend on the same factors, but the second vessel, or fixed structure in this case, has a speed of zero and a fixed location. As such, a similar procedure to head-on collisions is followed for the calculation of powered allision risk, in that the outputs from the pre-processing step are used as inputs for the applicable methodology as outlined in Zhang et al. (2019). NORM augments this methodology slightly to make it account for multiple turbines along a given corridor between turbine rows (as opposed to a single fixed object).

For powered allision risk calculations within a turbine field, the amount of traffic going down a particular corridor is dependent on the results of the routing pre-processing step (see Figure F.8, left), while the traffic distributions are dependent on the geometric constraints of the turbines and their placement (GIS and geometric inputs, see Figure F.8, right).

Drifting collisions are much more random and difficult to quantify. NORM assumes rates of vessel breakdown that are commonly used in literature and other navigational risk models which are outlined in Zhang et al. (2019) and Rasmussen et al. (2012):

Table F.2: Rates of Vessel Breakdown Used in NORM

Factor	Frequency (per vessel and hour)
Loss of propulsion	1.3E-04
Rudder failure	6.3E-05
Loss of propulsion and rudder failure	1.5E-05

Furthermore, a drift-repair function is assumed to model the probability that a vessel is still drifting at a certain time after breakdown. This drift-repair function is often modeled with a Weibull function with an assumed cut-off time. NORM assumes a 10-hour cut-off time. It is assumed that after 10 hours, all vessels will have been repaired or rescued. This repair function is illustrated in Figure F.9.

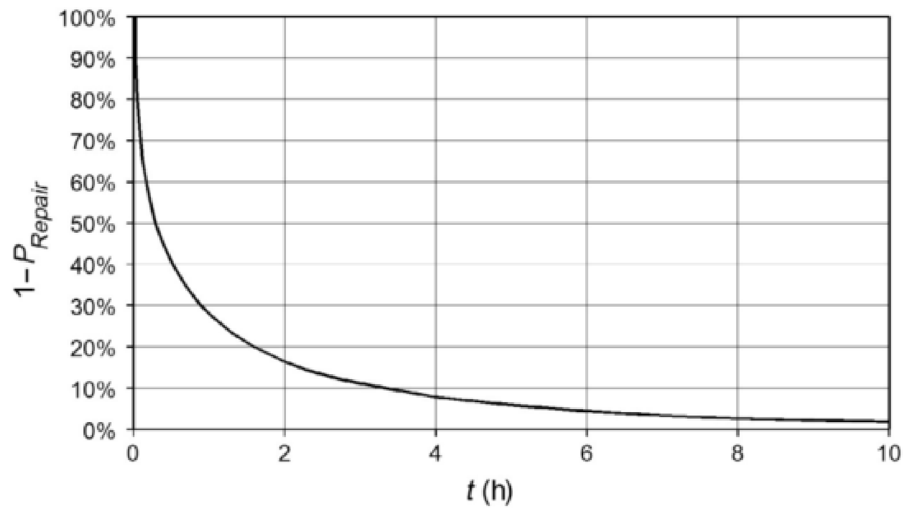


Figure F.9: Drift-Repair Function Used in NORM (image adopted from Zhang et al., 2019)

For the purposes of drifting allision risk calculations, NORM assumes a drift speed of 2 knots (literature suggests typical is 1-6 knots) with the same directional distribution as the local wind conditions. Alternately, NORM can use a drift velocity and directional distribution equal to local oceanographic and/or tidal currents. NORM then determines all the turbines within the vessels potential drift radius and calculates drifting allision risk for each turbine individually based on an initial starting position and sums them up. NORM's formulation for calculation drifting allision risk accounts for probability of vessel breakdown, probability of vessel drift-repair, turbine field placement, influence of metocean conditions on drift direction, and vessel characteristics.

F.1.4.4 Grounding Scenarios

Groundings are defined as the event of a vessel running aground, over a shoal, or any other event rendering them immobile. NORM considers both powered and drifting grounding scenarios as part of the overall risk calculation. To perform these calculations, NORM first develops a site-specific topo-bathymetric map (from Electronic Navigational Charts [ENCs] and external databases) that also incorporates features from ENCs such as shoals, shipwrecks, dredge areas, rocks, obstructions, etc.

The way the grounding is calculated is, in essence, the same as that for allision scenarios. For powered grounding, the exact same methodology is applied as powered allisions, but with the fixed "structure" now represented by the outline of the seabed and/or land surface. NORM computes potential groundings at locations based on vessel draft, topo-bathy elevations, wave conditions, water levels, and vessel orientation. The powered grounding scenario is depicted in Figure F.10.

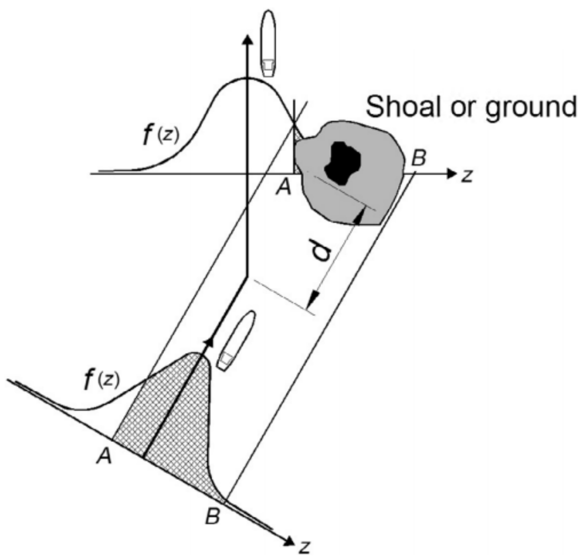


Figure F.10: Powered Grounding Scenario Considered by NORM (powered grounding image adopted from Zhang et al., 2019)

The methodology used to estimate risk due to drifting groundings is the same as that for drifting allisions. NORM assumes the same vessel breakdown rates, repair function, drift direction distribution, and drift speed. The only difference being that instead of the geometry being represented by turbine foundations, the geometry is represented by the area of potential grounding as determined from vessel draft, topo-bathy elevations, wave conditions, and water levels.