# VINEYARD NORTHEAST

## CONSTRUCTION AND OPERATIONS PLAN
### VOLUME II APPENDIX

**MARCH 2024**

**PREPARED BY:**

Epsilon
ASSOCIATES INC.

**SUBMITTED BY:**

VINEYARD NORTHEAST LLC

VINEYARD OFFSHORE

**PUBLIC VERSION**

# Vineyard Northeast COP

# Appendix II-G Navigation Safety Risk Assessment

Prepared by:
Baird

Prepared for:
Vineyard Northeast LLC

**March 2024**

| Revision | Date | Description |
|---|---|---|
| 0 | July 2022 | Initial submission. |
| 1 | March 2023 | Updated to address Bureau of Ocean Energy Management (BOEM) and United States Coast Guard (USCG) Round 1 Comments (dated January 13, 2023) and make minor corrections. |
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# Vineyard Northeast

## Navigation Safety Risk Assessment for Lease Area OCS-A 0522

November 6, 2023 | 13680.101.R1.Rev2

Baird.

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# Vineyard Northeast

## Navigation Safety Risk Assessment for Lease Area OCS-A 0522

**Prepared for:**

Epsilon Associates Inc.
3 Mill & Main Place,
Suite 250
Maynard, MA 01754

**Prepared by:**

W.F. Baird & Associates Ltd.

For further information, please contact
Larry A. Wise at +1 608 273 0592
lwise@baird.com
www.baird.com

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# Executive Summary

Vineyard Northeast LLC (the "Proponent") proposes to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0522 (the "Lease Area") along with associated offshore and onshore transmission systems. This proposed development is referred to as "Vineyard Northeast."

Vineyard Northeast includes 160 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area. Up to three of those positions will be occupied by ESP(s)[1] and the remaining positions will be occupied by WTGs. Two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—will connect the renewable wind energy facilities to onshore transmission systems in Massachusetts and Connecticut. The Offshore Development Area is comprised of Lease Area OCS-A 0522, the OECCs, and the broader region surrounding the offshore facilities that could be affected by Vineyard Northeast-related activities (Figure ES.1).

This document summarizes the methodology and findings of a Navigation Safety Risk Assessment (NSRA) conducted for Vineyard Northeast as required by the US Coast Guard (USCG). The USCG provides guidance on the information and factors that will be considered when reviewing an application for a permit to build and operate Offshore Renewable Energy Installation (OREI), such as Vineyard Northeast. This information, which is outlined in USCG Navigation and Vessel Inspection Circular No. 01-19 (NVIC 01-19), is to be summarized through conducting a NSRA. 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 existing uses of the waterway; and (3) the impact on maritime search and rescue (SAR) activities by the USCG and others.

Consultations were conducted with fishermen and mariners as part of the NSRA development. Vessel traffic in the vicinity of the Lease Area was analyzed based on Automatic Identification System (AIS) vessel tracking data. AIS data from the National Oceanic and Atmospheric Administration's (NOAA) Marine Cadastre dataset were analyzed for an approximately 10 nautical mile (NM) (18.52 km) radial area around the Lease Area with a southward extension to capture the full traffic separation scheme (TSS) south of the Lease Area. In total, over the 5.75 years assessed, there were a total of 1,687 unique vessels in the dataset that passed through the Lease Area. Table ES.1 provides a summary of the unique vessels and unique fishing vessels by year over the AIS data period. Commercial fishing vessels and recreational vessels dominate the traffic in the area, representing 73% of the unique tracks.

**Table ES.1: Summary of AIS dataset analyzed (Data Source: Marine Cadastre)**

| Year | 2016 | 2017 | 2018 | 2019 | 2020 | *2021 | **2016-2021 |
|---|---|---|---|---|---|---|---|
| Number of Unique Vessels | 280 | 343 | 558 | 648 | 504 | 400 | 1,687 |
| Number of Unique Fishing Vessels | 64 | 89 | 255 | 334 | 236 | 177 | 506 |

**Note that 2021 data was through September 2021 and represents three-quarters of a year.*

***Note that the number of unique vessels for a given year as compared to the total number of unique vessels per 2016-2021 will not sum up to the same number since the same vessel may frequent the area in different years.*

[1] If two or three ESPs are used, they may be located at separate positions or two of the ESPs may be co-located at the same grid position.

Existing navigation features in the Offshore Development Area, including channels, aids-to-navigation (ATONs), and navigation hazards are described in the NSRA based on a variety of data sources including the NOAA Coast Pilot and relevant navigation charts.

Vineyard Northeast consists of the following infrastructure components in the marine environment:

- 160 total WTG and ESP positions (up to three of which may be occupied by ESP[s]), with monopile or piled jacket foundations supporting the WTGs and ESP(s);
- Potentially one booster station supported by a monopile or piled jacket foundation;
- Inter-array cables and potentially inter-link cables; and
- Two OECCs.

The WTG includes the following components,

- Turbine blades that rotate under wind power;
- Nacelle that encloses the electrical generator (which transforms the kinetic energy of the moving turbine blades to electric energy), drivetrain, brake, and motors that yaw and pitch the WTG; and
- Tower, typically comprised of multiple sections, that extends from the foundation to the nacelle.

Vineyard Northeast is being permitted using a Project Design Envelope (PDE), which provides a reasonable range of project design parameters and installation techniques. For example, Vineyard Northeast includes two options for WTG, ESP, and booster station foundations: monopile or piled jacket. As the foundations have not been selected at this time this document assesses both types (monopile and piled jacket foundations).

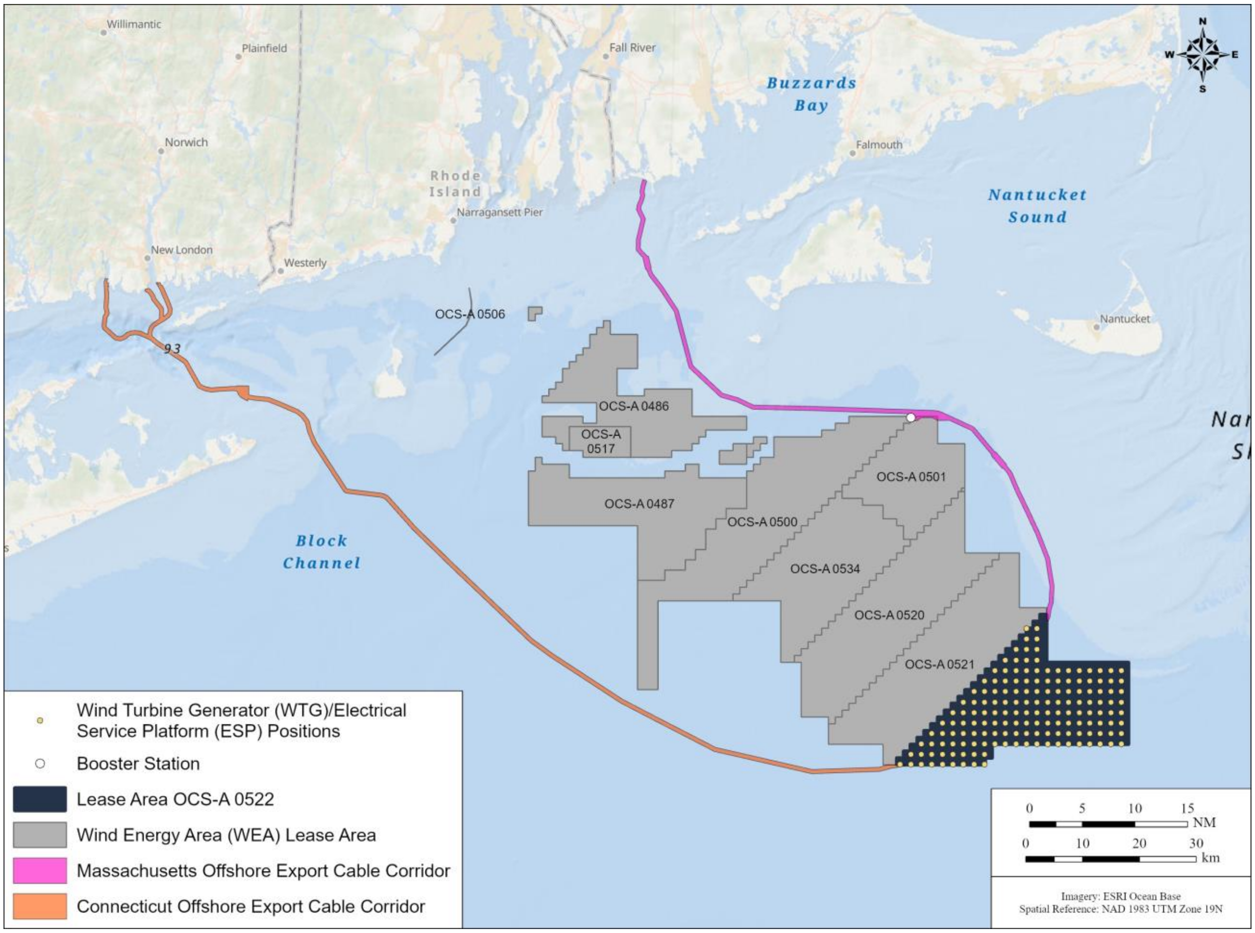


**Figure ES.1: Lease Area and Structure Locations**

The WTG/ESP layout has been developed to maximize energy production while minimizing impacts on navigation (Section 2.1). The WTGs and ESP(s) will be aligned in a uniform grid pattern with a nominal spacing of 1 NM (1.9 km) in the north-south and east-west directions. This arrangement also creates diagonal corridors in the northwest-southeast and southwest-northeast directions with a spacing of at least 0.6 NM (1.1 km). Figure ES.2 shows the relative arrangement of the WTGs and ESP(s). Groups of WTGs will be connected to the ESP(s) by inter-array cables and the ESP(s) may be connected to each other with inter-link cables; the inter-array and inter-link cables are not shown. The offshore export cables, which will be installed within the OECCs, will connect the ESP(s) to the landfall sites, as shown in Figure ES.3. If high voltage alternating current (HVAC) offshore export cables are used in the Massachusetts OECC, the cables would connect to a booster station in the northwestern aliquot[2] of Lease Area OCS-A 0534 (Figure ES.1 and Figure ES.3) to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity.

2 An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

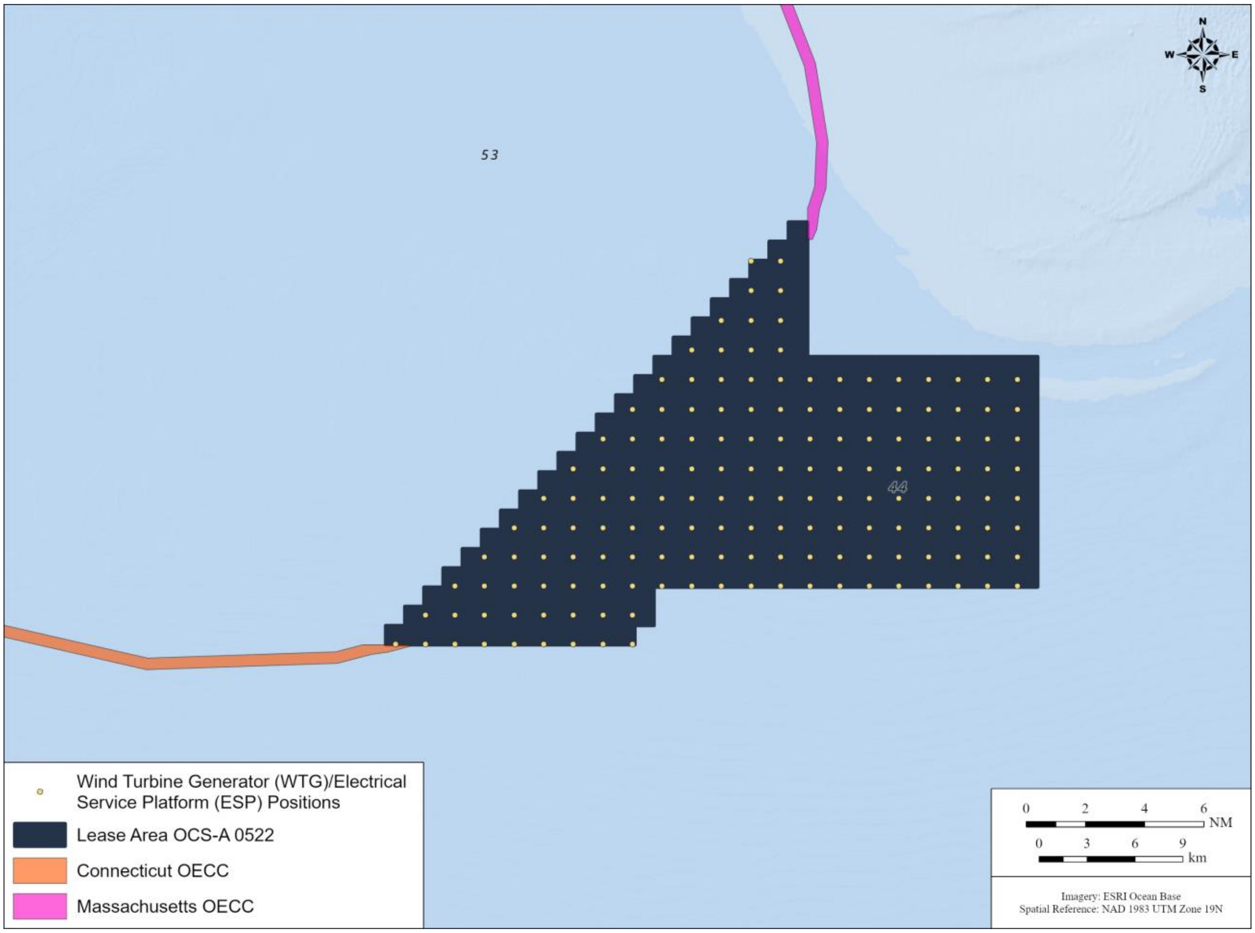


**Figure ES.2: WTG and ESP Layout**

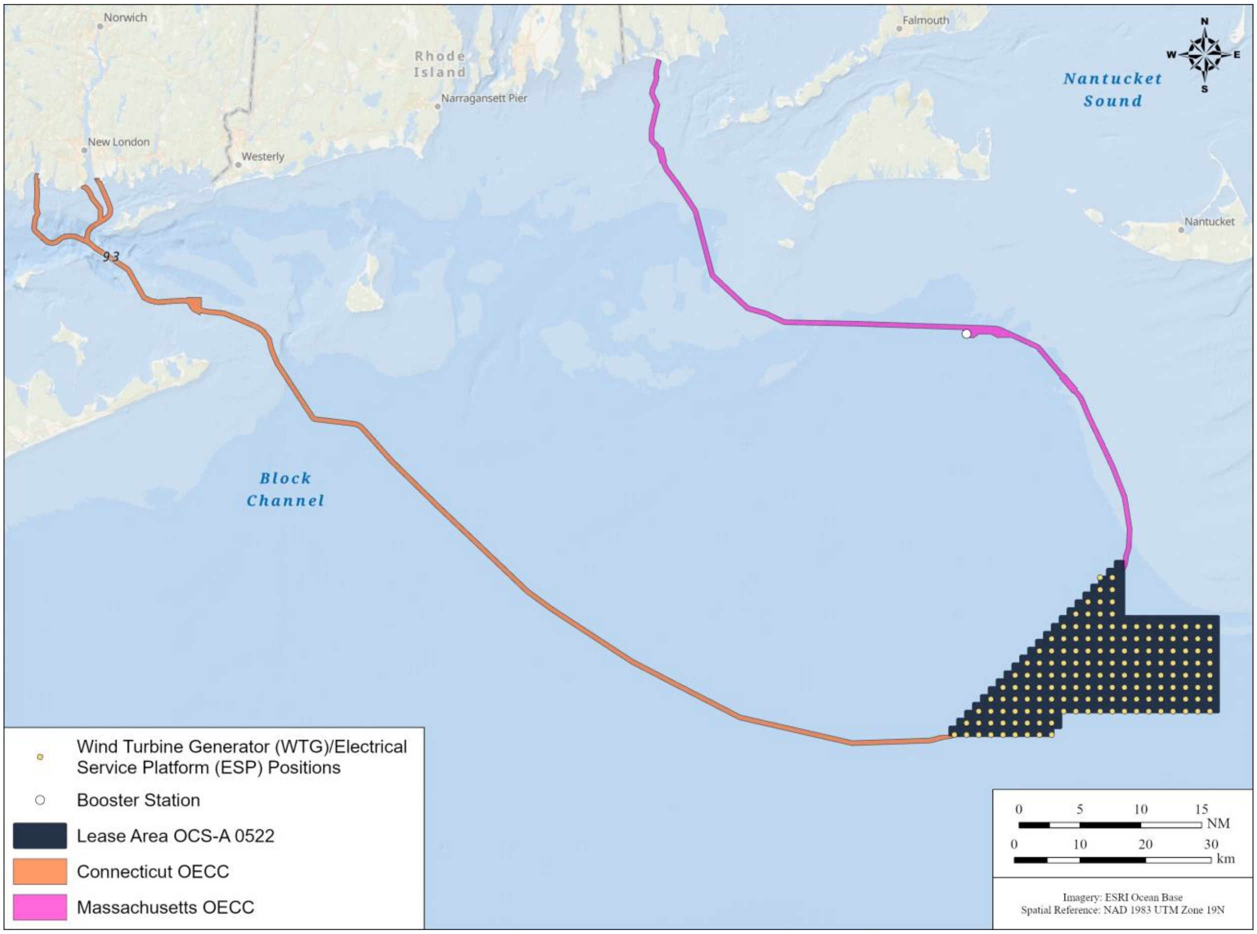


**Figure ES.3: Offshore Export Cable Corridors**

The meteorological / oceanographic (metocean) environment in the Offshore Development Area is provided in Section 4 of this NSRA. No substantive impacts on the metocean environment are expected from Vineyard Northeast.

To aid marine navigation and aviation, the WTGs, ESP(s), booster station (if used), and their foundations will be marked and lighted in accordance with USCG, Federal Aviation Administration (FAA), and BOEM requirements. The Proponent expects to paint each foundation (above sea level) in high visibility yellow paint. AIS will be used to mark each WTG, ESP, and booster station (virtually or using physical transponders). Mariner Radio Activated Sound Signals (MRASS) will be located on select foundations for low visibility conditions. Each WTG, ESP, and booster station will be maintained as a private aid-to-navigation (PATON) (all PATONs will be permitted through USCG) and provided to NOAA for incorporation on appropriate navigation charts.

A desktop analysis of the recommended maximum vessel length that can be accommodated by the corridors created by the 1 NM by 1 NM (1.9 by 1.9 km) WTG/ESP layout was completed based on the methodology used by the Massachusetts and Rhode Island Port Access Route Study (MARIPARS) (USCG, 2020) and other international guidance (e.g., PIANC, 2018). The analysis of the corridor width considers spacing for a navigation path, a ship collision avoidance zone, a safety margin for vessel turning, and an additional buffer around each turbine. With a 164 ft (50 m) buffer assumed, both the 1 NM (1.9 km) north-south and east-west corridors and the at least 0.6 NM (1.1 km) diagonal corridors would accommodate all of the fishing vessels in the existing fleet. MARIPARS also provided an estimate of the corridor width assuming a buffer radius of 820 ft (250 m)[3], resulting in all of the fishing vessel fleet being accommodated within a 1 NM (1.9 km) corridor and approximately 95% of the fishing vessel fleet being accommodated within a 0.6 NM (1.1 km) corridor. 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 in most locations (i.e., except at the WTGs themselves). In the case of the diagonal corridors, the turbines that define the corridor "edges" are offset from one another. The corridor spacing will also accommodate most of the recreational fleet, other than approximately 0 to 2% of the largest vessels in the north-south and east-west corridors and approximately 4 to 13% of the largest vessels in the diagonal corridors, depending on the size of the assumed buffer around each WTG. It is noted that while these largest vessels are classified as recreational by AIS category, these large recreational vessels are expected to be crewed by licensed professional mariners.

It is anticipated that larger commercial vessel (e.g., cargo, tanker, passenger, military, and tug tow) traffic may navigate to the south of the Lease Area toward and along existing shipping routes, including the Nantucket to Ambrose Safety Fairway (westbound) and Ambrose to Nantucket Safety Fairway (east bound), which are approximately 1.5 NM (2.8 km) to the south of the Lease Area, rather than through the turbine field. It has been estimated that this diversion will add less than 15 minutes to the overall journey time based on the average vessel speed. Various paths for re-routing of fishing and recreational vessels were also assessed should some of these vessels choose to divert around the Lease Area rather than travel through it. For most re-routing paths for fishing vessels and recreational vessels, the increase in transit time was a matter of a few minutes. The largest increase in transit time was approximately 30 minutes for fishing or recreational vessels that currently travel from northwest to southeast directly through the middle of the Lease Area under existing conditions.

The potential navigational impacts from Vineyard Northeast have been analyzed with a computer based statistical model which is based on existing traffic, as determined from AIS analysis, and assumed modifications to traffic patterns following construction of Vineyard Northeast. The analysis includes hazards of collision, allision (striking a fixed object), and grounding. The results of the model show that the overall risk for potential marine accidents is relatively low for both pre-construction and post-construction conditions, and that the bulk of the risk is for fishing and cargo vessels. The risk of a potential accident changes from an average of one in every 48 years to one in every 45 years and is primarily attributed to operations and maintenance (O&M) traffic and allisions with WTGs. This translates to one additional accident every 720 years.

The historic incidents of USCG SAR and marine environmental response (MER) in the vicinity of the Lease Area are described in the NSRA. No substantive impact to SAR or MER activities is expected from Vineyard Northeast.

A series of proposed measures to mitigate risk during both the construction and operation of Vineyard Northeast have been developed based on the NSRA's findings, as summarized below.

[3] In the MARIPARS, a 1,640 ft (500 m) safety zone was applied as a single value for the corridor; in this report, it has been interpreted as an 820 ft (250 m) radius applied around each WTG on both sides of the corridor. Note that the MARIPARS uses the term "safety zone," but to avoid confusion with a regulatory safety zone under 33 CFR 147, this NSRA uses the term "buffer" instead.

## Construction & Installation

To mitigate navigation risk, the Proponent proposes to:

- Utilize a Marine Coordinator to manage all construction vessel logistics and implement marine communication protocols.
- Provide Offshore Wind Mariner Updates and coordinate with the USCG regarding the issuance of Local Notices to Mariners (LNMs) advising other vessel operators of Vineyard Northeast's construction and installation activities.
- Regularly provide updates as to the locations of installed WTGs, ESP(s), and the booster station (if used) to the USCG and NOAA for use in navigational charts.
- Identify the WTGs, ESP(s), and booster station as PATONs.
- Provide temporary lighting and marking on foundation structures as they are built, depending on the sequence and timing of construction.
- Engage with the USCG early in the permitting process and coordinate closely to address ATONs in proximity to or within the OECCs. These ATONs will be avoided through micro-siting the offshore export cables (within the OECC) around the ATONs in accordance with USCG's Minimum Safe Distance requirements.
- Require all Vineyard Northeast construction vessels and equipment to display required navigation lighting and day shapes.
- Potentially request that USCG establish safety zones around WTGs, ESP(s), and the booster station during construction and/or certain maintenance activities, pursuant to 33 CFR Part 147. Additional details are provided in Section 8.1.1.
- When feasible, deploy one or more safety vessels to monitor vessel traffic approaching the construction areas.

## Operations & Maintenance (O&M)

Proposed measures to mitigate navigation risk during O&M of Vineyard Northeast are provided below.

## Overall Marine and SAR Coordination

- Utilize a Marine Liaison Officer who will act as the strategic maritime liaison between Vineyard Northeast's internal parties and all external maritime partners and stakeholders.
- Provide Offshore Wind Mariner Updates and coordinate with the USCG regarding the issuance of LNMs advising other vessel operators of Vineyard Northeast's O&M activities.
- Work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested Vineyard Northeast WTGs to be engaged within a specified time upon request from the USCG during SAR operations and other emergency response situations. This emergency braking system will be satisfactorily tested at least twice per year.
- Coordinate with the USCG to identify ways for Vineyard Northeast to support SAR efforts, which may include the use of cameras on WTGs and/or ESP(s) to aid in the detection of distressed mariners.
- Design the helipads on the ESP(s), if present, to accommodate USCG rescue helicopters.
- Operations center(s) will be maintained and continuously operated 24 hours per day throughout the life of Vineyard Northeast. The center(s) can assist the USCG in the response to distress calls through active control over the WTG braking system.

### Vessel Navigation

- Use of a 1 NM by 1 NM (1.9 by 1.9 km) WTG/ESP layout-oriented north-south and east-west will allow fixed fishing gear to be placed along the east-west turbine alignment so that it is visually apparent where this gear is located. This is consistent with the current practice of placing such gear along east-west LORAN lines.
- The locations of the WTGs, ESP(s), and booster station (if used) and air draft heights of the WTGs will be provided to the USCG and NOAA for identification on relevant navigational charts. USCG can advise NOAA of any other relevant notes or precautionary statements to be published on relevant navigational charts.
- The USCG can also advise on other restrictions and recommendations by means of LNMs.

### WTG, ESP, and Booster Station Marking and Lighting

- The WTGs, ESP(s), booster station (if used), and their foundations will be equipped with marine navigation lighting and marking in accordance with USCG and BOEM requirements. Each WTG, ESP, and booster station will be maintained as a Private Aids to Navigation (PATON) per the requirements of the USCG.
- Each structure will be marked with a unique alphanumeric identifier to aid in visual confirmation of vessel location. Alphanumeric marking of structures is expected to be consistent across the Massachusetts Wind Energy Area (MA WEA) and Rhode Island/Massachusetts WEA (RI/MA WEA) Lease Areas and such marking has been coordinated with USCG and BOEM as part of the “Rhode Island and Massachusetts Structure Labeling Plot.”
- MRASS and AIS transponders are included in the design of the offshore facilities to enhance safety; the number, location, and type of these items will be determined in coordination with the USCG, BOEM, and Bureau of Safety and Environmental Enforcement (BSEE) for the final WTG/ESP layout.
- The WTGs, ESP(s), and booster station will include an aviation obstruction lighting system in compliance with FAA and BOEM requirements.

### Marine Radar and AIS

BOEM recently sponsored a study by the National Academies of Sciences, Engineering, and Medicine to evaluate the impacts of WTGs on marine vessel radar and identify potential mitigation measures. The study provides a comprehensive overview of marine radar impacts and lays out potential mitigation measures as well as providing recommendations for further work. Mitigation for radar impacts (if needed) as well as communications consistency measures are expected to be based on regional efforts, which would be implemented in conjunction with other MA WEA and RI/MA WEA developers. Possible mitigation measures that may be considered are presented below; however, it is noted that these are preliminary concepts, and it is expected that such regional mitigation measures will be refined and updated pending ongoing consultations with BOEM, USCG, and other relevant agencies:

- Communications and training could be provided to local marine radar users regarding spurious signals and clutter that can occur in the vicinity of offshore structures as well as the recommended approaches for reducing these effects.
- Investigation of the use of more advanced radar systems that may provide improved filtering of spurious signals and the tracking of small vessels.
- Investigation of the use of AIS in smaller vessels as a more reliant means of navigating in a turbine field.

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# Acronyms

| | |
|---|---|
| °C | degrees Celsius |
| °F | degrees Fahrenheit |
| ABS | American Bureau of Shipping |
| AIS | Automatic Identification System |
| ADLS | Aircraft Detection Lighting System |
| AHTS | Anchor handling tug supply |
| ALARP | As Low As Reasonably Practicable |
| ASCC | Air Station Cape Cod |
| ATON | Aids to Navigation |
| BOEM | Bureau of Ocean Energy Management |
| CFR | Code of Federal Regulations |
| CPAPARS | Consolidated Port Approaches and International Entry and Departure Areas Port Access Route Study |
| COLREGS | International Regulations for Preventing Collisions at Sea |
| COP | Construction and Operations Plan |
| CRMC | Coastal Resources Management Council |
| CTV | Crew Transfer Vessel |
| dB | Decibels |
| DoD | Department of Defense |
| DSC | Digital Selective Calling |
| ECA | Emission Control Area |
| ECDIS | Electronic Chart Display and Information System |
| EMF | Electromagnetic Field |
| ENC | Electronic Navigational Chart |
| ERP | Emergency Response Plan |
| ESP | Electrical Service Platforms |
| ESRI | Environmental Systems Research Institute |
| ETV | Emergency Towing Vessels |
| FAA | Federal Aviation Administration |
| FCC | Federal Communications Commission |
| FCP | Fisheries Communication Plan |
| FLiDAR | Floating Light Detection and Ranging |
| ft | feet |
| GBS | Gravity Based Structure |
| GIS | Geographic Information System |

| | |
|---|---|
| GNSS | Global Navigation Satellite Systems |
| GPS | Global Positioning System |
| HAT | Highest Astronomical Tide |
| HLV | Heavy lift vessel |
| HSC | High Speed Craft |
| HTV | Heavy transport vessel |
| hr | hour |
| Hz | Hertz |
| IALA | International Association of Lighthouse Authorities |
| IEM | Iowa Environment Mesonet |
| IMO | International Maritime Organization |
| JBCC | Joint Base Cape Cod |
| kts | Knots - vessel speed in nautical miles per hour |
| LOA | length overall |
| LNM | Local Notice to Mariners (USCG publication) |
| m | meter |
| MARIPARS | Massachusetts and Rhode Island Port Access Route Study |
| MER | Marine Environmental Response |
| Met Tower | Meteorological Tower |
| MFN | Multifunction Node |
| MGN | Marine Guidance Note |
| MHHW | Mean Higher High Water |
| MISLE | Marine Information for Safety and Law Enforcement |
| MKD | Minimum Keyboard and Display |
| MLLW | Mean Lower Low Water |
| MMSI | Maritime Mobile Service Identity |
| MRASS | Mariner Radio Activated Sound Signal |
| MSBI | Marine Safety Information Bulletin |
| MSL | Mean Sea Level |
| MW | Megawatt |
| NJPARS | New Jersey Port Access Route Study |
| NM | Nautical Mile |
| NNYBPARS | Northern New York Bight Port Access Route Study |
| 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 |
| O&M | Operations and Maintenance |
| OECC | Offshore Export Cable Corridor |
| OREI | Offshore Renewable Energy Installation |
| OSRO | Oil Spill Response Organization |
| PATON | Private Aids to Navigation |
| PDE | Project Design Envelope |
| PIANC | World Association for Waterborne Transport Infrastructure |
| POI | Point of Interconnection |
| PIW | Person in Water |
| RACON | Radar Transponder |
| RFI | Request for Information |
| RH | Relative Humidity |
| RODA | Responsible Offshore Development Alliance |
| ROSA | Responsible Offshore Science Alliance |
| SAR | Search and Rescue |
| SMC | Search and Rescue Mission Coordinator |
| SOLAS | International Convention for the Safety of Life at Sea |
| SOV | Service Operational Vessel |
| SPS | Significant Peripheral Structures |
| TOW | Taking on Water |
| TSS | Traffic Separation Scheme |
| TP | Transition Piece |
| UKC | Under Keel Clearance |
| 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 |
| VHF | Very High Frequency Radio |
| VTS | Vessel Traffic Services |
| VMS | Vessel Monitoring System |
| WIG | Wing in Ground |
| WIS | Wave Information Studies |
| WTG | Wind Turbine Generator |
| WTRIM | Wind Turbine Radar Interference |

# 1. Introduction

## 1.1 Overview of Vineyard Northeast

Vineyard Northeast LLC (the “Proponent”) proposes to develop, construct, and operate offshore renewable wind energy facilities in Bureau of Ocean Energy Management (BOEM) Lease Area OCS-A 0522 (the “Lease Area”) along with associated offshore and onshore transmission systems. This proposed development is referred to as “Vineyard Northeast.” Vineyard Northeast includes 160 total wind turbine generator (WTG) and electrical service platform (ESP) positions within the Lease Area. Up to three of those positions will be occupied by ESP(s) and the remaining positions will be occupied by WTGs. Two offshore export cable corridors (OECCs)—the Massachusetts OECC and the Connecticut OECC—will connect the renewable wind energy facilities to onshore transmission systems in Massachusetts and Connecticut. Additionally, a booster station may be used along the Massachusetts OECC, as described below.

The Offshore Development Area is comprised of the Lease Area, the OECCs, and the broader region surrounding the offshore facilities that could be affected by Vineyard Northeast-related activities (Figure 1.1). At its closest point, the 132,370 acre (536 $km^2$) Lease Area is approximately 25 NM (46 km) from the southwest corner of Nantucket. As proposed, the WTGs and ESP(s) will be oriented in a grid layout with east-to-west rows and north-to-south columns with nominal 1 nautical mile (NM) spacing between positions.

The power generated from the Vineyard Northeast WTGs will be transmitted to the onshore transmission systems by offshore export cables installed within two OECCs. From the Lease Area boundary to the landfall site, the Massachusetts OECC is approximately 68 NM (126 km).[4] Depending on the approach used, the maximum length of the Connecticut OECC from the Lease Area boundary to the landfall site is approximately 92–96 NM (171–179 km).[5] If high voltage alternating current (HVAC) offshore export cables are used in the Massachusetts OECC, the cables would connect to a booster station in the northwestern aliquot[6] of Lease Area OCS-A 0534 to boost the electricity’s voltage level, reduce transmission losses, and enhance grid capacity.

Vineyard Northeast is being developed and permitted using a Project Design Envelope (PDE) that defines and brackets the characteristics of the facilities and activities for purposes of environmental review while maintaining a reasonable degree of flexibility with respect to the selection of key components, such as the WTGs, foundations, OECCs, and ESP(s).

To support Vineyard Northeast’s construction and operation activities, Vineyard Northeast will use a combination of North Atlantic ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and/or Canada.

[4] The length of the Massachusetts OECC is measured from the Lease Area boundary to the offshore edge of the corridor at the landfall site.

[5] The length of the Connecticut OECC is measured from the Lease Area boundary to the offshore edge of the corridor at each landfall site.

[6] An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

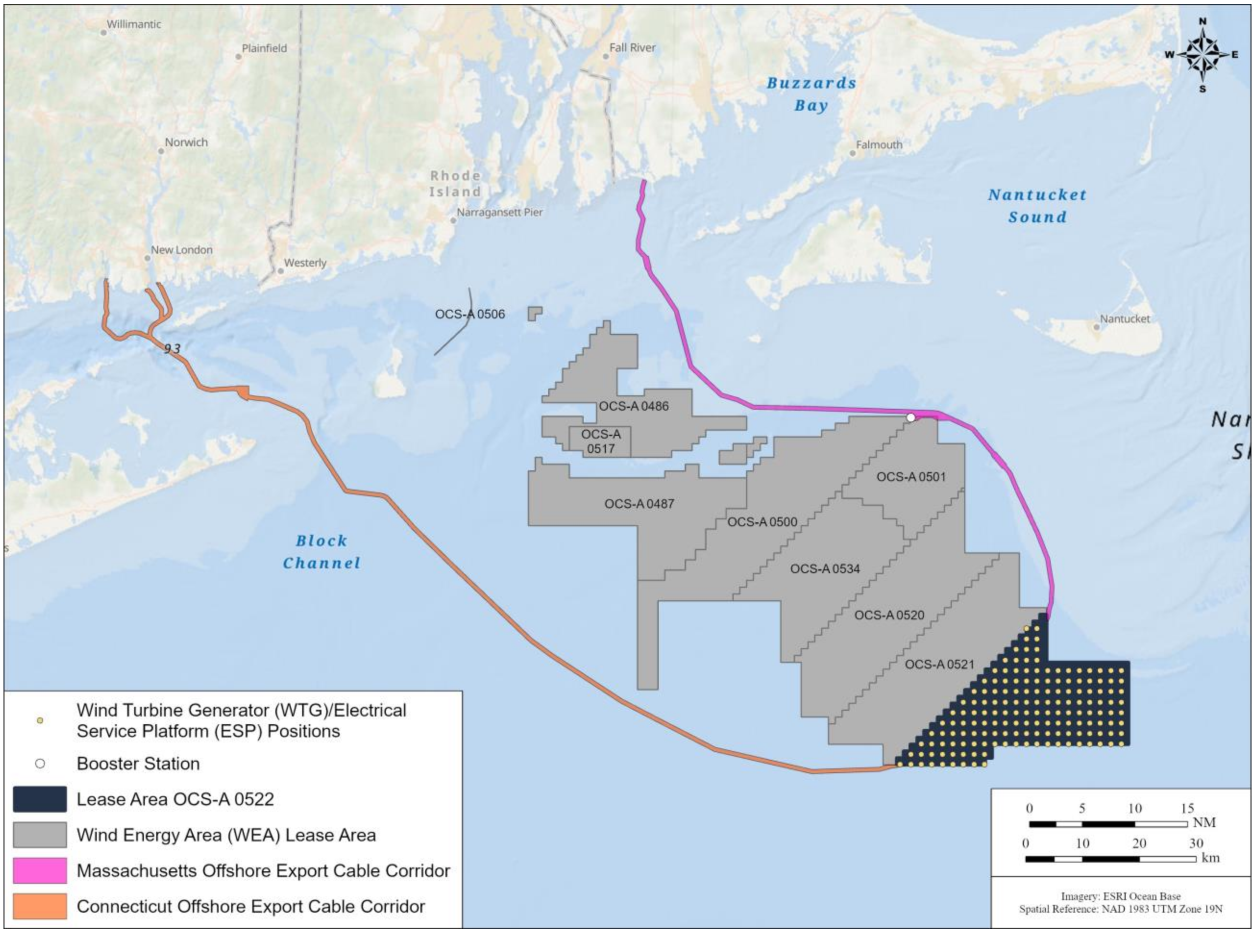


**Figure 1.1: Overview of Vineyard Northeast**

## 1.2 Purpose of the Navigation Safety Risk Assessment

The United States Coast Guard (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 Vineyard Northeast. This information, which is outlined in USCG Navigation and Vessel Inspection Circular No. 01-19 (NVIC 01-19), is to be summarized through conducting a Navigation Safety Risk Assessment (NSRA). 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 existing uses of the waterway; and (3) the impact on maritime search and rescue activities by the USCG and others.

The NSRA process is to be conducted in cooperation and consultation with a wide range of stakeholders, including federal, state, and local agencies, Native American tribes, 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 following sections include Site Information, Proposed Structures, Metocean Characteristics and Impacts, Navigation Impact Assessment, Risk of Collision, Allision, or Grounding, Emergency Response Considerations, and Facility Operations. The NVIC 01-19 Checklist is provided as 0. The AIS Data Analysis, Vessel Monitoring System (VMS) Data Maps, NORM Model Summary, and WTG/ESP and Booster Station Coordinates are also provided as appendices.

# 2. Site Information

## 2.1 Development of the Layout

The Lease Area's WTG/ESP layout has been developed to maximize energy production while minimizing impacts on navigation. As proposed, the 160 WTG and ESP positions will be aligned in a uniform grid pattern with a nominal spacing of 1 NM (1.9 km) in the north-south and east-west directions (Figure 2.1). This arrangement also creates diagonal corridors in the northwest-southeast and southwest-northeast directions with a spacing of at least 0.6 NM (1.1 km). Up to three of the 160 positions will be occupied by ESP(s) and the remaining positions will be occupied by WTGs. The ESP(s) may be located at any WTG/ESP position. If two or three ESP(s) are used, they may be located at separate positions or two of the ESP(s) may be co-located at one grid position. Additionally, one booster station may be located in the northwestern aliquot[7] of Lease Area OCS-A 0534 (Section 2.4). The coordinates of each WTG/ESP position and booster station position are listed in 0.

USCG's Massachusetts and Rhode Island Port Access Route Study (MARIPARS) recommends a standard and uniform WTG/ESP layout with:

- lanes for vessel transit oriented in a northwest to southeast direction that are 0.6 NM to 0.8 NM wide;
- lanes for commercial fishing vessels (that are actively fishing) in an east to west direction that are 1 NM wide; and
- lanes for USCG search and rescue (SAR) operations oriented in a north to south and east to west direction that are both 1 NM wide.

The Proponent notes that the 1 x 1 NM layout proposed by five New England leaseholders in "RE: Proposal for a uniform 1 X 1 nm wind turbine layout for New England Offshore Wind" (the "Joint Developer Letter"), which the USCG adopted as recommendations in the MARIPARS, arranges each grid position exactly 1 NM (1,852 m) apart, such that the placement of *any* structure centered on these grid positions will inherently narrow the east to west and north to south corridors to less than 1 NM. In addition, BOEM's regulations at 30 CFR Part 585.634(c)(6) state that a Construction and Operations Plan (COP) modification is needed only in the event of "changes in the location of bottom disturbances (anchors, chains, etc.) by 500 feet (152 meters) or greater from the approved locations." As such, any MA WEA or RI/MA WEA developer may micro-site WTG/ESP positions by up to 500 ft (152 m). A shift of a grid position by 500 ft (152 m) in any of the four cardinal directions would reduce the spacing between the centroids of adjacent grid positions to 0.92 NM (1,700 m).

In order to facilitate the commercial viability of the Lease Area, WTG/ESP positions in the four southernmost rows have been located in accordance with the MARIPARS recommendations, taking into consideration the flexibility for micro-siting permitted in BOEM's regulations. This results in east to west corridors between these rows with a spacing of 0.98 NM between grid positions (Figure 2.1). The northwest to southeast corridors remain wider than 0.6 NM and the north to south corridors are unaffected (Figure 2.2).

As noted above, two of the ESPs may be co-located at one of the potential grid positions shown on Figure 2.1 (there would only be one set of co-located ESPs). Co-located ESPs would be smaller structures installed on monopile foundations (i.e., there would be two monopile foundations at the same grid position). If co-located ESPs are used, each ESP's monopile foundation would be within 76 m (250 ft) of the grid position's centroid (i.e., the monopiles would be separated by up to 152 m [500 ft]) as shown in the co-located ESP detail on Figure 2.3. As shown in Table 2.1 and Figure 2.3, with the use of co-located ESPs, the northwest to southeast

[7] An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

corridors would remain wider than 0.6 NM and the east to west or north to south corridors would be slightly narrower in one discrete portion of the Lease Area. However, as noted above, the placement of any structure at any 1 x 1 NM grid position inherently narrows the east to west and north to south corridors to less than 1 NM, and BOEM's regulations at 30 CFR Part 585.634(c)(6) permit micro-siting by up to 500 ft (152 m), which would reduce the spacing between grid positions to 0.92 NM (1,700 m). Therefore, the use of co-located ESPs is consistent with the MARIPARS recommendations, when considering the flexibility for micro-siting permitted in BOEM's regulations.

**Table 2.1: Vineyard Northeast WTG/ESP Layout Spacing**

| | E-W Corridor Spacing | N-S Corridor Spacing | NW-SE/NE-SW Corridor Spacing |
|---|---|---|---|
| Rows BG – BR (ten rows) | 1.0 NM (1,852 m) | 1.0 NM (1,852 m) | 0.71 NM (1,310 m) |
| Rows BS – BV (four rows) | 0.98 NM (1,811 m) | 1.0 NM (1,852 m) | 0.70 NM (1,295 m) |
| Co-Located ESP (if used*) | 0.96 NM (1,776 m) | 0.96 NM (1,776 m) | 0.67 NM (1,233 m) |
| Micro-siting allowed by BOEM regulations (if needed) | 0.92 NM (1,700 m) | 0.92 NM (1,700 m) | 0.62 NM (1,157 m) |

* Minimum corridor spacing for co-located ESPs assuming that they are located in rows BG through BQ (Figure 2.1).

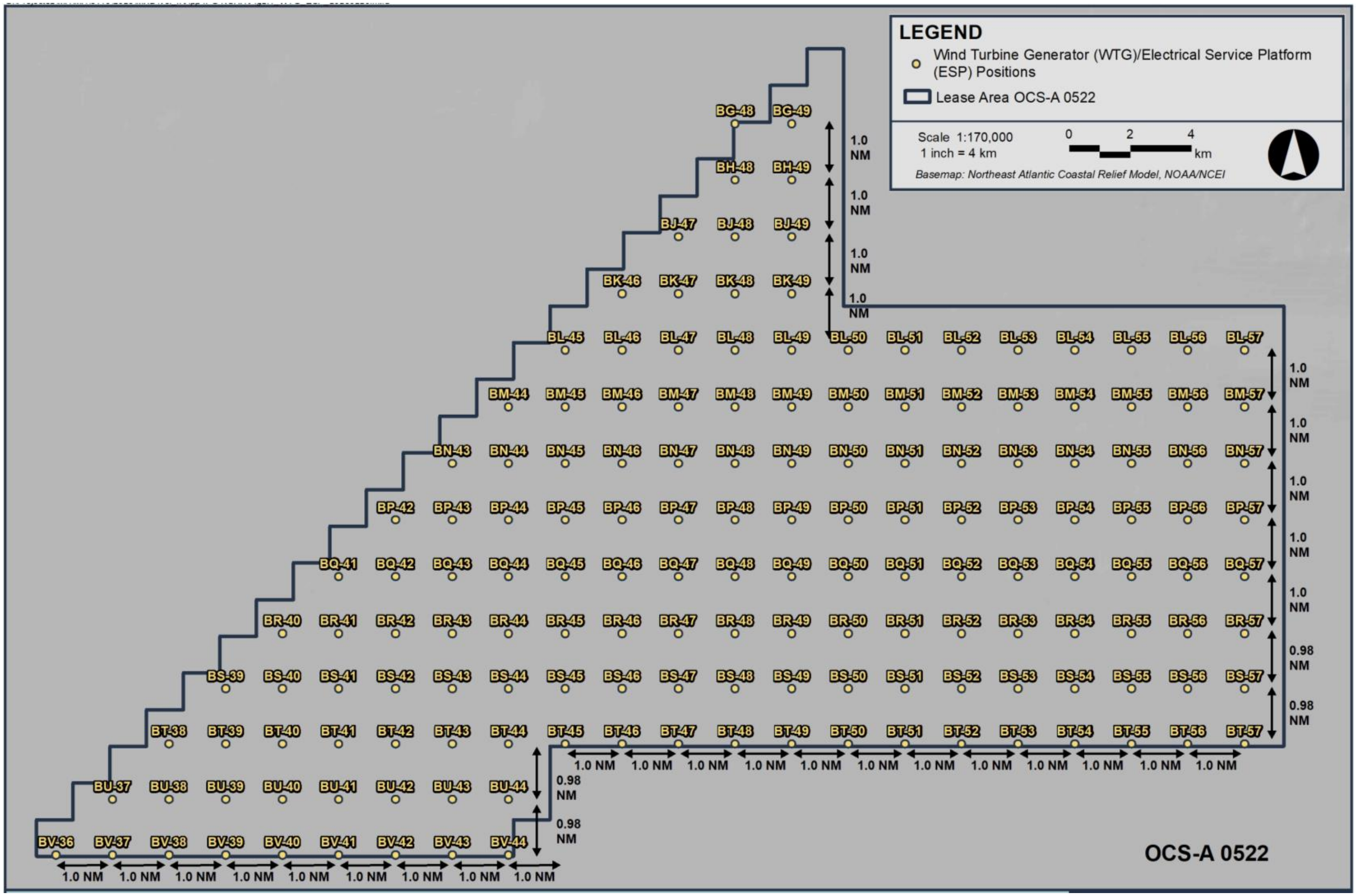


**Figure 2.1: WTG/ESP Layout**

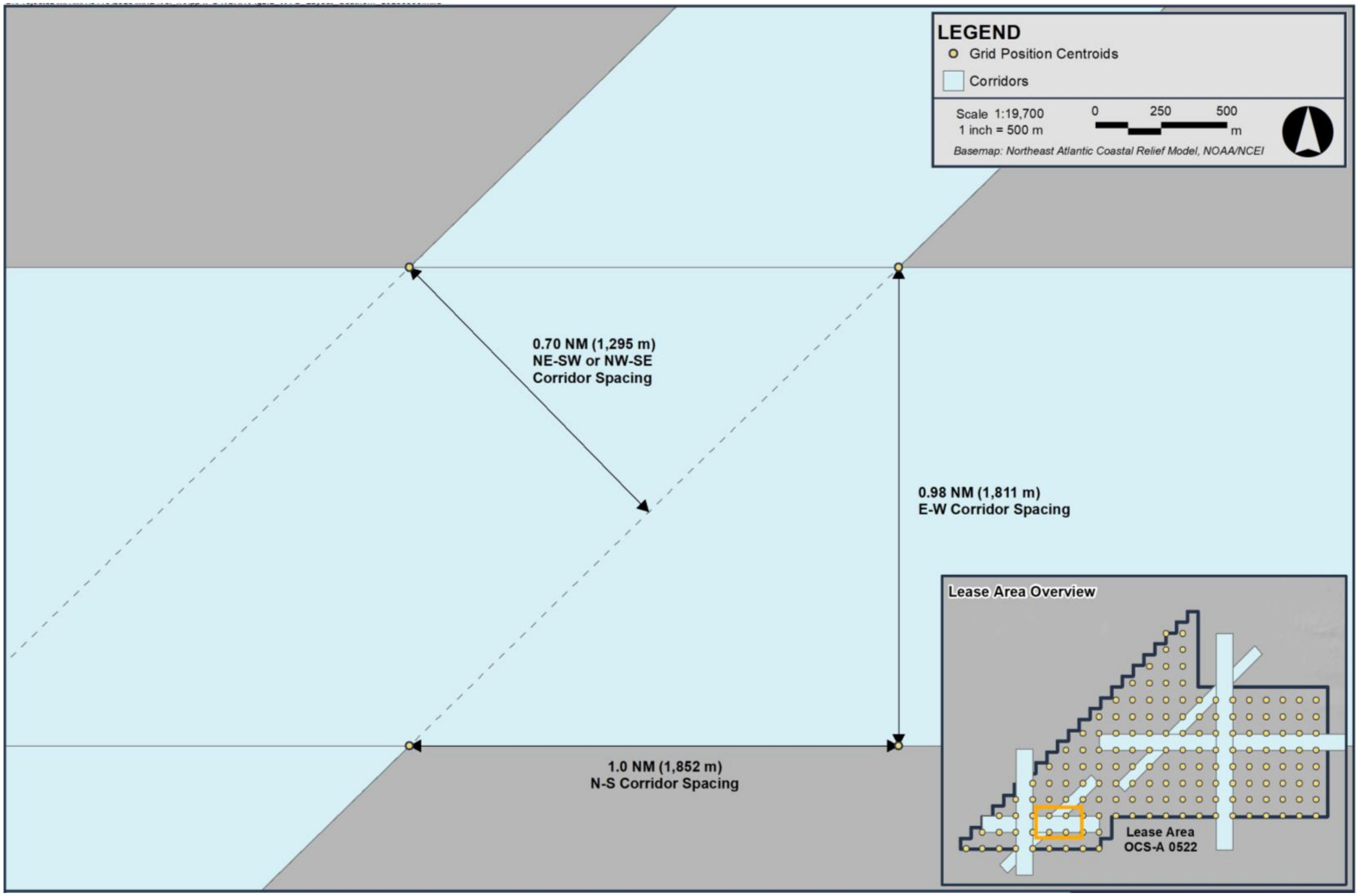


**Figure 2.2: WTG/ESP Layout (Southern Portion of Lease Area Detail)**

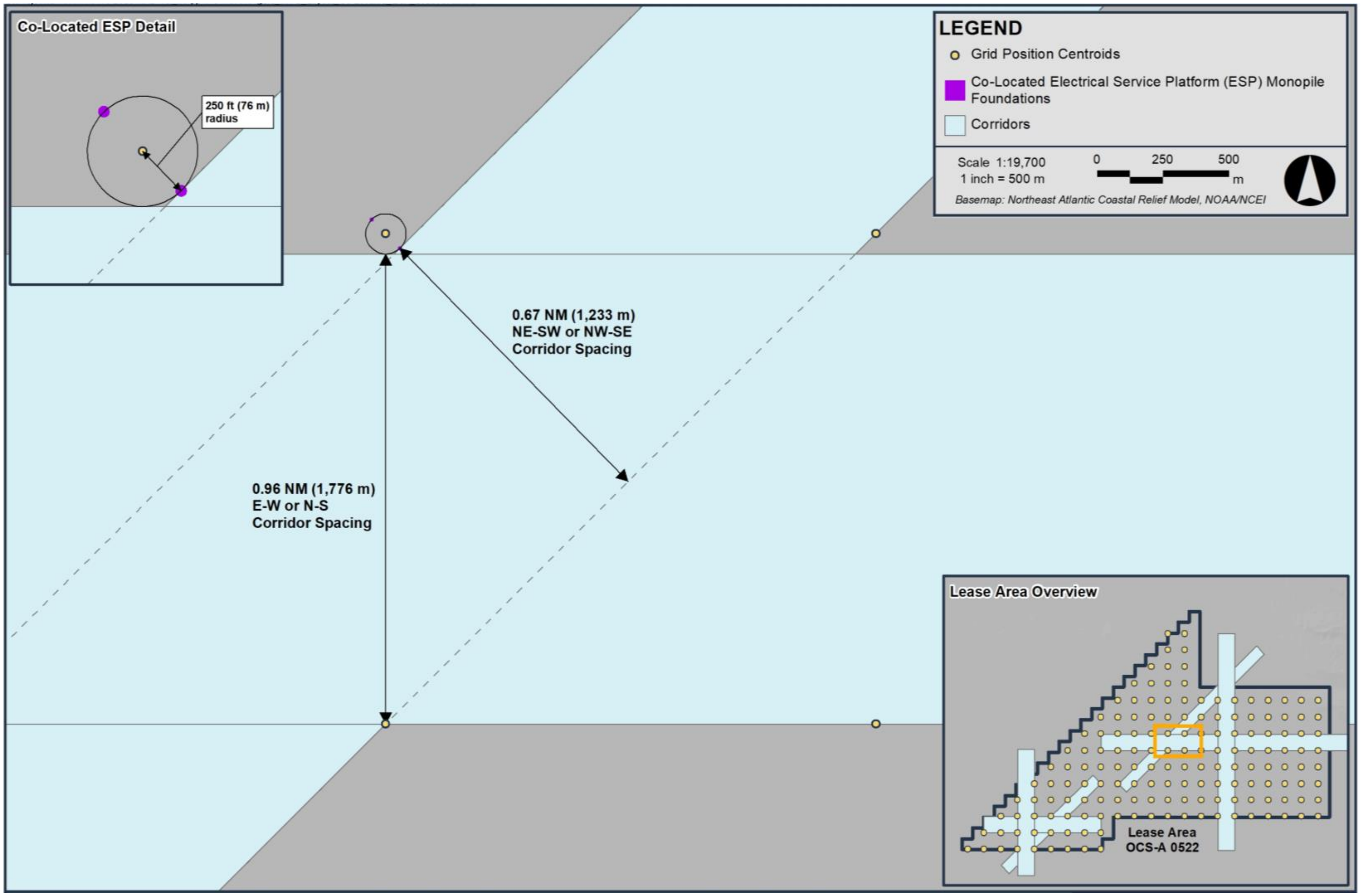


**Figure 2.3: WTG/ESP Layout (Co-Located ESP Detail)**

## 2.2 Wind Turbine Generators and Foundations

The Lease Area will contain up to 160 WTGs. With respect to vessel navigation, an important consideration is the WTG's minimum tip clearance, which is identified as being a minimum of 89 ft (27 m) relative to Mean Lower Low Water (MLLW). The PDE for the WTGs is provided in the table below.

**Table 2.2: WTG Dimensions**

| Parameter | Dimensions |
| --- | --- |
| Maximum Tip Height | 1,312 ft (400 m) MLLW[1] |
| Maximum Hub Height | 787 ft (240 m) MLLW |
| Maximum Rotor Diameter | 1,050 ft (320 m) |
| Minimum Tip Clearance | 89 ft (27 m) MLLW |
| Maximum Blade Chord | 33 ft (10 m) |
| Maximum Tower Diameter | 36 ft (10 m) |

1. *MLLW refers to Mean Lower Low Water, which is the average height of the lowest daily tide. Navigational charts in the US normally refer to this as the elevation datum.*

The WTGs will be supported on foundations are driven into the seabed. Two different foundation concepts are being considered:

- Monopiles – A monopile is a single, hollow steel cylinder that is driven into the seabed.
- Piled Jackets – A jacket foundation is a steel structure comprised of several legs that are inter-connected by steel tubular cross-bracing. The structure is secured to the seabed using pin piles.

The dimensions for the WTG foundations are provided in Table 2.3. Dimensions include the transition piece (TP). This NSRA has considered the maximum foundation dimensions.

Scour protection may be placed on the seabed around the base of the foundations to minimize sediment transport and erosion (i.e., scour development) caused by water currents. If used, scour protection would likely consist of loose rock material placed around the foundation in one or more layers. Although freely-laid rock is the most widely used scour protection material in the offshore wind industry, scour protection may alternatively consist of rock bags or scour mats. The horizontal extent of the scour protection depends on the foundation type.

**Table 2.3: WTG Foundation Maximum Dimensions**

| Concept | Monopile<br>With TP | Piled Jackets<br>Piles (max. 4 Piles) |
|---|---|---|
| Maximum Total Length (from interface with WTG to deepest point beneath the seafloor) | 472 ft (144 m) | 633 ft (193 m) |
| Maximum Pile Diameter at Base | 46 ft (14 m) | 14 ft (4.25 m) |
| Maximum Height of Foundation (including TP) above MLLW | 115 ft (35 m) | 115 ft (35 m) |
| Maximum Diameter/Dimensions of Foundation at the Waterline | 41 ft (12.5 m) | 169 ft x 169 ft<br>(51.5 m x 51.5 m)<br>On diagonal: 239 ft (73 m) |
| Maximum Diameter/Dimensions of Foundation at the Seabed | 46 ft (14 m) | 169 ft x 169 ft<br>(51.5 m x 51.5 m)<br>On diagonal: 239 ft (73 m) |
| Maximum Area of Scour Protection per Foundation | 1.8 acres<br>(7,238 $m^2$) | 2.9 acres<br>(11,660$m^2$) |

The WTG and its foundations will be marked and lighted in accordance with USCG, Federal Aviation Administration (FAA), and BOEM requirements. AIS will be used to mark each WTG (virtually or using physical transponders) so that the structure will display on AIS receivers. Mariner Radio Activated Sound Signals (MRASS) will be located on significant peripheral structures to aid mariners during low visibility conditions. See Section 5.1.1 for additional description of lighting, marking, and signaling for the WTGs.

## 2.3 Electrical Service Platforms and Foundations

The ESP(s) are offshore electrical substations that serve as common interconnection points for the WTGs and include step-up transformers and other electrical gear to increase the voltage of power generated by the WTGs.

The maximum width and length of the ESP topside is 279 x 558 ft (85 x 170 m). The ESP topsides will be supported by monopiles or piled jackets. Table 2.4 provides the maximum dimensions for the foundations.

Vineyard Northeast will include a maximum of three ESP(s). The ESP(s) will be located within the same 1 NM by 1 NM (1.9 by 1.9 km) grid as the WTGs. If co-located ESP(s) are used, each ESP's monopile foundation would be located within 250 ft (76 m) of the grid position's centroid (i.e., the monopiles would be separated by up to 500 ft [152 m]) as shown in Figure 2.5. While the exact topside dimensions for a co-located ESP have not yet been determined, the Proponent expects that a co-located ESP topside would be approximately 10-15% smaller than the dimensions provided above for a normal ESP topside.

Vineyard Northeast may employ an integrated ESP concept, which entails placing ESP equipment on one or more expanded WTG foundation platforms rather than having a separate ESP situated on its own foundation. If the ESP equipment is integrated onto the WTG foundations, the foundation dimensions would fall within the PDE for WTG foundations provided in Section 2.2. The Proponent does not expect to use both co-located ESPs and integrated ESPs.

**Table 2.4: ESP Maximum Foundation Dimensions**

| Concept | Monopile | Piled Jackets |
|---|---|---|
| Maximum No. of legs per foundation | 1 | 6 |
| Maximum No. of piles per foundation | 1 | 18 |
| Maximum Total Length (from interface with ESP to deepest point beneath the seafloor) | 472 ft (144 m) | 633 ft (193 m) |
| Maximum Pile Diameter at Base | 46 ft (14 m) | 14 ft (4.25 m) |
| Maximum Height of Foundation above MLLW | 115 ft (35 m) | 115 ft (35 m) |
| Maximum Diameter/Dimensions of Foundation at the Waterline | 41 ft (12.5 m) | 558 ft x 279 ft (170 m x 85 m) On diagonal: 624 ft (190 m) |
| Maximum Diameter/Dimensions of Foundation at the Seabed | 46 ft (14 m) | 558 ft x 279 ft (170 m x 85 m) On diagonal: 624 ft (190 m) |
| Maximum Area of Scour Protection per Foundation | 1.8 acres (7,238 $m^2$) | 8.1 acres (32,577 $m^2$) |

## 2.4 Booster Station and Foundations

Up to one booster station may be installed along the Massachusetts OECC and would be used for high voltage alternating current (HVAC) transmission. If installed, the booster station would be located in the northwestern aliquot[8] of Lease Area OCS-A 0534 and would be aligned with the 1 x 1 NM grid layout of the Vineyard Wind 1 project.[9] The booster station would be supported by either monopile or piled jacket foundations. Table 2.5 provides the maximum dimensions for the foundations.

8 An aliquot is 1/64th of a BOEM OCS Lease Block.

9 If the Proponent utilizes a booster station, the Proponent would install new HVAC offshore export cables (independent from any other project's offshore cables) within the Massachusetts OECC, which is a separate cable corridor from the Vineyard Wind 1 OECC.

**Table 2.5: Booster Station Maximum Foundation Dimensions**

| Concept | Monopile | Piled Jackets |
|---|---|---|
| Maximum No. of Legs per Foundation | 1 | 6 |
| Maximum No. of Piles per Foundation | 1 | 18 |
| Maximum Total Length (from interface with topside to deepest point beneath the seafloor) | 472 ft (144 m) | 633 ft (193 m) |
| Maximum Pile Diameter at Base | 46 ft (14 m) | 14 ft (4.25 m) |
| Maximum Height of Foundation above MLLW | 115 ft (35 m) | 115 ft (35 m) |
| Maximum Diameter/Dimensions of Foundation at the Waterline | 41 ft (12.5 m) | 328 ft x 197 ft (100 m x 60 m) On diagonal: 383 ft (117 m) |
| Maximum Diameter/Dimensions of Foundation at the Seabed | 46 ft (14 m) | 328 ft x 197 ft (100 m x 60 m) On diagonal: 383 ft (117 m) |
| Maximum Area of Scour Protection per Foundation | 1.8 acres (7,238 $m^2$) | 4.6 acres (18,427 $m^2$) |

## 2.5 Offshore Export Cable Corridors

Between the Lease Area and shore, the offshore export cables will be installed within two OECCs—the Massachusetts OECC and the Connecticut OECC—that connect to onshore transmission systems in Massachusetts and Connecticut (Figure 1.1). Up to two high voltage direct current (HVDC) cable bundles or up to three HVAC cables may be installed within the Massachusetts OECC. If HVAC offshore export cables are used, the cables would connect to a booster station in the northwestern aliquot[10] of Lease Area OCS-A 0534 to boost the electricity's voltage level, reduce transmission losses, and enhance grid capacity (Section 2.4). Up to two HVDC offshore export cable bundles may be installed within the Connecticut OECC. The offshore cables will be buried beneath the stable seafloor at a target depth of 5 to 8 ft (1.5 to 2.5 m).[11]

## 2.6 Traffic Survey

A comprehensive traffic survey was carried out by means of the following data sources: (1) stakeholder input; (2) AIS data analyses; and (3) National Oceanic Atmospheric Administration (NOAA) VMS data mapping. The results of the traffic survey are presented in the following report sub-sections and more detailed summaries and mapping may also be found in 0 and 0.

Key observations with regards to the AIS data are that fishing vessels are responsible for 64% of the traffic in the Lease Area, and the largest vessel passing through the Lease Area is 1,149.9 ft (350.5 m). Of the known vessel types, recreational vessels are responsible for the next greatest number of unique tracks, 9%. For the OECCs, the Connecticut OECC has a slightly greater average crossing rate of 35 to 44 vessels per day

[10] An aliquot is 1/64th of a BOEM OCS Lease Block.

[11] Unless the final Cable Burial Risk Assessment (CBRA) indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

compared to the Massachusetts OECC, with an average crossing rate of 33 to 42 vessels per day based on AIS data from 2016 to 2021 (Table B.15 and Table B.14, respectively). The BOEM analyzed polar histograms based on VMS data (2014-2019), which provide summaries of average vessel course by fished species, are presented in Appendix C.2.

### 2.6.1 Stakeholder Consultations

Vineyard Northeast is being developed by the same team that developed Vineyard Wind 1, the nation's first and most advanced commercial-scale offshore wind project. Stakeholder feedback gathered during the permitting of Vineyard Wind 1 and through the MARIPARS (described below) informed the siting and design of Vineyard Northeast. In particular, Vineyard Northeast's proposed 1 NM by 1 NM WTG/ESP grid layout was developed in direct response to feedback from the commercial fishing industry who consistently expressed the need for WTGs to be oriented east to west with 1 NM spacing to accommodate traditional fishing patterns within the RI/MA WEA and MA WEA, including the "gentlemen's agreement." As cited in the MARIPARS, the gentlemen's agreement is a longstanding informal arrangement between fixed gear fishermen (lobster, gillnet) and mobile gear fishermen (scallopers, trawlers, clammers) where fixed gear fisheries set their traps along regular lines of orientation (in an east to west direction) and mobile gear fishermen tow their gear between the lines of fixed gear. The Proponent also modified and refined the OECCs through numerous consultations with agencies, including USCG, as well as stakeholders (including fishermen) and, based on their feedback, consolidated the offshore export cables with other developers' proposed cables to the extent feasible.

The Proponent employs a Marine Liaison Officer who is responsible for safe marine operations and ensuring that the Proponent is a good neighbor while on the water. The Marine Liaison Officer currently serves as the Proponent's point of contact for all external maritime agencies, partners, and stakeholders, including USCG, US Navy, port authorities, state and local law enforcement, and commercial operators (e.g., ferry, tourist vessels, cargo vessels, tankers, fishing boat operators, and other offshore wind developers). There is frequent interaction, information exchange, and coordination between the Marine Liaison Officer and the fisheries team regarding fisheries outreach (see Section 2.6.1.1 for further discussion of fisheries outreach).

The Marine Liaison Officer is responsible for coordinating and issuing Offshore Wind Mariner Updates to notify maritime stakeholders of the Proponent's offshore activities. The Offshore Wind Mariner Updates include a description of the planned activity, pictures of the vessel(s) and equipment to be deployed, a chart showing the location of the activity, vessel contact information, and the Proponent's Onboard Fisheries Liaison's contact information, if applicable (based on feedback provided by Fisheries Representatives). Depending on the activity, the Offshore Wind Mariner Update may request that mariners give a wide berth to the work site or construction and maintenance vessel(s). These updates are published on the Proponent's website, social media channels, and sent via email and SMS text alert to those who have opted-in to receive notifications from the Proponent. Based on feedback from the Rhode Island Coastal Resources Management Council (CRMC) and several fishing vessel crews, the Proponent distributes a weekly email to consolidate and recirculate active Offshore Wind Mariner Updates to help mariners and fishermen keep track of the various notifications that they receive. The Proponent will also coordinate with the USCG to issue Local Notices to Mariners (LNMs) to notify recreational and commercial vessels of their planned offshore activities. To sign-up to receive Offshore Wind Mariner Updates, LNMs, and other Vineyard Northeast-related information, visit: https://www.vineyardoffshore.com/fishermen.

During construction, the Proponent expects to employ a dedicated marine coordinator to manage construction vessel logistics and implement communication protocols with external vessels at ports and offshore. During construction, the Marine Coordinator will be the primary point of contact with external maritime agencies, partners, and stakeholders for day-to-day offshore operations. The Marine Coordinator will use tools such as radio communications and safety vessels to address vessels entering active work sites. The safety vessels would provide guidance to mariners and fishing vessels, explain the ongoing activities, and request that they give a wide berth to the work site or construction vessel(s), if necessary. These safety vessels would have no enforcement authority; the safety vessels would only assist mariners in navigating in the vicinity of the activity.

The Proponent is also exploring options for conducting outreach with cargo vessel and tanker companies/operators, such as including project information in trade magazines and working with maritime pilot groups to obtain information about incoming vessels.

As part of the MARIPARS preparation, the USCG also conducted stakeholder outreach. This included the Federal Register notice and other outreach efforts, which included announcements via a Marine Safety Information Bulletin (MSIB), publication in the LNM, and social media posts. The outreach also included seven public meetings targeted to marine industries in the region as well as three open public meetings in Massachusetts, Rhode Island, and New York. USCG communicated and coordinated with appropriate federal and state agencies, non-governmental organizations, and other public stakeholders listed in Appendix D of the MARIPARS report. Additionally, the USCG coordinated with the Massachusetts Coastal Zone Management, CRMC, NOAA National Marine Fisheries Service (NMFS), World Shipping Council, American Waterways Operators, and Passenger Vessel Association representatives. All comments and supporting documents are available in the public docket (USCG-2019-0131). The MARIPARS provides a summary of the comments received from the public notice and stakeholder coordination meetings.

#### 2.6.1.1 Outreach to Fisheries Stakeholders

Communication with fisheries stakeholders, and particularly fishing vessel crews, is a priority of the Proponent. The Proponent's team has over a decade of experience engaging with commercial and recreational fishermen, vessel owners, fishing advocacy organizations, shore support services, and fisheries research institutions on offshore wind. The Proponent has translated that experience to develop a robust fisheries communication strategy for Vineyard Northeast.

The Proponent has developed a Fisheries Communication Plan (FCP) to facilitate effective and regular engagement with fisheries stakeholders throughout the life of Vineyard Northeast (see Appendix I-I of the COP). The communication protocols outlined in the FCP are designed to help avoid interactions with fishing vessels and fishing gear. The FCP aligns with the Vineyard Wind 1 FCP, which was first drafted in 2011 to improve communication with fishermen during that offshore wind project and subsequently refined with over ten years of input from fisheries stakeholders. The Vineyard Northeast FCP will be updated regularly, in response to stakeholder feedback and to incorporate lessons learned, to ensure that the communication protocols and tools remain relevant and effective.

As described in the FCP, the Proponent's fisheries communication efforts are led by Fisheries Manager (FM) Crista Bank, a fisheries biologist with deep knowledge of fishing practices as well as an extensive network of personal relationships with fishermen and fishery organizations in the region. The fisheries team also includes a Fisheries Liaison (FL), Fisheries Representatives (FRs), and Onboard Fisheries Liaisons (OFLs). The FL is responsible for implementing the FCP and serves as a communication conduit between the Proponent and the fishing industry. FRs are individuals or organizations that represent a particular fishing community, organization, gear type, port, region, state, or sector(s). While FRs are compensated for their time and expenses by the Proponent, their duty is to the fishing region, industry, organization, gear type, or sector they represent. The Proponent already engages with nine FRs who represent a variety of gear types and homeports in Connecticut, Massachusetts, New York, and Rhode Island. The FM/FL will continue to hold frequent meetings with the FRs and proactively seek their input on a variety of different issues, including the content of the FCP and the design of fisheries programs and protocols.

OFLs are experienced fishermen employed by the Proponent to assist survey vessel captains with communication and to document fishing gear in the area to help avoid interactions. Among other things, the OFL records observed fisheries activities, ensures survey vessel operations are compliant with the FCP and other fisheries-related policies, and seeks to avoid negative fisheries interactions by looking out for fixed gear and establishing communications with fishing vessels when appropriate. The use of OFLs on the Proponent's survey vessels is based on feedback gathered from fishing vessel crews who have indicated a preference for having other fishermen monitor for fishing gear. Additional information about the role of the FM, FL, FRs, and OFLs is provided in the FCP (see Appendix I-I of the COP).

The Proponent's FM will continue to conduct individual outreach to fishing vessel crews to evaluate opportunities to hire local vessels. The Proponent expects to hire local fishing vessels to operate as scout vessels, which work ahead of survey vessels to locate and report fixed gear locations that could potentially impact survey operations. Scout vessels help communicate with fishing vessels in their area, sharing information on the survey vessel's activity and timeline of operation. The use of local fishing vessels as scout vessels is a direct result of feedback from fishing vessel crews who indicated that it would be useful to have other fishing vessels monitoring for the presence of their gear.

The Proponent maintains a webpage with information specifically for fishermen, including fisheries science information, charts, Offshore Wind Mariner Updates, and vessel Requests for Information (RFIs), which can be found at: https://www.vineyardoffshore.com/fishermen

Fisheries communication is conducted through numerous other methods including email, SMS text message alerts, letter mailings, webinars, phone calls, meetings, and social media channels. When appropriate and weather permitting, the Proponent's FM holds "port hours" with FLs for other offshore wind developers at ports in New Bedford, Massachusetts, Narragansett, Rhode Island, Stonington, Connecticut, and Montauk, New York to provide information to fishermen who fish in or transit through offshore wind Offshore Development Area. The Proponent also hosts information tables and attends regional trade shows and conferences for fishermen and mariners.

The Proponent is in regular contact with relevant federal and state agencies on fisheries-related matters. The Proponent also uses its membership and participation in fisheries-related technical working groups, advisory boards, councils, and commissions to provide project updates, better understand fisheries stakeholders' concerns, build relationships, and collaborate on research and education. The Proponent is or will become a member of and/or active participant in the Massachusetts Fisheries Working Group on Offshore Wind Energy, the Massachusetts Habitat Working Group on Offshore Wind Energy, the Mid-Atlantic Fishery Management Council, the New England Fishery Management Council, New York State Energy Research and Development's (NYSERDA's) Environmental Technical Working Group, NYSERDA's Fisheries Technical Working Group, the Regional Wildlife Science Collaborative for Offshore Wind, and the Responsible Offshore Science Alliance, among others.

### 2.6.2 AIS Based Traffic Survey

AIS data was downloaded and processed for the time period of January 1, 2016 to September 31, 2021 from NOAA's Marine Cadastre dataset. A regional subset of the data was extracted for longitudes between 69.75° W to 71.95° W and latitudes between 40.35° N to 41.73° N. In total, there are 1,573,410 track records within the regional subset and a total of 19,089 unique vessels in the data set. Table 2.6 provides a summary of the unique vessels and unique fishing vessels by year over the AIS data period.

**Table 2.6: Summary of AIS dataset analyzed (Data Source: Marine Cadastre)**

| Parameter | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2016-2021 |
|---|---|---|---|---|---|---|---|
| Number of Unique Vessels | 280 | 343 | 558 | 648 | 504 | 400 | 1,687 |
| Number of Unique Fishing Vessels | 64 | 89 | 255 | 334 | 236 | 177 | 506 |

***Note that the number of unique vessels for a given year as compared to the total number of unique vessels per 2016-2021 will not sum up to the same number since the same vessel may frequent the area in different years.*

Figure 2.4 presents a colored contour map of the annual average traffic density within the regional subset area for all vessel types. Table 2.7 provides a breakdown of the vessel traffic types passing through the Lease Area. Over half of the tracks in the Lease Area are from commercial fishing vessels, which also contributes to over a fourth of the unique vessels. A distinction is made between fishing vessels that are transiting and actively fishing based on vessel speed. If a fishing vessel is moving faster than 4 kts (2.1 m/s), it is assumed to be transiting and not actively fishing.

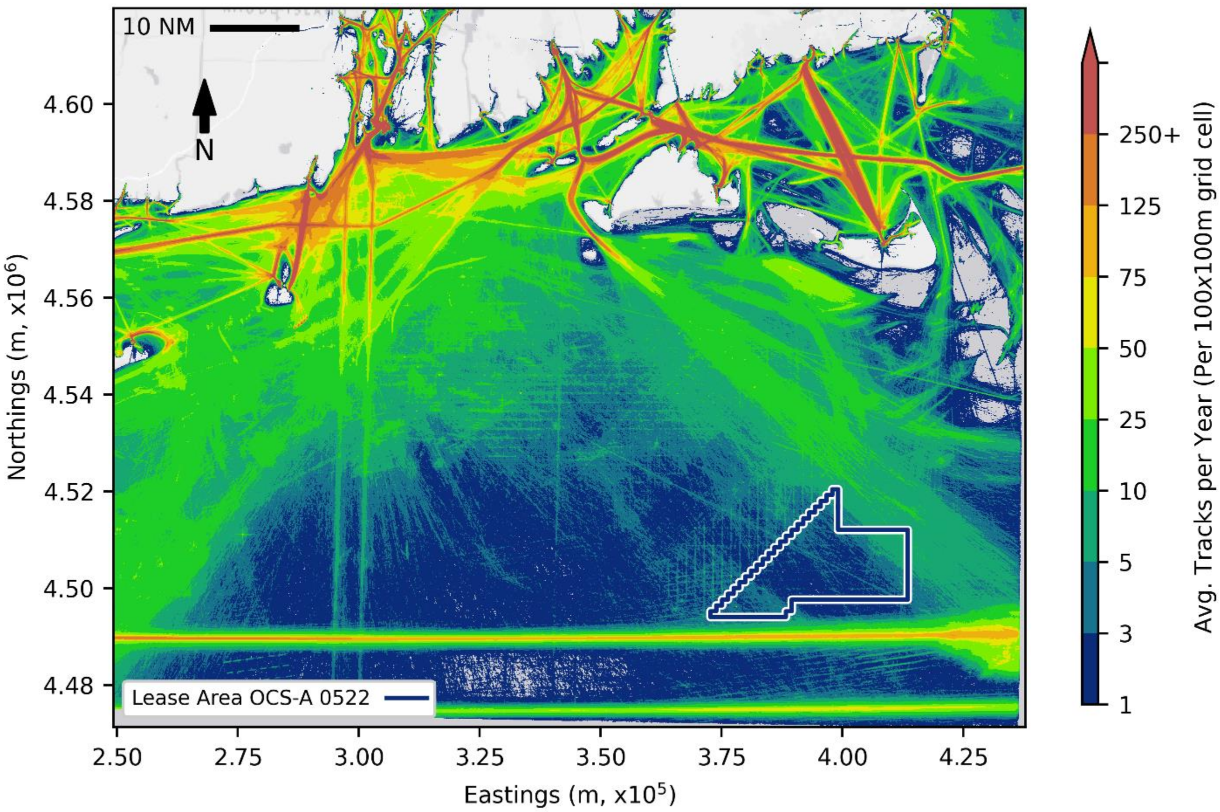


**Figure 2.4: Annual average vessel traffic density for AIS-equipped vessels**

**Table 2.7: Numbers of vessels entering the Lease Area (2016-2021)**

| | Unique Vessels | | Unique Tracks | |
|---|---|---|---|---|
| | Number | Percentage | Number | Percentage |
| Cargo Vessels | 288 | 17% | 501 | 6% |
| Tankers | 232 | 14% | 439 | 5% |
| Passenger Vessels | 39 | 2% | 139 | 2% |
| Tug-barge Vessels | 31 | 2% | 64 | 1% |
| Recreational Vessels | 340 | 20% | 773 | 9% |
| Fishing Vessels | 506 | 30% | 5,692 | 64% |
| Other Vessels | 68 | 4% | 267 | 3% |
| Unspecified AIS Type | 183 | 11% | 966 | 11% |
| Total (2016–Sep. 2021) | 1,687 | 100% | 8,841 | 100% |
| **Annual Average** | 293 | - | 1,538 | - |

It is important to recognize that AIS is only required on vessels 65 ft (20 m) and longer and, as a result, not all vessels, particularly fishing vessels, are equipped with AIS equipment. If there are any other smaller non-fishing commercial vessels that are not AIS-equipped, the number of these vessels is likely very small and would not impact on the vessel traffic analyses presented in this report. Additionally, many recreational vessels do not carry AIS equipment.

Although AIS data may not include the total number of vessels that could potentially transit the AIS analysis area, it is believed to provide a suitable representation of the overall fleet distribution and traffic patterns in terms of track density and orientation.

The following sub-sections provide a more detailed review of the different types of vessel traffic encountered at the project site. Additional details are presented in 0.

#### 2.6.2.1 Commercial (Non-Fishing) Traffic

On average, approximately 102 unique commercial vessels transit through the Lease Area annually. These include passenger vessels, cargo vessels, tankers and tug-barge tows. Cumulatively, these vessels represent about 14% of the vessel traffic transiting through the Lease Area. Figure 2.5 presents the track density plots for these vessels. It is noted that much of the traffic is heading to or from the fairways to the south of the Lease Area and Narraganset Bay. Table 2.8 summarizes the largest vessels that have transited the AIS analysis area over the 2016 to 2021 time.

**Table 2.8: Size of largest vessels through the AIS analysis area**

| Vessel Type | Name | LOA (ft) | LOA (m) |
|---|---|---|---|
| Passenger | ANTHEM OF THE SEAS | 1149.9 | 350.5 |
| Dry Cargo | CMA CGM IVANHOE | 1148.3 | 350.0 |
| Tanker | SKS SKEENA | 899.8 | 274.3 |
| Other | USS ZUMWALT | 564.4 | 172.0 |
| Tug Tows | BENYAURD | 170.0 | 51.8 |

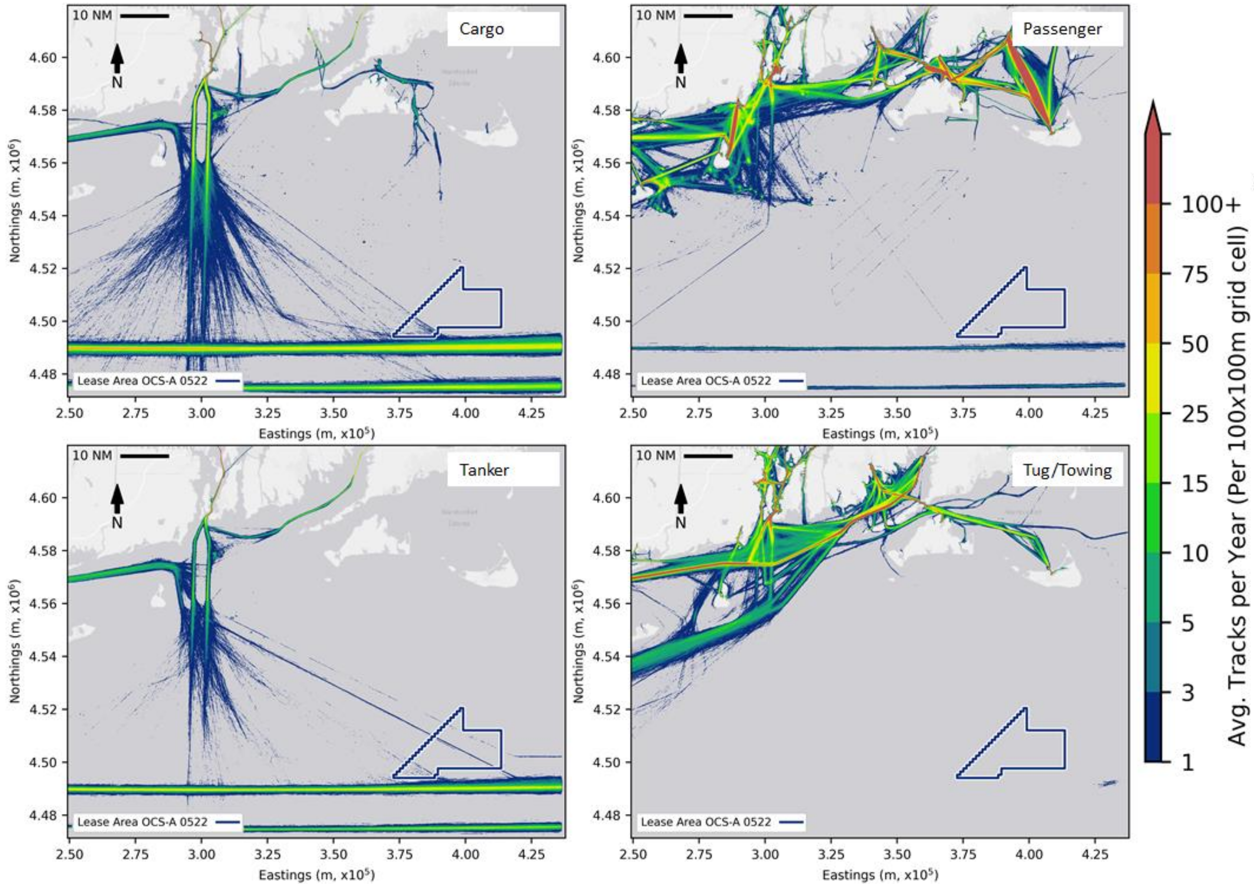


**Figure 2.5: Commercial (non-fishing) vessel average annual traffic densities**

#### 2.6.2.2 Commercial Fishing Traffic

Commercial fishing vessels make up over a fourth of unique vessels (30%) and over half (64%) of the tracks passing through the Lease Area. Vessels transit through the AIS analysis area on a variety of courses but the dominant track orientation historically has been a northwest to southeast course, and the reciprocal course for return trips. Figure 2.6 provides track plots for fishing vessels when transiting and actively fishing.

Fishing activity does vary seasonally with a greater number of vessel tracks during the summer months as summarized in Table 2.9. Overall, vessel activity is relatively low with only 4.5 fishing vessels entering the AIS analysis area per day (on average) during the peak summer months.

**Table 2.9: Average number of AIS Fishing tracks per day in the Lease Area based on season (2016-2021)**

| | Meteorological Season | | | |
|---|---|---|---|---|
| **Vessel Activity** | **Winter** | **Spring** | **Summer** | **Autumn** |
| Active Fishing | 0.1 | 0.1 | 0.3 | 0.3 |
| Transiting | 1.0 | 2.8 | 4.4 | 2.1 |
| All Vessels | 1.0 | 2.9 | 4.5 | 2.3 |

Figure 2.6 provides average annual track density plots for fishing vessels in the regional subset when transiting and actively fishing.

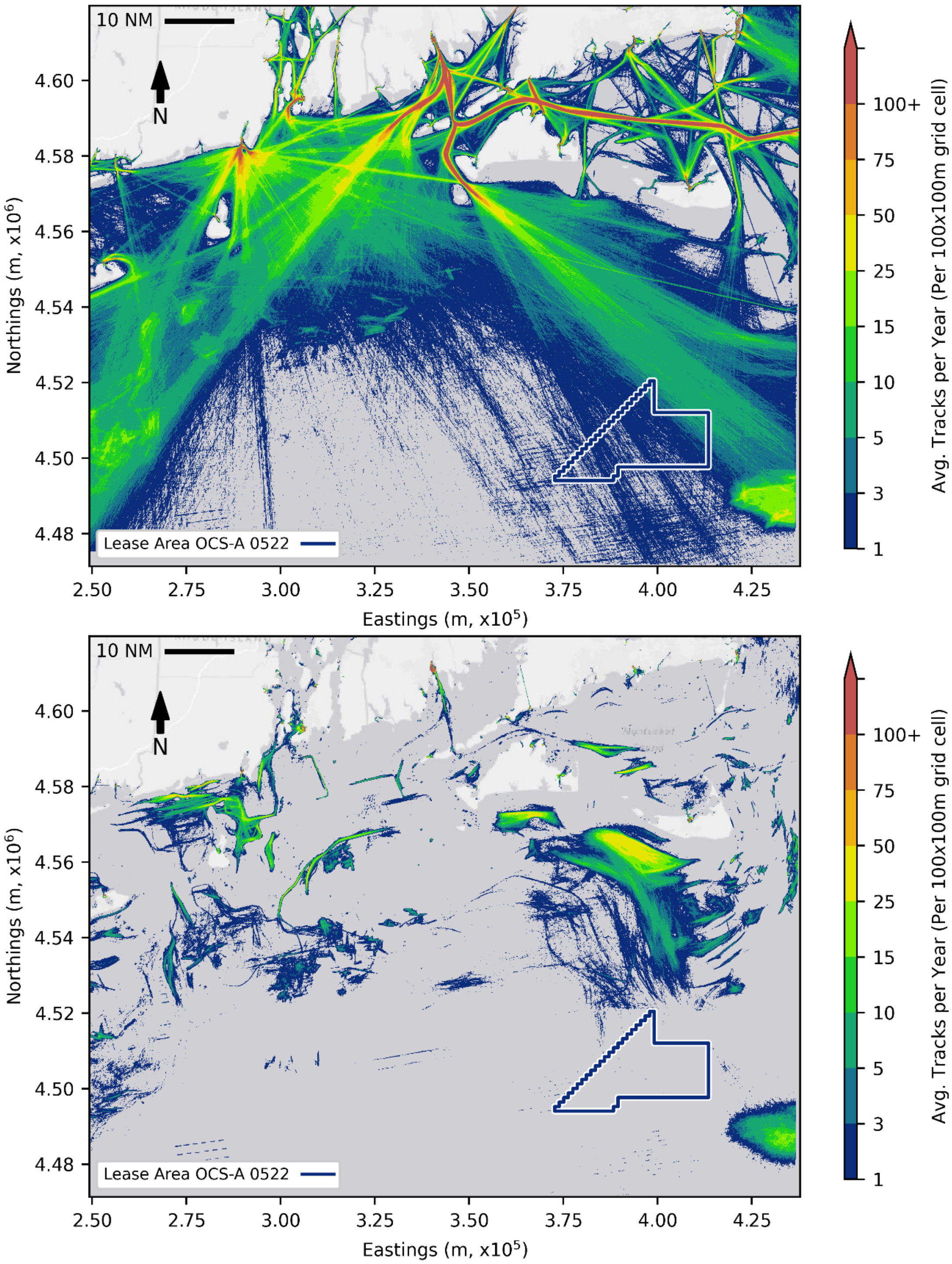


**Figure 2.6: Transiting (top) and actively fishing (bottom) vessel average annual traffic densities**

#### 2.6.2.3 Recreational Traffic

Approximately 9% of the AIS-equipped vessel traffic in the Lease Area is associated with recreational traffic. As noted previously, it is likely that this traffic volume is under-represented in the AIS dataset as vessels smaller than 65 ft in length are not required to utilize AIS equipment. Figure 2.7 shows the recreational annual average track density of the AIS regional dataset. These vessels have a range of track directions, with the dominant courses being north-northwest, and south-southeast.

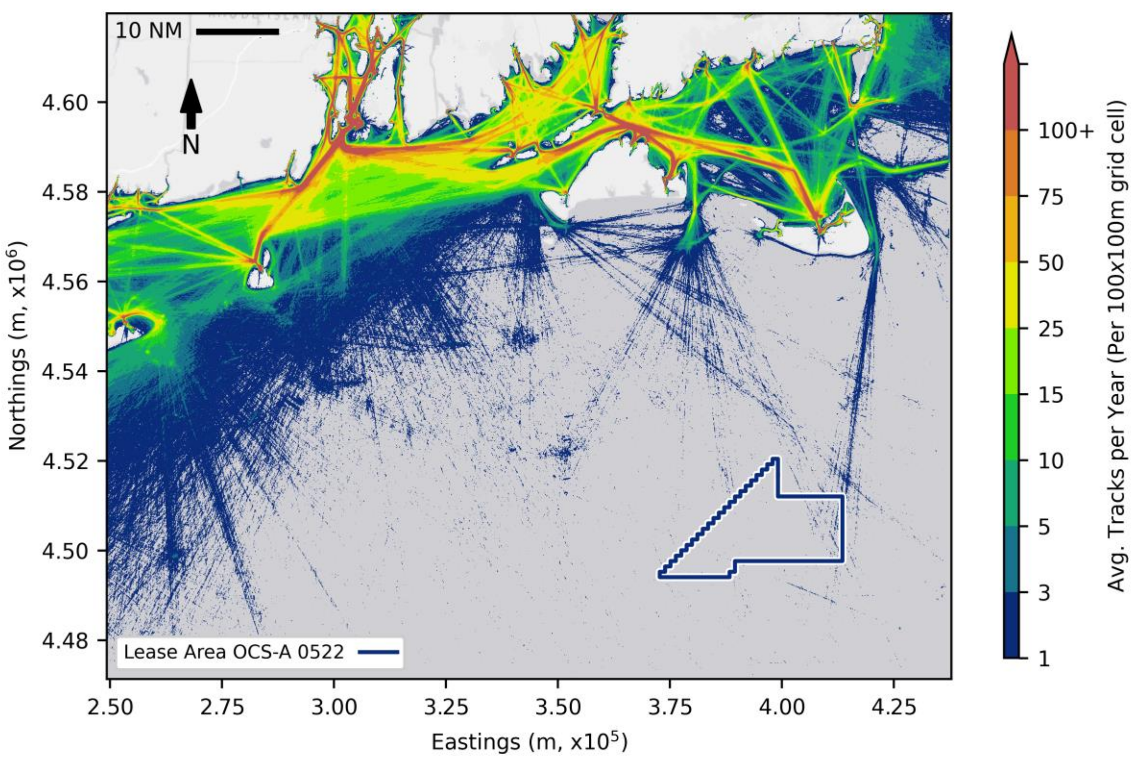


**Figure 2.7: Recreational vessel average annual traffic densities**

#### 2.6.2.4 Offshore Export Cable Corridors (OECCs)

An AIS analysis was carried out to assess the number of vessels crossing the Massachusetts OECC and the Connecticut OECC. The annual average track density for both cables is shown in Figure 2.8. For the OECCs, the Connecticut OECC has a slightly greater average crossing rate of 35 to 44 vessels per day compared to the Massachusetts OECC, with an average crossing rate of 33 to 42 vessels per day based on AIS data from 2016 to 2021. For the Massachusetts OECC, fishing vessels are responsible for a majority of the crossings; however, in the summer months, recreational vessel crossings exceed the fishing vessels. For the Connecticut OECC, passenger vessels are responsible for a majority of the crossings, excluding the summer months where recreational vessel crossings are the most frequent and the winter months where tug/towing vessels are the most frequent. The Connecticut OECC generally has a greater average number of vessel crossings except in the summer when the Massachusetts OECC has, on average, about 20 additional vessel crossings per day.

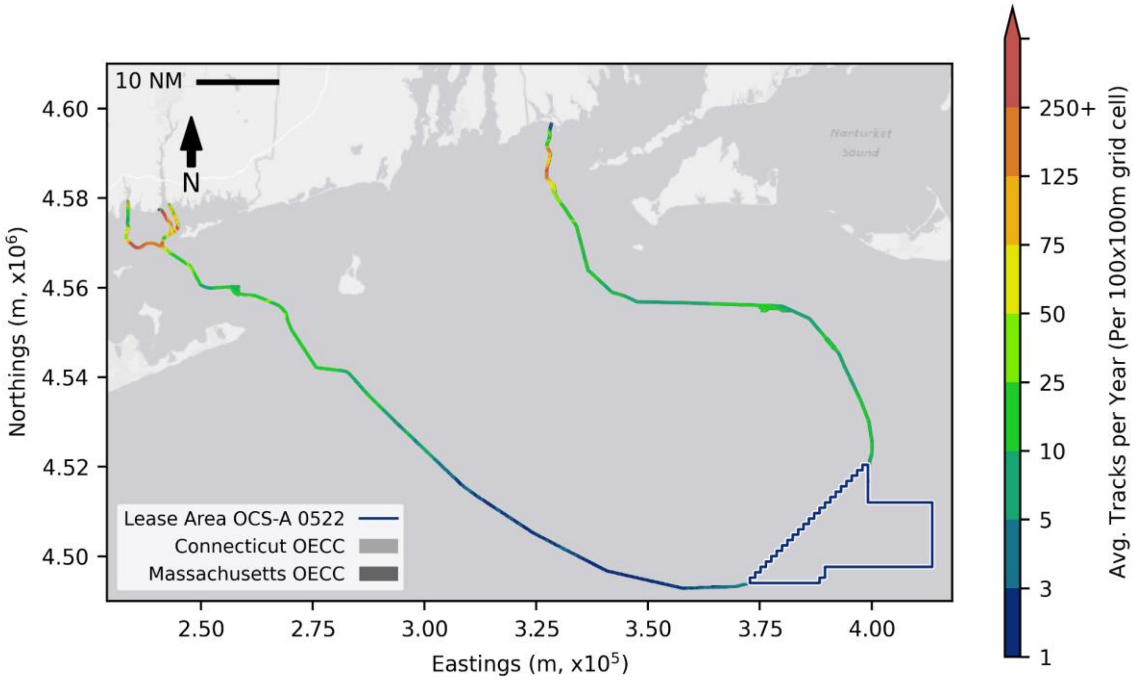


**Figure 2.8: Annual average track densities for vessels crossing the Offshore Export Cable Corridors**

### 2.6.3 VMS Traffic Analysis

The AIS data for fishing vessels is supplemented with a review of NOAA Fisheries' VMS data. VMS is a satellite surveillance system primarily used to monitor the location and movement of certain commercial fishing vessels fishing for certain species (i.e., not all fishing vessels are included) within the US. Unlike the AIS dataset, it provides 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 Fisheries. 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. 0 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 (Northeast)
- Pelagics (Mackerel, Squid, Butterfish)
- Atlantic Sea Scallop
- Surfclam / ocean quahog
- Squid (VMS plots only)

In addition, BOEM has extracted and processed raw VMS data for the Lease Area and provided data summaries to Epsilon Associates in the form of polar histograms showing the variation in vessel track headings by species. These are provided in Appendix C.2. In the VMS dataset, vessel speed is used to distinguish vessels that are actively fishing as opposed to transiting. For most species, vessels sailing at less than 4 kts are considered fishing, but for scallop fishing, the vessel speed is assumed less than 5 kts. Thus, density maps and polar histograms for both actively fishing and all vessel speed are present for both species in 0.

Additionally, NOAA Fisheries collects fishery data by means of Vessel Trip Reports (VTRs) 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 Fisheries and are available online as GIS map files broken out by type of fishing activity and time period. VTR maps for the Lease Area are also provided in 0. Figure 2.9 provides an example density plot for Monkfish fishing while actively fishing and Figure 2.10 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.

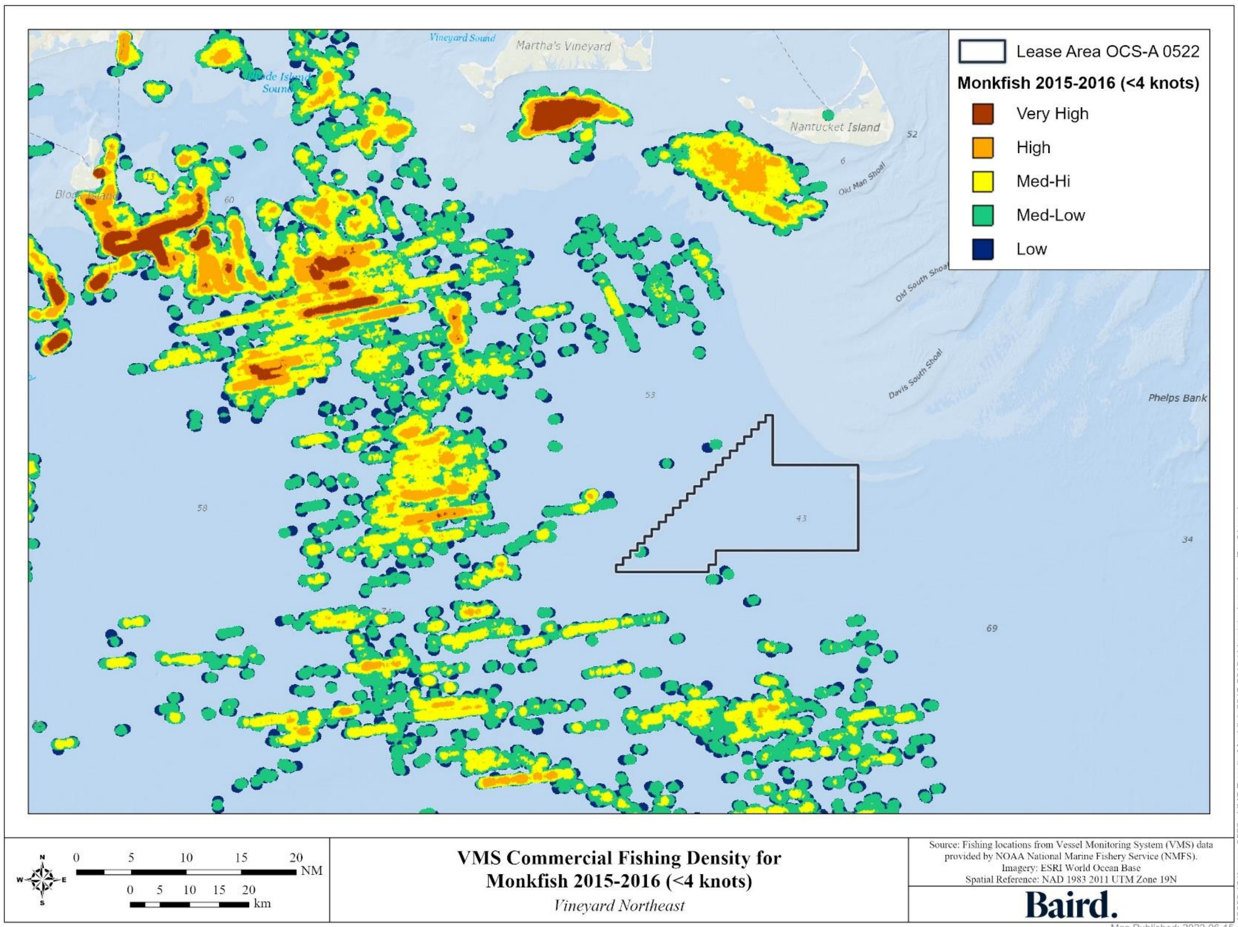


**Figure 2.9: VMS map of active Monkfish fishing for the 2015-2016 time period**

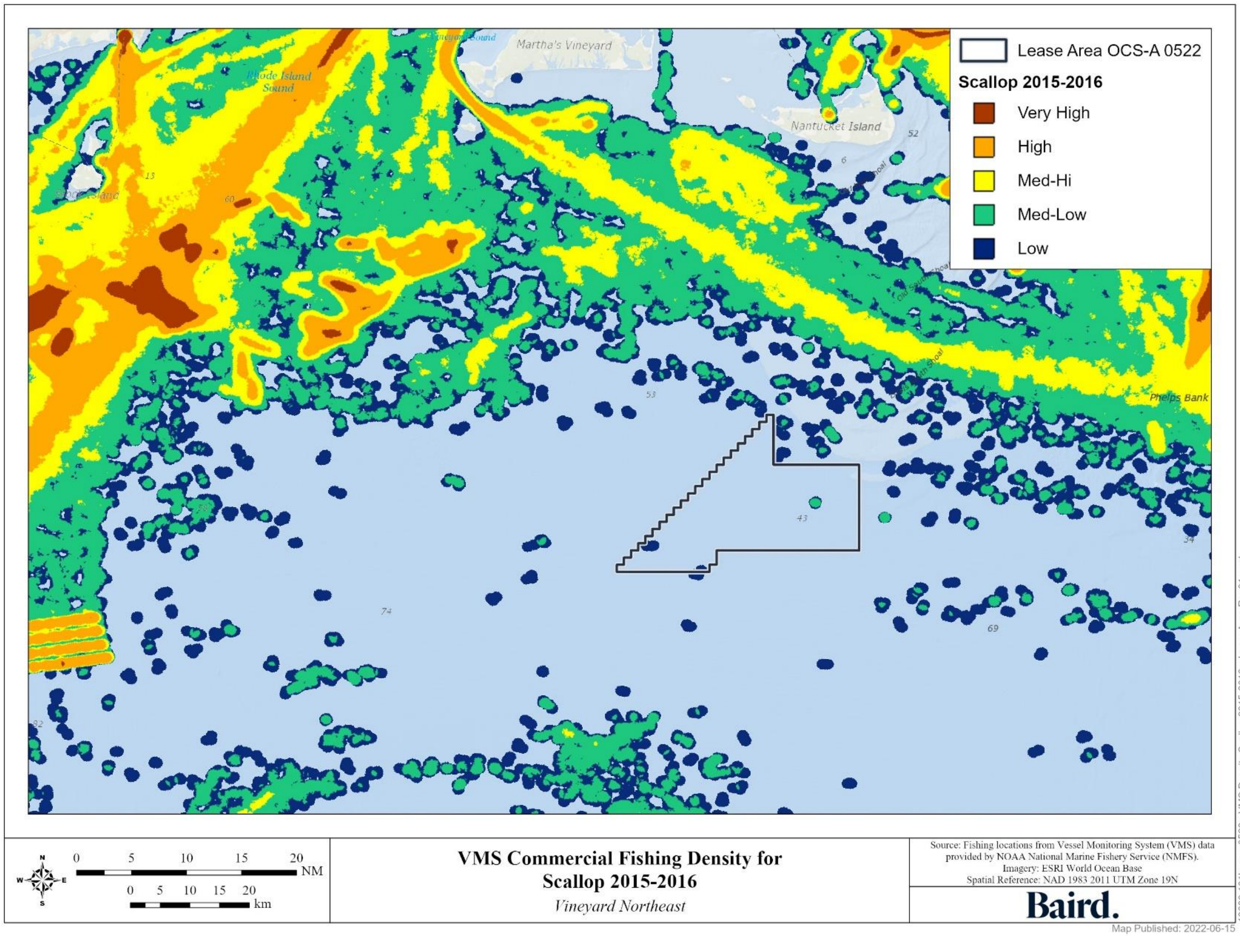


**Figure 2.10: VMS map of Atlantic Sea Scallop fishing at all speeds for the 2015-2016 time period**

Figure 2.11 provides two example polar histograms for transiting vessels that were fishing monkfish and scallops in the Lease Area. It may be observed that the monkfish vessels follow track orientations that are north-northeast or south-southwest (~15° and 195°). The scallop vessels tend to transit the Lease Area following track orientations that are southeast or northwest (~135° and 315°).

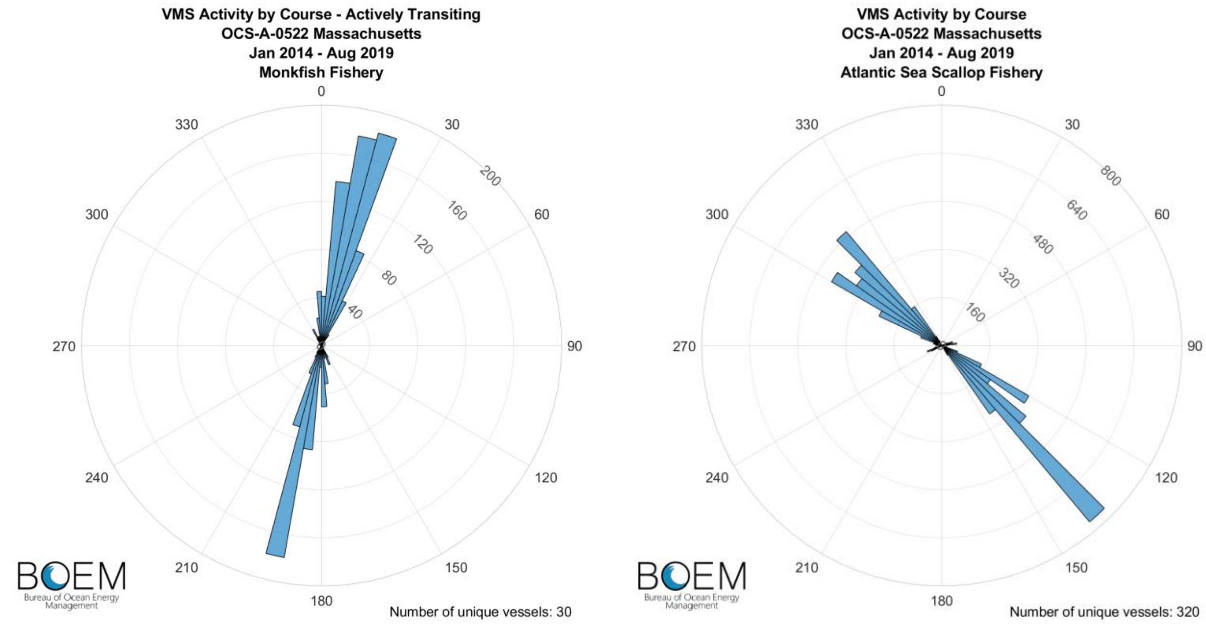


**Figure 2.11: Polar Histograms for Transiting Monkfish Vessels (top) and Atlantic Sea Scallop Vessels (bottom)**

### 2.6.4 Existing Navigation Features

At its closest point, the Lease Area is just over 25 NM (46 km) from the southern edge of Nantucket Island and approximately 1.5 NM (2.8 km) north of the Nantucket to Ambrose Safety Fairway westbound lane as well as the Nantucket to Ambrose Traffic Lane (westbound TSS lane), as shown in Figure 2.12 and Figure 2.13. The waterway characteristics are described in USCG Coast Pilot Vol. 2 section Cape Cod to Sandy Hook.

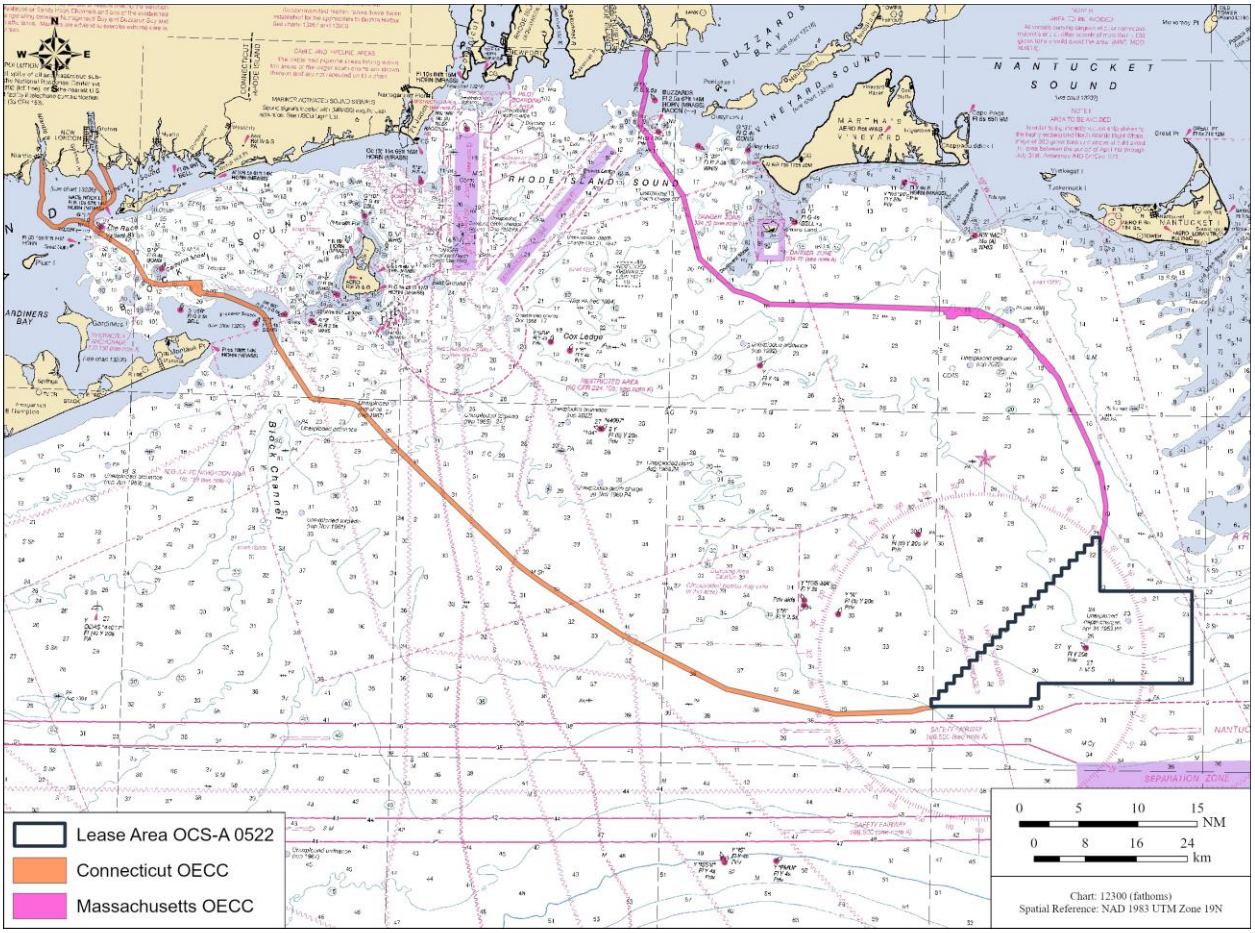


**Figure 2.12: Location of Vineyard Northeast shown in NOAA Chart 13006**

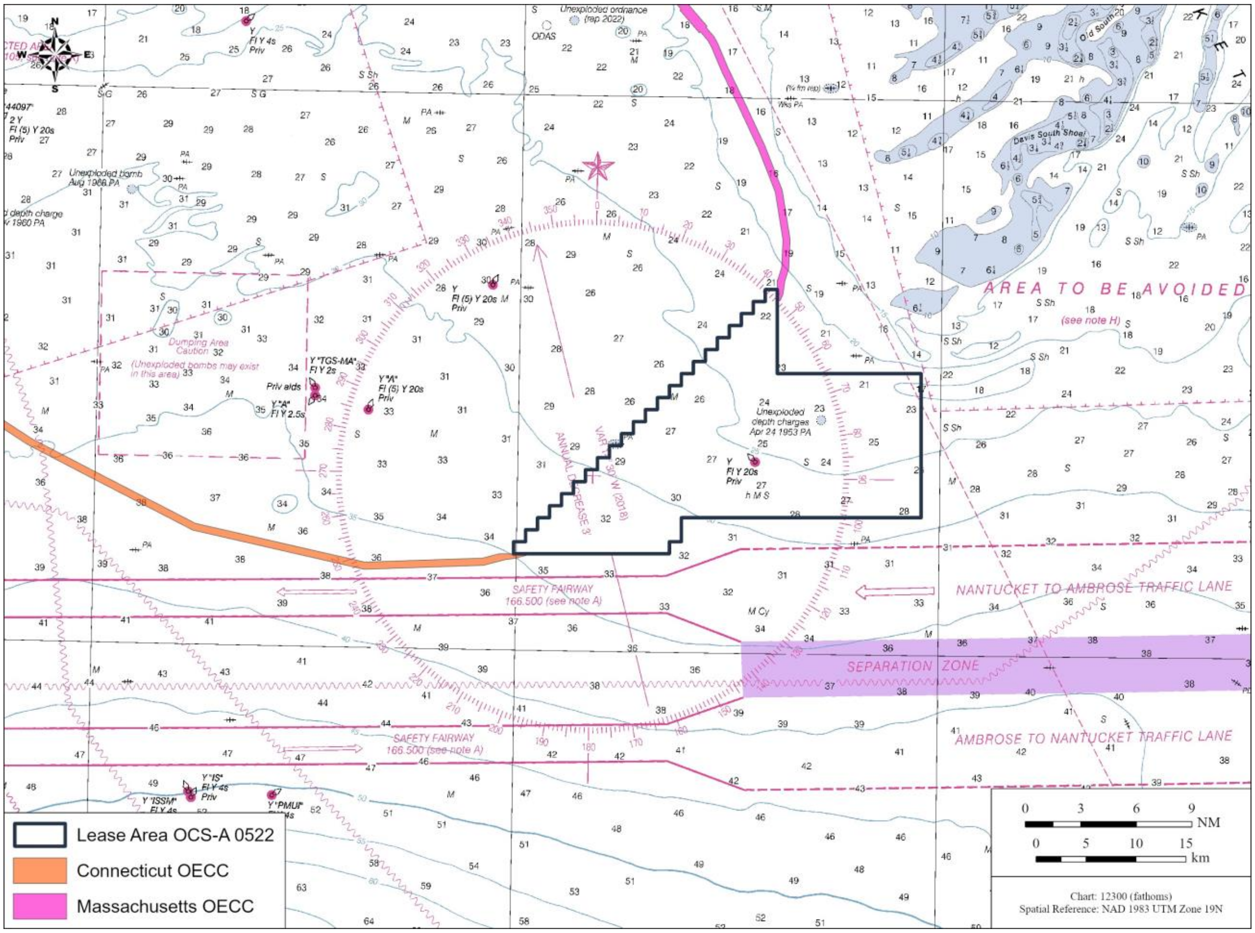


**Figure 2.13: Closer view of the Lease Area location**

#### 2.6.4.1 Existing Aids to Navigation

Aids to navigation including PATONs, Federal ATONs, and radar transponders are located throughout the Offshore Development Area. These aids to navigation serve as visual and audible references to support safe maritime navigation and consist of buoys, lights, sound horns, and onshore lighthouses. Federal ATONs are developed, operated, and maintained or regulated by the USCG to assist mariners in determining their position, identify safe courses, and warn of dangers and obstructions. ATONs are marked on the NOAA nautical charts.

PATONs and Federal ATONs in the Offshore Development Area are located in the vicinity of the Lease Area and OECCs. With the exception of Vineyard Northeast's temporary meteorological oceanographic ("metocean") buoy,[12] which is marked as a Private Aids to Navigation (PATON) (LLN 645), there are no other PATONs or Federal ATONs in the Lease Area (Figure 2.14). The closest Federal ATON to the Lease Area is the Muskeget Channel Lighted Whistle Buoy MC located approximately 27 NM (51 km) northwest of the Lease Area.[13] The closest lighthouse to the Lease Area is the Sankaty Light on Nantucket Island. The lighthouse is 29 NM (54 km) from the Lease Area. The lighthouse has a height of 158 ft and a nominal 20 NM visibility. The lighthouse would not be visible from the Lease Area.

There are several federal ATONs and/or PATONs within 1,640 ft (500 m) of the OECCs. As shown in Figure 2.15 and Table 2.10 below, there are no federal ATONs or PATONs within the Massachusetts OECC; there is only one ATON within 1,640 ft (500 m) from the edge of the Massachusetts OECC. As the Connecticut OECC approaches shore, it splits into three variations—the Eastern Point Beach Approach, the Ocean Beach Approach, and the Niantic Beach Approach—to connect to three potential landfall sites. Only one of these variations would be used. For the Connecticut OECC using the Eastern Point Beach Approach, two ATONs are within the OECC and six additional ATONs/PATONs are located within 1,640 ft (500 m) of the OECC. Using the Ocean Beach Approach, two ATONs are within the OECC and five additional ATONS/PATONs are located within 1,640 ft (500 m) of the OECC. Using the Niantic Beach Approach, four ATONs are within the OECC and five additional ATONs/PATONs are located within 1,640 ft (500 m) of the OECC. Aids to navigation in proximity to the Connecticut OECC are summarized in Table 2.10 and shown in Figure 2.16.

The Proponent will engage with the USCG early in the permitting process and coordinate closely to address ATONs in proximity to or within the OECCs. These ATONs will be avoided through micro-siting the offshore export cables (within the OECC) around the ATONs in accordance with the following Minimum Safe Distance (MSD) equation provided through consultation with USCG[14] (the specific inputs for each ATON would be obtained from USCG):

> MSD ≥ Position Tolerance (PT) + Chain Length (CL) + Length of Servicing Vessel (LSV) (+ shoaling consideration)

ATONs within approximately 4,920 ft (1,500 m) from the landfall sites may be avoided through the use of horizontal directional drilling (HDD), subject to further detailed engineering. If deemed necessary, the Proponent would coordinate with the owners of PATONs located in proximity to the Connecticut OECC.

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[12] The Proponent deployed a metocean buoy in Lease Area OCS-A 0522 on November 3, 2022. The buoy will remain in position for approximately 1 to 2 years.

[13] As shown on Figure 2.13 and Figure 2.14, there are PATONs located closer to the Lease Area; many of these PATONs are research or metocean buoys that are temporarily deployed by other offshore wind developers.

[14] The MSD equation was provided to the Proponent by the USCG during a call with USCG and BOEM on February 10, 2023.

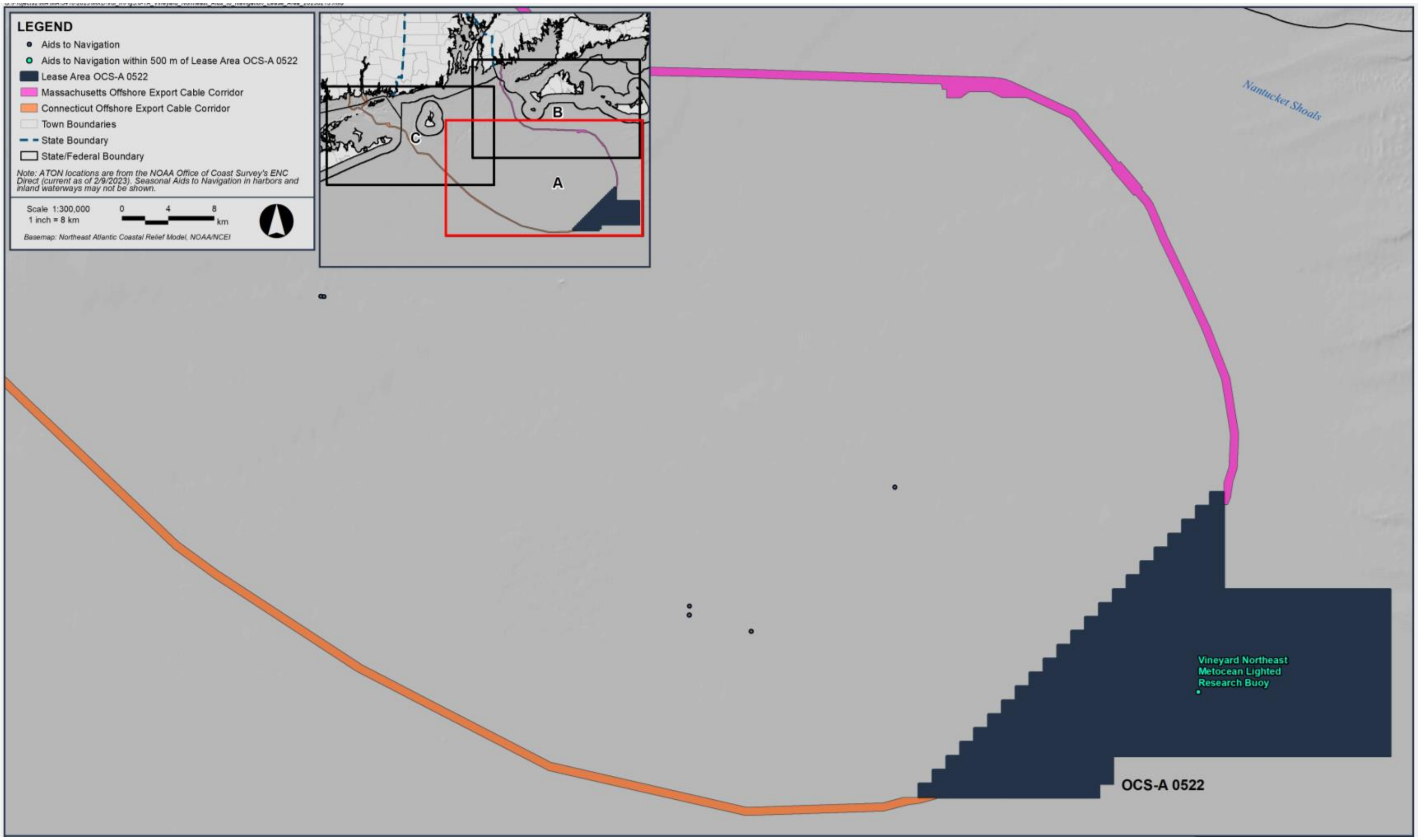


**Figure 2.14: ATONs and PATONs in Proximity to the Lease Area**

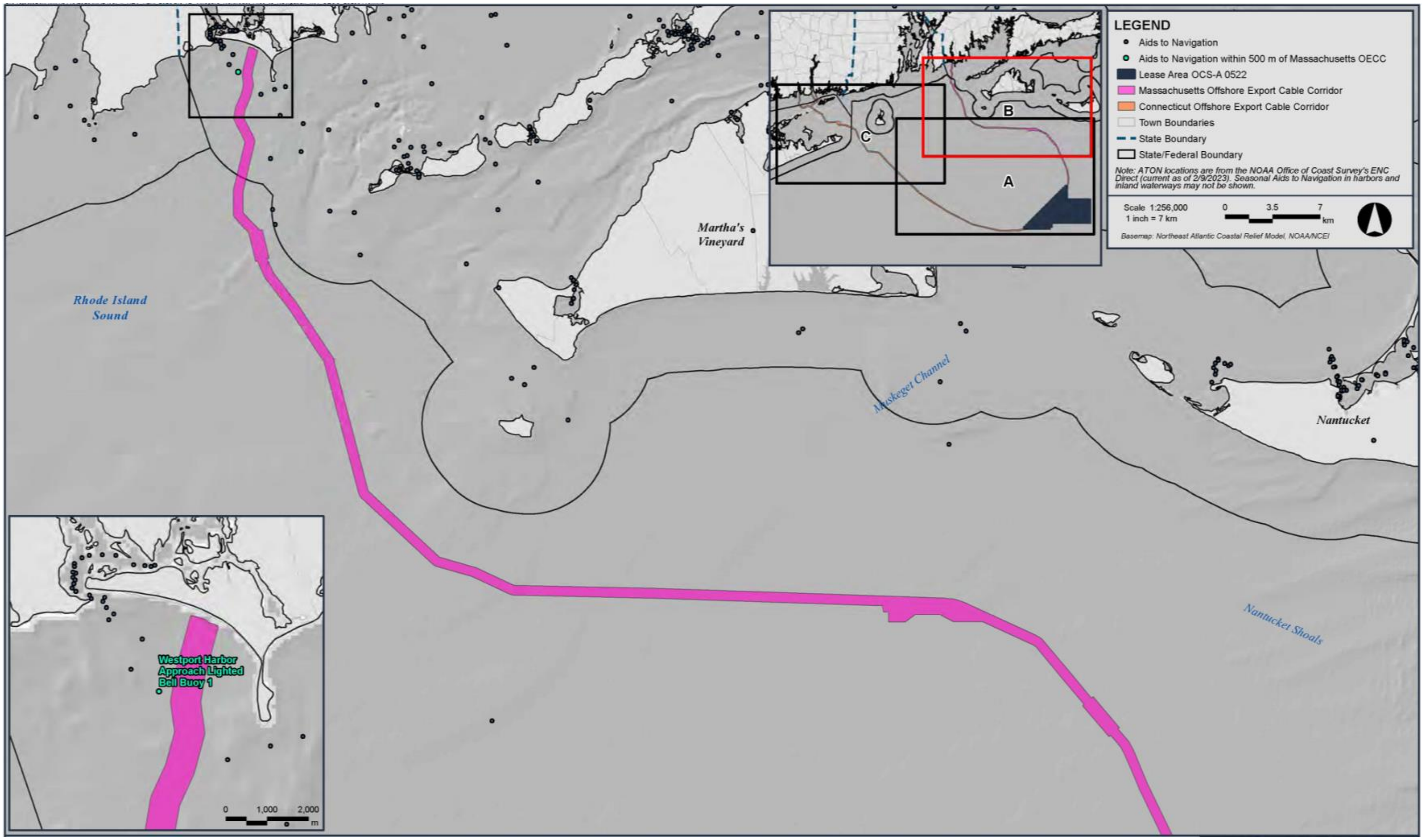


**Figure 2.15: ATONs and PATONs in Proximity to the Massachusetts OECC**

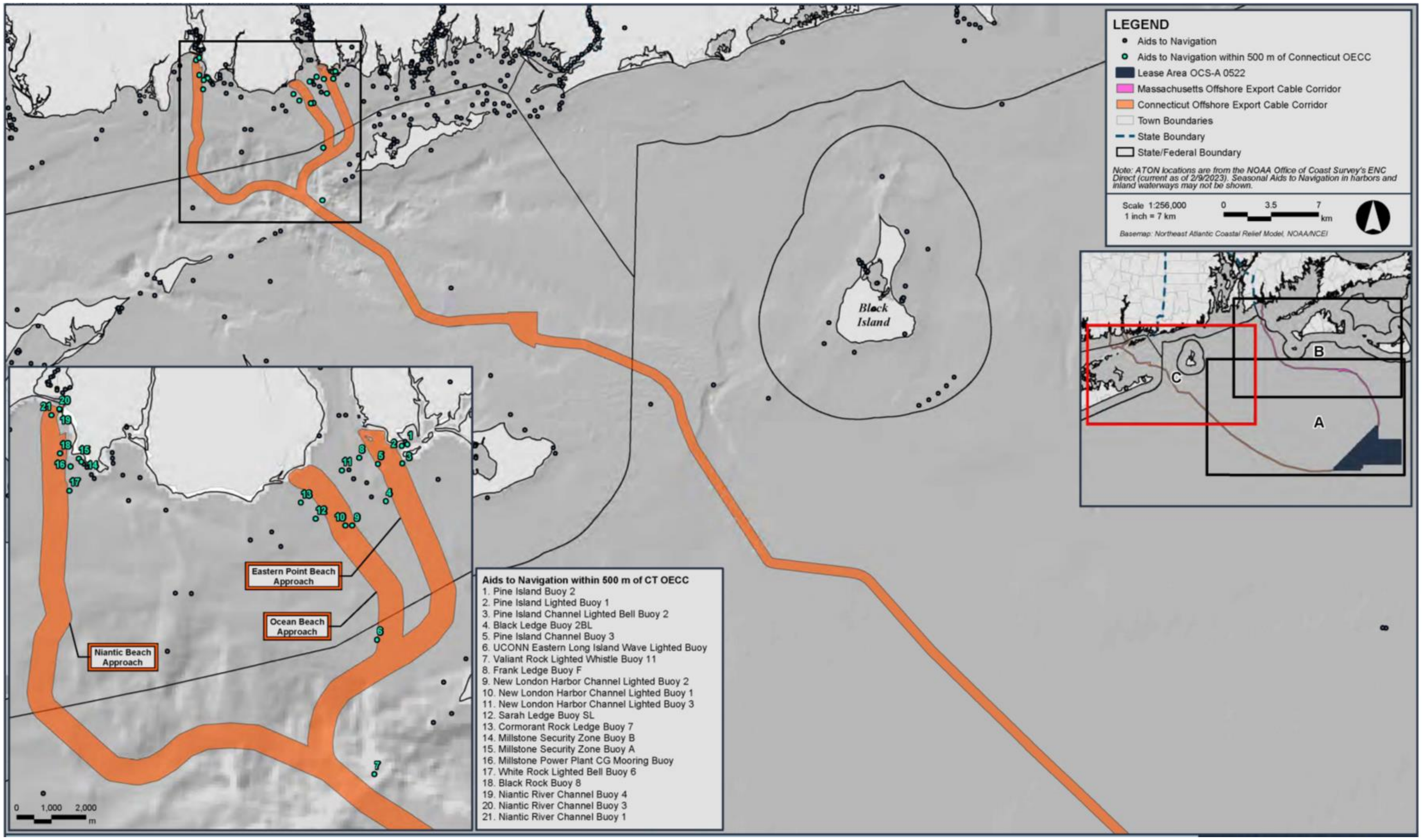


**Figure 2.16: ATONs and PATONs in Proximity to the Connecticut OECC**

**Table 2.10: ATONs and PATONs within 500 m of the OECCs**

| | Aid to Navigation Name | USCG Light List Number | Description | Distance from OECC |
|---|---|---|---|---|
| | **Massachusetts OECC** | | | |
| 1 | Westport Harbor Approach Lighted Bell Buoy 1 | 17445 | Green, federal aid | 1,000 ft (305 m) |
| | **Connecticut OECC Using Eastern Point Beach Approach** | | | |
| 1 | Pine Island Channel Buoy 3 | 21740 | Green can, federal aid | Within OECC |
| 2 | Pine Island Channel Lighted Bell Buoy 2 | 21735 | Red, federal aid | Within OECC |
| 4 | Pine Island Lighted Buoy 1 | 21745 | Green, federal aid | 608 ft (185 m) |
| 5 | Black Ledge Buoy 2BL | 21810 | Red nun, federal aid | 622 ft (190 m) |
| 3 | UCONN Eastern Long Island Wave Lighted Buoy | 21060 | Yellow, private aid | 1,031 ft (314 m) |
| 6 | Frank Ledge Buoy F | 21840 | Green and red bands can, federal aid | 1,102 ft (336 m) |
| 7 | Pine Island Buoy 2 | 21755 | Red nun, federal aid | 1,140 ft (347 m) |
| 8 | Valiant Rock Lighted Whistle Buoy 11 | 19825 | Federal aid | 1,213 ft (370 m) |
| | **Connecticut OECC Using Ocean Beach Approach** | | | |
| 1 | New London Harbor Channel Lighted Buoy 1 | 21795 | Green, federal aid | Within OECC |
| 2 | New London Harbor Channel Lighted Buoy 2 | 21790 | Red, federal aid | Within OECC |
| 3 | UCONN Eastern Long Island Wave Lighted Buoy | 21060 | Yellow, private aid | 30 ft (9 m) |
| 4 | Sarah Ledge Buoy SL | 21780 | Green and red bands can, federal aid | 903 ft (275 m) |
| 5 | Cormorant Rock Ledge Buoy 7 | 21775 | Green can, federal aid | 1,113 ft (339 m) |
| 6 | Valiant Rock Lighted Whistle Buoy 11 | 19825 | Federal aid | 1,213 ft (370 m) |
| 7 | New London Harbor Channel Lighted Buoy 3 | 21800 | Green, federal aid | 1,437 ft (438 m) |
| | **Connecticut OECC Using Niantic Beach Approach** | | | |
| 1 | Niantic River Channel Buoy 1 | 22305 | Green can, federal aid | Within OECC |
| 2 | Black Rock Buoy 8 | 22285 | Red nun, federal aid | Within OECC |
| 3 | Niantic River Channel Buoy 3 | 22310 | Green can, federal aid | Within OECC |
| 4 | Niantic River Channel Buoy 4 | 22315 | Red nun, federal aid | Within OECC |
| 5 | White Rock Lighted Bell Buoy 6 | 22275 | Red, federal aid | 199 ft (61 m) |
| 6 | Millstone Power Plant CG Mooring Buoy | 22279.1 | White with blue band, federal aid | 382 ft (116 m) |

| | Aid to Navigation Name | USCG Light List Number | Description | Distance from OECC |
|---|---|---|---|---|
| 7 | Millstone Security Zone Buoy A | 22276 | White and orange can, private aid | 1,166 ft (355 m) |
| 8 | Valiant Rock Lighted Whistle Buoy 11 | 19825 | Federal aid | 1,213 ft (370 m) |
| 9 | Millstone Security Zone Buoy B | 22277 | White and orange can, private aid | 1,414 ft (431 m) |

#### 2.6.4.2 Proximity to Transit Routes

The Lease Area is in deep water with depths of approximately 105 to 210 ft (32 to 64 m). The navigation features near the Lease Area are depicted in Figure 2.12 and Figure 2.13.

There are several vessel routing measures in the vicinity of the Lease Area including a TSS, fairways, and areas to be avoided (Figure 2.12 and Figure 2.13). Precautionary areas are defined areas where vessels must exercise particular caution and should follow the recommended direction of traffic flow. Implementing a TSS is one of several routing measures adopted by the International Maritime Organization (IMO) to facilitate safe navigation in areas where dense, congested, and/or converging vessel traffic may occur, or where navigation (particularly for deep-draft vessels) is constrained. A TSS separates opposing streams of vessel traffic by creating separate unidirectional traffic lanes and is typically designed to safely guide commercial vessels transiting to and from major ports. A TSS is not necessarily marked by an ATON, but it is marked on NOAA nautical charts. Fairways are corridors in which no artificial islands or fixed structures (temporary or permanent) are permitted. These are used so vessels will have unobstructed approaches to major US ports. While there are vessel routing measures in the vicinity of the Lease Area, there are no vessel routing measures within the Lease Area (or more broadly, within the MA WEA or RI/MA WEA).

Most of these vessels which transit in the Offshore Development Area but not through the Lease Area do so along the marked fairways and TSSs. These include the Off New York Shipping Safety Fairway (33 CFR 166.500) which consists of the Ambrose to Nantucket Safety Fairway (eastbound) and the Nantucket to Ambrose Safety Fairway (westbound). The Nantucket to Ambrose Safety Fairway (westbound) lies approximately 1.5 NM (2.8 km) south of the southern boundary of the Lease Area. The Ambrose to Nantucket Safety Fairway (eastbound) lies approximately 9.5 NM (17.6 km) south of the Lease Area. Each safety fairway has a width of 2 NM (3.7 km) with a separation of 6 NM (11 km) between them. The Off New York Shipping Safety Fairway connects to the Off New York Traffic Separation Scheme (33 CFR 167.150), encompassing the Off New York; Eastern approach eastbound lane, westbound lane, and separation zone (33 CFR 167.153), which is located approximately 150 NM (278 km) to the west of the Lease Area. The Off New York: Eastern Approach, Off Nantucket Traffic Separation Scheme (33 CFR 167.152), consists of the Nantucket to Ambrose (westbound) and Ambrose to Nantucket (eastbound) Traffic Lanes. The Nantucket to Ambrose Traffic Lane lies approximately 1.25 NM (2.3 km) south of the Lease Area. Each lane is 5 NM (9.2 km) in width with a 3 NM (5.6 km) separation zone between them.

Commercial vessel traffic is described in Section 2.6.2.1. In general, large non-fishing commercial vessels do not frequently transit through the Lease Area and comprise approximately 17% of the traffic. Those that do travel through the Lease Area are frequently transiting between the Ambrose to Nantucket Traffic Lanes and Safety Fairway and Narraganset Bay.

The Northern New York Bight PARS (NNYBPARS) included a recommended measure to combine the Nantucket to Ambrose Safety Fairway and Ambrose to Nantucket Safety Fairway into a single Nantucket to

Ambrose Fairway with a total width of 13 NM (24 km) matching the width of the existing TSS (including the separation zone). The subsequent Consolidated Port Approaches and International Entry and Departure Transit Areas PARS (CPAPARS) modified this recommendation to keep the boundaries of the proposed combined fairway to the existing width of the two existing fairways and the space between them, for a total width of 10 NM (18.5 km). This modification of the NNYBPARS was recommended to ensure there is sufficient room for safe navigation and the resulting fairways do not conflict with the Lease Area (CPAPARS 2022).

#### 2.6.4.3 Lease Area Proximity to Other Waterway Uses

There is a designated naval operations area adjacent to Nomans Island, just southwest of Martha's Vineyard, per 33 CFR 334.70(a) with extents designated on NOAA Navigation Chart 13218. At its nearest point this designated area is approximately 35 NM (65 km) northwest of the Lease Area. Other areas near the Lease Area may be used for military exercises but are not formally designated as marine cautionary zones. There are no existing or proposed offshore OREI/gas platform or known proposed structure developments near the Lease Area, other than additional WTGs and ESP(s)associated with other offshore wind developments. There are no other known designated beach nourishment borrow areas, mineral, aggregate, or sand/gravel mining operations in the area. The Lease Area is not within or adjacent to the jurisdiction of any port authority or navigation district.

There are numerous non-transit waterway features in the Offshore Development Area; however, none are located within or immediately adjacent to the Lease Area (Figure 2.17). There are several sailboat races (regattas) whose straight line courses transit through or near the Lease Area; however, it is noted that the vessels racing are not necessarily following these idealized straight line courses.

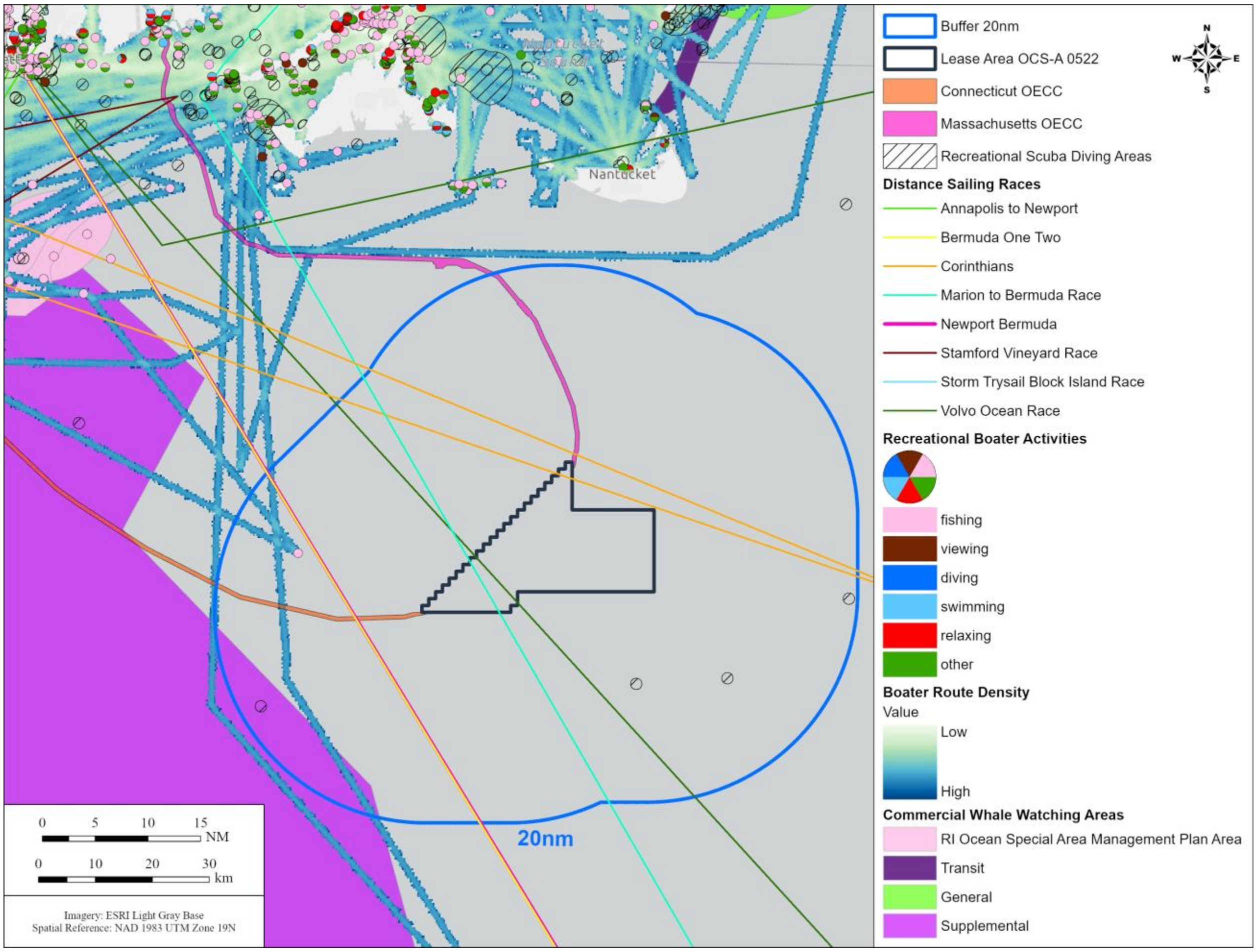


**Figure 2.17: Non-Transit Waterway Uses**

## 2.6.5 Marine Hazards

The primary marine hazard in the vicinity of the Lease Area is the Nantucket Shoals which are marked on the navigation charts as an Area to be Avoided. At its closest point, the caution area is immediately east of the northeast corner of the Lease Area. In addition to shoals, within the precautionary area there are also numerous wrecks and areas with noted tidal current rips.

Approximately 16 NM (29 km) west of the Lease Area is a caution area marked as a Dumping Area that is noted to potentially contain unexploded ordinance. This area has an east—west dimension of approximately 11 NM (20 km) and a north-south dimension of approximately 10 NM (18.5 km). There are unexploded depth charges marked on the navigation charts within the boundaries of the Lease Area. There are no other designated ocean disposal or dredged material placement areas in proximity to the Lease Area. There is one marked wreck on the northwestern edge of the Lease Area and two additional marked wrecks just northeast of the Lease Area.

A Right Whale Seasonal Management Area (speed restrictions to protect North Atlantic Right Whales per 50 CFR § 224.105) lies 14.9 NM (29 km) northwest of the Lease Area. There are no other safety or security zones in the vicinity of the Lease Area.

There are no pilot boarding areas, safe havens, or anchorages in the vicinity of the Lease Area as designated in the Coast Pilot (Vol. 2, 2020). Nantucket Island lies approximately 25 NM (47 km) north-northeast of the Lease Area with protected anchorages on the north side (opposite) side of the island. There are numerous other areas where smaller vessels anchor throughout Vineyard Sound, Nantucket Sound, and Buzzards Bay. There are no vessel traffic service (VTS) areas in the vicinity of the Lease Area.

There are no operating ferries along this section of the coast. The nearest ferries serve Nantucket Island from various mainland terminals.

## 2.7 Effects of Vineyard Northeast on Vessel Traffic

### 2.7.1 Allowable 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, approximately 105 to 210 ft (32 to 64 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 543), there is no specific guidance provided regarding the routing of vessels through a wind turbine field.

The USCG MARIPARS (2020) assessed turbine corridor width based on the UK Maritime Guidance document MGN 543[15], which recommended the following provisions:

- Standard turning circles for collision avoidance of vessels that are six times vessel length;
- Requirements for stopping in an emergency; and
- Adequate space for vessels to safely pass and overtake each other, equivalent to a lane width of two to four vessel lengths, depending on traffic density.

The last consideration derives from a Government of Netherlands White Paper on Offshore Wind Energy (2014). If there are less than 4,400 vessels per year transiting the corridor, a corridor width of four ship lengths (i.e., lanes of two times the ship length in each direction) of the “standard design vessel” are considered. If there is greater than 4,400 and less than 18,000 vessels per year, a corridor width of six ship lengths is considered. If greater than 18,000 vessels per year, then a corridor width of eight ship lengths is recommended. Note that the standard design vessel is considered to be the 98.5% percentile vessel length (i.e., exceeded by 1.5% of vessels). Under existing conditions, there are less than 4,400 vessels per year that transit through the entire Lease Area.

Figure 2.18 illustrates the methodology used by the USCG to determine the turbine spacing that would enable safe transits between WTGs in the MARIPARS. It is made up of the following components:

- 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, will satisfy the 1,538 average vessels transiting through the Lease Area annually.
- 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.

[15] It is noted that MGN 543 has been supplanted by MGN 654; however, the newer document does not directly address buffers around structures.

- An additional buffer[16] that may range in size from 0 to 1,640 ft (500 m) around the WTG. At the time the USCG (2020) MARIPARS was prepared, USCG did not have the authority to establish safety zones around structures for offshore wind farms beyond 12 NM from the territorial sea baseline. However, MARIPARS considered that a buffer of 1,640 ft (500 m) might be considered in the future based on international regulations and USCG regulatory authority (i.e., 33 CFR 147) for oil and gas platforms. In the MARIPARS, a 1,640 ft (500 m) buffer was applied as a single value for the corridor; in this report, it has been interpreted as an 820 ft (250 m) radius applied around each WTG.
    - It is noted that the USCG NJPARS (2021a) assessed required lane widths for fishing vessels in the region offshore of New Jersey and concluded that a 1,640 ft (500 m) buffer may be excessive or overly conservative for vessels of 200 ft (60 m) length or less as these vessels frequently operate in the tight confines of coastal ports in the area.
    - As discussed further in Section 8.1.1, the Proponent may request that USCG establish temporary safety zones around each structure during construction and/or certain maintenance activities under their authority under 33 CFR 147; however, this analysis of allowable transit corridor widths is focused on normal operational conditions. The buffers used in this analysis are not considered regulatory safety zones.

[16] Note that the MARIPARS and MGN 543 use the term “safety zone,” but to avoid confusion with a regulatory safety zone under 33 CFR 147, this NSRA uses the term “buffer” instead.

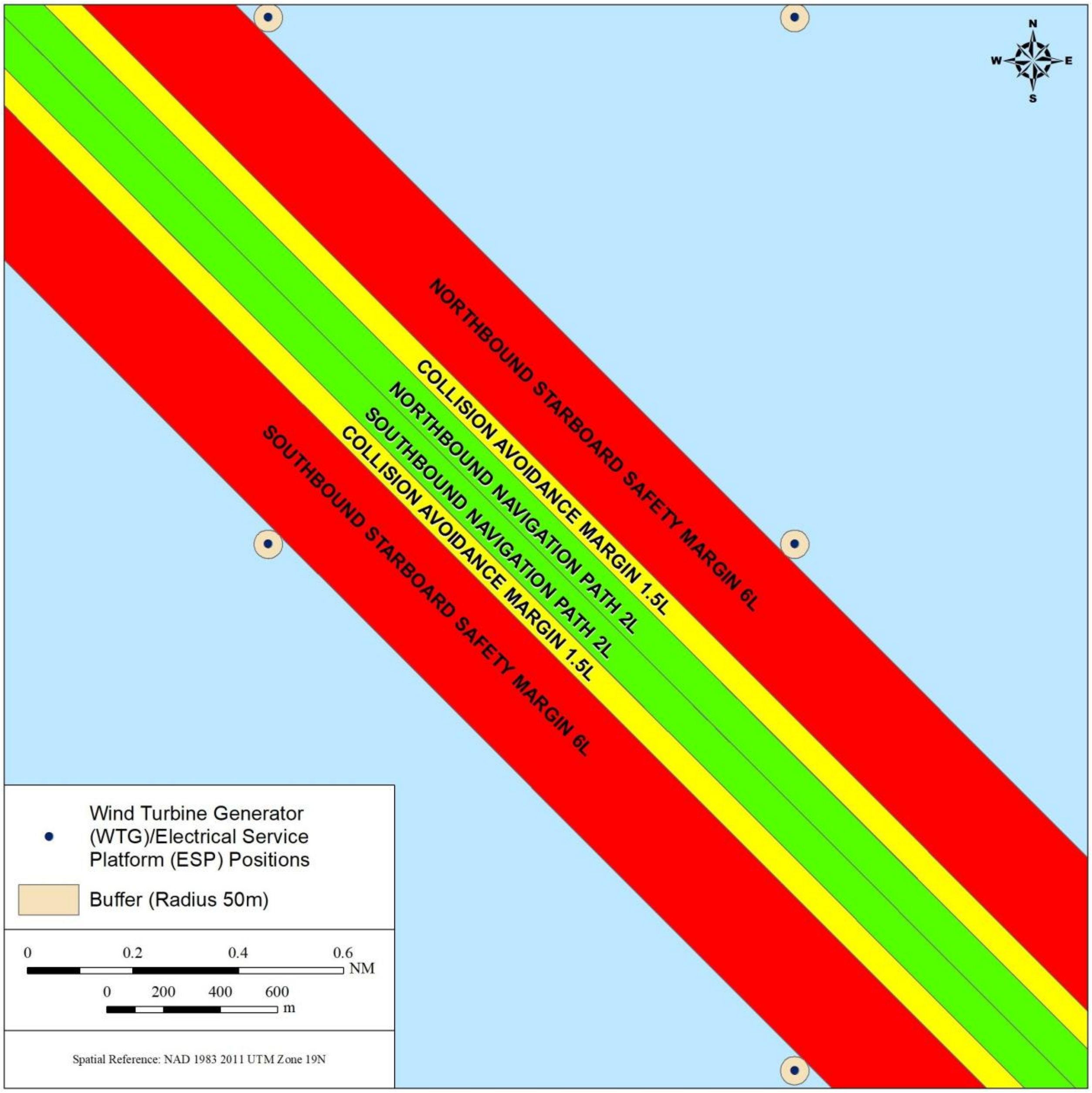


**Figure 2.18: Recommended Corridor Width Based on MARIPARS Methodology (Buffer of 164 ft [50 m] radius shown)**

An alternative approach from MGN 543 (UK Maritime & Coastguard Agency 2016), which specifically considers offshore renewable energy installations (OREIs), states "The mention of the IMO/UNCLOS safety zone limited to 500 meters does not imply a direct parallel to be applied to OREIs." Further, MGN 543 allows for a buffer of 164 ft (50 m) around turbines during operation. This suggests that a 1,640 ft (500 m) buffer during operation, as presented in MARIPARS, is conservative for OREIs. Furthermore, a buffer of 1,640 ft (500 m) in addition to a safety margin of six times the vessel length may be overly conservative. Based on present USCG practice it is understood that safety zones of up to 1,640 ft (500 m) may be designated during construction and/or certain maintenance activities as discussed further in Section 8.1.1, but are not intended to be permanent safety zones.

In this NSRA, Baird has conservatively applied the MARIPARS approach for defining corridor widths based on three different buffers around the WTGs, with radii ranging from 0 to 820 ft (250 m) per side. Table 2.11 below shows the recommended maximum vessel length that can be accommodated by the largest and smallest corridor widths present in the Lease Area: (1) 1.0 NM (1.9 km) north to south and east to west corridors; and (2) at least 0.6 NM (1.1 km) northwest-southeast diagonal corridors (see Section 2.1 and Figure 2.3 for additional discussion of the spacing between Vineyard Northeast's WTG/ESP positions).

Table 2.12 and Table 2.13 indicate the percentage of fishing and recreational fleets, respectively, that have lengths less than the values given in Table 2.11. Based on this comparison, all of the AIS fishing vessels (Section 2.6.2) and recreational vessels would be able to transit through the primary 1 NM (1.9 km) north to south and east to west corridors with no buffer around the WTGs. For the minimum 0.6 NM corridor, depending on the assumed buffer (0 m, 50 m, or 250 m), between 87% and 96% of recreational vessels and between 95% and 100% of the fishing vessels could transit through the corridors based on the MARIPARS navigation corridor width methodology.

**Table 2.11: Recommended Maximum Vessel Length by Corridor Width**

| | Allowable Vessel Length (ft) | | |
|---|---|---|---|
| | No Buffer | 50 m Buffer | 250 m Buffer |
| 1.0 NM Corridors | 320 | 303 | 233 |
| 0.60 NM Corridors | 192 | 175 | 106 |

**Table 2.12: Percentage of AIS-Equipped Fishing Fleet with Length Less than Maximum**

| | Percentage of Fleet | | |
|---|---|---|---|
| | No Buffer | 50 m Buffer | 250 m Buffer |
| 1.0 NM Corridors | 100.0% | 100.0% | 100.0% |
| 0.60 NM Corridors | 100.0% | 100.0% | 95.5% |

**Table 2.13: Percentage of AIS-Equipped Recreational Fleet with Length Less than Maximum**

| | Percentage of Fleet | | |
|---|---|---|---|
| | No Buffer | 50 m Buffer | 250 m Buffer |
| 1.0 NM Corridors | 100.0% | 99.2% | 98.1% |
| 0.60 NM Corridors | 96.1% | 95.7% | 87.9% |

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 in most areas (i.e., except at the actual locations of WTGs and/or ESP(s)).

### 2.7.2 Future Vessel Traffic Changes

As further discussed in Sections 3.1.2, 3.2.3, and 6.9, it is anticipated that most non-fishing commercial vessels will re-route around the Lease Area following the construction of Vineyard Northeast. While the layout is expected to accommodate fishing and recreational vessels, some fishing and recreational vessels may opt to reroute transits around the Lease Area. However, for the purposes of modeling the risks for collision and allision, it has been assumed that these types of vessels will transit through the WTG/ESP field in the Lease Area as discussed in subsequent sections of this report.

# 3. Proposed Structures

## 3.1 Above Water Structure Description

### 3.1.1 WTG, ESPs, and Booster Station

As noted previously, Vineyard Northeast includes 160 total WTG and ESP positions within the Lease Area. Up to three of those positions will be occupied by ESP(s) and the remaining positions will be occupied by WTGs. Two of the ESPs may be co-located at the same grid position (co-located ESPs would be smaller structures installed on two adjacent monopile foundations). Additionally, the Proponent may install a booster station in the northwestern aliquot of Lease Area OCS-A 0534. The WTGs, ESP(s), and booster station (if used) will be supported by monopile foundations or piled jacket foundations. In total, Vineyard Northeast could include up to 162 monopile foundations (assuming the use of co-located ESPs) or up to 161 piled jacket foundations.

The PDE of dimensions for the WTGs and their foundations is provided in Section 0. With respect to vessel navigation, an important consideration is the minimum WTG tip clearance, which is 89 ft (27 m) relative to MLLW. The PDE of dimensions for the ESP(s) is provided in Section 2.3 and the PDE of dimensions for the booster station is provided in Section 2.4. This NSRA has considered the overall envelope of the dimensions.

### 3.1.2 Above Water Structure Impacts on Navigation

The foundations of the WTGs and ESP(s) are considered as part of the allision and collision risk modeling described later in this report (Section 6). The collision and allision risk modeling for the booster station (if used) is also addressed in Section 6. The potential impacts to air draft are covered in the following subsection.

#### 3.1.2.1 Air Draft

It is important to check the vertical clearance between the top of the largest vessels and the turbine rotor. Figure 3.1 shows that the minimum rotor tip clearance is 89 ft (27 m) relative to MLLW. Highest Astronomical Tide (HAT) is 3.18 ft (0.97 m) above MLLW based a calibrated and validated global tidal model (Pringle et al., 2021). Therefore, the minimum possible tip clearance from a high tide level is approximately 80 ft (24.4 m), allowing for a 5 ft (1.5 m) safety margin. This is the maximum allowable vessel “air draft” under calm conditions. Air draft refers to the maximum distance from the water line to the highest point on the vessel.

Waves induce vertical motions of vessels and will reduce the required vertical clearance. PIANC (2014) provides a means to estimate the vertical motion of vessels due to wave action. The largest vertical response tends to occur when the length of the vessel is approximately equal to wavelength. For wave periods of 10 to 12 s, the wavelength ranges from 480 ft to 640 ft (146 m to 194 m), which is the approximate size of the larger vessels. The estimated vertical response for such vessels would be approximately 1.5 times the magnitude of the significant wave height. The tallest sailing vessel to historically transit the Lease Area is the Athena, which has a main mast height of approximately 212 ft (65 m) above the vessel water line. The mast of such a vessel is at risk of allision with the turbines.

Note that both the cargo and sailing vessels are at little risk of interacting with the WTG blades 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 LNMs and on the navigational chart, subject to USCG practices and regulations.

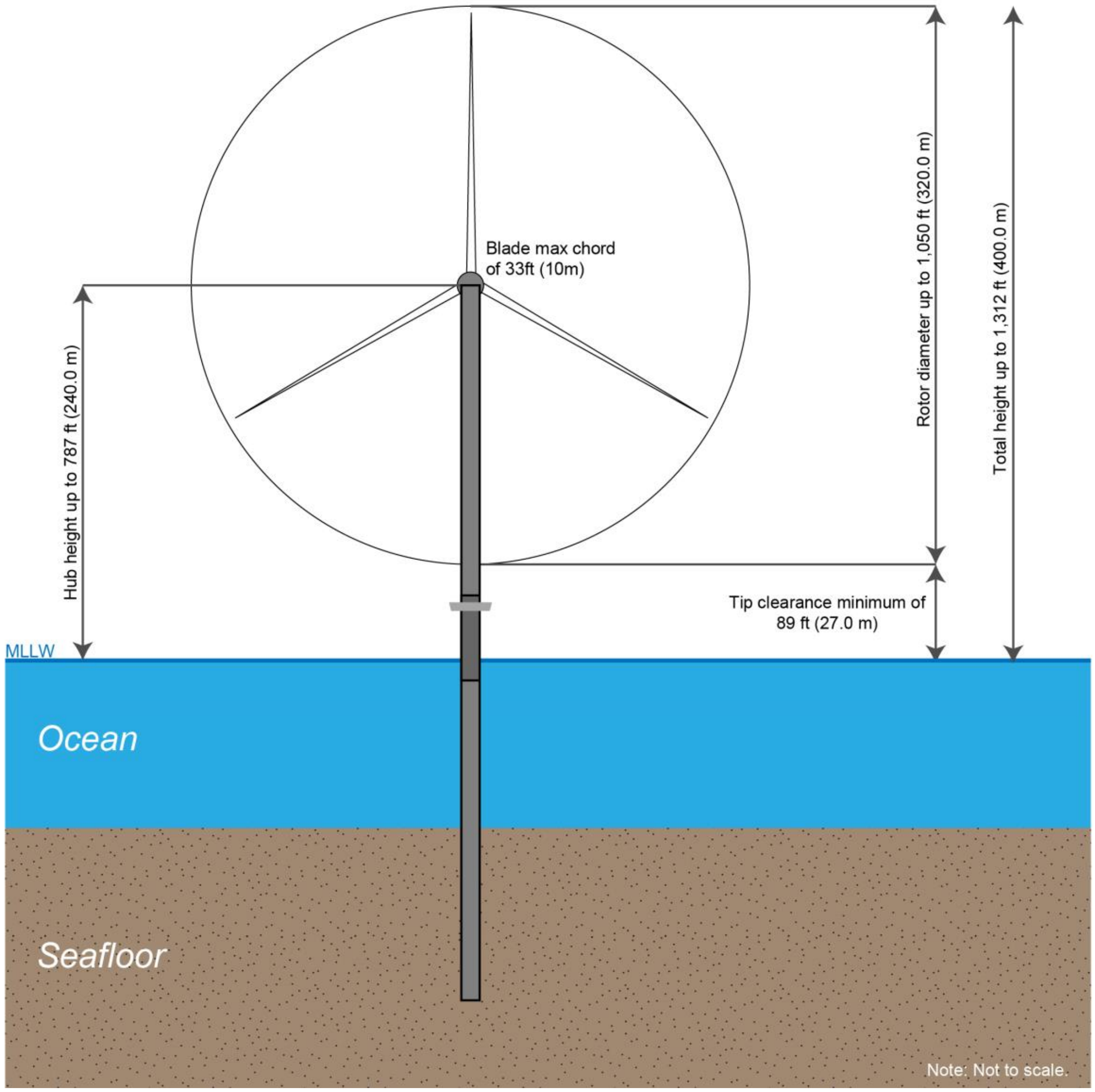


**Figure 3.1: WTG Vertical Dimensions**

## 3.2 Below Water Structure Description

### 3.2.1 Foundations

As described above, the WTGs, ESP(s), and booster station (if used) will be supported by monopile foundations or piled jacket foundations:

- 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. Typically, a TP is 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 TP 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(s), ladders, work platforms, electrical equipment, and various ancillary equipment (e.g., cranes).

- Piled Jacket – Piled jacket foundations are steel structures comprised of several legs connected by welded tubular cross bracing, which are fixed to the seabed using piles connected to each leg of the jacket. 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(s), ladders, work platforms, electrical equipment, and various ancillary equipment (e.g., cranes).
- Scour Protection – 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.

See Sections 2.2, 2.3, and 2.4 for additional details and dimensions for WTG, ESP, and booster station foundations.

### 3.2.2 Offshore Cables

Offshore export cables installed within two OECCs will transmit electricity from the ESP(s) to landfall sites in Massachusetts and Connecticut. Up to two high voltage direct current (HVDC) cable bundles or up to three HVAC cables may be installed within the Massachusetts OECC. If HVAC offshore export cables are used, the cables would connect to a booster station in the northwestern aliquot[17] of Lease Area OCS-A 0534 to boost the electricity’s voltage level, reduce transmission losses, and enhance grid capacity. Up to two HVDC offshore export cable bundles may be installed within the Connecticut OECC.

Inter-array cables will connect strings of multiple WTGs to the ESP(s). If two or three ESPs are used, they may be connected with inter-link cables.

The Proponent 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 burial depth of 5 to 8 ft (1.5 to 2.5 m) beneath the stable seafloor.[18] The cable burial depth is based upon a preliminary Cable Burial Risk Assessment (CBRA) for the export cables that considers activities such as commercial fishing practices and anchor use to develop a safe target burial depth for the cables. The Proponent 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. The Proponent’s engineers have determined that the target burial depth is more than twice the burial depth required to protect the cables from fishing activities and also generally provides a maximum of 1 in 100,000 year probability of anchor strike[19], which is considered a negligible risk.

While every effort will be made to achieve sufficient burial, a limited portion of the inter-array cables (up to 2%), inter-link cables (up to 2%), and offshore export cables (up to 9% for the offshore export cables to Massachusetts and up to 6% for the offshore export cables to Connecticut) may require remedial cable protection (rocks, rock bags, concrete mattresses, half-shell pipes, or similar) if a sufficient burial depth cannot be achieved. Cable protection may also be used where the cables need to cross other infrastructure (e.g.,

---

[17] An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

[18] Unless the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.

[19] Based on a preliminary CBRA, in portions of the Ocean Beach Approach and Eastern Point Beach Approach of the Connecticut OECC, a greater target burial depth of approximately 3 m (10 ft) is needed to achieve a 1 in 100,000 year probability of anchor strike.

existing cables, pipelines, etc.), to secure the cable entry protection system in place, or where a cable splice requires protection.

### 3.2.3 Below Water Structure Impacts on Navigation

The foundations of the WTGs and ESP(s) are considered as part of the allision and collision risk modeling described later in this report (Section 6). The collision and allision risk modeling for the booster station (if used) is also addressed in Section 6. The draft of vessels operating in proximity to the structures is significantly less than the water depths in the area and the structures are generally near vertical near the waterline; thus, vessel navigation would only be impacted if they allide with a structure.

The potential for navigation impacts within the OECCs is primarily during construction as discussed in Sections 3.2.2 and 8.1.1. Once in place, the primary impact to navigation will be limited to those portions of the OECC where cable protection is installed, which may cause localized restrictions on dredging and anchoring. As described above, while every effort will be made to achieve sufficient burial, a limited portion of the offshore cables may require cable protection if a sufficient burial depth cannot be achieved. Cable protection may also be used if the cables need to cross other infrastructure (e.g., existing cables, pipelines, etc.), to secure the cable entry protection system in place, or where a cable splice requires protection. Cable protection will be designed and installed to minimize interfering with bottom fishing gear, dredging, and anchoring to the maximum extent practicable and mariners will be informed of exactly where cable protection exists.

## 3.3 Vineyard Northeast Vessel Traffic

### 3.3.1 Construction, Installation, and Decommissioning

Construction and installation of Vineyard Northeast will require the use of a wide range of construction and support vessels. These vessels will transit within the Lease Area, along the OECCs, and along vessel routes between the Lease Area, OECCs, and various ports. Estimates of the numbers and types of vessels are provided in Sections 3 and 4 of COP Volume I. Table 3.1 summarizes the type, numbers, and expected activities of some of the larger vessels that might be utilized. As this stage of the development process, vessel data is highly speculative given that the Proponent has not selected the contractors or specific vessels that will carry out construction or decommissioning activities.

Assuming a build-out of the entire Lease Area, the offshore construction activities may occur over a period of approximately 18 to 24 months for each major activity (e.g., offshore export cable installation, WTG foundation installation, ESP and booster station installation and commissioning, inter-array and inter-link cable installation, and WTG installation and commissioning), with considerable overlap in the timeframes of each of these activities. A representative draft construction schedule for one potential build-out scenario is provided in Section 3 of COP Volume I. The Proponent has identified several ports in Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Canada that may be used to stage offshore construction components (Table 3.2). These staging ports could be used for frequent crew transfer and to offload, store, pre-assemble, inspect, pre-commission, and/or load components onto vessels for delivery to the Lease Area and OECCs.[20]

Volume I of the COP provides a summary of the anticipated fleet requirements during construction and installation; however, it is difficult to quantify the numbers of vessels and vessel trips from each port at this time. Assuming the maximum design scenario (see Section 3.11 of COP Volume I), it is estimated that an

[20] Some components (e.g., monopiles) may instead be pulled by tugs while floating in the water rather than loaded onto vessels.

average of 25 vessels would operate at the Lease Area or along the OECCs at any given time during offshore construction. During the most active period of construction, it is conservatively estimated that a maximum of approximately 61 vessels could operate in the Offshore Development Area at one time[21]. During the most active month of construction, it is anticipated that an average of approximately 19 daily vessel round trips could occur.

**Table 3.1: Representative Construction Vessels**

| Vessel Type | Expected No. of Vessels | Expected Vessel Activity |
|---|---|---|
| Anchor handling tug supply (AHTS) vessels | 1-6 | Vessels that primarily handle and reposition the anchors of other vessels (e.g., cable laying vessels), but may also be used to transport equipment or for other services. |
| Barges | 2-10 | Vessels with or without propulsion that may be used for transporting components (e.g., foundations, WTGs, etc.) or installation activities. |
| Bunkering vessels | 1-4 | Vessels used to supply fuel and other provisions to other vessels offshore. |
| Cable laying vessels | 1-5 | Specialized vessels/barges that lay and bury offshore cables into the seafloor. |
| Crew transfer vessels (CTVs) | 2-12 | Smaller vessels that transport crew, marine mammal observers, parts, and/or equipment. |
| Dredging vessels | 1-2 | Specialized vessels used to remove the upper portions of sand bedforms. |
| Heavy lift vessels (HLVs) | 1-4 | Vessels that may be used to lift, support, and orient the WTGs, ESP(s), booster station, and foundations during installation. |
| Heavy transport vessels (HTVs)/modified cargo vessels | 2-12 | Ocean-going vessels that may transport components to staging ports or directly to the Lease Area. |
| Jack-up vessels | 1-9 | Vessels that extend legs to the seafloor to provide a safe, stable working platform. Jack-up vessels may be used to install foundations, ESP and booster station topsides, and/or WTGs, to transport components to the Lease Area, for offshore accommodations, for cable splicing activities, and/or for cable pull-in at the landfall sites. |
| Scour/cable protection installation vessels | 1-3 | Vessels (e.g., fallpipe vessels) that may be used to deposit a layer of rock around the foundations or over limited sections of the offshore cable system. |
| Service operation vessels (SOVs) | 1-3 | Larger vessels that provide offshore living accommodations and workspace as well as transport crew to and from the Lease Area. |
| Support vessels | 1-8 | Multipurpose vessels (e.g., work boats, supply boats, accommodation vessels, diving support vessels) that may be used for a variety of activities, such as the pre-lay grapnel runs, supporting cable installation, commissioning WTGs, or transporting equipment. |
| Survey vessels | 1-3 | Specialized vessels used to perform geophysical, geotechnical, and environmental surveys. |

[21] This includes vessels at the Lease Area, at the OECCs, and in transit to, from, or within a port.

| Vessel Type | Expected No. of Vessels | Expected Vessel Activity |
|---|---|---|
| Tugboats | 2-16 | Ocean-going vessels or smaller harbor craft used to transport equipment and barges. |

### 3.3.2 Operations and Maintenance

The Proponent expects to use one or a combination of service operation vessel(s) (SOV), service accommodation and transfer vessels (SATVs), and crew transfer vessels and helicopters during the routine operations and maintenance (O&M) of Vineyard Northeast. The Proponent may use one or more SOVs to provide workers with offshore accommodations during multi-week service trips to the Lease Area and/or one or more SATVs for multi-day or week-long service trips to the offshore facilities. In a different approach, multiple CTVs and/or helicopters would make frequent trips (e.g., daily) to transfer crew and supplies between the offshore facilities and shore. The Proponent may periodically use larger vessels (e.g., jack-up vessels, cable laying vessels) to perform certain maintenance and repair activities, if needed. These vessels would be similar to the vessels used during construction.

The Proponent expects to use one or more onshore O&M facilities to support the operation of Vineyard Northeast's offshore facilities. The O&M facilities, which could be located at or near any of the ports identified in Table 3.2, are expected to include dock space for SOVs, SATVs, CTVs, and/or other support vessels.

**Table 3.2: Potential Construction and O&M Ports**

| Port |
|---|
| **Massachusetts Ports** |
| Brayton Point Commerce Center |
| Fall River Ports |
| Port of New Bedford (New Bedford Marine Commerce Terminal & other areas in New Bedford) |
| Salem Harbor |
| Vineyard Haven Harbor |
| **Rhode Island Ports** |
| Port of Davisville (Quonset) |
| Port of Providence (ProvPort) |
| South Quay Terminal |
| **Connecticut Ports** |
| Port of Bridgeport |
| New London State Pier |
| Port of New Haven (O&M only) |
| **New York Ports** |
| Capital Region Ports (Port of Albany-Rensselaer, NYS Offshore Wind Port, Port of Coeymans Marine Terminal) |
| Staten Island Ports (Arthur Kill Terminal & Homeport Pier) |
| Brooklyn Ports (South Brooklyn Marine Terminal, GMD Shipyard, & Red Hook Container Terminal [O&M only]) |
| Long Island Ports (Shoreham, Port Jefferson Harbor, & Greenport Harbor [O&M only]) |
| **New Jersey Ports** |
| Paulsboro Marine Terminal |
| New Jersey Wind Port |
| **Canadian Ports** |
| Potential Canadian Ports (Port of Halifax, Sheet Harbor, & Port Saint John)[1] |

*Note: 1. Analysis of potential Canadian ports that may be used is ongoing.*

During the busiest year of O&M, an average of approximately nine vessels are anticipated to operate in the Offshore Development Area at any given time, although additional vessels may be required during certain maintenance or repair activities. Based on the maximum design scenario, approximately 575 vessel round trips are estimated to take place annually during the O&M. However, these estimates are highly dependent on the logistics approach used during O&M, the location of the O&M facilities, the timing and frequency of activities, and the final design of the offshore facilities. All vessels used during the operation of Vineyard Northeast will be equipped with AIS to track vessel activity and monitor compliance with permit requirements.

# 4. Metocean Characterization and Impacts

## 4.1 Data Sources

This section summarizes the metocean conditions local to the Lease Area. The data used for this analysis were sourced from field measurements from instruments deployed near the Lease Area[22] and were supplemented with additional data from the United States Army Corps of Engineers (USACE) Wave Information Study (WIS) hindcast (WIS, 2010), Climate Forecast System Reanalysis atmospheric model (Saha et al., 2010), NOAA's National Centers for Environmental Information (NCEI, 2020), and the OOI Pioneer Inshore Coastal Surface Mooring. Figure 4.1 depicts the relative location of NOAA's National Data Buoy Center (NDBC) buoys, the SouthCoast Wind Buoy,[23] the Vineyard Wind 1 Buoy, and the OOI Pioneer Inshore Surface Mooring.

## 4.2 Conventions

The following conventions were used in the measurement and processing of the monitoring data:

- **Wind:** direction refers to the compass direction from which the wind is blowing (ºN)
- **Currents:** direction refers to the compass direction that the current is flowing towards (ºN)
- **Waves:** direction refers to the compass direction from which the wave is coming (ºN)
- **Directions:** measured clockwise relative to true or grid North (0º)

The following sections summarize the conditions observed by the various field data sources and historical conditions from other sources.

[22] A metocean buoy was deployed for Vineyard Northeast in Lease Area OCS-A 0522 in November 2022; however, the data record from the buoy is not of sufficient duration to provide annualized statistics and thus, is not used for this NSRA. Data from the SouthCoast Wind metocean buoy (which was deployed in adjacent Lease Area OCS-A 0521) is used herein for metocean characterization of Lease Area OCS-A 0522. There is expected to be minimal difference between the metocean climate at the SouthCoast Wind buoy and the Vineyard Northeast Lease Area.

[23] At the time this buoy was deployed, the SouthCoast Wind project was called Mayflower Wind.

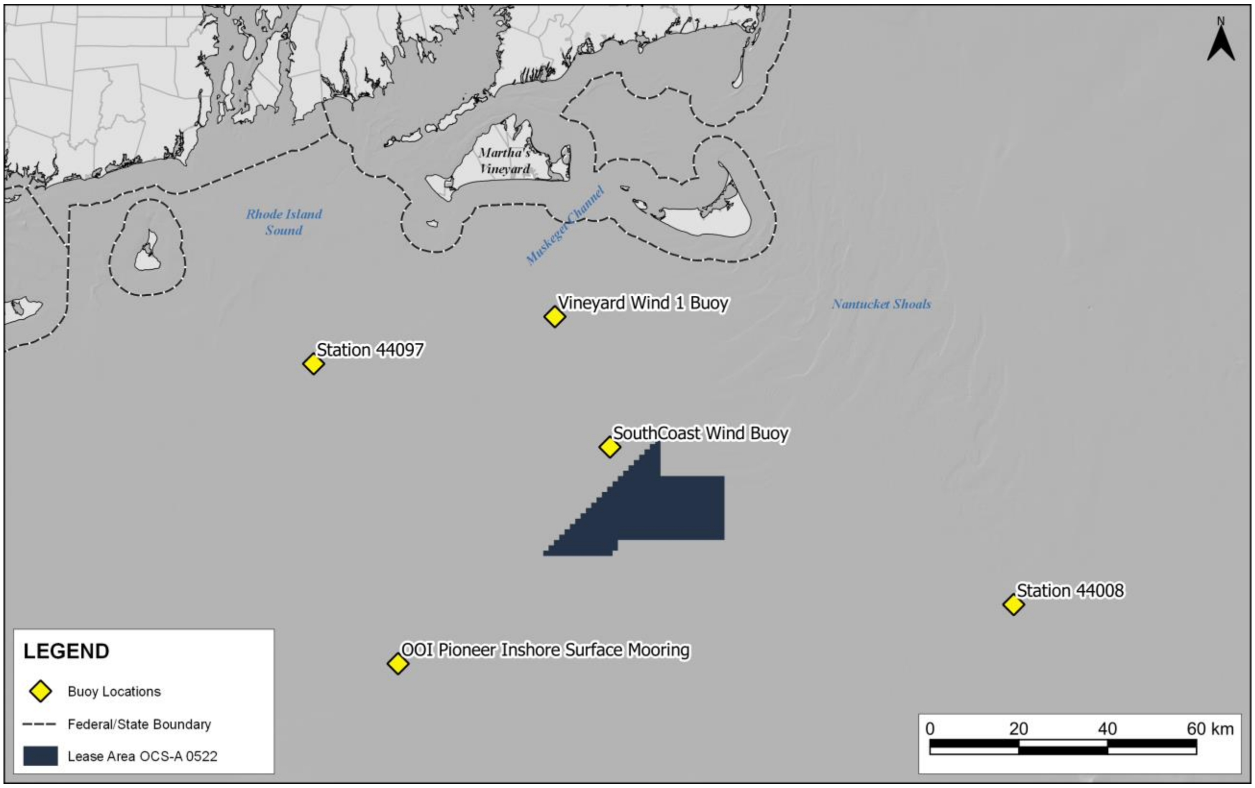


**Figure 4.1: Metocean Data Sources**

## 4.3 Wind

Wind data from the SouthCoast Wind Buoy (the sensor was approximately 13 ft [4.0 m] above sea level), located approximately 9 NM (17 km) to the site, is presented in Figure 4.2. Data date ranges from April 2020 through March 2021 and includes 289 measurements. Units are in meters per second. It should be noted that this buoy is no longer transmitting data and has likely been removed since it is no longer included on USCG list of aids to navigation at the time of this report. At the buoy location, the measurements show that winds are predominantly from the southwest, with some instances out of the southeast and northeast.

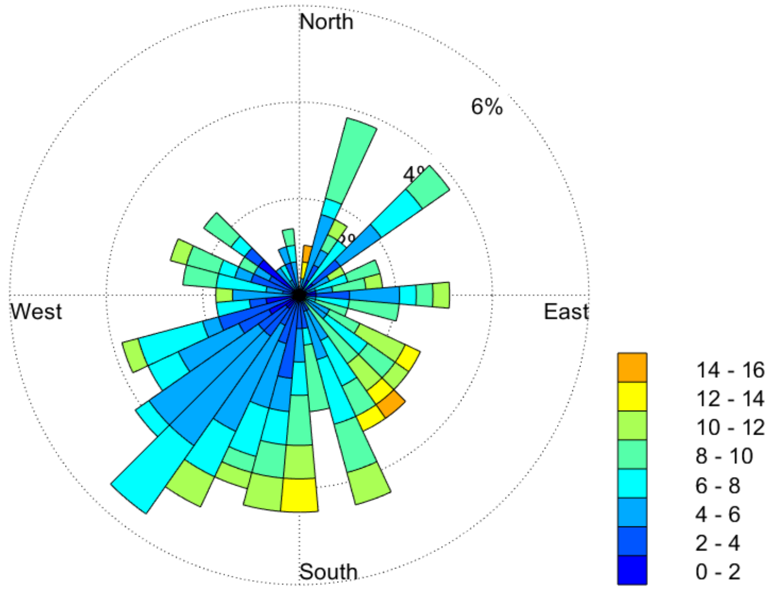


**Figure 4.2: SouthCoast Wind Buoy**

Maximum wind speeds observed during this period at the 4 m elevation are over 29 kts (15 m/s) with an average of 12.4 kts (6.4 m/s).

Wind data from an anemometer deployed at Martha's Vineyard Airport (41.393º N, 70.615º W) were obtained from NCEI's Integrated Surface Hourly Database for the period of 1973 to 2017 (NCEI, 2020). A wind rose summarizing the wind conditions at this location over this entire period is shown in Figure 4.3. Note that a large percentage of this hourly timeseries is only considered missing because for approximately half of the time series, the measurement frequency was greater than one hour.

The data collected at Martha's Vineyard Airport are in general agreement with the wind conditions recorded by the buoy near the Lease Area. The majority of the wind appears to be somewhat uniformly distributed within the directional range of approximately 200 to 360 degrees. For a significant amount of this period, the wind speeds ranged from 0 to 16 kts (0 to 8 m/s) with periodic gusts reaching speeds up to 80 kts (41 m/s), which was recorded on August 1, 1974.

An analysis by month reveals that from approximately November to March, winds predominantly blow from the northwest quadrant and then from the southwest quadrant from approximately May to September. The majority of the wind speeds above 16 kts (8 m/s) occurred within the approximate October to April window.

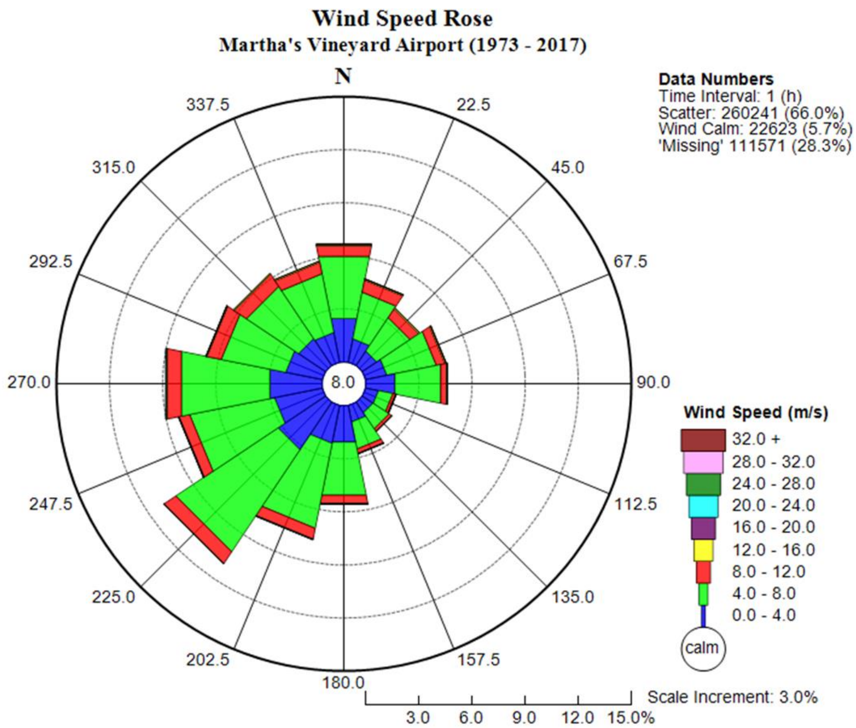


**Figure 4.3: Martha's Vineyard Airport Wind Rose**

## 4.4 Storms

The Lease Area experiences storms both from hurricanes and Nor'easters. Hurricanes develop in the lower latitudes of the North Atlantic Basin and can travel to the Lease Area. According to the NOAA Historical Hurricane Track database, approximately 73 historic tropical storms and hurricanes have passed within 60 NM of the Lease Area since 1851. These storms had storm intensities of tropical storm through Category 3, as measured on the Saffir-Simpson Hurricane Wind scale.

Nor'easters are not included in the NOAA Historic Hurricane Track database since their generation location and characteristics are different from tropical storms and hurricanes. Nor'easter winds typically come from the northeast towards the East Coast of North America. Hurricanes generally occur between June and November, while Nor'easters mostly occur between September and April. Extreme significant wave heights from a variety of hurricanes are summarized in Section 4.5 below and in Table 4.1.

## 4.5 Waves

Sea state data were extracted for a representative location near the Lease Area from the USACE WIS hindcast database at node 63099 (41.00º N, 69.9166º W) located approximately 17 NM (31 km) northward from the Lease Area.

The wave height and direction information for this extraction point is summarized in the wave rose in Figure 4.4. The figure shows that the waves are dominated by seas 3.3-6.5 ft (1-2 m) in height from the southwest to southeast direction with an average significant wave height of approximately 2.6 ft (0.8 m). The wave rose includes hindcast wave data from 1980 – 2019 with over 350,000 hindcast predictions. The node water depth was not available at the time of the database query.

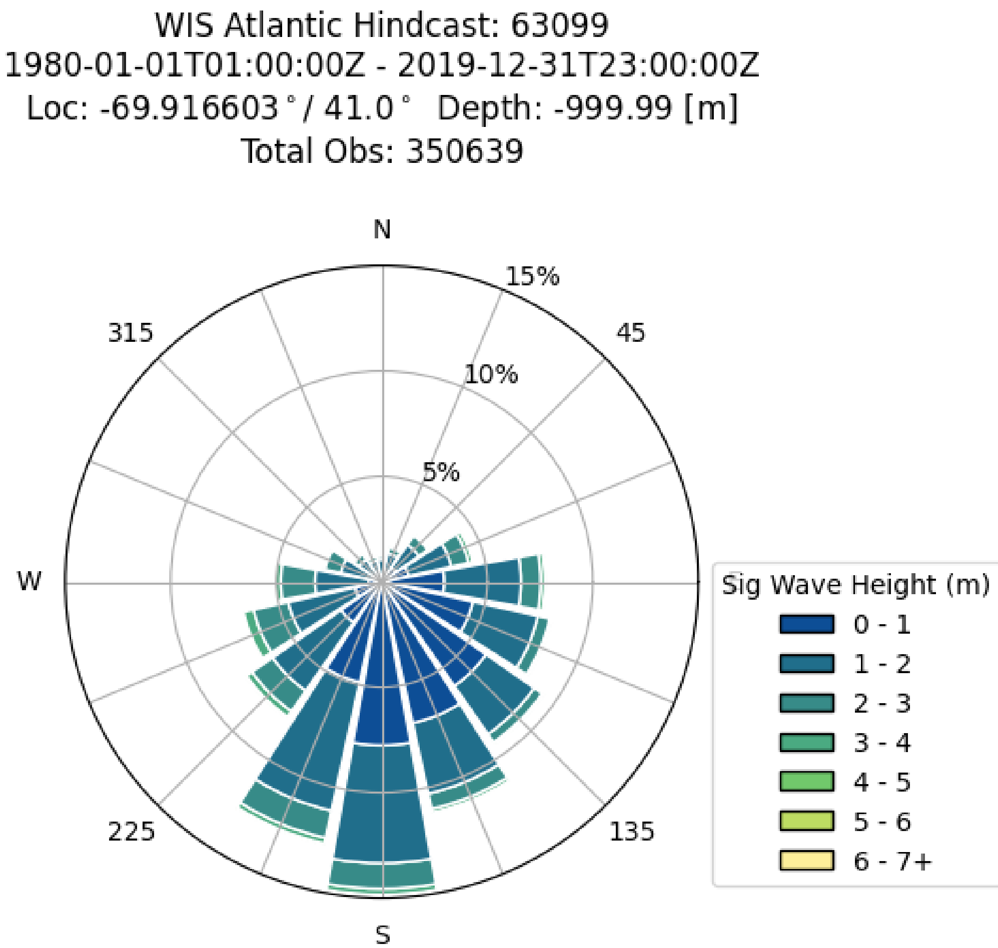


**Figure 4.4: USACE WIS Node 63099 Directional Wave Plot**

Extreme wave conditions in the area are associated with major storms that affect the region. Table 4.1 shows a list of extreme wave conditions recorded at the NOAA-44097 buoy (shown in Figure 4.1) over the past 12 years, along with the storm they were associated with.

**Table 4.1: Extreme Significant Wave Heights recorded at NOAA 44097 Buoy**

| Storm | Date | Wave Height |
|---|---|---|
| Hurricane Earl | 4 September 2010 | 5.6 m (18.4 ft) |
| Hurricane Irene | 28 August 2011 | 9.4 m (30.8 ft) |
| Hurricane Sandy | 29–30 October 2012 | 9.5 m (31.2 ft) |
| Hurricane Joaquin | 2–5 October 2015 | 3.6 m (11.8 ft) |
| Hurricane Florence | 18 September 2018 | <2 m (<6.6 ft) |
| Hurricane Michael | 12 October 2018 | 3.0 m (9.8 ft) |
| Hurricane Dorian | 7 September 2019 | 3.8 m (12.5 ft) |
| Tropical Storm Melissa | 11–13 October 2019 | 5.4 m (17.8 ft) |

While waves can reach heights up to nearly 31.2 ft (9.5 m) during extreme storm conditions, all datasets indicate that waves greater than 6.6 ft (2 m) are rarely seen during normal conditions.

## 4.6 Currents

The OOI Pioneer Inshore Coastal Surface Mooring (Figure 4.1) is located approximately 23 NM (43 km) southeast of the Lease Area situated in 300 ft (91.5 m) water depth. The monitoring station consists of a coastal surface buoy, near surface instrument frame approximately 23 ft (7 m) below the surface, and an instrument platform at the base of the mooring. Mooring configuration and payload are depicted in Figure 4.5. The coastal surface buoy supports a bulk meteorology instrument package as well as conductivity and temperature sensors. The near surface instrument frame is in line with the mooring system and includes single point velocity meter and chemical oceanography monitoring sensors. The multifunction node (MFN) located at the base of the mooring includes a single point velocity meter and velocity profiler as well as chemical and physical oceanographic monitoring sensors.

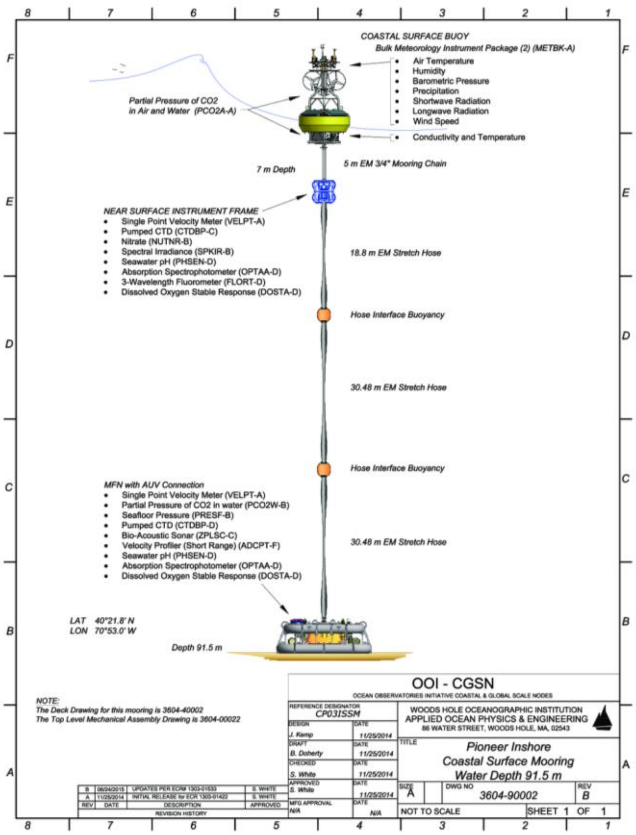


**Figure 4.5: Pioneer Inshore Coastal Surface Mooring (IOOI, n.d.)**

The most relevant sensor for understanding surface currents is the mid column near surface instrument frame using the single point velocity meter located at 23 ft (7 m) water depth. The following plots show the eastward and northward absolute current velocity at this water depth. The observation period includes over 200,000 samples spanning between December 2014 through March 2022.

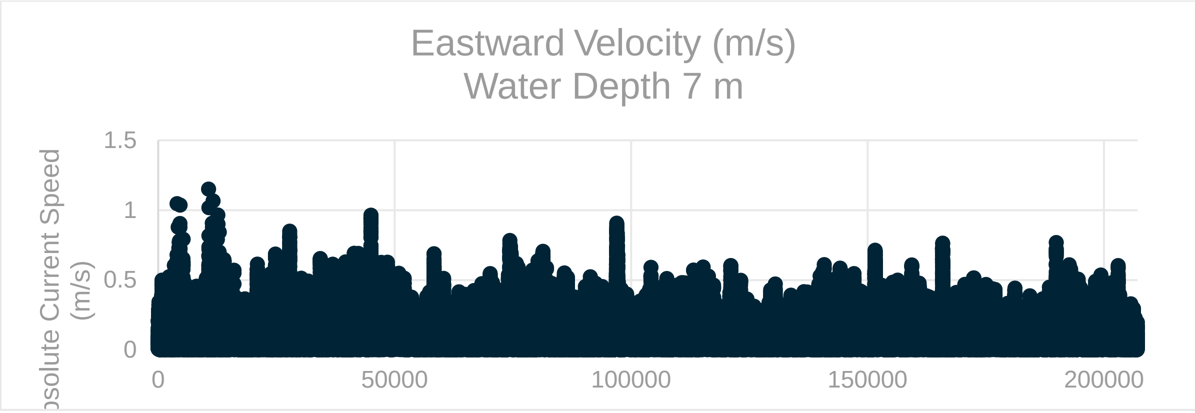


**Figure 4.6: Eastward Velocity at Pioneer Inshore Coastal Surface Mooring**

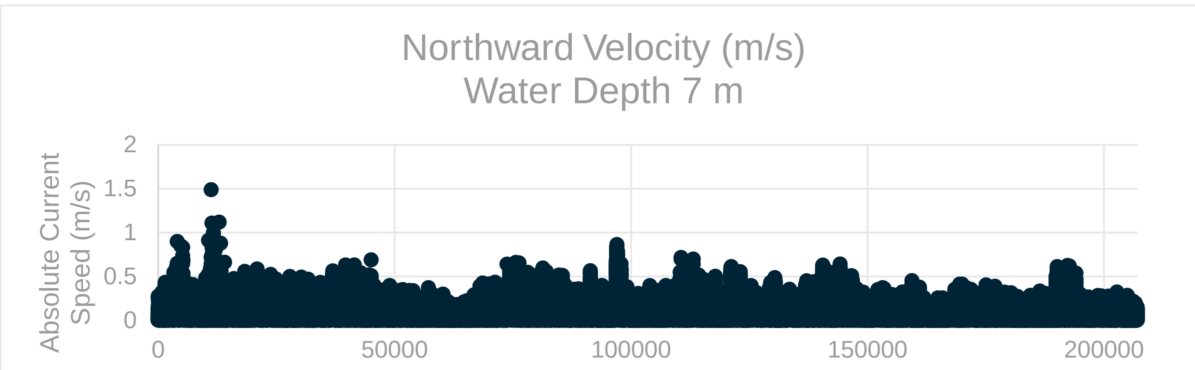


**Figure 4.7: Northward Velocity at Pioneer Inshore Coastal Surface Mooring**

Current speeds at this location are predominantly eastward during quiescent conditions with an average of 0.23 kts (0.12 m/s) and a maximum of 2.24 kts (1.15 m/s) during episodic events. Northward current speeds average 0.17 kts (0.09 m/s) with a maximum of 2.90 kts (1.49 m/s). Maximum current velocity is dependent upon the storm track.

During strong currents, maintaining proper vessel course can become challenging and maneuverability can be impacted. In addition, in the event of equipment failure and subsequent vessel breakdown, near-surface currents will dictate the direction and rate at which vessels will drift. The combination of these affects 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.

The Vineyard Wind 1 Floating Light Detection and Ranging (FLiDAR) metocean buoy was deployed in Lease Area OCS-A 0501 in late May 2018 to acquire measurements of environmental and oceanographic data at 10-minute intervals (with some small intermittent gaps). The buoy was deployed at 41.0732˚ N, 70.4829˚ W, which is approximately 22 NM (41 km) from Lease Area OCS-A 0522 (Figure 4.1). The Nortek Aquadopp Profiler aboard the FLiDAR buoy was used to measure current profiles and are presented at depths of 6.6 ft (2 m), 68.9 ft (21 m), 118.1 ft (36 m), and 128 ft (39 m) in Figure 4.8. As expected from the tidal influence, the current directions follow a strongly bimodal distribution at all depths with an approximate E – W alignment. Mean current speeds vary with depth and are greatest near the 68.9 ft (21 m) mark, at approximately 0.4 kts (0.2

m/s) on average. Currents decrease slightly towards the air-water interface and also decrease to approximately 0.2 kts (0.10 m/s) or less near the bottom.

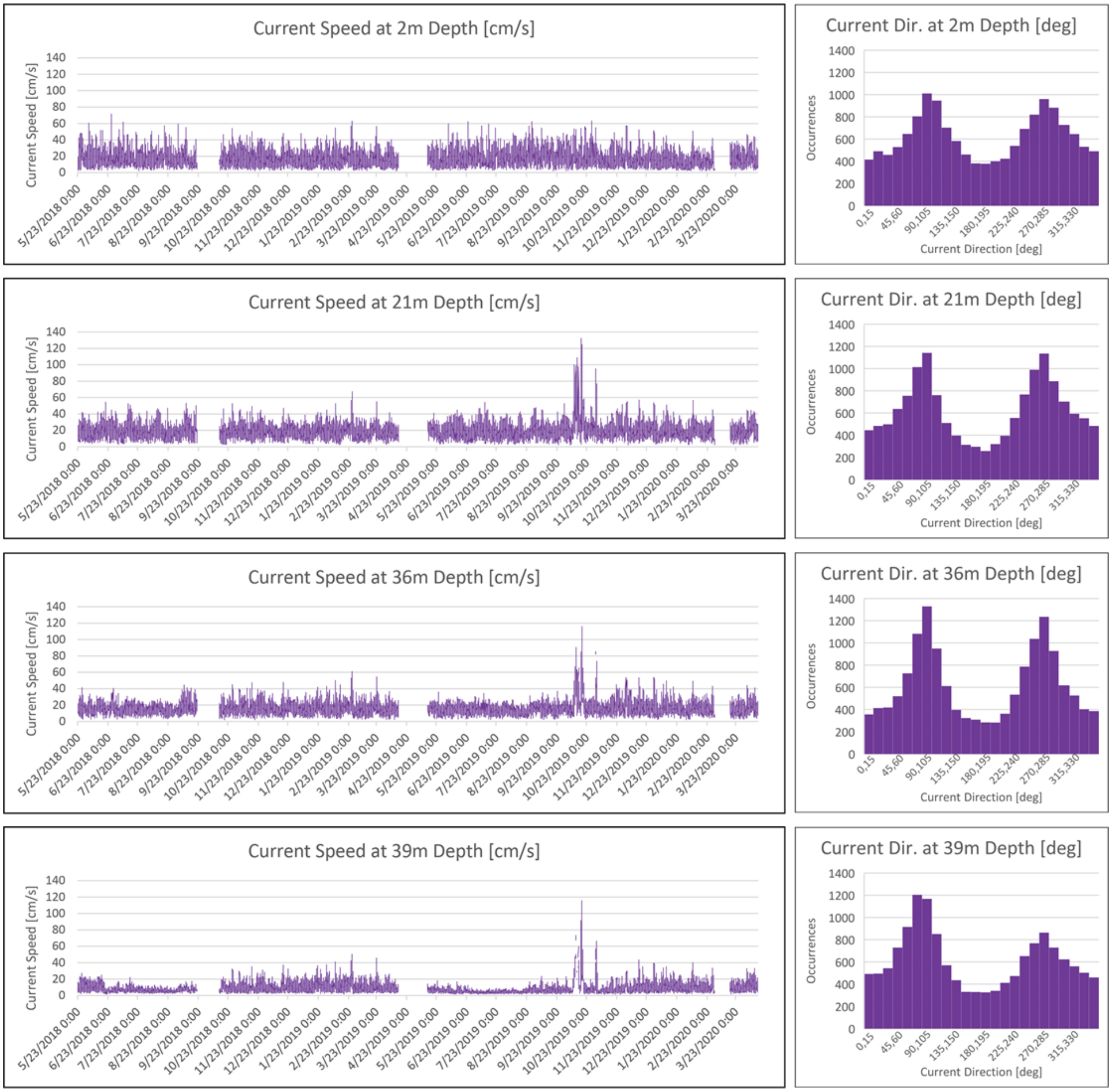


**Figure 4.8: FLiDAR Current Speed and Direction**

Given the size and spacing of the proposed structures there is no anticipated impact on currents in the Lease Area's vicinity. Likewise, there are no anticipated impacts on siltation or scour beyond the proposed scour protection. There is no anticipated impact on the air column, water column, seabed, or sub-seabed in the vicinity of the Lease Area beyond those navigation aspects discussed in this NSRA and the non-navigation related impacts presented in the COP.

## 4.7 Ice

Ice can affect vessel navigation within an offshore wind farm by two means: (1) collision with floating ice; and (2) ice accretion on turbine rotors that is subsequently thrown by means of centrifugal force or simply falls. Both potential ice conditions were considered.

Review of the United States Coastal Pilot Volume 2 (2020) for the areas of Narragansett Bay and Vineyard Sound did not make any mention of the presence of floating ice offshore although there is risk of ice nearshore and within the confines of bays. This was confirmed through examination of Sentinel-2 (Phiri et al. (2020)) satellite imagery from a 5-year period from 2015-2020, which revealed no apparent risk due to ice formation of any form. As such, ice formation in open water is not considered a significant source of navigational risk within the vicinity of the Lease Area.

Under certain meteorological conditions ice accretion may occur on WTG blades, presenting a possible falling ice risk if dislodged/ejected. 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 0°C, relative humidity (RH) was greater than 95%, and when wind speeds were relatively low (<10 kts [5 m/s]). To evaluate this risk, meteorological data from two NDBC ocean buoys (44008, 44017) were obtained. Buoy 44008 is located approximately 69 NM (130 km) east-southeast of the Lease Area and Buoy 44017 is located approximately 71 NM (132 km) west-southwest. Relative humidity data were only available at Martha's Vineyard Airport for a 20-year period.

These datasets are visualized in Figure 4.9 for stations for the two buoys spanning 2000-2019. Points represent hourly observations, with increasing relative humidity (from Martha's Vineyard Airport) along the x-axis, increasing wind speed along the y-axis, and point size and color varying with air temperature. Using this visualization, blue points in the lower right corner represent hours when ice accretion would likely have occurred (wind speeds below 10 kts [5 m/s], air temperatures below 32°F (0°C), and relative humidity above 95%). The analysis indicated only 2 to 3 hours of potential icing for Buoy 44008 and Buoy 44017, respectively, over the 20-year analysis period, which is 0.031% of the observations (note, periods when buoys were not operational were excluded, with these periods included the total time represents 0.0016% of entire analysis period). It was concluded that the risk of ice formation on the turbine rotors is very low in this area.

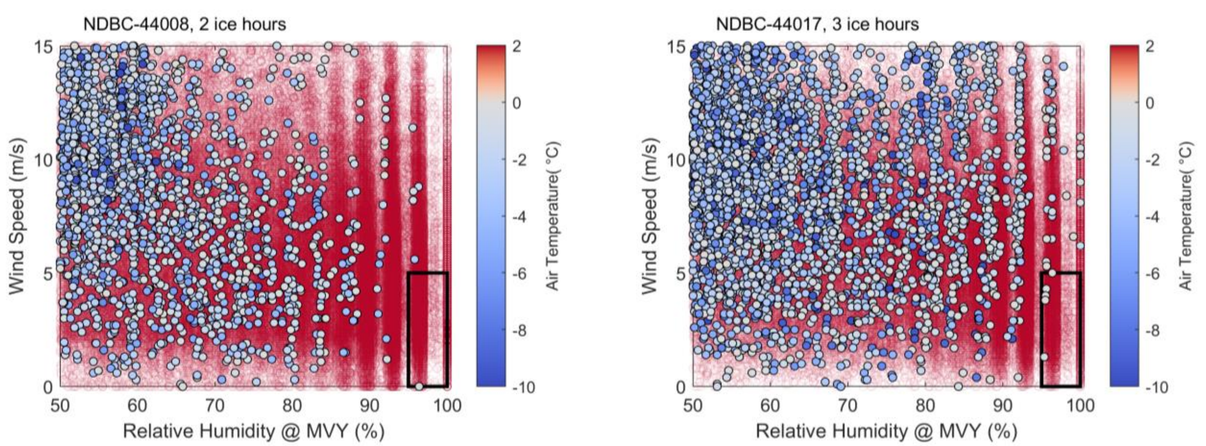


**Figure 4.9: Visualization of Meteorological Conditions at Two Stations**

## 4.8 Visibility

Visibility data measured at Martha's Vineyard airport over the period of 1973 to 2020 were obtained from Iowa State University's Iowa Environmental Mesonet database (IEM, 2020). This is the closest station to the Lease Area and is considered generally representative of the conditions there. Figure 4.10 shows the probability and cumulative probability distributions of visibility observed over this time period. Visibility can reach extremes of less than 0.5 NM (1 km) approximately 8% of the time. The majority of visibility conditions recorded were within the 3.2 to 3.8 NM (6 to 7 km) range, with more adverse conditions occurring approximately half as frequently. A smaller number of readings recorded visibility greater than 3.8 NM (7 km).

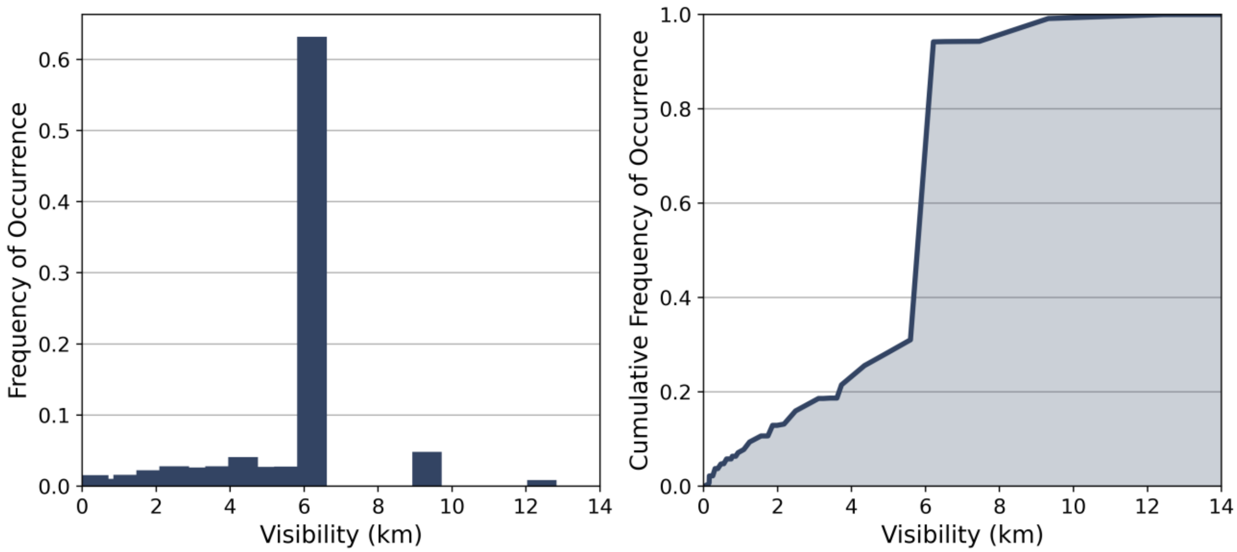


**Figure 4.10: Martha's Vineyard Airport Visibility Conditions (1973 to 2020)**

## 4.9 Tides

Tides within the Lease Area experience semi-diurnal peaks; both the tidal amplitude and resulting tidal currents are key considerations for safe navigation of vessels. Data from the nearest NOAA CO-OPS tidal station (8449130) were extracted to understand the range of tidal conditions within the vicinity of the Lease Area. This tidal station is located on Nantucket Island approximately 25 NM (47 km) northwest of the Lease Area. The full set of tidal constituents for this station is available from the NOAA CO-OPS station page (NOAA Tides & Currents, 2022) which can be used for tidal predictions. Table 4.2 summarizes the tidal conditions at this station, which are considered to be representative of conditions within the Lease Area.

**Table 4.2: NOAA CO-OPS 844910 Tidal Station Summary**

| Station Name | Station ID | Mean Tidal Range | Maximum Spring High Tide | Maximum Recorded Tide |
|---|---|---|---|---|
| Nantucket Island | 8449130 | 3.04 ft (0.92 m) | 3.57 ft (1.09 m) | 4.30 ft (1.31 m) |

Figure 4.11 shows the extreme high and low water levels at this station, and their respective recurrence intervals.

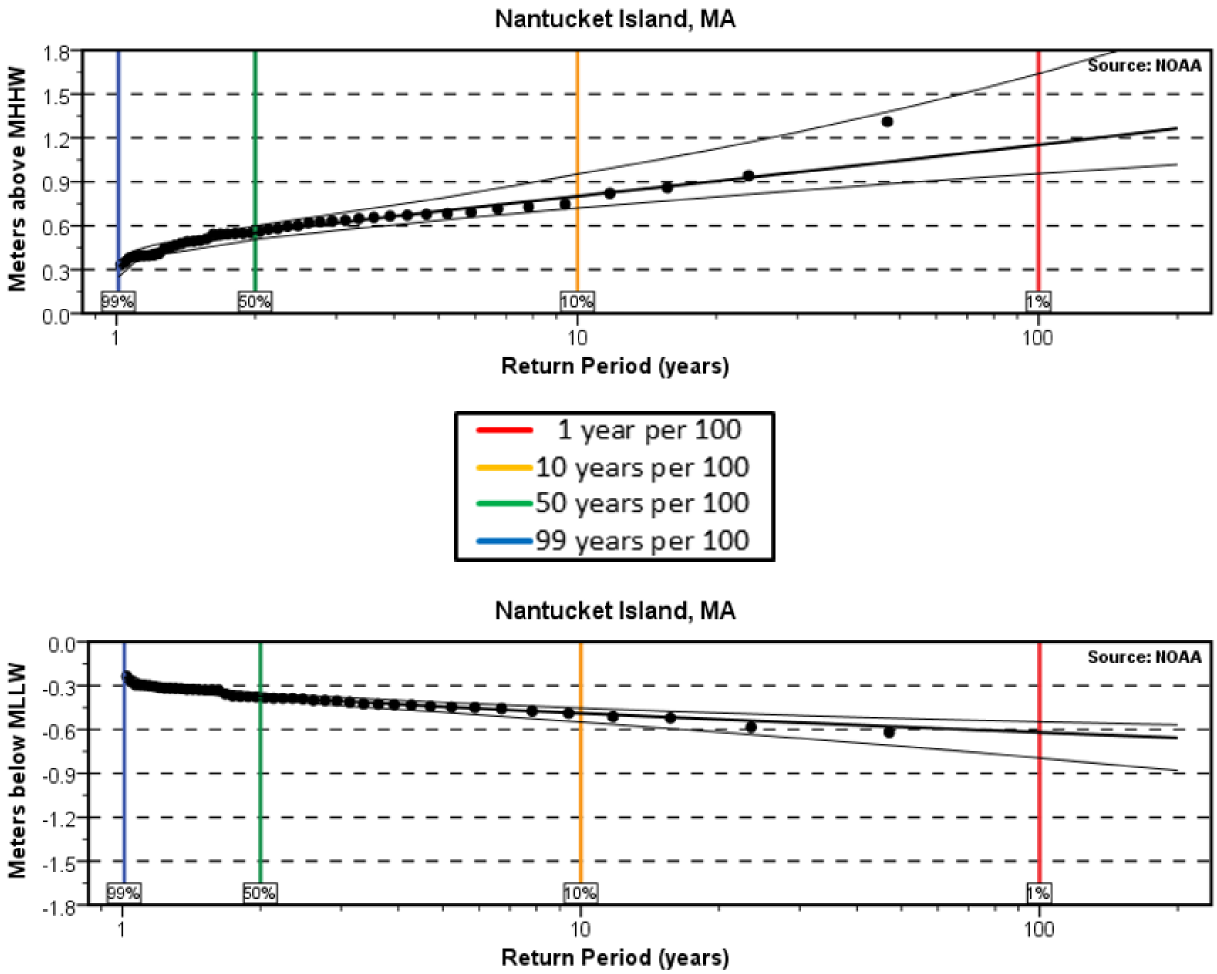


**Figure 4.11: NOAA CO-OPS 844910 Tidal Station Extreme Water Levels (image from NOAA, 2020)**

## 4.10 Summary

An analysis was conducted on environmental data collected from a variety of sources. This effort sought to understand the environmental conditions within the vicinity of the Lease Area, and to identify potential effects on navigational risk. The analysis showed that winds blow predominantly from the southwest quadrant from approximately May to September, and the northwest quadrant from approximately November to March. Maximum wind speeds observed during this period at the 13 ft (4 m) elevation are over 29 kts (15 m/s) with an average of 12.4 kts (6.4 m/s). Wind speeds have historically reached speeds up to 80 kts (41 m/s) at Martha's Vineyard Airport. Waves predominantly approach from the southeast to southwest direction, with an average significant wave height of approximately 2.6 ft (0.8 m). Extreme waves up to 31.2 ft (9.5 m) have been noted to occur near the Lease Area and can be heavily influenced by storm events. Currents in the Lease Area are mainly tidally influenced but can be wind driven near the surface. An analysis into ice patterns in the area showed that open-water ice in any form is not expected to have an impact on navigational risk. Additionally, environmental conditions in the area only met the criteria required for ice accretion on WTG blades for 2 to 3 hours over a 20-year time-period, indicating a very low risk. Data from Martha's Vineyard revealed that the average visibility in the area is approximately 3 to 4 NM (6 to 7 km) and can reach extremes of less than 0.5 NM (1 km) approximately 8% of the time.

In terms of navigational risk, it is expected that the small currents, tidal effects, and ice in any form will be negligible. Waves, winds, and visibility in the vicinity of the Lease Area will influence navigational risk. Adverse wave conditions can pose safety issues for mariners; average wave conditions near the Lease Area may not be of concern but can pose significant issues during extreme weather events. High winds can dictate drifting vessel directions and speeds. Low visibility reduces the ability of operators to respond to potential accident scenarios and increases the overall risk.

# 5. Navigation Impact Assessment

## 5.1 Vineyard Northeast Configuration & Collision Avoidance

### 5.1.1 Visual Navigation

#### 5.1.1.1 Marine Navigational Marking and Lighting

Each WTG, ESP, and booster station (if used) will be permitted as a PATON and appropriate markings, lighting, and signaling will be installed in accordance with USCG's *ME, NH, MA, RI, CT, NY, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance*[24] and the BOEM *Guidelines for Lighting and Marking Structures Supporting Renewable Energy Development* (BOEM 2021). Per USCG guidance, the Proponent will include unique alphanumeric identifiers on each WTG, ESP, and booster station; alphanumeric marking of structures is expected to be consistent across the MA WEA and RI/MA WEA Lease Areas. All PATONs will meet USCG availability standards and will be maintained throughout the life of Vineyard Northeast, including maintaining procedures to correct any discrepancies. The Proponent will provide required information to USCG and/or NOAA to add the WTGs, ESP(s), booster station (if used), OECCs, and all associated PATONs to appropriate navigation charts.

Based on current USCG, BOEM, and Federal Aviation Administration (FAA) guidance, the following lighting, marking, and signaling requirements are expected; however, all structures will be marked and lit in accordance with USCG, BOEM, and FAA guidance in effect at the time Vineyard Northeast is being constructed and operated. The Proponent expects to provide a detailed lighting, marking, and signaling plan to BOEM, the Bureau of Safety and Environmental Enforcement (BSEE), and USCG prior to construction of the offshore facilities. The plan would provide detailed information on the lighting, marking, and signaling of the WTGs, ESP(s) (including co-located ESPs, if included in the final design of Vineyard Northeast), and the booster station (if included in the final design).

Structure Color:

- Each WTG will be no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey in color; the Proponent anticipates that the WTGs will be painted off-white/light grey to reduce their visibility against the horizon. The ESP and booster station topsides are expected to be light grey in color.
- Visible portions of each foundation above the waterline are expected to be coated in high-visibility yellow paint.

Structure Identification Marking:

- Each structure (i.e., WTG, ESP, booster station) will be uniquely lettered and numbered in an organized pattern of rows and columns
- Letters and numbers on the WTG tower will be as near to 3 m high as possible
- Letters and numbers on the ESP(s) and booster station will be as near to 1 m high as possible
- Identification markings will be visible above any servicing platforms (e.g., transition piece platform)
- Structures will also be labelled below the servicing platform, if feasible
- Identification markings will be visible throughout a 360-degree arc from the water's surface

[24] USCG's PATON guidance for offshore wind energy structures in First District-area waters is periodically updated in District 1 Local Notice to Mariners (LNMs).

- Identification markings on each WTG nacelle will be visible from above
- Identification markings will also be visible at night through use of retro-reflective paint and lettering/numbering materials

Structure Lighting:

- Lighting will be located on all structures, preferably on the servicing platform, visible throughout a 360-degree arc from the water's surface
- WTGs and ESP(s) designated as Significant Peripheral Structures (SPSs) (i.e., located at corners or other significant points on the periphery of the wind farm) will be lighted with quick flashing yellow (QY, 0.3s on/0.7s off, 60 flashes per minute) lights energized at a 5 NM range
- Other WTGs or ESP(s) along the outer boundary will be lighted with yellow 2.5 second (FL Y 2.5s, 1.0s on 1.5s off, 12 flashes per minute) lights energized at a 3 NM range
- All remaining, interior WTGs and ESP(s) will be lighted with yellow 6 second (FL Y 6,1.0s on 5.0s off, 10 flashes per minute) or yellow 10 second (FL Y 10, 1.0s on 9s off, 6 flashes per minute) lights energized at a 2 NM range
- All lights will be synchronized by their structure location within the field of structures

Sound Signals:

- Sound signals will be located on all structures designated as SPSs.
- Sound signals will sound every 30 seconds (4 second Blast, 26 seconds off)
- Sound signals will be set to project at a range of 2 NM
- Sound signals will not exceed 3 NM spacing
- Sound signals will be MRASS activated by keying VHF Radio frequency 83A five times within 10 seconds
- Sound signals will be timed to energize for 45 minutes from the last VHF activation

If Vineyard Northeast includes a booster station, which would be located adjacent to the Vineyard Wind 1 project, the Proponent would coordinate with Vineyard Wind 1 to ensure that the booster station's lighting, marking, and signaling scheme is compatible with the lighting, marking, and signaling scheme for Vineyard Wind 1 including use of MRASS.

#### 5.1.1.2 Aviation Obstruction Lighting

The WTGs will include an aviation obstruction lighting system in compliance with FAA (2017, 2019, and 2020) and/or BOEM (2021) requirements. The aviation obstruction lighting system will consist of two synchronized FAA L-864 red flashing aviation obstruction lights placed on the nacelle of each WTG. If the WTGs' total tip height is 699 ft (213 m) or higher, there will be at least three additional low intensity L-810 flashing red lights on the tower at a point approximately midway between the top of the nacelle and sea level. If approved by BOEM and the FAA, 30 flashes per minute will be utilized for air navigation lighting. Other temporary lighting (e.g., helicopter hoist status lights) may be utilized for safety purposes when necessary.

The Proponent is working to reduce lighting to lessen the potential impacts of nighttime light on migratory birds and to address potential visual impacts. The Proponent expects to use an Aircraft Detection Lighting System (ADLS) that automatically activates all aviation obstruction lights (any FAA lights on both the nacelle and tower) when aircraft approach the WTGs, subject to BOEM approval. A report on how often the ADLS would likely be activated is included in Appendix II-I of the COP for informational purposes. If the use of ADLS is not approved, reduced lighting schemes will be reviewed and discussed with BOEM. Aviation concerns are further discussed in Section 5.7 of COP Volume II.

If an ESP or booster station exceeds an overall height of 200 ft (61 m) above ground level/above mean sea level or exceeds any obstruction standard contained in 14 CFR Part 77, the structure will include an aviation obstruction lighting system in compliance with FAA and/or BOEM requirements. If approved by BOEM and the FAA, 30 flashes per minute will be utilized for air navigation lighting. Subject to BOEM approval, the aviation lights on the ESP(s) and booster station will also be activated by ADLS. Other temporary lighting (e.g., helipad lights) may be utilized for safety purposes when necessary.

#### 5.1.1.3 AIS Marking

AIS systems are used to collect, exchange, present, and analyze information onboard vessels and ashore by electronic means. All Vineyard Northeast related vessels will be equipped with operational AIS. AIS transponders are also included in the design of offshore structures (WTGs, ESP(s), booster station) where appropriate to enhance marine navigation safety. These AIS markers would supplement the information on the electronic chart and/or radar overlay. AIS markers will be used to mark all WTGs, ESP(s), and the booster station (if used) and can be viewed on an electronic chart display and information system (ECDIS), radar overlay, or a minimum keyboard and display (MKD). The addition of AIS markers will supplement the radar overlay; however, it should be noted that not all vessels have the capacity to receive AIS data and hence, physical aids to navigation would also be employed as described above. The following outlines the AIS reporting all structures based on current USCG guidance, which may be modified by the time Vineyard Northeast becomes operational:

- AIS devices will be Federal Communications Commission (FCC) certified
- AIS transponder signals will be transmitted superimposed at all SPSs
- AIS transponders will be capable of transmitting signals to mark all locations of all structures throughout Vineyard Northeast
- AIS transponder specifics will be coordinated with the USCG District 1 and approved by USCG headquarters level (CG-NAV)

Subject to USCG's recommendations, the AIS marker system could be installed prior to construction of the turbines in order to facilitate adaption of the changed navigational approach in the Lease Area. AIS systems operate on VHF frequency band. Vessels that are equipped and using Class B AIS systems could be recommended to have dual channel receivers to improve the reliability of frequent AIS data updates from multiple targets in the range of reception.

Based on a review of various studies conducted for existing offshore wind fields, and as discussed further in Section 5.1.2.1, the Vineyard Northeast WTGs are expected to have little impact on VHF and digital select calling (DSC) communications or AIS reception.

#### 5.1.1.4 Visual Navigation Impacts

The WTGs, ESP(s), and booster station will result in a degree of visual blockage for objects or vessels that lie directly beyond and opposite (i.e., behind) the structure from the viewer. The size of object or vessel fully obscured depends on the relative distance between the visual obstruction and both the viewing vessel and the obscured vessel (Figure 5.1). Tables of the maximum size of object fully obscured, as well as the maximum amount of time a 45 ft vessel is fully obscured, are presented in Table 5.1 through Table 5.4 for WTGs with both monopile and piled jacket foundations as well as ESP(s) and booster station with piled jacket foundations. It is noted that jacket foundations have large amounts of open space between structural members and would result in an object being partially obscured rather than fully obscured. This analysis presumes that the line of sight is perpendicular to the viewing vessel's direction of travel, that the viewing vessel is traveling at 8 kts, and that the object being sighted is stationary.

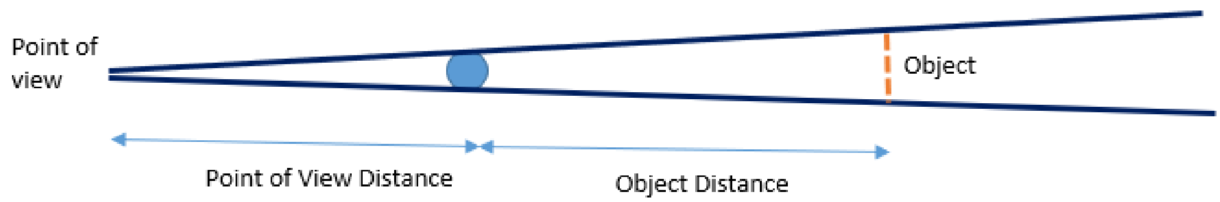


**Figure 5.1: Visual Blockage Conceptual Diagram**

**Table 5.1: Visual Blockage Object Size and Time 45 ft Vessel is Fully Obscured at 8 kts Speed for WTG Monopile Foundations**

| **Size of Object Blocked (ft)** | | | |
|---|---|---|---|
| | Object Distance (ft) | | |
| Point of View Distance (ft) | 500 | 1000 | 1500 |
| 500 | 82 | 123 | 164 |
| 1000 | 62 | 82 | 103 |
| 1500 | 55 | 68 | 82 |
| **Time 45 ft Vessel is Fully Obscured at 8 kts (s)** | | | |
| | Vessel Distance (ft) | | |
| Point of View Distance (ft) | 500 | 1000 | 1500 |
| 500 | 3 | 6 | 9 |
| 1000 | 1 | 3 | 4 |
| 1500 | 1 | 2 | 3 |

**Table 5.2: Visual Blockage Object Size and Time 45 ft Vessel is Partially Obscured at 8 kts Speed for WTG Piled Jacket Foundations**

| **Size of Object Blocked (ft)** | | | |
|---|---|---|---|
| | Object Distance (ft) | | |
| Point of View Distance (ft) | 500 | 1000 | 1500 |
| 500 | 479 | 719 | 958 |
| 1000 | 359 | 479 | 599 |
| 1500 | 319 | 399 | 479 |
| **Time 45 ft Vessel is Partially Obscured at 8 kts (s)** | | | |
| | Vessel Distance (ft) | | |
| Point of View Distance (ft) | 500 | 1000 | 1500 |
| 500 | 32 | 50 | 68 |
| 1000 | 23 | 32 | 41 |
| 1500 | 20 | 26 | 32 |

**Table 5.3: Visual Blockage Object Size and Time 45 ft Vessel is Partially Obscured at 8 kts Speed for ESP Piled Jacket Foundations**

| **Size of Object Blocked (ft)** | | | |
|---|---|---|---|
| | | Object Distance (ft) | |
| Point of View Distance (ft) | 500 | 1000 | 1500 |
| 500 | 1247 | 1870 | 2493 |
| 1000 | 935 | 1247 | 1558 |
| 1500 | 831 | 1039 | 1247 |
| **Time 45 ft Vessel is Partially Obscured at 8 kts (s)** | | | |
| | | Vessel Distance (ft) | |
| Point of View Distance (ft) | 500 | 1000 | 1500 |
| 500 | 89 | 135 | 181 |
| 1000 | 66 | 89 | 112 |
| 1500 | 58 | 74 | 89 |

**Table 5.4: Visual Blockage Object Size and Time 45 ft Vessel is Partially Obscured at 8 kts Speed for Booster Station Piled Jacket Foundations**

| **Size of Object Blocked (ft)** | | | |
|---|---|---|---|
| | | Object Distance (ft) | |
| Point of View Distance (ft) | 500 | 1000 | 1500 |
| 500 | 768 | 1152 | 1535 |
| 1000 | 576 | 768 | 960 |
| 1500 | 512 | 640 | 768 |
| **Time 45 ft Vessel is Partially Obscured at 8 kts (s)** | | | |
| | | Vessel Distance (ft) | |
| Point of View Distance (ft) | 500 | 1000 | 1500 |
| 500 | 54 | 82 | 110 |
| 1000 | 39 | 54 | 68 |
| 1500 | 35 | 44 | 54 |

As described in Section 2.6.4.1, there are no USCG maintained ATONs within the Lease Area. The closest lighthouse to the Lease Area is the Sankaty Lighthouse, located on Nantucket Island. However, the lighthouse visibility range is significantly less than the distance to the Lease Area, and it is expected that Sankaty Lighthouse would not be visible at sea level at any location within the Lease Area.

### 5.1.2 Communications, Radar, & Positioning System Impacts (incl. electromagnetic & noise)

WTGs, ESP(s), booster station, and offshore cables may theoretically distort various types of electromagnetic signals (PIANC 2018) including:

- Radio communications, such as VHF radio;
- AIS;
- Radar systems;
- Global Navigation Satellite Systems (GNSS); and
- Magnetic navigation systems.

The potential effects of Vineyard Northeast on these various systems are discussed in this report section.

#### 5.1.2.1 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. 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 5.5 for a partial listing).

**Table 5.5: 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, DSC operates in the VHF range. Along with other capabilities, 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 Global Positioning System (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.

#### 5.1.2.2 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 5.2 shows the coverage map for the Cape Cod 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.

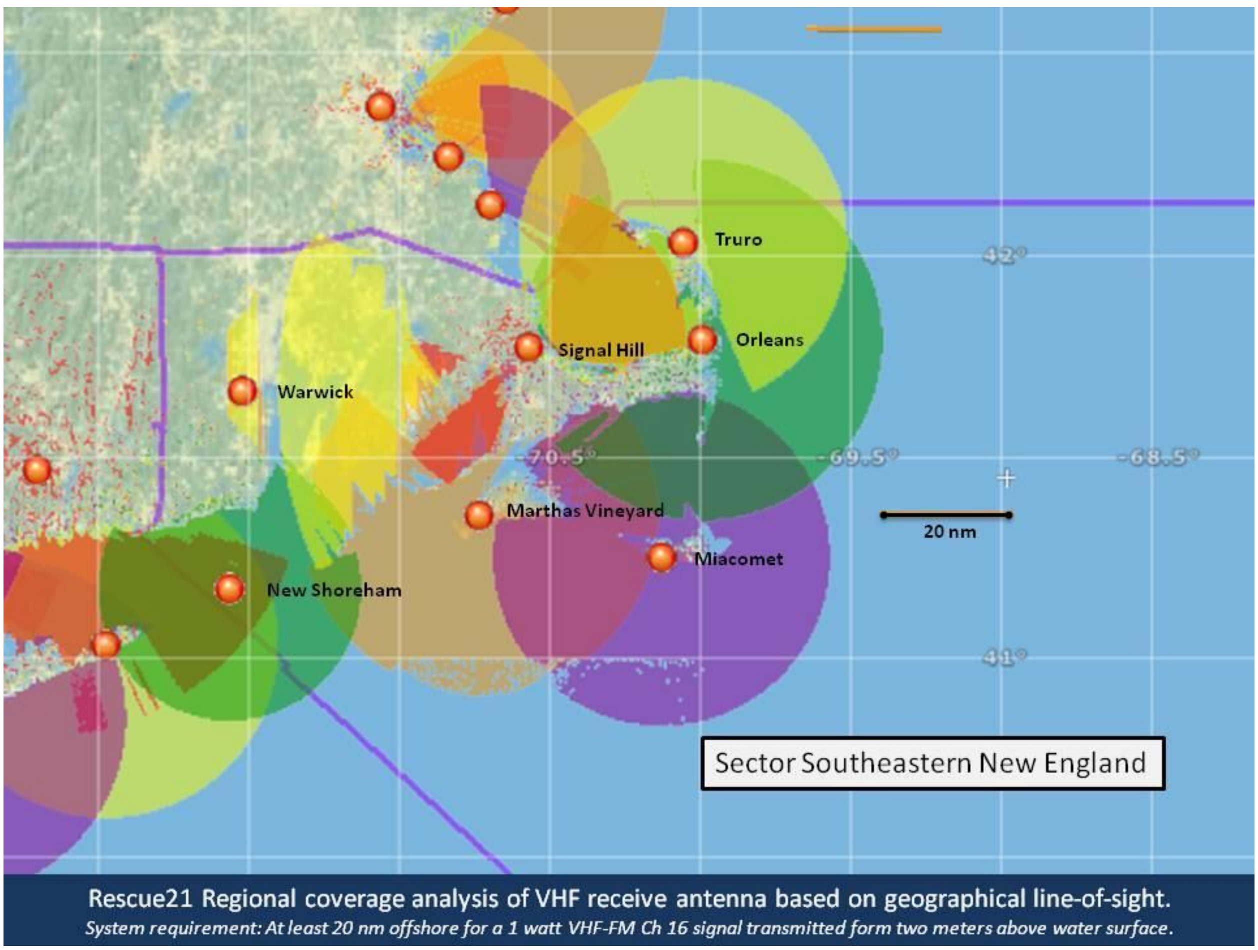


Figure 5.2: Rescue 21 Coverage Map (USCG NAVCEN)

#### 5.1.2.3 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 be in 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 only 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, ESP(s), or the booster station 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 did identify 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.

As part of the recent MARIPARS (USCG 2020a), the USCG reviewed several studies related to WTG-induced radar interference and concluded that they were not aware of any authoritative scientific study that confirms or refutes the concern that WTGs will degrade marine radar. It was noted that mariners traveling near or within the WEA "should use extra caution, ensure proper watch and assess all risk factors."

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 2022 the National Academy of Sciences, Engineering, and Medicine published the *Wind Turbine Generator Impacts to Marine Vessel Radar* (NASEM, 2022) which provides a comprehensive overview of marine radar impacts and lays out potential mitigation measures as well as providing recommendations for further work.

In summary, it appears likely that Vineyard Northeast project, as with many other similar facilities around the world, may have an impact on certain marine radar systems. The principal 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 south 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, ESP(s), and booster station, as well as the use of AIS and MRASS as per USCG requirements will help mitigate potential allision risk due to the presence of Vineyard Northeast offshore facilities.

#### 5.1.2.4 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. 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 simultaneously block signals from a significant number of satellites visible in the sky. Thus, it is not anticipated that the WTGs will adversely affect GNSS.

#### 5.1.2.5 High Frequency Radar for Current Measurement

NOAA maintains a network of high-frequency radar stations along the coastline, which are capable of measuring currents and wave heights offshore, an example of which is shown in Figure 5.3. These radars can measure currents over a large region of the coastal ocean, from a few miles offshore up to about 60 NM (111 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 SAR planning systems.

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 wind turbines on the doppler shifts used to measure currents and wave heights. However, it is possible that the known interference effects can be partially or fully addressed with additional filtering and software improvements. BOEM sponsored research has recently been completed

(Trockel et al 2021) to address and develop mitigations for WTG impacts on high frequency radar systems used for oceanographic measurements.

As part of the COP assessments, Westslope Consulting performed additional analysis on the potential impacts on HF Radar sites which have previously been operational in the project vicinity. Their analysis and a list of potential mitigation options is presented in COP Appendix II-H.

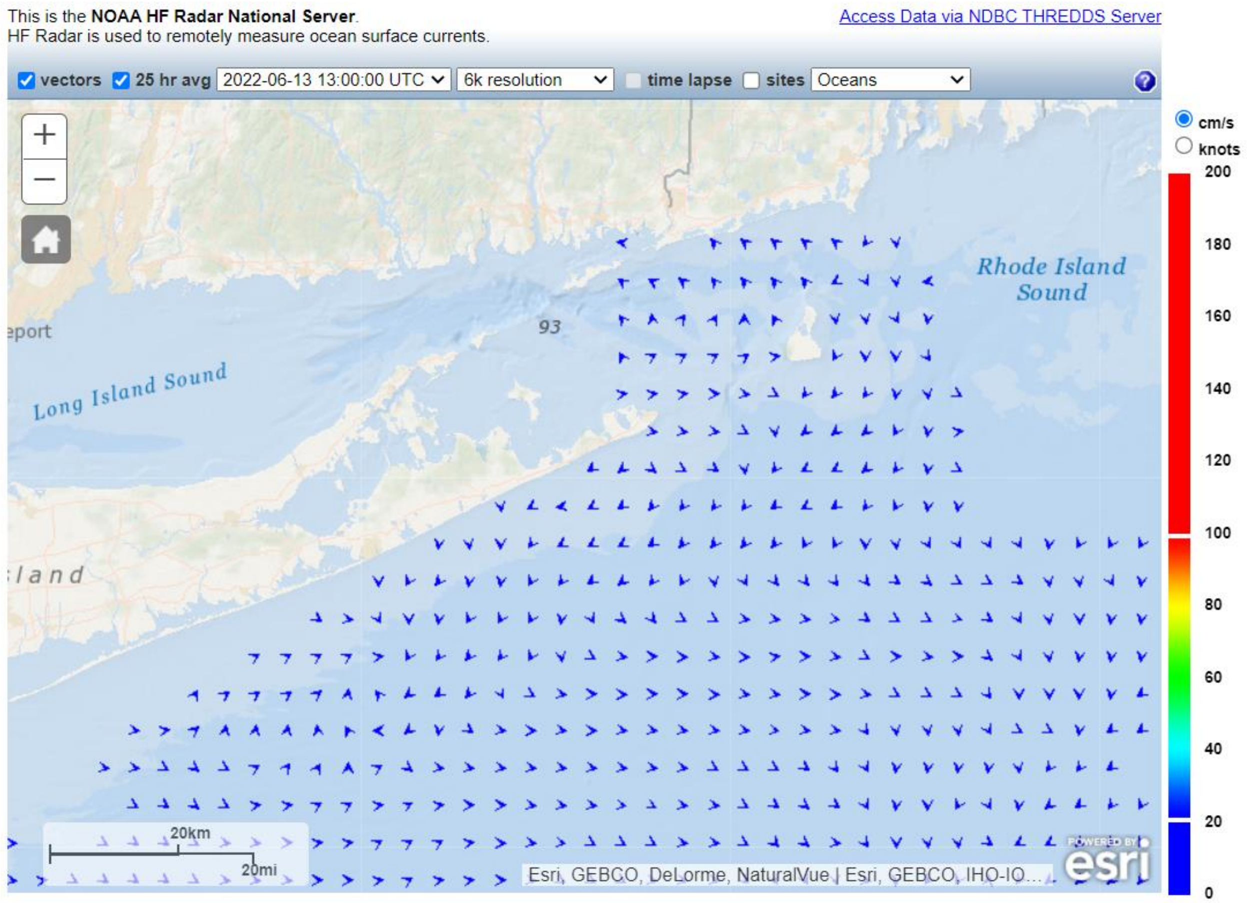


**Figure 5.3: Example of Current Fields from HF Radar Output**

### 5.1.2.6 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.

#### 5.1.2.7 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 underwater 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.

#### 5.1.2.8 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 OECCs 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 target cable burial depth of 5 to 8 ft (1.5 to 2.5 m) below the stable seabed.

The effect of EMFs is expected to be negligible.

### 5.1.3 Risk to Vessels Under Sail

Potential impacts from Vineyard Northeast on sailing vessels, beyond the air draft and other impacts described in the sections above, 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.

### 5.1.4 Effect on Anchoring

There will not be any impediment to vessels anchoring within the Lease Area other than the presence of the WTGs, ESP(s), and booster station (and associated scour protection) and limited placement of cable protection (conservatively estimated to occur along up to approximately 2% of the total length of the export, inter-array and inter-link cables within the Lease Area). The WTG and ESP spacing allows ample space for emergency anchoring of vessels between the structures, including allowance for an anchor sweep radius. All inter-array, inter-link, and offshore export cables will be buried beneath the stable seafloor at a target depth of 5 to 8 ft (1.5 to 2.5 m).[25] The Proponent's engineers have determined that this target burial depth is more than twice the burial depth required to protect the cables from fishing activities and also generally provides a maximum of 1 in 100,000 year probability of anchor strike,[26] which is considered a negligible risk.

[25] Unless the final CBRA indicates that a greater burial depth is necessary and taking into consideration technical feasibility factors, including thermal conductivity.
[26] Based on a preliminary CBRA, in portions of the Ocean Beach Approach and Eastern Point Beach Approach of the Connecticut OECC, a greater target burial depth of approximately 3 m (10 ft) is needed to achieve a 1 in 100,000 year probability of anchor strike.

### 5.1.5 Proximity to Dredge Disposal Sites

There are no active dredge material placement areas in proximity to the Lease Area for which dredge navigation would be affected by the WTGs or ESP(s). The nearest ocean disposal site for dredged material is located east of Block Island, approximately 56 NM (103 km) northwest from the Lease Area.

### 5.1.6 Vessel Emissions

The Lease Area is located within the North American Emission Control Area (ECA). More stringent emission and fuel sulfur content standards apply to ships operating within the North American ECA, which extends approximately 200 NM from the US coastline. Fuel switching activities to comply with the North American ECA fuel standards would occur at the ECA boundary well outside of the Lease Area. Thus, there are no anticipated effects resulting from changes in emission/fuel standards upon entering the North American ECA on vessel traffic patterns or collision/allision risks in the Offshore Development Area.

### 5.1.7 Temporary Safety Zones

The Proponent may request that the USCG establish temporary safety zones under authority of 33 CFR 147 around work areas during construction, maintenance, and/or decommissioning activities. Temporary safety zones are used to help ensure safety within the vicinity of active work areas. These zones would only affect discrete portions of the Lease Area at any given time. See Section 8.1.1 for a description of temporary safety zones.

# 6. Risk of Collision, Allision, or Grounding

A quantitative navigational safety risk assessment was conducted for the Lease Area. The analysis was carried out for both the pre-construction and operational (post-construction) phases of Vineyard Northeast, to determine the impact and relative change in navigational risk due to the installation of the WTGs and ESP(s). The navigational safety risk assessment was carried out using Baird's proprietary Navigational and Operational Risk Model (NORM); refer to 0 for a more detailed outline of the model capabilities and methodology.

## 6.1 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, bathymetry data, navigational charts, metocean conditions, and fixed structure information (i.e., WTGs, platforms, etc.) 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 equation below:

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

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 vessels are 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 such as 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.

## 6.2 Accident Scenarios

The navigational safety risk assessment was carried out for three main categories of accident scenarios: vessel grounding, vessel collisions, and vessel allisions with WTGs and ESP(s). The booster station, which is in Lease Area OCS-A 0534, was previously modeled as part of the NSRA for New England Wind and the results are discussed in Section 6.8. Collisions are further broken down into head-on, overtaking, and crossing collisions. Allisions and groundings are further broken down into powered and drifting categories. 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.

## 6.3 Study Area

To perform the navigational safety risk assessment, the study area was carefully chosen to only contain traffic that may be affected by the WTG and ESP positions. 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 WTG/ESP position, resulting in an underestimation of the change in navigational risk. If an overly small area is chosen, the analysis may only consider vessels that are affected by the WTG/ESP position, biasing the model results towards an overestimation of the change in navigational risk.

The study area used for the navigational safety risk assessment is shown in Figure 6.1. The study area encompasses an approximately 10 NM (19 km) region around the Lease Boundary and was enlarged in the southward-direction to include the traffic separation zone to the south of the Lease Area. As mentioned above, this area was chosen to best capture only the vessel traffic that may be appreciably affected by the installation.

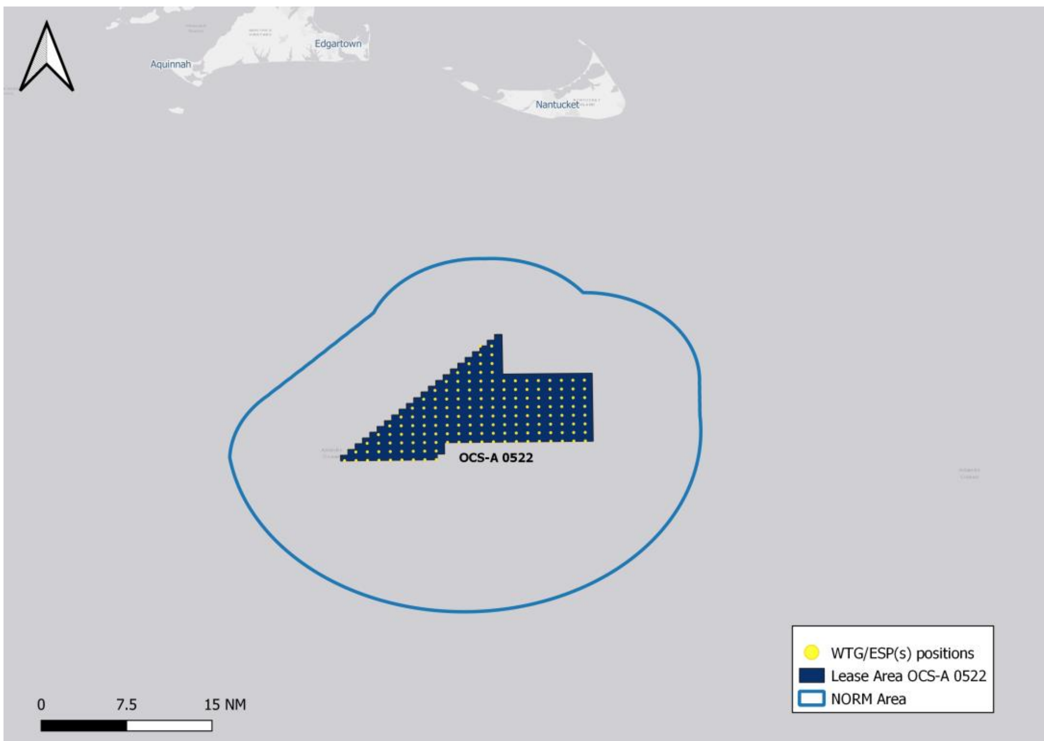


**Figure 6.1: NORM model area**

## 6.4 AIS Traffic Inputs

NORM makes use of AIS inputs to analyze vessel and traffic patterns and characteristics and is also used to develop statistical relationships used for the risk calculations. For this study, the same set of AIS data was used (Section 2.6.2) from 2016 through September of 2021, clipped to the extents of the NORM area (Figure 6.1). The AIS data was processed and analyzed to determine statistics and distributions of vessel/traffic characteristics within the NORM study area (i.e., length, beam, speed, annual volume, etc.) as well as to determine the range and distribution of track characteristics (i.e., track 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 (0). 0 outlines NORM's usage of AIS data in further detail.

## 6.5 Metocean Inputs

### 6.5.1 Winds

The distribution of near surface current winds and directions are correlated to drifting vessel directions and are used in the drifting allision risk calculations. Near surface wind speeds and directions were extracted from the Mayflower Wind LiDAR tower that was provided to Baird from Geo SubSea consulting. Wind data and directions distributions were calculated for the period between April 2020 to March 2021 (Section 4.3).

### 6.5.2 Visibility

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%.

The visibility conditions were obtained from Iowa Environmental Mesonet (IEM) system for the Nantucket station ("ACK") from 2019-01-01 to 2021-12-31. Based on this data and the research, a visibility multiplier factor of two was used in all NORM modeling scenarios.

## 6.6 GIS and Geometric Inputs

To calculate the navigational risk in the presence of the constructed WTGs and ESP(s), GIS layers of the WTG and ESP positions were used as inputs for the NORM. The positions of the WTGs and ESP(s) and the corridors between the positions are detailed in Section 3.

For modeling purposes, three representative ESP(s) are located within the Lease Area to provide a conservative estimate of risk from ESP installation. The three ESPs are presumed to be two co-located ESPs at the southeast end of the Lease Area and one ESP at the northern edge of the Lease Area as shown in Figure 6.2.

A dimensional range of 42.65 ft (12.5 m) to 624 ft (190.0 m) in width was assumed to encompass the range of maximum sizes for the different WTG/ESP foundation types. Monopiles for WTGs have a maximum diameter at the waterline of 42.65 ft (12.5 m) while the max dimension of piled jacket for WTGs on the diagonal is 73 m. Monopiles for ESPs have a maximum dimension at the waterline of 12.5 m whereas piled jackets for ESP(s) have a maximum dimension (on the diagonal) of 624 ft (190.0 m) at the waterline. (Note, this is based on a cylinder with a diameter of 624 ft [190 m] at the waterline being circumscribed around the rectangular footprint of the jacket structure.)

For the NORM area, the National Center for Environmental Information's U.S. Coastal Relief Model Vol.1-Northeast Atlantic was used to provide elevations for grounding calculations.

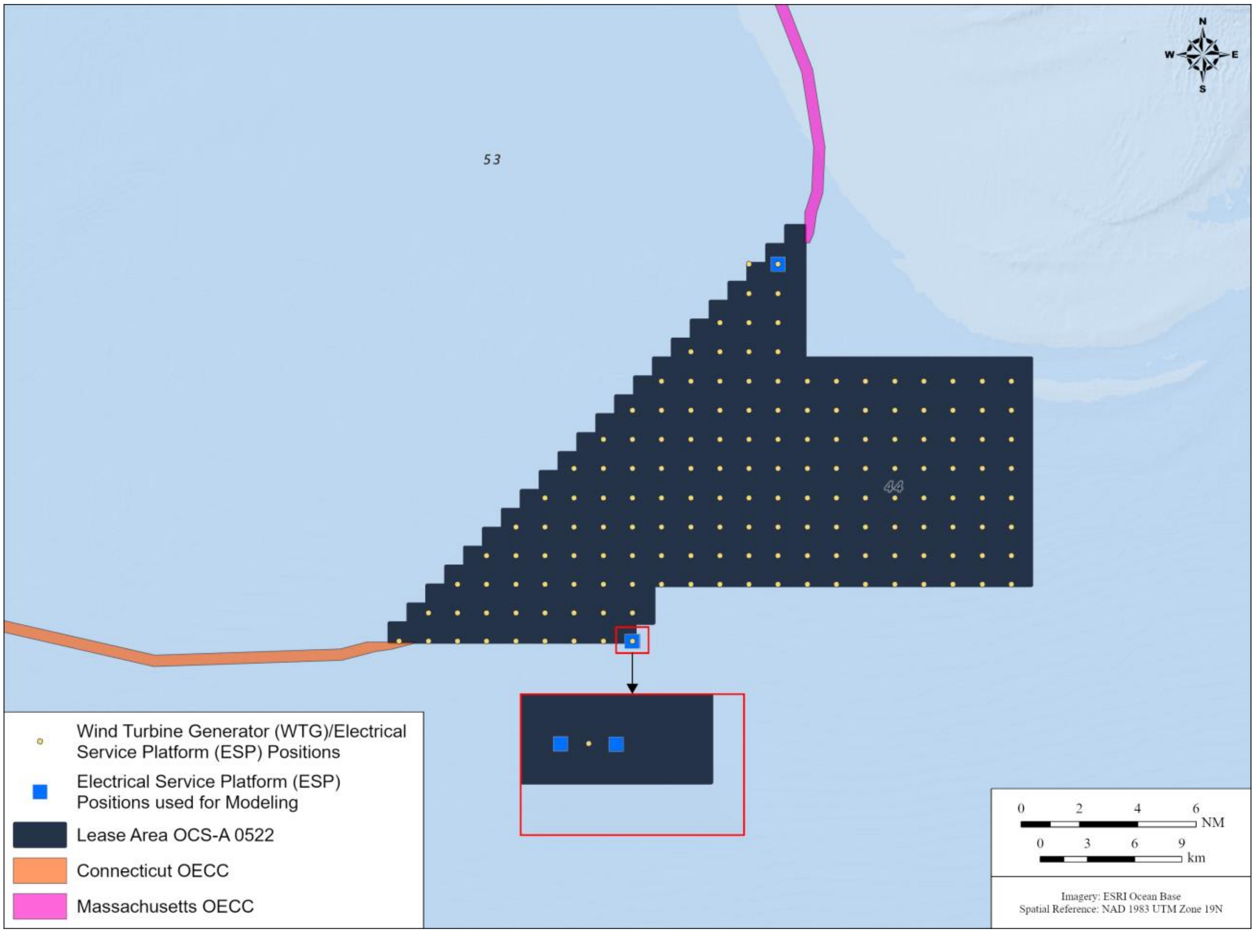


**Figure 6.2: Representative locations of the three ESPs used in the risk modeling**

## 6.7 Data Adjustments and Assumptions

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., length, beam, speed, etc.), the 50% percentile value recorded 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.

As part of NORM's capabilities, an inter-class overtaking calculation is performed. This calculation would then essentially have two representative vessels of the same type traveling at the same speed, resulting in a null risk of overtaking collision. To account for this limitation, it was assumed that in this situation one of the vessels would be traveling at 50% of the speed of the other.

In the NORM area, there are potential encounters between vessels from various angles. To separate parallel/opposing encounters from oblique encounters (i.e., potential head-on and overtaking collisions from crossing collisions), a crossing angle threshold of 10 degrees was assumed. Encounters occurring at angles greater than 10 degrees were considered crossings, whereas angles less than 10 degrees were considered either head-on or overtaking, depending on direction.

The metocean conditions were used as inputs for NORM's drifting allision methodology to determine the drift direction following a vessel breakdown. Near surface winds were deemed to be of greater influence than currents; thus, it was assumed that the drift direction distribution is equal to the wind direction distribution. Secondly, a constant drift speed was assumed of 2 kts (1 m/s). While the drift speed will ultimately determine the maximum drift extent during a given time period, sensitivity testing of this parameter revealed that it was not a highly sensitive parameter, and the chosen value is in line with frequently occurring surface currents.

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 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 the Offshore Development Area. 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.

Only commercial vessels greater than 65 ft (20 m) length overall are required to carry AIS under USCG requirements. This can lead to an underestimation of vessel traffic, particularly for recreational and small fishing vessels which make up most of the vessel traffic in the NORM area. This proportion was treated as a sensitivity parameter in the NORM model. Multiples ranging from one to five (representing 100% down to 20% of vessels equipped) were applied to the fishing and recreational traffic volumes as part of this sensitivity testing. Ultimately, a value of two (i.e., an AIS adoption rate of 50%) was chosen which produced results in the NORM model that agreed with historic accident frequencies.

As part of the post-construction NORM modeling, assumptions were made in terms of vessel re-routing to avoid the WTGs once constructed. Commercial fishing and recreational vessels were assumed to transit through the Lease Area around the WTGs and ESP(s). The larger commercial cargo vessels that are assumed to route around the Lease Area were rerouted along representative tracks that were determined by analyzing historical traffic patterns and considering the development of the Lease Area boundary. For the fishing and recreational vessels that transited through the Lease Area, a vector-rerouting approach was used whereby the vessel's track would be routed down the first corridor the vessel intersected with.

This re-routing process was performed to create a synthetic post-construction AIS dataset which was largely a copy of the pre-construction AIS dataset, but with specific tracks altered to represent the change in traffic patterns due to the presence of WTGs and ESPs. Note that the rerouting approach used here is focused on the incremental change in routing associated with the build-out of the Lease Area (cumulative impacts from the build-out of the adjacent lease areas are qualitatively described in Section0).

Further, several survey vessels in the AIS traffic analysis that was used that may not be representative of the post-construction traffic, but they were not excluded in the analysis as it remained intractable to determine whether or not these vessels were solely performing survey activities or additionally performing other activities such as fishing. In this sense, results can be considered conservative. These survey vessel types are represented in the "other "vessel category.

## 6.8 Navigational Risk Results

This section presents the results of the quantitative navigational safety risk assessment for Lease Area OCS-A 0522. Two scenarios were modeled using NORM: one for the pre-construction (present) conditions, and another for the post-construction conditions. The NORM model was run using AIS data from 2016 to 2021. Performing these two scenarios (pre-construction and post-construction) individually allows for a comparison of the relative change in risk due to Vineyard Northeast.

It is noted that the booster station, which may be installed in the northwestern aliquot of Lease Area OCS-A 0534, was modeled separately as a part of the NSRA for New England Wind[27]. Because this single structure is geographically separate from the Lease Area OCS-A 0522 structures, integrating it into the risk modeling for Lease Area OCS-A 0522 would not have provided a meaningful or accurate estimation of risk associated with the booster station. Instead, the risks associated with the booster station (if used) are documented in the NSRA for New England Wind; the results of the New England Wind NSRA are summarized in Section6.8.2.

### 6.8.1 Pre-construction

The AIS data used in NORM covers 2016 to September 2021 inclusive. The navigational risk calculated using inputs from this period is considered as the reference point for future comparisons. Table 6.1, Table 6.2, and Figure 6.3 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 expected average time between "events" (i.e., a collision). For example, a risk of 2.0E-5 (0.00002) incidents per year is equal to an average recurrence interval of one incident per 50,000 years.

**Table 6.1: Estimated pre-construction inter-class collision annual frequencies**

| Vessel Class | Collisions | Grounding | Total |
|---|---|---|---|
| Cargo | 4.69E-03 | 9.92E-09 | 4.69E-03 |
| Fishing | 1.06E-2 | -- | 1.06E-2 |
| Recreational | 1.19E-03 | -- | 1.19E-03 |
| Tanker | 2.25E-03 | 6.22E-09 | 2.25E-03 |
| Tug | 3.10E-05 | 7.29E-13 | 3.10E-05 |
| Passenger | 9.71E-05 | 1.40E-11 | 9.71E-05 |
| Other | 3.92E-04 | 8.74E-12 | 3.92E-04 |
| Unknown | 1.33E-03 | 8.47E-10 | 1.33E-03 |
| **All** | 2.07E-02 | 1.70E-08 | 2.07E-02 |

*1. Note dashes indicate risk is less than 1E-14.*

[27] New England Wind NSRA can be accessed here: https://www.boem.gov/sites/default/files/documents/renewable-energy/NE%20Wind%20COP%20App%20III-I%20NSRA_June%202022_PUBLIC.pdf

**Table 6.2: Estimated pre-construction inter-class collision average recurrence intervals (years)**

| Vessel Class | Collisions | Grounding | Total |
|---|---|---|---|
| Cargo | 213 | -- | 213 |
| Fishing | 94 | -- | 94 |
| Recreational | 840 | -- | 840 |
| Tanker | 444 | -- | 444 |
| Tug | 32,258 | -- | 32,258 |
| Passenger | 10,299 | -- | 10,299 |
| Other | 2,551 | -- | 2,551 |
| Unknown | 752 | -- | 752 |
| **All** | 48.3 | -- | 48.3 |

1. *Average Recurrence Interval refers to the average time in years between collision events.*
2. *For clarity ground risk is not shown above 1,000,000 year expected return periods.*

As can be seen in Table 6.1, much of the pre-construction navigational risk is associated with fishing, tanker, cargo vessels due to the volume of traffic associated with these vessel categories.

Much of the pre-construction navigational risk is a result of overtaking collisions in comparison to head-on scenarios. Given the well-defined traffic separation scheme to the south of the Lease Area, most of the traffic traverse the NORM area in one-way traffic lanes thus minimizing the probability of both crossing and head-on collision scenarios. Crossing collision risk mostly stems from the fishing, passenger, other, and unknown vessel classes which do not necessarily travel following the traffic separation scheme.

Overall, the total frequency of all accident scenarios for all vessel classes was calculated to be 0.0207 accidents per year (2.07% annual probability), corresponding to an approximately 48.3-year average recurrence interval.

The SAR incident data presented in Section 7.1 indicates that the NORM model is within the statistical uncertainty associated with the observed incident rate in the vicinity of the Lease Area.

### 6.8.2 Post-construction

The operational phase (post-construction) scenario was carried out in NORM using the modified post-construction AIS dataset and incorporating the 160 WTG and ESP positions as obstacles into the model.

Vineyard Northeast's O&M vessels are expected to transit to and from the Lease Area. This was accounted for in the NORM model by creating synthetic vessel tracks traveling to the WTGs. All O&M tracks were assumed to originate from the port of New Bedford.

It was assumed that these vessels will consist of CTVs originating from this location (as use of CTVs produced the largest number of transits). The CTVs were conservatively assigned a 98 ft (30 m) LOA, 33 ft (10 m) beam, and an average speed of 15 kts. Though it is expected that CTV's will be smaller than these dimensions, this assumption leads to more conservative (higher) estimate of collision risk. The volume of O&M traffic was estimated to be up to 575 round trips per year. It was also assumed that the O&M vessels would return to their origin point from the WTG along the same path that was used to get there, to account for their potential interaction with other vessels on the way back. Inside the Lease Area, the O&M tracks are assumed to be distributed equally in space throughout each corridor.

As explained in Section 6.6, allisions were carried out in NORM for the post-construction scenarios by using a structure footprint at the waterline of the WTG assuming a monopile foundation with a diameter of 41 ft (12.5 m) and a separate scenario assuming piled jacket foundation with a diameter of 239 ft (73 m). Additionally, three ESP(s) were modeled for additional allision risk: two co-located in the southern portion of the Lease Area on 41 ft (12.5 m) (monopile foundations) and one located in the northern portion of the Lease Area on a piled jacket foundation with a diameter of 624 ft (190 m) at the waterline.

Table 6.3 shows the NORM model results for the post-construction scenario as an annual accident frequency. Table 6.4 presents the same information as recurrence intervals; Figure 6.3 also graphically presents a comparison between the pre-construction and post-construction scenarios.

The increase in navigational risk is generally dominated by crossing collisions and mostly by fishing and recreational vessels. For the post-construction phase, there are also the contributions from potential collisions with O&M vessels, which becomes a factor that increases risk in the post-construction phase. Note that all collision, allision, and grounding scenarios between Vineyard Northeast's O&M vessels are neglected. Overall, the allision results suggest that jacket-type foundations result in more overall risk than monopile type foundations. Due to the local water depth, vessel draft characteristics, and frequency and distribution of vessel traffic, grounding does not pose a serious risk to navigation in the area.

**Table 6.3: Estimated post-construction inter-class collision annual frequencies**

| Vessel Class | Collisions | Groundings | Allisions | Total |
|---|---|---|---|---|
| Cargo | 4.69E-03<br>(4.69E-03) | 9.64E-09<br>(9.64E-09) | 1.54E-05<br>(8.52E-05) | 4.70E-03<br>(4.77E-03) |
| Fishing | 1.07E-02<br>(1.07E-02) | -- | 8.17E-04<br>(1.73E-03) | 1.15E-02<br>(1.24E-02) |
| Recreational | 1.24E-03<br>(1.24E-03) | -- | 9.59E-05<br>(1.89E-04) | 1.34E-03<br>(1.43E-03) |
| Tanker | 2.27E-03<br>(2.27E-03) | 8.04E-09<br>(8.04E-09) | 9.51E-06<br>(5.22E-05) | 2.28E-03<br>(2.32E-03) |
| Tug | 3.15E-05<br>(3.15E-05) | 1.09E-12<br>(1.09E-12) | 1.06E-06<br>(5.80E-06) | 3.26E-05<br>(3.73E-05) |
| Passenger | 9.78E-05<br>(9.78E-05) | 1.69E-11<br>(1.69E-11) | 1.95E-06<br>(1.06E-05) | 9.98E-05<br>(1.08E-04) |
| Other | 3.92E-04<br>(3.92E-04) | 1.27E-11<br>(1.27E-11) | 3.86E-06<br>(2.06E-05) | 3.96E-04<br>(4.13E-04) |
| Unknown | 1.51E-03<br>(1.51E-03) | 9.95E-10<br>(9.95E-10) | 1.55E-05<br>(8.30E-05) | 1.52E-03<br>(1.59E-03) |
| O&M | 2.30E-04<br>(2.30E-04) | -- | -- | 2.30E-04<br>(2.30E-04) |

| Vessel Class | Collisions | Groundings | Allisions | Total |
|---|---|---|---|---|
| **All** | 2.12E-02 (2.12E-02) | 1.87E-08 (1.87E-08) | 9.60E-04 (2.18E-03) | 2.21E-02 (2.33E-02) |

*Note that results for both the 41 ft (12.5 m) and 239 ft (73 m) foundation widths are presented. The 41 ft (12.5 m) foundation width is associated with the monopile. The 239 ft (73 m) foundation width is associated with the piled jacket WTG foundation types; the results for these foundation types are presented in parentheses.*

*1. Note dashes indicate risk is less than 1E-14.*

**Table 6.4: Estimated post-construction inter-class collision average recurrence intervals (years)**

| Vessel Class | Collisions | Groundings | Allisions | Total |
|---|---|---|---|---|
| Cargo | 213 (213) | -- | 64,850 (11,742) | 213 (209) |
| Fishing | 93 (93) | -- | 1,225 (577) | 87 (80) |
| Recreational | 805 (805) | -- | 10,427 (5,281) | 747 (699) |
| Tanker | 440 (440) | -- | 105,163 (19,150) | 439 (431) |
| Tug | 31,746 (31,746) | -- | 940,140 (172,385) | 30,713 (26,810) |
| Passenger | 10,225 (10,225) | -- | 512,407 (93,956) | 10,025 (9,225) |
| Other | 2,549 (2,549) | -- | 259,034 (48,550) | 2,524 (2,422) |
| Unknown | 664 (664) | -- | 64,583 (12,051) | 657 (629) |
| O&M | 4,340 (4,340) | -- | -- | 4,340 (4,340) |
| **All** | 47 | -- | 1,041.91 (458.9) | 45.2 (42.9) |

1. *Average Recurrence Interval refers to the average time in years between collision events.*
2. *For clarity ground risk is not shown above 1,000,000 year expected return periods.*

*Note that results for both 41 ft (12.5 m) and 239 ft (73 m) foundation widths are presented. The 41 ft (12.5 m) foundation width is associated with the monopile. The 239 ft (73 m) foundation width is associated with the piled jacket WTG foundation types; the results for these foundation types are presented in parentheses.*

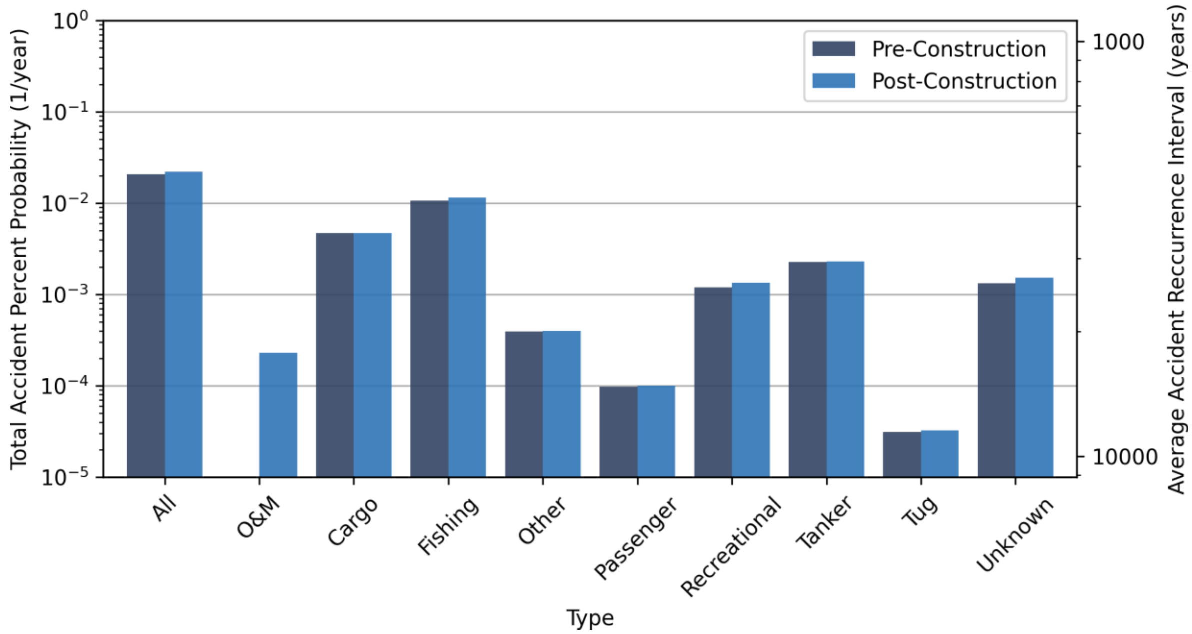


**Figure 6.3: NORM results for pre-construction and post-constructions phases by vessel type (for monopile-type WTG foundations)**

The collision/allision risk resulting from the booster station (if used) was modeled as part of the New England Wind NSRA, which modeled the collision/allision risk for the full build out of Lease Areas OCS-A 0534 (New England Wind) and OCS-A 0501 (Vineyard Wind 1). The construction of offshore wind energy facilities in Lease Areas OCS-A 0534 and OCS-A 0501, including the booster station position, results in a small increase in risk (approximately 0.015 to 0.017 additional accidents per year) when compared to the estimated pre-construction collision risk and equates to an additional vessel collision or allision once every 59 to 67 years on average, depending on foundation type. Although it is not possible within the NORM model to segregate the risk due to any one position, the booster station is one of 194 total positions modeled and is expected to represent a very small proportion of this increased risk.

### 6.8.3 Interpretation of Results

The results of the NORM model show that the overall risk for potential marine accidents is approximately 40-50 years for both pre-construction and post-construction conditions, and that the bulk of the risk is coming from collisions and allisions in comparison with groundings. Risk associated with cargo, passenger, and tanker vessels largely remains the same between pre- and post-construction phases as the development of the Lease Area does not impinge on the traffic separation scheme to the south of the Lease Area. The larger piled jacket foundation footprints for the WTGs increase calculated allision risk by 5% as compared to the monopile foundation. The anticipated O&M traffic marginally contributes to future collision risk with other vessel types (i.e., not O&M vessels) but remains relatively low in comparison with other vessel classes. On average, with assuming the use of WTG monopile foundations and three ESP platforms, the risk of a potential accident changes from one in every 48 years to one in every 45 years, which represents a 6% increase. On average, assuming WTG piled jacket foundations and three ESP platforms, the risk of a potential accident changes from one in every 48 years to one in every 43 years, which represents a 10% increase. The collision avoidance measures outlined in Section 5.1 are expected to maintain safe operation of vessels both day and night, and in all weather conditions.  No prohibitions or restrictions on navigation are proposed with the exception of the temporary construction measures outlined in Section 8.1.1.

### 6.8.4 Potential Consequences of an Allision with a WTG or ESP

There are two types of potential allision—drifting and powered—each with 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 at 1.9 knot [1.0 m/s]), as it is moved by the actions of wind and current, and results 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, it is not anticipated that there would be any appreciable structural damage to the WTGs or ESP(s) for either type of allision. The potential damage to the vessel is expected to be moderate due to the low speed, though wave conditions will be important in the outcome.

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 at risk of powered allisions) will be either recreational or fishing vessels. As such, the small size of the vessels in relation to the WTG and ESP foundations would likely result in only minor consequences for the WTG or ESP 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 kts. The consequences to the vessel may be moderate to severe, depending on the speed of the allision, and could result in crew injury or may be life threatening.

Larger vessels (e.g., cargo, tanker, passenger) will likely be present near the perimeter of the Lease Area as the TSS is located near the southern boundary of the Lease Area and vessels transiting to Narragansett Bay are expected to re-route around the Lease Area. In the unlikely event one of these larger vessels drifts off-course and strikes a perimeter WTG or ESP at speed, the consequences could be significant. Structural damage could be experienced by the WTG or ESP structure, though the design of the WTGs and ESP(s) considers an allision potential. The vessel may also be significantly damaged, the crew may be injured, and/or the vessel may lose cargo containment. As noted previously, the NORM model reported overall allision risk that was very small with average recurrence intervals of greater than 1,000 years.

## 6.9 Future Vessel Traffic Changes Resulting from Vineyard Northeast

The proposed development of the Lease Area will have some potential impacts on future vessel traffic, particularly with respect to commercial fishing and passenger, tanker, and cargo vessels. Figure 6.4 presents a selection of prevailing transit routes of commercial fishing vessels through the Lease Area and various alternative bypass routes to avoid the Lease Area during and post-construction. Table 6.5 presents a summary of the transit distances and estimated transit times (based on average vessel speed in the AIS dataset). The impact on the transit time because of bypassing the Lease Area is relatively small (typically 5 to 30 minutes or less). Figure 6.5 and Table 6.6 present similar existing transit routes through the Lease Area and bypass routes for cargo, tanker, passenger, and other AIS vessel types and the impact on transit times because of bypassing the Lease Area, which is also found to be 5 to 15 minutes or less.

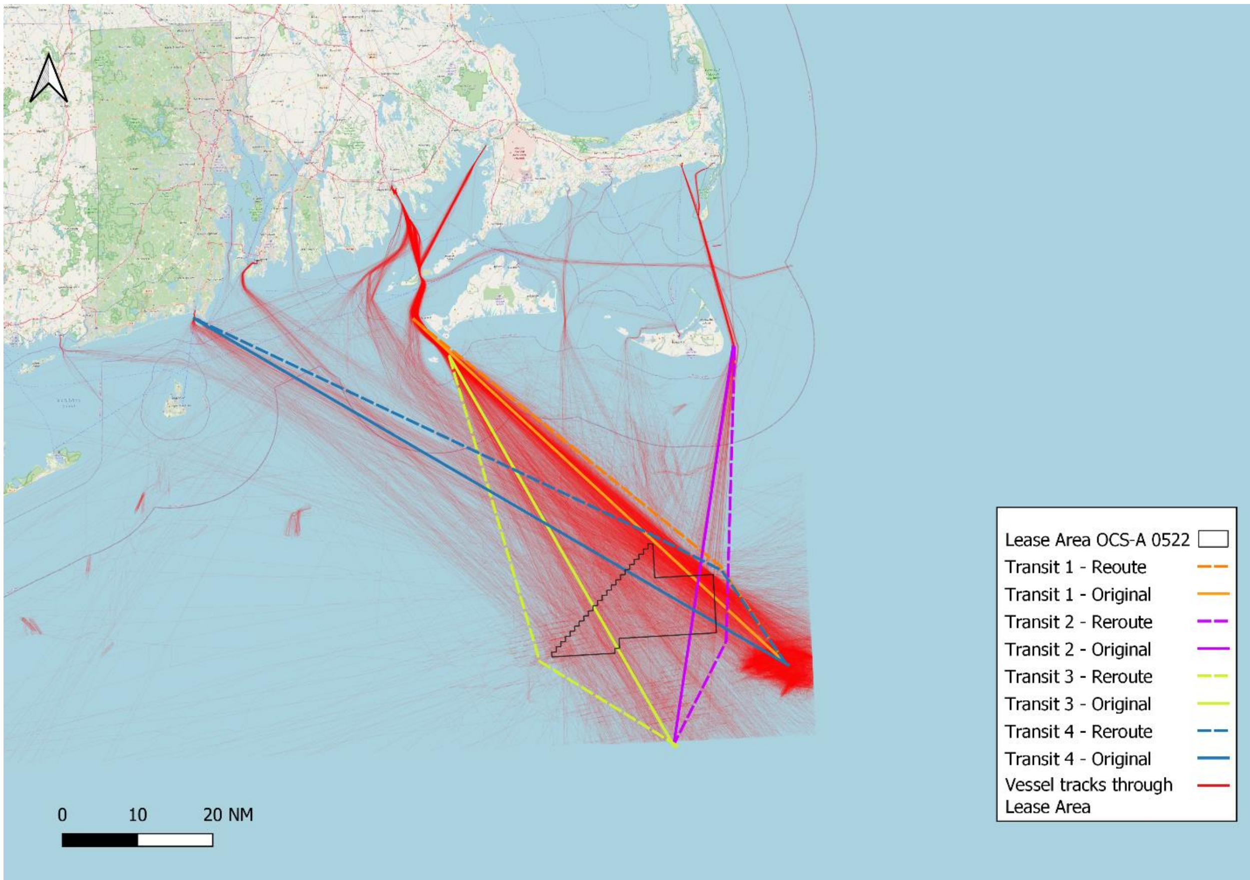


**Figure 6.4: Analysis of transit routes for commercial fishing vessels: existing and post-construction (bypassing Lease Area)**

**Table 6.5: Transit route analysis for commercial fishing vessels currently transiting the Lease Area: existing and Lease Area bypass route.**

| Transit Route | Avg. Vessel Speed (kts) | Existing Route | | Bypass Route | | Change in Time (min.) |
|---|---|---|---|---|---|---|
| | | Distance (NM) | Transit Time (hr) | Distance (NM) | Transit Time (hr) | |
| 1 | 8 | 67.2 | 8.4 | 67.7 | 8.47 | 3.74 |
| 2 | 8 | 53.2 | 6.65 | 54.3 | 6.79 | 8.17 |
| 3 | 8 | 59.8 | 7.48 | 63.8 | 7.97 | 29.6 |
| 4 | 8 | 91.5 | 11.4 | 92.5 | 11.6 | 7.45 |

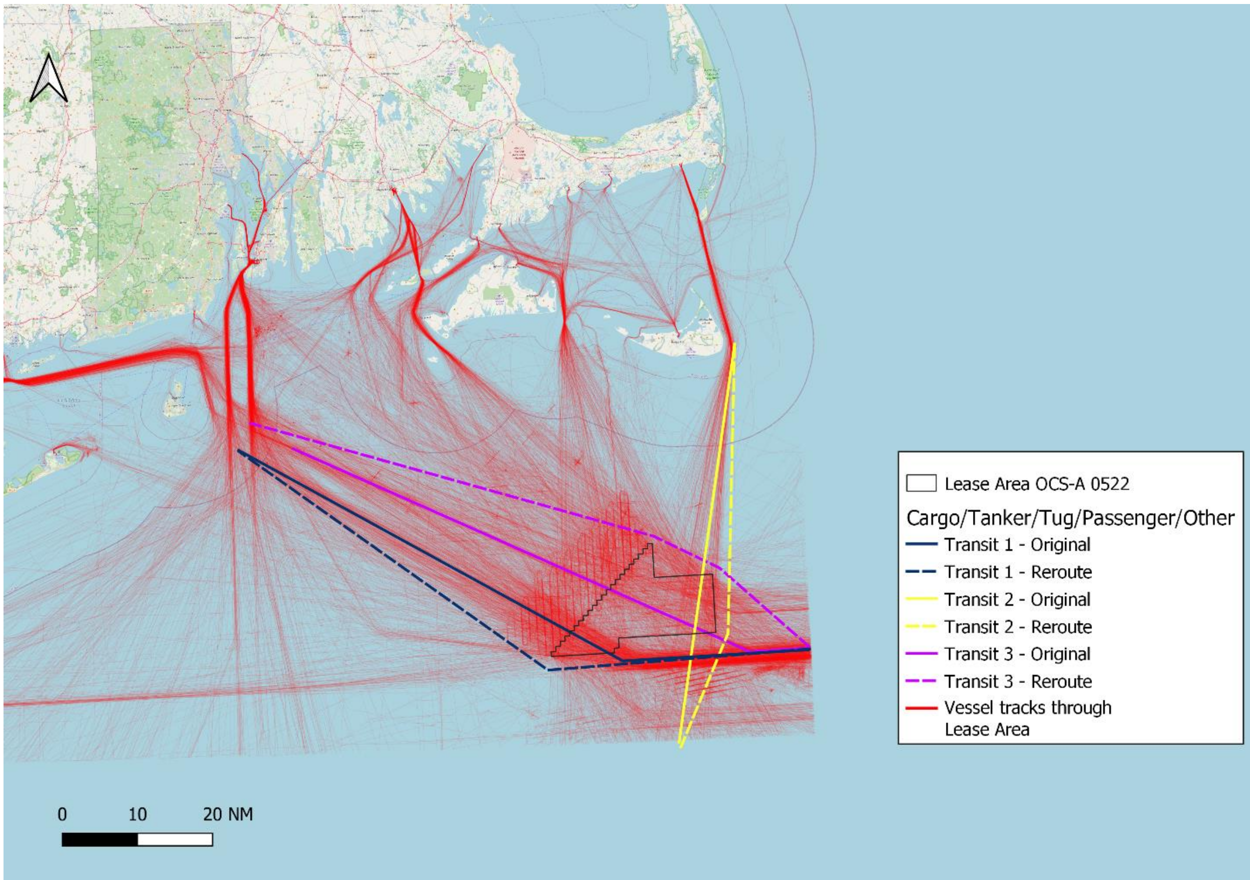


**Figure 6.5: Analysis of transit routes for all other vessels besides commercial fishing and recreational vessels: existing and post-construction (bypassing Lease Area)**

**Table 6.6: Transit route analysis for cargo/tanker/tug/passenger/other vessels currently transiting the Lease Area: existing and Lease Area bypass route.**

| Transit Route | Avg. Vessel Speed (kts) | Existing Route | | Bypass Route | | Change in Time (min.) |
|---|---|---|---|---|---|---|
| | | Distance (NM) | Transit Time (hr) | Distance (NM) | Transit Time (hr) | |
| 1 | 12 | 83 | 6.92 | 85.3 | 7.11 | 11.4 |
| 2 | 12 | 53.5 | 4.46 | 54.6 | 4.55 | 5.58 |
| 3 | 12 | 80.6 | 6.72 | 81.2 | 6.77 | 3.08 |

## 6.10 Cumulative Effects of Vineyard Northeast and Nearby Offshore Wind Projects

Additionally, the construction of offshore wind facilities in multiple lease areas across the MA WEA and RI/MA WEA was analyzed. The impacts of full build-out of these lease areas is not solely the impact of Lease Area OCS-A 0522; however, the anticipated representative bypass routes for traffic which presently passes through the Lease Area is provided in Figure 6.6 and Figure 6.7 below. Table 6.7 and Table 6.8 present the lengths of the existing and bypass routes for the full build-out scenarios as well as the additional transit time required for the bypass routes. When considering the cumulative effects of other lease areas, the impact on the transit time from bypassing the Lease Area is moderate (typically 5 to 45 minutes or less with one route identified up to 91 minutes or 20% increased transit time); however, it is noted that many of these vessels are transiting long distances (including Trans-Atlantic voyages) and the relative increase in trip duration may be small. For commercial fishing vessels, the re-routing would result in a small increase the total effort required for the same catch. In addition to the added sailing time, these vessels will also burn more fuel for the added transit distance, thus also increasing emissions.

Lastly, the changing traffic patterns from the build-out of all lease areas in the MA WEA and RI/MA WEA may result in additional traffic density near the edges of the WEAs and/or compression of traffic into corridors through the structures. If more vessels choose to route around the WEAs, there would be a decrease in collisions and allision risk within the WEAs, but an increased risk of collision outside the WEAs and/or allision risk with the structures on the edges of the WEAs due to the traffic density increase. The construction phase and O&M vessel traffic associated with multiple projects in the WEAs would be greater than the vessel traffic described for Vineyard Northeast in Section3.3, but would be simultaneously distributed over a larger area. The potential impacts to visual and radar-based navigation discussed in Section 5.1would occur over a larger area but would not be substantively different than for a single project. Similarly, the impacts on SAR and Marine Environmental Response (MER) missions would extend over a larger area, but would not differ in nature from the impacts from any single project.

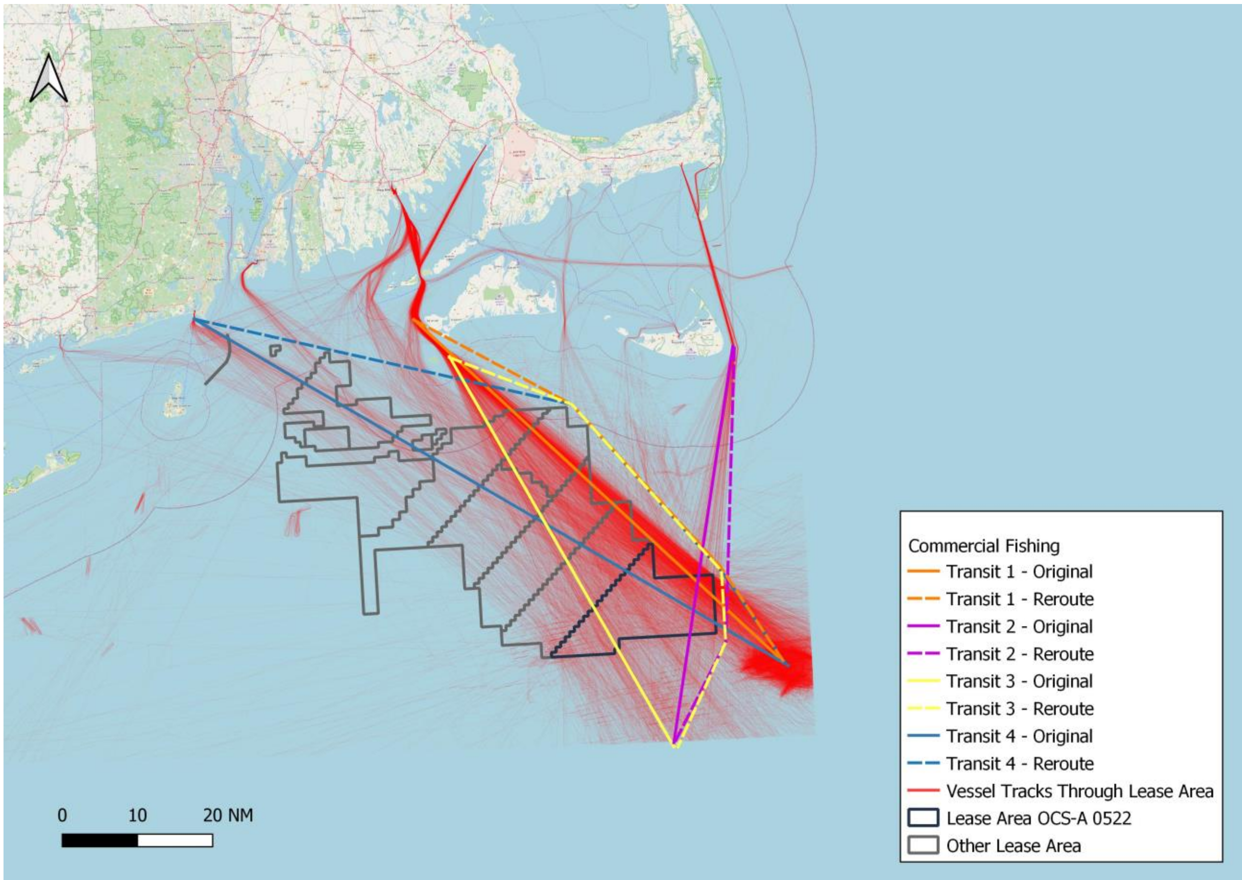


**Figure 6.6: Analysis of transit routes for commercial fishing vessels: existing and post-construction (bypassing WEAs)**

**Table 6.7: Transit route analysis for commercial fishing vessels currently transiting the Lease Area: existing and WEA bypass route.**

| Transit Route | Avg. Vessel Speed (kts) | Existing Route | | Bypass Route | | Change in Time (min.) |
|---|---|---|---|---|---|---|
| | | Distance (NM) | Transit Time (hr) | Distance (NM) | Transit Time (hr) | |
| 1 | 8 | 67.2 | 8.4 | 68 | 8.5 | 6 |
| 2 | 8 | 53.2 | 6.65 | 54 | 6.75 | 6 |
| 3 | 8 | 59.8 | 7.48 | 72 | 9 | 91 |
| 4 | 8 | 91.5 | 11.4 | 96 | 12 | 36 |

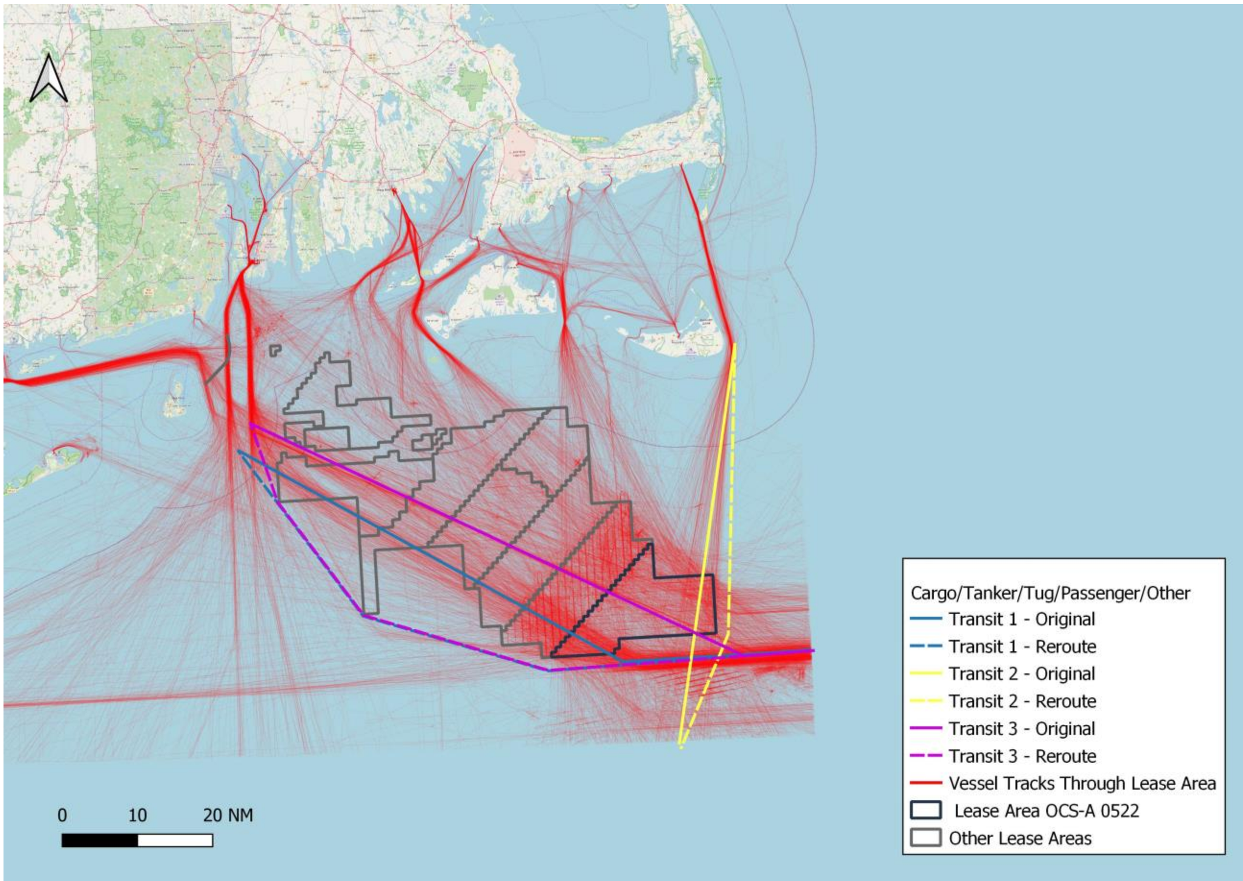


**Figure 6.7: Analysis of transit routes for all other vessels besides commercial fishing and recreational vessels: existing and post-construction (bypassing WEAs)**

**Table 6.8: Transit route analysis for cargo/tanker/tug/passenger/other vessels currently transiting the Lease Area: existing and WEA bypass route.**

| Transit Route | Avg. Vessel Speed (kts) | Existing Route | | Bypass Route | | Change in Time (min.) |
|---|---|---|---|---|---|---|
| | | Distance (NM) | Transit Time (hr) | Distance (NM) | Transit Time (hr) | |
| 1 | 12 | 154 | 12.8 | 163 | 13.6 | 45 |
| 2 | 12 | 99 | 8.3 | 101 | 8.4 | 10 |
| 3 | 12 | 151 | 12.6 | 168 | 14 | 85 |

# 7. Emergency Response Considerations

## 7.1 SAR History & Potential Impacts

### 7.1.1 USCG SAR Assets

The USCG SAR and MER assets in the Offshore Development Area are summarized below.

#### 7.1.1.1 Aerial Assets

The USCG has one aviation facility in the Northeast called Air Station Cape Cod (ASCC), approximately 51 NM (95 km) north of the Lease Area. This facility has a mission area spanning from New Jersey to the Canadian border. The base is located at the Joint Base Cape Cod (JBCC) in Bourne, MA. This base is a full scale, joint-use base that is home to five military commands training for missions both domestic and abroad, conducting airborne SAR missions, and intelligence command and control.

Aviation assets at ASCC include MH-60T Jayhawk helicopters and HC-144A Ocean Sentry fixed-wing aircraft. These assets can be operational within 30 minutes of a distress call in any weather, all year round. The USCG completes approximately 250 SAR missions per year from ASCC (USCG, n.d.). The Jayhawk helicopters are designed for high maneuverability and are capable of performing hoisting operations and deploying dewatering equipment in SAR mission scenarios. The Sentry aircraft are designed for high-speed response and reconnaissance and are capable of longer flight times and distances than the Jayhawk helicopters; the Sentry aircraft are typically used for long-range missions.

#### 7.1.1.2 Marine Assets

The USCG maintains a fleet of vessels at these stations for use in SAR and environmental response missions. Table 7.1 summarizes the USCG vessel fleet in the Southeastern New England Sector.

**Table 7.1: USCG Marine Assets in Southeastern New England Sector – District 1 Jurisdiction**

| Vessel Name | Type | Home Port |
|---|---|---|
| USCG Cutter Tybee | 110 ft (34 m) USCG Patrol Boat | Woods Hole, MA |
| USCG Cutter Sanibel | 110 ft (34 m) USCG Patrol Boat | Woods Hole, MA |
| USCG Cutter Cobia | 87 ft (27 m) USCG Patrol Boat | Woods Hole, MA |
| USCG Cutter Steelhead | 87 ft (27 m) USCG Patrol Boat | Newport, RI |

The USCG stations listed in Table 7.2 also have additional vessels active in the area.

**Table 7.2: Marine Assets Active at USCG Stations near the Lease Area**

| Station | Type | Quantity |
|---|---|---|
| USCG Station Menemsha | 47 ft (14 m) Motor Life Boats | 2 |
| | 29 ft (9 m) Response Boat – Small | 1 |
| USCG Station Castle Hill | 45 ft (14 m) Response Boat – Medium | 3 |
| | 29 ft (9 m) Response Boat – Small | 2 |
| USCG Station Woods Hole | 45 ft (14 m) Response Boat – Medium | 2 |
| | 29 ft (9 m) Response Boat – Small | 1 |
| USCG Station Brant Point | 47 ft (14 m) Motor Life Boats | 2 |
| | 29 ft (9 m) Response Boat – Small | 1 |

This group of USCG stations and vessel assets coordinates as an integrated team to conduct active patrols, SAR missions, and environmental response missions. The vessels listed in Table 7.1 are active in the area surrounding the Lease Area and are capable of multiple-day-at-sea missions. The vessels listed in Table 7.2 are geared towards rapid response missions near their home-port locations and USCG Stations.

#### 7.1.1.3 Shore Based Units

The Lease Area is within the District 1 – USCG Atlantic Area jurisdiction, in the Southeastern New England Sector. This sector is tasked with the area that covers the Lease Area and is serviced by USCG assets from stations nearby. The closest USCG marine stations to the Lease Area are listed below in order of distance from the Lease Area:

- USCG Station Brant Point, Nantucket, MA
- USCG Station Chatham, Chatham, MA
- USCG Station Menemsha, Martha's Vineyard, MA
- USCG Station Montauk, Montauk Point, NY
- USCG Station Castle Hill, Newport, RI
- USCG Station Point Judith, Point Judith, RI
- USCG Station Woods Hole, Woods Hole, MA

The closest is USCG Station Brant Point, which is located approximately 28 NM (53 km) northwest from the extents of the Lease Area.

### 7.1.2 Historical SAR Incidents

USCG SAR data were compiled by USCG from the Marine Information for Safety and Law Enforcement (MISLE) database for an approximate 10-year period (fiscal years 2011 through 2020) and supplied to the Proponent. Though the search area from individual incidents is not explicitly defined, Figure 7.1 shows the spatial positioning of the SAR incidents that were obtained in this dataset, which are within a 20 NM (37 km) range around the Lease Area.

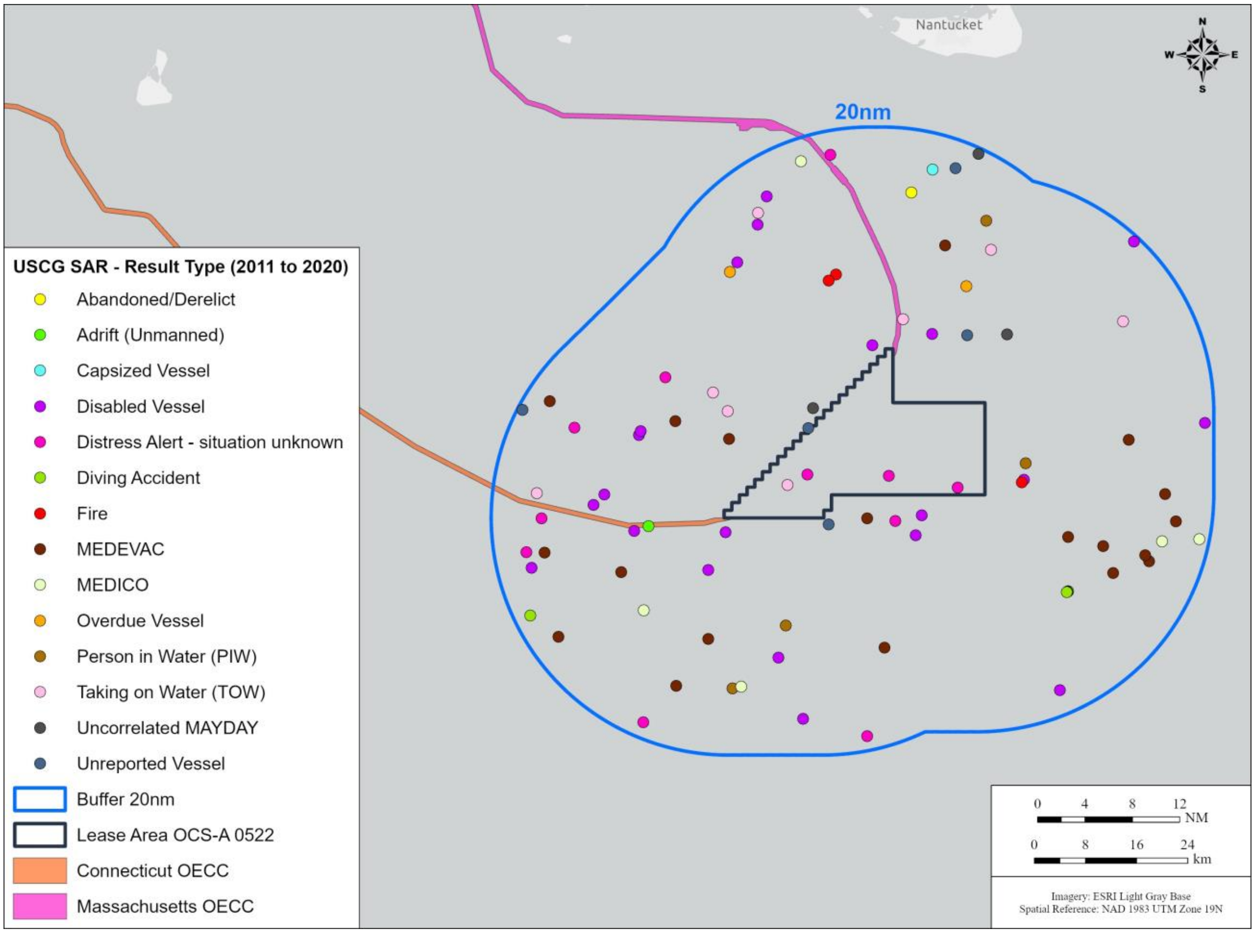


**Figure 7.1: USCG historical SAR sorties**

Four incidents occurred within or immediately adjacent to the Lease Area. These consisted of one unreported vessel which was subsequently located, one distress alert later deemed to be a hoax or false alarm, one distress call which was later recalled, and one reported flare for which no vessel or person in water was subsequently located.

Of the 91 reported SAR incidents within a 20 NM (37 km) buffer of the Lease Area, approximately half of the incidents occurred in the months of June, July, and August. There was an average of 9.1 incidents per year. The types of incidents are shown in Table 7.3, the uninvestigated causes of the incidents are shown in Table 7.4, and the results of the first on scene sortie are shown in Table 7.5. There were no reported collisions in the Lease Area vicinity.

**Table 7.3: SAR Incident Type for Incidents within 20 NM of the Lease Area (2011-2020)**

| SAR Incident Type | Count |
|---|---|
| Abandoned/Derelict | 1 |
| Adrift (Unmanned) | 1 |
| Capsized Vessel | 1 |
| Disabled Vessel | 21 |
| Distress Alert - situation unknown | 11 |
| Diving Accident | 4 |
| Fire | 3 |
| MEDEVAC | 19 |
| MEDICO | 5 |
| Overdue Vessel | 2 |
| Person in Water (PIW) | 5 |
| Taking on Water (TOW) | 9 |
| Uncorrelated MAYDAY | 3 |
| Unreported Vessel | 6 |

**Table 7.4: SAR Incident Uninvestigated Cause Type for Incidents within 20 NM of the Lease Area (2011-2020)**

| Uninvestigated Cause Type | Count |
|---|---|
| Cause Unknown | 23 |
| Engine Failure | 7 |
| Fall/other mishap on vessel | 4 |
| False alarm/Hoax | 2 |
| High winds/high waves | 1 |
| Incapacitating attack/seizure | 1 |
| Other electrical problems | 2 |
| Other medical condition | 5 |
| Other personnel related cause | 1 |
| Other weather factor | 2 |
| Propulsion problem (shaft or propeller) | 3 |
| UNSPECIFIED | 40 |

**Table 7.5: SAR Results of First On Scene Sortie for Incidents within 20 NM of the Lease Area (2011-2020)**

| First On Scene Sortie Result | Count |
|---|---|
| Located directly (no search conducted) | 14 |
| Mission Complete | 12 |
| Recalled (assistance rendered by non-CG unit) | 3 |
| Recalled/returned, assistance no longer required | 5 |
| Searched/failed to locate | 13 |
| Searched/located | 15 |
| UNSPECIFIED | 29 |

### 7.1.3 Private Salvors

Commercial salvors also exist in the area that provide a range of marine services to recreational and commercial boaters, such as towing, engine start, vessel salvage, and general assistance to mariners. Commercial salvors have also historically assisted the USCG in SAR operations. The commercial salvors tend to operate during the boating season (April through October) and are generally located in boating communities and ports. Below is a list of nearby commercial salvors that service the area around the Lease Area:

- TowBoatUs New Bedford – New Bedford, MA;
- TowBoatUS Falmouth – Falmouth, MA;
- TowBoatUS Bass River, Cape Cod, Nantucket – South Yarmouth, MA;
- TowBoatUS Provincetown – Provincetown, MA;
- Sea Tow South Shore – Marshfield, MA;
- Safe/Sea RI – North Kingstown, RI;
- Baywatch RI – Warwick, RI.; and
- Tucker Roy Marine Salvage – Mattapoisett, MA.

Based on discussions with personnel from TowBoatUS New Bedford, they only respond to recreational vessel calls. In an average boating season, they may respond to approximately 30 calls in the area south of Nomans Land, which is located off the southwest corner of Martha's Vineyard. Most of these incidents occur within the range of 3 to 5 NM (5 to 10 km) south of Nomans Land, well northwest of the Lease Area, although some have occurred farther south. The calls are typically for towing vessels, and TowBoatUS estimates they typically rescue approximately 25 vessels per year within their service area. TowBoatUS is also equipped to aid USCG with SAR missions south of Martha's Vineyard and has done so in the past. Comprehensive information detailing all operations and their spatial distribution was not available.

### 7.1.4 SAR Impacts

According to the USCG's (2020) MARIPARS, "SAR capabilities in the WEA will be impacted by the presence of structures in the ocean where before there were no such structures." The presence of the Vineyard Northeast WTGs and ESP(s) can increase the risk of incident with SAR vessels and the presence of WTGs may affect the USCG's airborne SAR assets.

However, the 1 NM by 1 NM WTG/ESP layout of Vineyard Northeast is consistent with the USCG's WTG spacing recommendations to accommodate SAR operations contained in the MARIPARS (Section 2.1). The MARIPARS found that, "One NM spacing between WTGs allows aircrews to safely execute turns to the adjacent lane using normal flight procedures in visual conditions" and "may allow sufficient navigational room for aircrews to execute USCG missions in diverse and challenging weather conditions or deal with an aircraft emergency and/or navigational malfunction." In fact, Vineyard Northeast may facilitate SAR operations as the WTGs and ESP(s) will be marked and lighted (in particular, the WTGs will contain alphanumeric identifiers on the nacelles) and Vineyard Northeast vessels will operate frequently within the Lease Area. According to the MARIPARS, a standard and uniform WTG/ESP layout will assist SAR in favorable weather conditions. Alphanumeric markings on the WTG towers may also aid mariners in reporting their position during distress calls and alphanumeric markings on the WTG nacelles, visible to SAR pilots, could also aid SAR pilots during a SAR response.

As described in this section, the USCG responds to multiple emergency, environmental, and law enforcement related matters each year in the area surrounding and containing the Lease Area. During the operations phase of Vineyard Northeast, the primary impacts related to SAR operations will be confined to the immediate vicinity surrounding the Lease Area.

The WTG spacing and minimum tip clearance of the blades are not expected to impact the operation of USCG marine assets that are in use in the area. It is expected that these marine assets will be able to safely navigate and maneuver adequately within the Lease Area. Given the WTG spacing and relative size, it is not expected that Vineyard Northeast will significantly affect travel times to and within the Lease Area by vessels responding to SAR distress calls. Section 5.1.2 outlines potential impacts to radar and communication within the Lease Area during the operations phase; further investigation is required to fully quantify the subsequent impact on USCG SAR operations. No major impact is expected to affect the operation of emergency transponder systems used by many ocean-going vessels.

Response times for USCG aviation assets should not be impacted by Vineyard Northeast, except for missions directly within the Lease Area, where aviation assets may have their operations impacted when near a physical WTG. The Proponent will work with the USCG to develop an operational protocol that outlines the procedures for the braking system on requested Vineyard Northeast WTGs to be engaged within a specified time upon request from the USCG during SAR operations and other emergency response situations. USCG ASCC pilots recommend a minimum spacing of 1 NM (1.9 km) between turbines for search paths; which creates a 0.5 NM navigational buffer on either side of the aviation asset as it transits (USCG, 2020). Helicopter operations for USCG SAR missions typically travel at speeds of 70 to 90 kts (36 to 46 m/s) and are able to turn with a diameter from 0.8 to 1 NM (1.5 to 1.9 km) at these speeds. The 1 NM (1.9 km) spacing of the WTGs is considered adequate for the maneuverability of USCG aviation assets within the Lease Area.

The specific mitigations for SAR operations are discussed in Section 8.1.3.

## 7.2 MER History & Potential Impacts

### 7.2.1 MER Assets

The USCG assets in the area have basic capabilities to respond to MER incidents. Beyond this level, MER incidents would call upon other state and Federal agencies as well as potentially Oil Spill Response Organizations (OSROs) who are contracted to vessel or facility owners (see Appendix I-F of the COP for Vineyard Northeast's Oil Spill Response Plan).

### 7.2.2 MER Incidents

The USCG MISLE database includes spill and environmental pollution incidents and responses in the region. Similar to SAR activities, the MER incidents in the area were also provided by USCG. Based on the fiscal year 2011 to 2020 analysis of the data for Vineyard Northeast, no MER activities occurred within the Lease Area during this time period. However, as shown in Figure 7.2, seven incidents occurred within a 20 NM (37 km) buffer around the Lease Area. These incidents were primarily small oil or fuel spills.

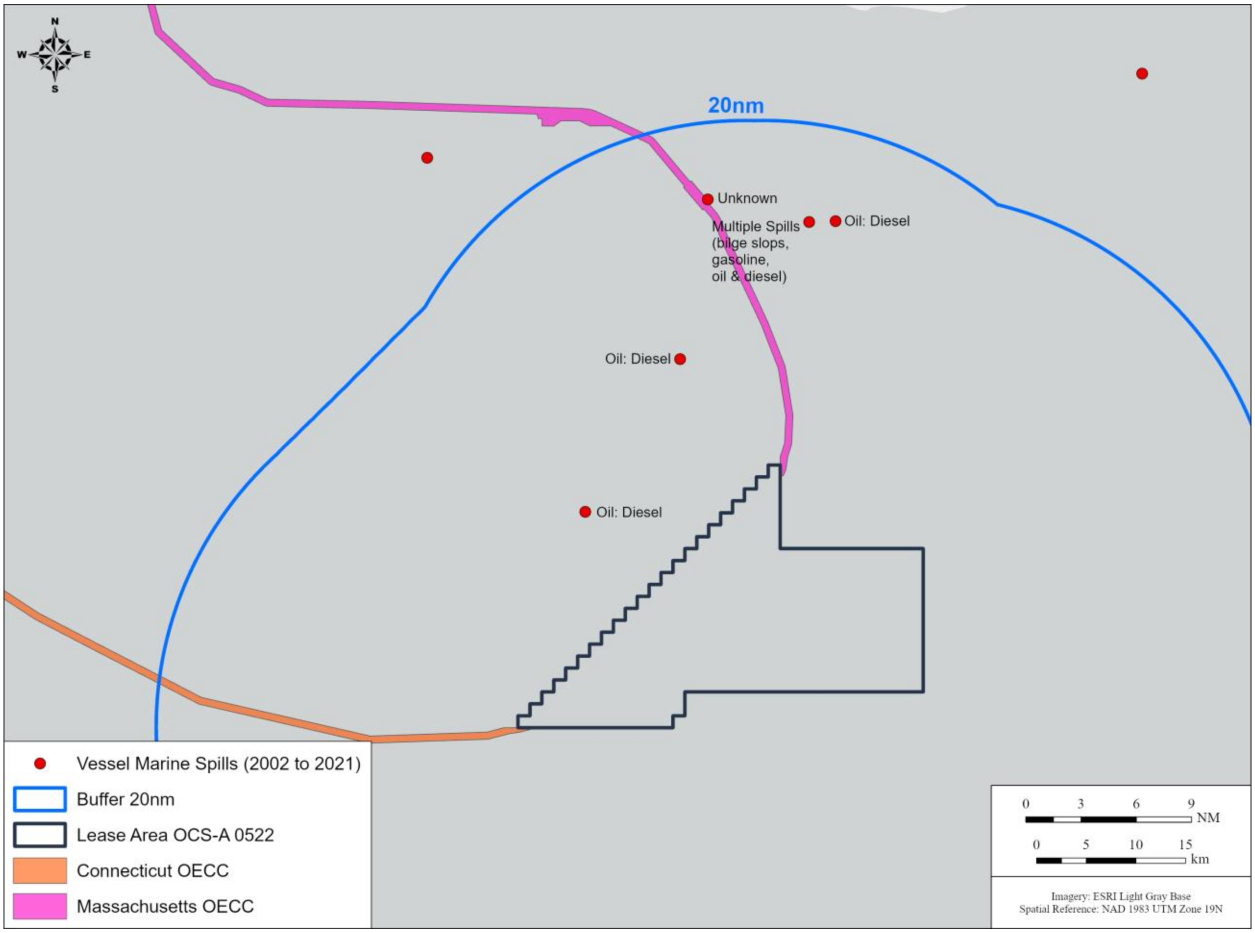


**Figure 7.2: MER incidents in project vicinity (2011 to 2020)**

At a regional level, there were 300 spill and environmental pollution incidents occurring during this time period in nearby ports and harbors of Narragansett Bay and Buzzards Bay including New Bedford, Providence, and Fall River. Historically there have been larger liquid cargo spills in the region including the M/V World Prodigy incident in 1989 which spilled 300,000 gallons (1.1 million L) of oil near the entrance of Narragansett Bay due to a grounding with a root cause of human error. In 1996 the M/V North Cape grounded near Moonstone Beach (RI) and spilled approximately 820,000 gallons (3.1 million L) of home heating oil. In 2003, the Bouchard 120 barge struck a bedrock ledge in Buzzards Bay and spilled approximately 98,000 gallons (370,000 L) of oil.

### 7.2.3 MER Impacts

Given the relative size of vessels used by USCG for SAR and MER operations, the WTG and ESP spacing relative to vessel maneuverability should pose no issues. In addition, travel times to incidents within the Lease Area are not expected to have any significant increase due to the placement of WTGs. Thus, it is expected that Vineyard Northeast will have minimal impact on USCG MER operations. As outlined in Section 7.2.2, MISLE data over an approximately 10-year period reveal no spills within the Lease Area and only small-scale spills outside of the Lease Area. Historical data also shows that MER incidents are highly unlikely to occur within the Lease Area.

Based on the minimal expected impact to USCG MER operations and low frequency of MER incidents, it is expected that Vineyard Northeast will not have any appreciable effect on the response to marine spills or pollution events. No additional MER incidents are expected as a result of Vineyard Northeast.

# 8. Facility Operations

## 8.1 Communications

### 8.1.1 During Construction

Coordination among the USCG, port authorities/operators, ferry operators, local pilots, and other entities will be necessary to ensure that impacts from Vineyard Northeast's construction and installation vessels are minimized. The Proponent is committed to working with each stakeholder to address navigation and other concerns during the construction of Vineyard Northeast. As part of this effort, the Proponent plans to develop and implement a marine communications procedure to engage these stakeholders.

To facilitate effective and regular engagement with fisheries stakeholders throughout the life of Vineyard Northeast, the Proponent has developed an FCP (see Appendix I-I of the COP). The communication protocols outlined in the FCP are designed to help avoid interactions with fishing vessels and fishing gear. The Vineyard Northeast FCP will be updated regularly, in response to stakeholder feedback and to incorporate lessons learned, to ensure that the communication protocols and tools remain relevant and effective. Additional information about the Proponent's fisheries communication methods and fisheries team is provided in 2.6.1.1.

The Proponent employs a Marine Liaison Officer who is responsible for safe marine operations and ensuring that the Proponent is a good neighbor while on the water. The Marine Liaison Officer currently serves as the Proponent's point of contact for all external maritime agencies, partners, and stakeholders, including USCG, US Navy, port authorities, state and local law enforcement, and commercial operators (e.g., ferry, tourist vessels, cargo vessels, tankers, fishing boat operators, and other offshore wind developers). There is frequent interaction, information exchange, and coordination between the Marine Liaison Officer and the fisheries team regarding fisheries outreach.

During construction of Vineyard Northeast, the Proponent expects to employ a dedicated Marine Coordinator to manage all construction vessel logistics and implement communication protocols with external vessels at the harbor and offshore. During construction, the Marine Coordinator will be the primary point of contact for day-to-day operations with the USCG, port authorities, state and local law enforcement, marine patrol, and commercial operators. As such, the Marine Coordinator will be responsible for coordination with USCG regarding any required LNMs. The Marine Coordinator will operate from a marine coordination center that is established to control vessel movements throughout the Offshore Development Area. The marine coordination center is expected to be located at a staging port near the Lease Area. Daily meetings will be held by the Proponent to coordinate between contractors and avoid unnecessary simultaneous operations at the port facilities and routes to the Offshore Development Area. The Marine Coordinator will use tools such as radio communications and safety vessels to address vessels entering active work sites. The safety vessels would provide guidance to mariners and fishing vessels, explain the ongoing activities, and request that they give a wide berth to the work site or construction vessel(s), if necessary. These safety vessels would have no enforcement authority; the safety vessels would only assist mariners in navigating in the vicinity of the activity.

As further described in Section 2.6.1, the Proponent will provide Offshore Wind Mariner Updates to notify maritime stakeholders of the Proponent's offshore activities. Depending on the activity, the Offshore Wind Mariner Update may request that mariners give a wide berth to the work site or construction vessel(s). The Proponent will also coordinate with the USCG to issue LMNs advising other vessel operators of Vineyard Northeast's construction and installation activities. Local port communities and local media will also be notified and kept informed as the construction progresses. The Proponent's website will be updated regularly to provide information on the construction activities and specific Vineyard Northeast information. The Proponent will regularly provide updates as to the locations of installed structures (e.g., WTGs, ESP[s]) to the USCG and NOAA for use in navigational charts.

To minimize hazards to navigation, all Vineyard Northeast related vessels and equipment will display the required navigation lighting and day shapes. Vineyard Northeast related vessels will be also equipped with operational AIS and will comply with applicable US or SOLAS standards, with regards to vessel construction, vessel safety equipment, and crewing practices.

The WTGs, ESP(s), and booster station (if used) will become PATONs once they are installed. Temporary marine navigation lighting and marking will be installed on the foundation structures as they are being constructed, depending on the timing and sequence of foundation installation. Per USCG's current *ME, NH, MA, RI, CT, NY, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance*[28] and BOEM's *Guidelines for Lighting and Marking Structures Supporting Renewable Energy Development* (BOEM 2021), all temporary base, tower, and construction components preceding the final structure completion will be marked with Quick Yellow (QY) obstruction lights visible 360 degrees around the structure at a distance of 5 NM. The USCG will be notified as temporary lights are planned and activated in order for the USCG to provide appropriate marine notices and broadcasts until the final structure marking is established. The Proponent is committed to working with the USCG to mitigate safety concerns during construction.

During construction and certain maintenance activities, the Proponent may request that the USCG establish safety zones around the WTGs, ESP(s), and booster station (if used) pursuant to 33 CFR Part 147, which provides USCG with authority to implement safety zones on the Outer Continental Shelf (OCS) for offshore renewable energy installations (OREIs). These temporary safety zones would extend 1,640 ft (500 m) around each structure. The safety zones would be enforced by USCG individually as construction progresses from one structure to the next. The USCG would make notice of each enforcement period via Notice to Mariners. When enforced, only attending vessels and those vessels specifically authorized by the USCG would be permitted to enter or remain in the temporary safety zones. It is very unlikely that USCG will have vessels actively monitoring the safety zones (unless there are compliance issues). The USCG may grant the Proponent permission to use their own safety vessels to communicate safety information and/or safety zone parameters to mariners in the vicinity of active work sites. The Proponent's safety vessels would monitor the zones, document any compliance issues, and report those issues to the USCG who would then investigate the incident and issue fines or warnings to the owner of the vessel.

Additional construction-related vessel traffic at individual port facilities, as identified in Section 3.3, will result in a relatively small increase in traffic at these facilities and the adjacent waterways. LNM's will be issued by the USCG to address potential conflicts which may be identified.

### 8.1.2 Operations and Maintenance

The following are mitigation approaches affecting vessel operations that could be adopted to reduce the impacts of Vineyard Northeast on navigation:

- The USCG could advise mariners of the air draft restriction within the Lease Area by means of LNMs.
- The use of a 1 NM by 1 NM east-west layout would allow fixed fishing gear to be placed along the east-west turbine alignment in line with the WTGs, so it is visually apparent where this gear is potentially located and is not within the corridors between turbine rows. This is consistent with the current practice of placing such gear along east-west LORAN lines.

[28] USCG's PATON guidance for offshore wind energy structures in First District-area waters is periodically updated in District 1 LNMs.

- Similarly, the use of a 1 NM by 1 NM east-west layout would allow trawlers to utilize the east-west corridors between turbine rows.
- NOAA could update navigational charts to show the turbine locations and provide guidance as to limits to air draft and vessel lengths. Each WTG will be marked with an alphanumeric identifier to serve as a point of reference for mariners when visually determining their position within the Lease Area.

The Proponent will provide required information to USCG and/or NOAA to add the WTGs, ESP(s), booster station (if used), OECCs, and all associated PATONs to appropriate navigation charts. As an example, Figure 8.1 shows how the Block Island Wind Farm's WTGs and cable routes are depicted on the NOAA navigation chart (see the portion of the chart outlined in a red box).

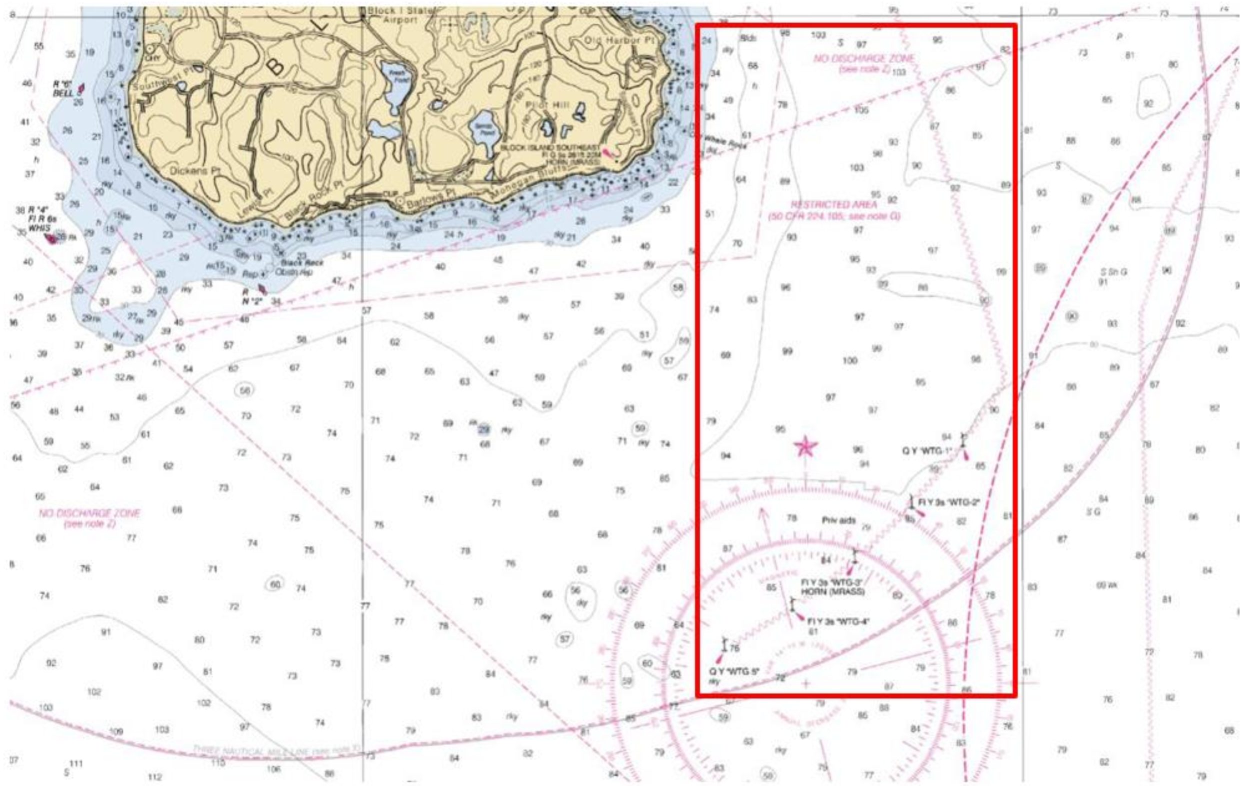

**Figure 8.1: Example offshore wind facility mapping on navigation chart (Block Island, RI, Chart 13215)**

The following sections provide additional information on proposed mitigation and monitoring measures during Vineyard Northeast's operations and maintenance phase. All mitigation measures described below would be maintained constantly throughout the life of Vineyard Northeast to ensure navigational safety.

### 8.1.3 Emergency Response

To mitigate potential impacts to SAR aircraft operating in the Lease Area, the Proponent will work with the USCG and the Department of Defense (DoD) to develop an operational protocol that outlines the procedures for the braking system on requested Vineyard Northeast WTGs to be engaged within a specified time upon request from the USCG or DoD during SAR operations and other emergency response situations. The protocol will include formal procedures that will enable efficient, effective processes for communicating and engaging the braking mechanism requests during SAR operations and other emergency response situations. These communications and shutdown procedures, as well as the brake systems, will be satisfactorily tested at least twice per year. The Proponent will participate in periodic USCG-coordinated training and exercises to test and refine notification and shutdown procedures and to provide SAR training opportunities for USCG vessels and aircraft.

The Proponent will maintain continuously operated (24 hours per day) operations center(s) throughout the life of Vineyard Northeast to monitor the offshore facilities. The center(s) will be located at the Proponent's O&M facilities and/or a third party's facilities. The location of the center(s) has not been determined at present. The center(s) will be able to immediately initiate the shutdown of any ordered WTG(s) and assist the USCG and/or the DoD in the response to distress calls through active control over the WTG braking system. The operations center personnel will have access to charts providing GPS position and identification numbers for each structure. The USCG will also be provided with this chart. The contact telephone number for the operations center(s) will be provided to the USCG and posted in various public notices that are issued. Additional details regarding the location, staffing, and capabilities of the control center(s) will be provided as part of the Proponent's Emergency Response Plan (ERP), which is expected to be prepared prior to construction. The Proponent plans to coordinate with USCG during the development of the ERP.

If the ESP(s) include a helipad, the helipad will be designed to accommodate USCG rescue helicopters. Enabling USCG helicopters to land on the ESP(s) could allow for more efficient responses to potential emergency situations within and outside the Lease Area. The Proponent is also evaluating the use of cameras on WTGs and/or ESP(s), which may aid in the detection of distressed mariners and enhance the USCG's ability to respond in emergency situations. In the event that a vessel allides with a structure, the Proponent will conduct a structural inspection as quickly as possible and advise the USCG if the structure has become a hazard to navigation.

The WTG nacelle hatches for access will be designed to enable opening, access, entry, and exit from both inside and outside. It will be possible to unsecure and open the nacelle roof hatch from the outside of the nacelle to facilitate emergency rescue from the nacelle top.

## 8.2 System Controls and Operations

The Proponent employs a Marine Liaison Officer who is responsible for safe marine operations and ensuring that the Proponent is a good neighbor while on the water. The Marine Liaison Officer currently serves as the liaison between the Proponent's internal parties and all external maritime partners and stakeholders (e.g., USCG, US Navy, port authorities, state and local law enforcement, marine patrol, commercial operators, etc.). The Marine Liaison Officer is also expected to be responsible for coordinating and issuing Offshore Wind Mariner Updates to notify maritime stakeholders of the Proponent's offshore activities. The Marine Liaison Officer will also assist in coordination of vessel inspections for construction and ongoing operations.

The Proponent will provide Offshore Wind Mariner Updates and coordinate with the USCG to issue LNMs advising other vessel operators of O&M activities. The Proponent's website will be regularly updated to provide information on the O&M activities occurring in the Offshore Development Area. The WTGs, ESP(s), and booster station (if used) will also be clearly identified on NOAA nautical charts.

Finally, the Proponent will continue to work with the USCG, BOEM, and other stakeholders to maintain safe navigation within the Offshore Development Area and to identify additional potential mitigation measures, as necessary.

Impacts associated with decommissioning activities will be adequately mitigated through the implementation of best management practices, where practicable. Avoidance, minimization, and mitigation measures are anticipated to be similar to those described above in Section 8.1.1.

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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. E** | |
| Has the coordinate data been supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format?<br><br>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. | **N/A** | ESRI Shapefile can be provided upon request; however, for a single WTG it is understood that latitude/longitude coordinates for the point should be sufficient. Latitude/longitude coordinates are provided in App. E. |
| **2. TRAFFIC SURVEY** | | |
| Was the traffic survey conducted within 12 months of the NSRA? | **Sec. 2.6.2** | |
| Does the survey include all vessel types? | **Sec. 2.6.2** | Table 2.5 |
| Is the time period of the survey at least 28 days duration? | **Sec. 2.6.2** | 5.75 years of AIS traffic data used |
| Does the survey include consultation with recreational vessel organizations? | **Sec. 2.6.1** | |
| Does the survey include consultation with fishing vessel organizations? | **Sec. 2.6.1** | |
| Does the survey include consultation with pilot organizations? | **Sec. 2.6.1** | |
| Does the survey include consultation with commercial vessel organizations? | **Sec. 2.6.1** | |
| Does the survey include consultation with port authorities? | **Sec. 2.6.1** | |
| Does the survey include proposed structure location relative to areas used by any type of vessel? | **Sec. 2.6.2 and Sec. 2.6.4** | See Fig. 2.2 for Lease Area proximity to principal traffic routes<br><br>See Fig. 2.10 and 2.11 for Lease Area and OECC proximity to designated fairways and TSS |
| Does the survey include numbers, types, sizes and other characteristics of vessels presently using such areas? | **Sec. 2.6.2 and App. B** | App. B.1 through B.4 presents traffic data on various types of vessels and characteristics for those vessels. Similarly, B.5 summarizes traffic which crosses the OECC. |

| ISSUE | REPORT SECTION | NOTES |
|---|---|---|
| Does the survey include types of cargo carried by vessels presently using such areas? | **Sec. 2.6.2.1 and App. B** | App. B.2 presents data on commercial traffic including cargo carrying vessels |
| 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)? | **Sec. 2.6.4.3** | |
| Does the survey include whether these areas contain transit routes used by coastal or deep-draft vessels, ferry routes, and fishing vessel routes? | **Sec. 2.6.4.2** | |
| Does the survey include alignment and proximity of the site relative to adjacent shipping routes | **Sec. 2.6.4.2** | |
| Does the survey include whether the nearby area contains prescribed or recommended routing measures or precautionary areas? | **Sec. 2.6.4.2** | |
| 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? | **Sec. 2.6.4.2** | |
| Does the survey include the proximity of the site to anchorage grounds or areas, safe haven, port approaches, and pilot boarding or landing areas? | **Sec. 2.6.5** | |
| Does the survey include the feasibility of allowing vessels to anchor within the vicinity of the structure field? | **Sec. 2.6.5 and Sec. 5.1.3** | |
| Does the survey include the proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds? | **Sec. 2.6.2.2 and Sec. 6.1.9** | Sec. 2.6.2.2 presents existing routes and Sec. 6.1.9 presents anticipated changes to routes |
| Does the survey include whether the site lies within the limits of jurisdiction of a port and/or navigation authority? | **Sec. 2.6.4.3** | |
| Does the survey include the proximity of the site to offshore firing/bombing ranges and areas used for any marine or airborne military purposes? | **Sec. 2.6.4.3** | |
| Does the survey include the proximity of the site to existing or proposed offshore OREi/gas platform or marine aggregate mining? | **Sec. 2.6.4.3** | |
| Does the survey include the proximity of the site to existing or proposed structure developments? | **Sec. 2.6.4.3** | |
| Does the survey includes the proximity of the site relative to any designated areas for the disposal of dredging material or ocean disposal site? | **Sec. 2.6.5** | |
| 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? | **Sec. 2.6.4.1 and Sec. 2.6.5** | |

| ISSUE | REPORT SECTION | NOTES |
|---|---|---|
| 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? | **Sec. 6 and App. D** | App. D provide summary of model used for analysis in Sec. 6 |
| 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? | **Sec. 5.1.6** | |
| Does the survey include seasonal variations in traffic? | **App. B** | Table B.4 |
| **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?<br>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. | **Sec. 3.1.2, Sec. 3.2.3 and Sec. 5** | |
| 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 vessels types identified in the traffic survey?<br>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. | **Sec. 3.1.1 and 3.1.2.1** | |
| 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)? | **Sec. 7.1.4** | |
| Does the NSRA denote how rotor blade rotation and power transmission, etc., will be controlled by the<br><br>designated services when this is required in an emergency? | **Sec. 8.1.3** | |
| Does the NSRA denote 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? | **Sec. 5.1.2.6** | |
| 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? | **Sec. 6.1.8.4** | |

| ISSUE | REPORT SECTION | NOTES |
|---|---|---|
| **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? | **Sec. 3.2.3** | |
| 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** | Water depth in the area exceed maximum vessel drafts by more than 50 ft; therefore, underkeel clearance is not of concern. |
| To establish a minimum clearance depth over devices, has the developer identified from the traffic survey the deepest draft of observed traffic?<br>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. | **App. B** | Vessel drafts for largest vessels in each class of vessel operating in the area are identified in App. B.<br>Water depths in the area exceed maximum vessel drafts by more than 50 ft; therefore, underkeel clearance is not of concern. |
| 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?<br>• By all vessels or<br>• By specified vessel types, operations and/or sizes?<br>• In all directions or areas; or<br>• In specified directions or areas?<br>• In specified tidal, weather or other conditions; and<br>• At any time, day or night? | **Sec. 6.1.8.3** | |
| Navigation in and/or near the site should be<br>• Prohibited by specified vessel types, operations and/or sizes;<br>• 'Prohibited in respect to specific activities;<br>• Prohibited in all areas or directions;<br>• Prohibited in specified areas or directions;<br>• Prohibited in specified tidal or weather conditions;<br>• Prohibited during certain times of the day or night; or<br>• Recommended to be avoided? | **Sec. 6.1.8.3 and Sec. 8.1.1** | Sec. 8.1.1 discusses proposed temporary measures during construction. |

| ISSUE | REPORT SECTION | NOTES |
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| 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? | | The NSRA in its entirety addresses this question. |
| **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? | **Sec. 3.2.3** | |
| 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? | **Sec. 4.5** | |
| 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? | **Sec. 4.5** | |
| Current directions/velocities might aggravate or mitigate the likelihood of allision with the structure? | **Sec. 4.5** | |
| The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect? | **Sec. 4.5** | |
| The set is across the major axis of the layout at any time, and, if so, at what rate? | **Sec. 4.5** | |
| In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream or currents? | **Sec. 4.5 and Sec. 6** | Sec. 4.5 presents information on currents and Sec. 6 presents results of allision modeling. |
| Structures themselves could cause changes in the set and rate of the tidal stream or direction and rate of the currents? | **Sec. 4.5** | |
| 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? | **Sec. 4.5** | |
| Structures would cause danger and/or severely affect the air column, water column, seabed and sub-seabed in the general vicinity of the structure? | **Sec. 4.5** | |
| **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? | **Sec. 6.1.8.3** | |

| ISSUE | REPORT SECTION | NOTES |
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| The structures could create problems in the area for vessels under sail, such as wind masking, turbulence, or sheer? | Sec. 5.1.3 | |
| 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? | Sec. 4.3 and Sec. 6 | |
| Depending on the location of the structure and the presence of cold weather, sea ice and/or icing of the structure may cause problems?<br>A thorough analysis of how the presence of the structure would mitigate or exacerbate icing? | Sec. 4.6 | |
| 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? | Sec. 4.6 | |
| **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.<br>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?<br>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. | Sec. 7.1.4 | |
| Each OREi layout design will be assessed on a case-by-case basis. | N/A | |

| 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). | **Sec. 5, Sec. 6, Sec. 7, and Sec. 8** | |
| 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. | **N/A** | Consistent spacing is proposed throughout the Lease Area |
| **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? | **Sec. 5.1.1.4** | |
| Structures could block or hinder the view of the coastline or of any other navigational feature such as aids to navigation, landmarks, promontories? | **Sec. 5.1.1.4** | |
| Structures and locations could limit the ability of vessels to maneuver in order to avoid collisions? | **Sec. 2.7.1** | |
| **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? | **Sec. 5.1.2.1** | |
| Structures could produce radar reflections, blind spots, shadow areas or other adverse effects in the following interrelationships:<br>• Vessel to vessel;<br>• Vessel to shore;<br>• Vessel Traffic Service radar to vessel;<br>• Radio Beacons (RACONS) to/from vessel; and<br>• Aircraft and Air Traffic Control? | **Sec. 5.1.2.3** | |

| ISSUE | REPORT SECTION | NOTES |
|---|---|---|
| Structures, in general, would comply with current recommendations concerning electromagnetic interference? | **Sec. 5.1.2.8** | |
| 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? | **Sec. 5.1.2.6** | |
| Structures, generators, and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems? | **Sec. 5.1.2.8** | |
| The power and noise generated by structures above or below the water would create physical risks that would affect the health of vessel crews? | **Sec. 5.1.2.6** | |
| **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);<br>• Likely consequences of collision ("What if' analysis);<br>• Likely location of collision;<br>• Likely type of collision;<br>• Likely vessel type involved in collision;<br>• Likely frequency of allision (vessel to structure)<br>• Likely consequences of allision ("What if' analysis);<br>• Likely location of allision;<br>• Likely vessel type involved in allision;<br>• Likely frequency of grounding;<br>• Likely consequences of grounding ("What if' analysis);<br>• Likely location of grounding; and<br>• Likely vessel type involved in grounding? | **Sec. 6** | |
| **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:<br>• How many marine environmental/pollution response cases has the USCG conducted in the proposed structure region over the last ten years?<br>• What type of pollution cases were they?<br>• What type and how many assets responded?<br>• How many additional pollution cases are projected due to allisions with the structures? | **Sec. 7.2** | |

| 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? | **Sec. 5.1.1** | |
| 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? | **Sec. 5.1.1.1** | |
| 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? | **Sec. 5.1.1.1** | |
| 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? | **Sec. 5.1.1.3** | |
| 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? | **Sec. 5.1.1.1** | |
| 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? | **Sec. 5.1.1.2** | |
| Whether the proposed site and/or its individual generators would comply in general with markings for such structures, as required by the Coast Guard? | **Sec. 5.1.1.1** | |
| 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? | **Sec. 5.1.1.1** | |
| 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? | **Sec. 5.1.1.1** | |
| How the marking of the structure will impact existing Federal aids to navigation in the vicinity of the structure? | **Sec. 5.1.1.4** | |

| ISSUE | REPORT SECTION | NOTES |
|---|---|---|
| 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). | **Sec. 5.1.1.1** | |
| All generators and transmission systems should be equipped with control mechanisms that can be operated from an operations center of the installation. | **Sec. 8.1.3** | |
| 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. | **Sec. 8.1.3** | |
| 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. | **Sec. 8.1.3** | |
| **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? | **Sec. 8.1.3** | |
| The operations center personnel should have a chart indicating the Global Positioning System (GPS) position and unique identification numbers of each of the structure? | **App. E** | |

| ISSUE | REPORT SECTION | NOTES |
|---|---|---|
| All applicable Coast Guard command centers (District and Sector) will be advised of the contact telephone number of the operations center? | **Sec. 8.1.3** | |
| All applicable Coast Guard command centers will have a chart indicating the position and unique identification number of each of the structures? | **Sec. 8.1.3** | |
| **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. | **Sec. 8.1.3** | |
| 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. | **Sec. 8.1.3** | |
| Communication and shutdown procedures should be tested satisfactorily at least twice each year. | **Sec. 8.1.3** | |
| After an allision, the applicant should submit documentation that verifies the structural integrity of the structure | **Sec. 8.1.3** | |

# Appendix B

## AIS Data Analyses

# B.1 AIS Data Summary

AIS data were compiled in a consistent format from different data sets to the cover the period from 1 January 2016 to 30 September 2021. Table B.1 summarizes the details of the AIS datasets available for each year. Figure B.1 presents the spatial extent of the analysis regions adopted for the AIS data in this report which covered longitudes between 69.75°W to 71.95°W and latitudes between 40.35° N to 41.73°N. The AIS data analysis has focused on Lease Area OSC-A 0522 (the "Lease Area").

In total over the 5.75 year period analyzed, there are 1,687 unique vessels interacting with the Lease Area, a majority of which are fishing. A total of 506 unique fishing vessels in the data set.  Note that the number of unique vessels for a given year as compared to the total number of unique vessels per 2016-2021 will not sum up to the same number since the same vessel may frequent the area in different years.

**Table B.1: Summary of AIS dataset analyzed (Data Source: Marine Cadastre)**

| Parameter | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2016- Sep. 2021 |
|---|---|---|---|---|---|---|---|
| Number of Unique Vessels | 280 | 343 | 558 | 648 | 504 | 400 | 1,687 |
| Number of Unique Fishing Vessels | 64 | 89 | 255 | 334 | 236 | 177 | 506 |

***Note that the number of unique vessels for a given year as compared to the total number of unique vessels per 2016-2021 will not sum up to the same number since the same vessel may frequent the area in different years.*

Table B.2 summarizes the vessel categories that each AIS vessel code has been assigned to in this study while Table B.3 provides a summary of numbers of unique vessels and unique tracks by vessel type. The seasonal breakdown of vessel traffic is given Table B.4.

**Table B.2: AIS vessel type codes and vessel classes in this NSRA**

| AIS Code | Description | Vessel Class in this NSRA |
|---|---|---|
| 0 | Not available (default) | Unspecified AIS Type |
| 1 to 19 | Reserved for future use | Other |
| 20 | Wing in ground (WIG), all ships of this type | Other |
| 21 | Wing in ground (WIG), Hazardous category A | Other |
| 22 | Wing in ground (WIG), Hazardous category B | Other |
| 23 | Wing in ground (WIG), Hazardous category C | Other |
| 24 | Wing in ground (WIG), Hazardous category D | Other |
| 25 | Wing in ground (WIG), Reserved for future use | Other |
| 26 | Wing in ground (WIG), Reserved for future use | Other |
| 27 | Wing in ground (WIG), Reserved for future use | Other |
| 28 | Wing in ground (WIG), Reserved for future use | Other |
| 29 | Wing in ground (WIG), Reserved for future use | Other |
| 30 | Fishing | Fishing |
| 31 | Towing | Tug Tows |
| 32 | Towing: length exceeds 200m or breadth exceeds 25m | Tug Tows |

| AIS Code | Description | Vessel Class in this NSRA |
|---|---|---|
| 33 | Dredging or underwater ops | Other |
| 34 | Diving ops | Other |
| 35 | Military ops | Military |
| 36 | Sailing | Recreational |
| 37 | Pleasure Craft | Recreational |
| 38 | Reserved | Other |
| 39 | Reserved | Other |
| 40 | High speed craft (HSC), all ships of this type | Other |
| 41 | High speed craft (HSC), Hazardous category A | Other |
| 42 | High speed craft (HSC), Hazardous category B | Other |
| 43 | High speed craft (HSC), Hazardous category C | Other |
| 44 | High speed craft (HSC), Hazardous category D | Other |
| 45 | High speed craft (HSC), Reserved for future use | Other |
| 46 | High speed craft (HSC), Reserved for future use | Other |
| 47 | High speed craft (HSC), Reserved for future use | Other |
| 48 | High speed craft (HSC), Reserved for future use | Other |
| 49 | High speed craft (HSC), No additional information | Other |
| 50 | Pilot Vessel | Other |
| 51 | Search and Rescue vessel | Military |
| 52 | Tug | Tug Tows |
| 53 | Port Tender | Other |
| 54 | Anti-pollution equipment | Other |
| 55 | Law Enforcement | Military |
| 56 | Spare - Local Vessel | Tug Tows |
| 57 | Spare - Local Vessel | Tug Tows |
| 58 | Medical Transport | Other |
| 59 | Noncombatant ship according to RR Resolution No. 18 | Other |
| 60 | Passenger, all ships of this type | Passenger |
| 61 | Passenger, Hazardous category A | Passenger |
| 62 | Passenger, Hazardous category B | Passenger |
| 63 | Passenger, Hazardous category C | Passenger |
| 64 | Passenger, Hazardous category D | Passenger |
| 65 | Passenger, Reserved for future use | Passenger |
| 66 | Passenger, Reserved for future use | Passenger |
| 67 | Passenger, Reserved for future use | Passenger |
| 68 | Passenger, Reserved for future use | Passenger |

| AIS Code | Description | Vessel Class in this NSRA |
|---|---|---|
| 69 | Passenger, No additional information | Passenger |
| 70 | Cargo, all ships of this type | Cargo |
| 71 | Cargo, Hazardous category A | Cargo |
| 72 | Cargo, Hazardous category B | Cargo |
| 73 | Cargo, Hazardous category C | Cargo |
| 74 | Cargo, Hazardous category D | Cargo |
| 75 | Cargo, Reserved for future use | Cargo |
| 76 | Cargo, Reserved for future use | Cargo |
| 77 | Cargo, Reserved for future use | Cargo |
| 78 | Cargo, Reserved for future use | Cargo |
| 79 | Cargo, No additional information | Cargo |
| 80 | Tanker, all ships of this type | Tanker |
| 81 | Tanker, Hazardous category A | Tanker |
| 82 | Tanker, Hazardous category B | Tanker |
| 83 | Tanker, Hazardous category C | Tanker |
| 84 | Tanker, Hazardous category D | Tanker |
| 85 | Tanker, Reserved for future use | Tanker |
| 86 | Tanker, Reserved for future use | Tanker |
| 87 | Tanker, Reserved for future use | Tanker |
| 88 | Tanker, Reserved for future use | Tanker |
| 89 | Tanker, No additional information | Tanker |
| 90 | Other Type, all ships of this type | Other |
| 91 | Other Type, Hazardous category A | Other |
| 92 | Other Type, Hazardous category B | Other |
| 93 | Other Type, Hazardous category C | Other |
| 94 | Other Type, Hazardous category D | Other |
| 95 | Other Type, Reserved for future use | Other |
| 96 | Other Type, Reserved for future use | Other |
| 97 | Other Type, Reserved for future use | Other |
| 98 | Other Type, Reserved for future use | Other |
| 99 | Other Type, no additional information | Other |
| 100 to 199 | Reserved for regional use | Other |
| 200 to 255 | Reserved for future use | Other |
| 256 to 999 | No designation | Other |
| 1001 | Commercial Fishing Vessel | Fishing |
| 1002 | Fish Processing Vessel | Fishing |

| AIS Code | Description | Vessel Class in this NSRA |
|---|---|---|
| 1003 | Freight Barge | Cargo |
| 1004 | Freight Ship | Cargo |
| 1005 | Industrial Vessel | Other |
| 1006 | Miscellaneous Vessel | Other |
| 1007 | Mobile Offshore Drilling Unit | Other |
| 1008 and 1009 | Non-Vessel | Other |
| 1010 | Offshore Supply Vessel | Other |
| 1011 | Oil Recovery | Other |
| 1012 | Passenger (Inspected) | Passenger |
| 1013 | Passenger (Uninspected) | Passenger |
| 1014 | Passenger Barge (Inspected) | Passenger |
| 1015 | Passenger Barge (Uninspected) | Passenger |
| 1016 | Public Freight | Cargo |
| 1017 | Public Tankship/Barge | Tanker |
| 1018 | Public Vessel, Unclassified | Other |
| 1019 | Pleasure Craft/Sailing | Recreational |
| 1020 | Research Vessel | Other |
| 1021 | SAR Aircraft | Military |
| 1022 | School Ship | Other |
| 1023 | Tank Barge | Tug Tows |
| 1024 | Tank Ship | Tanker |
| 1025 | Towing Vessel | Tug Tows |
| 1026 to 1051 | No designation | Other |
| 1052 | Towing Vessel | Tug Tows |
| 1053 to 2000 | No designation | Other |

**Table B.3: Vessel types within the Lease Area based on 2016-2021 AIS data**

| | Unique Vessels | | Unique Tracks | |
|---|---|---|---|---|
| | Number | Percentage | Number | Percentage |
| Cargo Vessels | 288 | 17% | 501 | 6% |
| Tankers | 232 | 14% | 439 | 5% |
| Passenger Vessels | 39 | 2% | 139 | 2% |
| Tug Tow Vessels | 31 | 2% | 64 | 1% |
| Military Vessels | 0 | 0% | 0 | 0% |
| Recreational Vessels | 340 | 20% | 773 | 9% |
| Fishing Vessels, In Transit [1] | 500 | 30% | 5,556 | 63% |
| Fishing Vessels, Fishing [1] | 125 | 7% | 398 | 5% |
| Fishing Vessels, All [1] | 506 | 30% | 5,692 | 64% |
| Other Vessels | 68 | 4% | 267 | 3% |
| Unspecified AIS Type | 183 | 11% | 966 | 11% |
| Total (2016–Sep. 2021) | 1,687 | 100% | 8,841 | 100% |
| Annual Average | 293 | - | 1,538 | - |

1. There is some double counting of vessels between transiting and fishing. For the purposes of this analysis, it is assumed that fishing vessels with speeds less than 4 kts (~2 meters per second) are trawling while those with speeds greater than 4 kts are transiting the Lease Area. Some fishing vessels have speeds both above and below 4 kts while in the AIS analysis area and thus are counted as both in transit and trawling.

**Table B.4: Vessel types within the Lease Area by month on 2016-2021 AIS data**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total (2016-2021) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Unique Vessels - Cargo Vessels | 37 | 24 | 39 | 32 | 44 | 35 | 35 | 49 | 42 | 37 | 27 | 28 | 288 |
| Number of Unique Tracks - Cargo Vessels | 48 | 27 | 43 | 39 | 51 | 44 | 45 | 57 | 48 | 39 | 32 | 28 | 501 |
| Number of Unique Vessels - Fishing Vessels (all) | 58 | 60 | 87 | 190 | 223 | 244 | 246 | 234 | 188 | 116 | 90 | 75 | 506 |
| Number of Unique Tracks - Fishing Vessels (all) | 175 | 172 | 243 | 571 | 761 | 776 | 839 | 850 | 571 | 329 | 237 | 168 | 5,692 |
| Number of Unique Vessels - Passenger Vessels | - | - | 1 | 4 | 5 | 5 | 2 | 8 | 19 | 16 | 3 | 1 | 39 |
| Number of Unique Tracks - Passenger Vessels | - | - | 2 | 11 | 18 | 18 | 4 | 9 | 42 | 30 | 3 | 2 | 139 |
| Number of Unique Vessels - Recreational Vessels | 1 | 3 | 1 | 6 | 44 | 107 | 112 | 95 | 32 | 25 | 16 | 3 | 340 |
| Number of Unique Tracks - Recreational Vessels | 15 | 15 | 25 | 41 | 68 | 133 | 216 | 165 | 47 | 28 | 17 | 3 | 773 |
| Number of Unique Vessels - Tankers | 30 | 23 | 22 | 26 | 33 | 30 | 35 | 31 | 25 | 26 | 29 | 24 | 232 |
| Number of Unique Tracks - Tankers | 40 | 27 | 28 | 33 | 43 | 46 | 48 | 44 | 34 | 30 | 33 | 33 | 439 |
| Number of Unique Vessels - Tug Tow Vessels | 3 | 5 | 2 | 6 | 2 | 3 | 6 | 7 | 6 | 6 | 5 | 2 | 31 |
| Number of Unique Tracks - Tug Tow Vessels | 3 | 5 | 3 | 6 | 4 | 5 | 8 | 9 | 6 | 8 | 5 | 2 | 64 |
| Number of Unique Vessels - Other Vessels | 4 | 1 | 7 | 14 | 17 | 27 | 21 | 23 | 10 | 11 | 11 | 5 | 68 |
| Number of Unique Tracks - Other Vessels | 5 | 1 | 7 | 24 | 33 | 50 | 35 | 49 | 18 | 24 | 15 | 6 | 267 |
| Number of Unique Vessels - Unspecified AIS Type | 16 | 10 | 21 | 37 | 43 | 51 | 55 | 58 | 44 | 32 | 19 | 16 | 183 |
| Number of Unique Tracks - Unspecified AIS Type | 34 | 38 | 77 | 115 | 113 | 99 | 127 | 146 | 95 | 68 | 32 | 22 | 966 |
| **Total (2016-2021)** | | | | | | | | | | | | | |
| Total Number of Unique Vessels | 149 | 126 | 180 | 315 | 411 | 502 | 512 | 505 | 366 | 269 | 200 | 154 | 1,687 |
| Total Number of Unique Tracks | 320 | 285 | 428 | 840 | 1,091 | 1,171 | 1,322 | 1,329 | 861 | 556 | 374 | 264 | 8,841 |

Vessel track density plots for all vessels that transited through the Lease Area is presented in Figure B.1. Figure B.2 provides a polar histogram gives the distribution of vessel courses through the Lease Area The dominant courses are noted to be northwest and southeast.

AIS vessel traffic density for all vessels that transited through the Lease Area

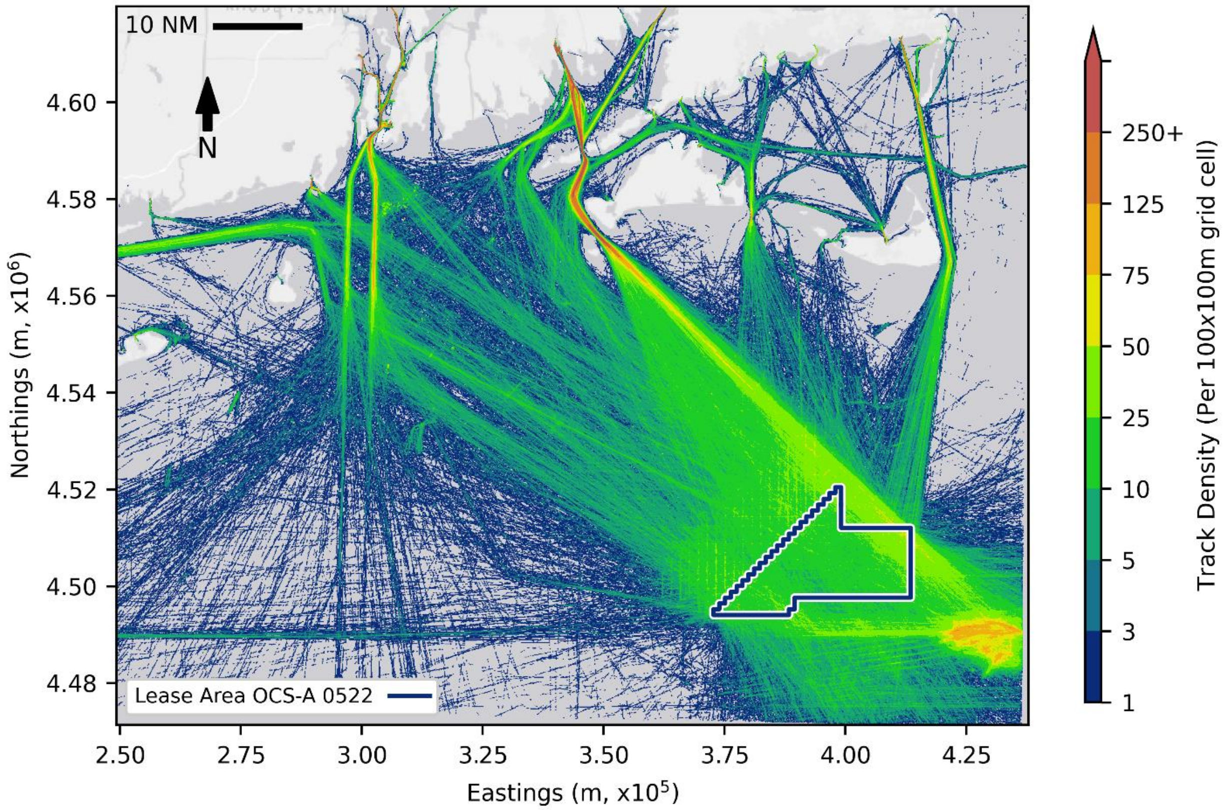



Figure B.1: AIS vessel traffic density for all vessels that transited through the Lease Area

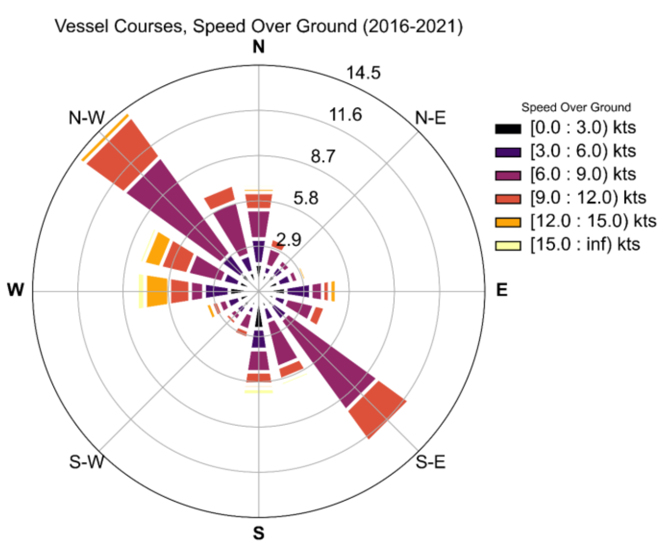



Figure B.2: All vessels' courses throughout and speed through the Lease Area

# B.2 Commercial Traffic

A summary of the various commercial and military vessels that transited through the Lease Area is presented in the following sections.

## B.2.1 Passenger Vessels

A total of 39 unique passenger vessels transited through the Lease Area during the 5.75-year AIS data record. The total vessel tracks passing through the Lease Area was 139. Table B.5 summarizes the vessel details for the 10 largest (LOA) passenger vessels that transited though the AIS analysis area. A histogram of vessel length is also presented in Figure B.3. Vessel length ranges from 42 to 1150 ft (13 to 350 m) LOA.

**Table B.5: Vessel details – 10 largest passenger vessels transiting the AIS analysis area**

| Vessel Name | AIS Code | MMSI Number | IMO Number | LOA (ft) | LOA (m) | Beam (ft) | Beam (m) |
|---|---|---|---|---|---|---|---|
| ANTHEM OF THE SEAS | 1012 | 311000274 | 9656101 | 1149.9 | 350.5 | 135.8 | 41.4 |
| NORWEGIAN ESCAPE | 60 | 311000341 | 9677076 | 1098.0 | 334.7 | - | - |
| REGAL PRINCESS | 1012 | 310674000 | 9584724 | 1082.0 | 329.8 | 154.0 | 46.9 |
| ROYAL PRINCESS | 60 | 310661000 | 9584712 | 1082.3 | 329.9 | 126.0 | 38.4 |
| QUEEN MARY 2 | 1012 | 310627000 | 9241061 | 992.9 | 302.6 | 134.5 | 41.0 |
| NORWEGIAN GEM | 1012 | 309951000 | 9355733 | 965.0 | 294.1 | 125.0 | 38.1 |
| NORWEGIAN DAWN | 1012 | 311307000 | 9195169 | 964.7 | 294.0 | 105.6 | 32.2 |
| CELEBRITY SUMMIT | 1012 | 249047000 | 9192387 | 964.6 | 294.0 | 105.6 | 32.2 |
| CARIBBEAN PRINCESS | 1012 | 310423000 | 9215490 | 951.0 | 289.9 | 118.0 | 36.0 |
| DISNEY MAGIC | 1012 | 308516000 | 9126807 | 864.9 | 263.6 | 105.8 | 32.2 |

NOTE: Vessel dimensions updated based on dimensions registered on the Coast Guard database (https://cgmix.uscg.mil/PSIX/PSIXSearch.aspx)

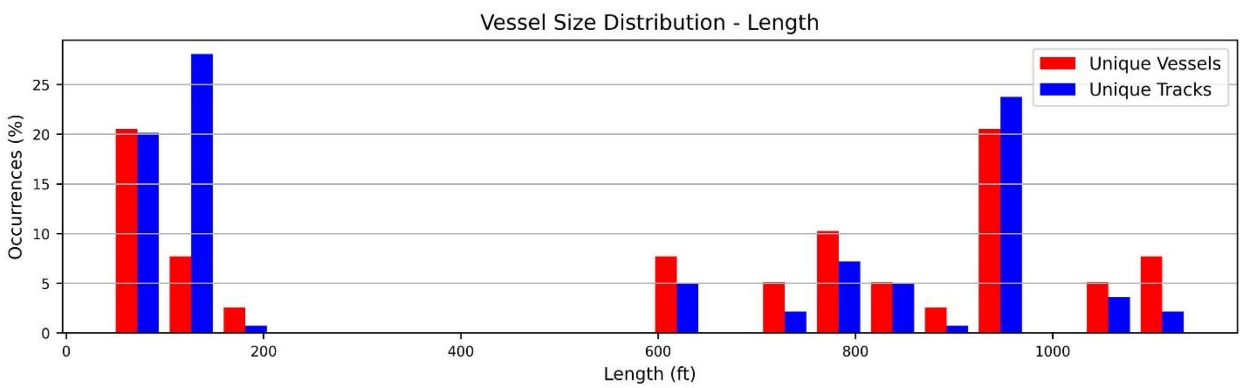



**Figure B.3: Histogram of passenger vessel size (LOA) transiting through AIS analysis area**

Figure B.4 presents a plot of all passenger vessel tracks, and Figure B.5 presents the courses and speeds of the passenger vessels in the Lease Area. The dominant courses observed are west, west-southwest and east southeast.

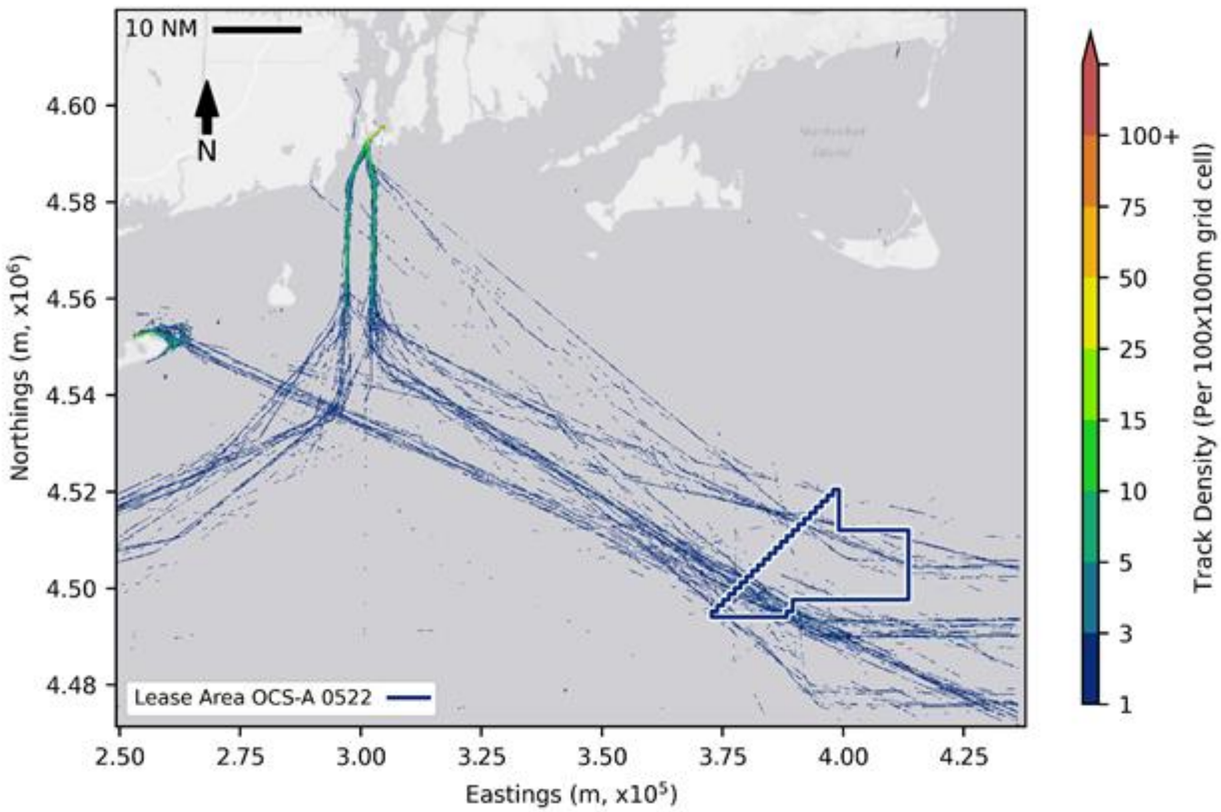



**Figure B.4: Total (2016-2021) Passenger vessel tracks through the Lease Area**

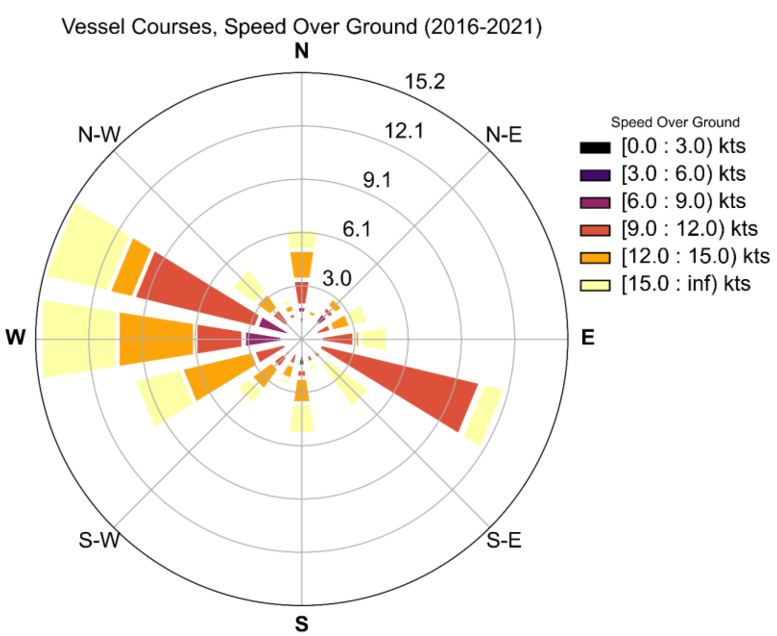



**Figure B.5: Passenger vessels' courses and speed through the Lease Area**

### B.2.2 Tanker Vessels

A total of 232 unique tanker vessels transited through the Lease Area during the 5.75-year AIS data record. The total number of unique vessel tracks through the Lease Area was 439. Table B.6 summarizes the vessel details for the 10 largest (LOA) tankers vessels that transited through the AIS analysis area. A histogram of vessel length is presented in Figure B.6 with the majority of tankers having an approximate 600 ft (183 m) LOA (approx.).

Figure B.7 presents a plot of all tanker vessel tracks and indicates that a majority of the tracks come from the west and west-northwest direction.

**Table B.6: Vessel details – 10 largest tanker vessels transiting the AIS analysis area**

| Vessel Name | AIS Code | MMSI Number | IMO Number | LOA (ft) | LOA (m) | Beam (ft) | Beam (m) |
|---|---|---|---|---|---|---|---|
| SKS SKEENA | 80 | 258722000 | 9301536 | 899.8 | 274.3 | 158.7 | 48.4 |
| SAN JACINTO | 1024 | 538006700 | 9730373 | 899.5 | 274.2 | 157.5 | 48.0 |
| PHOENIX ADMIRAL | 80 | 563353000 | 9482603 | 820.2 | 250.0 | 144.4 | 44.0 |
| EVERGLADES | 80 | 538003321 | 9394935 | 820.1 | 250.0 | 144.4 | 44.0 |
| VIKTOR BAKAEV | 80 | 636015565 | 9610810 | 819.9 | 249.9 | - | - |
| WHISTLER SPIRIT | 80 | 311000224 | 9417323 | 797.2 | 243.0 | 137.8 | 42.0 |
| ALGERIA I | 1024 | 373090000 | 9543536 | 750.0 | 228.6 | 137.7 | 42.0 |
| NORSTAR INTEGRITY | 1024 | 538003032 | 9329758 | 750.0 | 228.6 | 105.8 | 32.3 |
| TWO MILLION WAYS | 80 | 209294000 | 9334571 | 749.7 | 228.5 | 105.6 | 32.2 |
| NAVE CIELO | 1024 | 319767000 | 9301976 | 748.0 | 228.0 | 105.8 | 32.2 |

NOTE: Vessel dimensions updated based on dimensions registered on the Coast Guard database (https://cgmix.uscg.mil/PSIX/PSIXSearch.aspx)

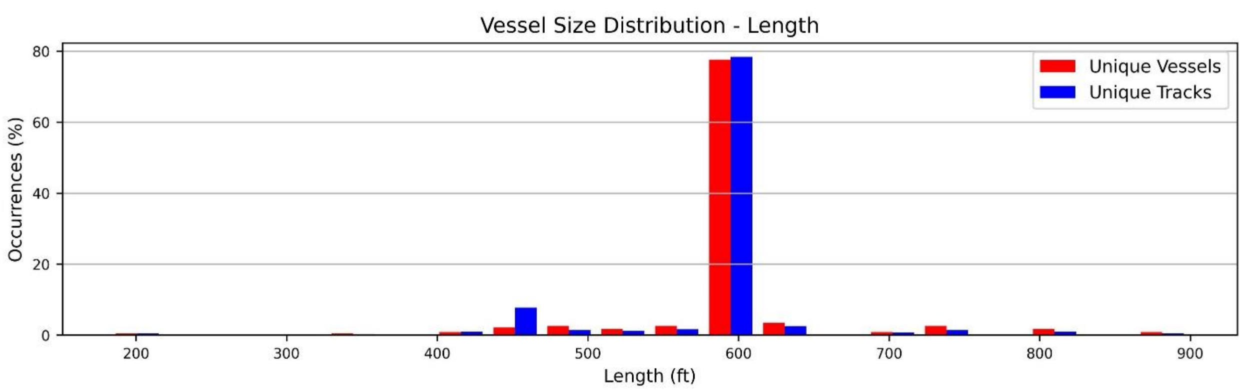



**Figure B.6: Histogram of tanker vessel size (LOA) transiting through the Lease Area**

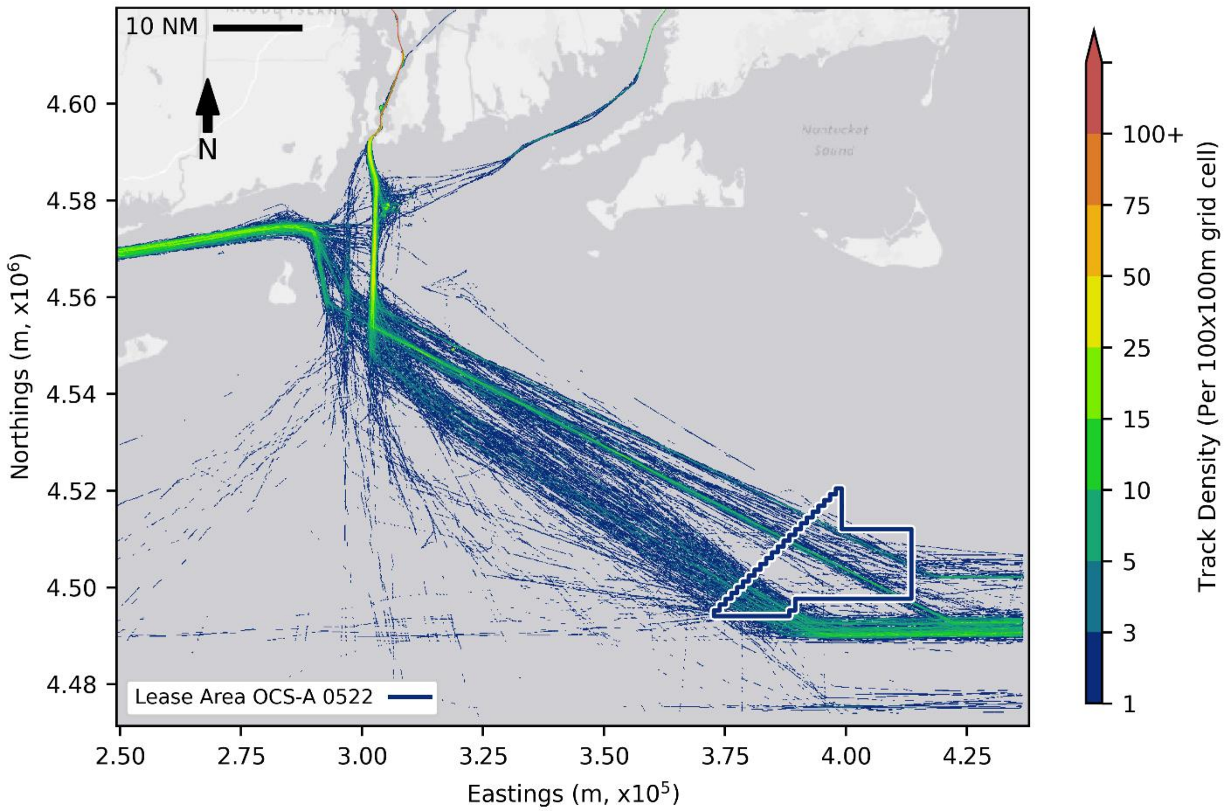



**Figure B.7: Total (2016-2021) Tanker vessel tracks through the Lease Area**

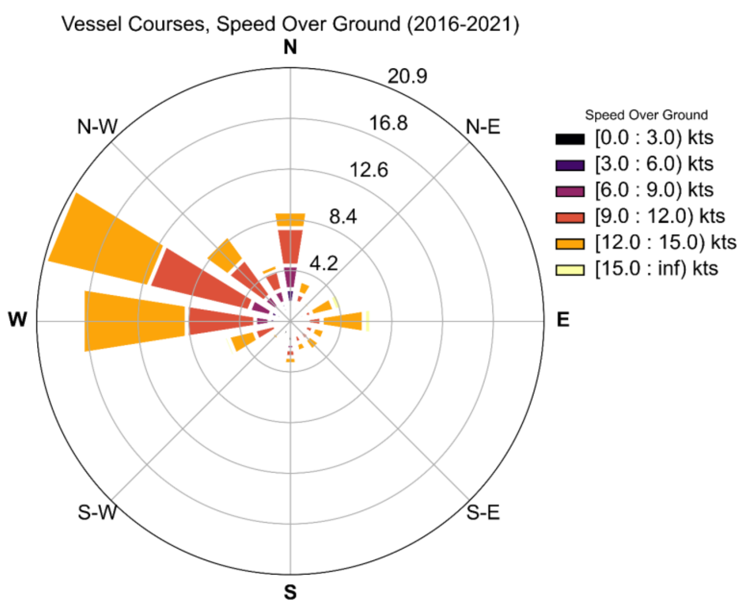



**Figure B.8: Tanker vessels' courses throughout and speed through the Lease Area**

### B.2.3 Dry Cargo Vessels

A total of 288 unique cargo vessels transited through the Lease Area during the 5.75-year AIS data record. The total unique vessel tracks through the Lease Area was 501. Table B.7 summarizes the vessel details for the 10 largest (LOA) cargo vessels that transited through the Lease Area. A histogram of vessel length is presented in Figure B.9 with the majority of cargo vessels ranging between 575 to 660 ft (175 to 201 m) LOA (approx.).

**Table B.7: Vessel details – 10 largest dry cargo vessels transiting the AIS analysis area**

| Vessel Name | AIS Code | MMSI Number | IMO Number | LOA (ft) | LOA (m) | Beam (ft) | Beam (m) |
|---|---|---|---|---|---|---|---|
| CMA CGM IVANHOE | 1004 | 218844000 | 9365805 | 1148.3 | 350.0 | 140.4 | 42.8 |
| APL YANGSHAN | 1004 | 566482000 | 9462031 | 1138.5 | 347.0 | 148.3 | 45.2 |
| CHICAGO EXPRESS | 1004 | 218366000 | 9295268 | 1103.0 | 336.2 | 140.9 | 42.9 |
| SOFIA EXPRESS | 1004 | 218366000 | 9450404 | 1100.6 | 335.5 | 140.9 | 42.9 |
| MAERSK SARNIA | 1004 | 563000800 | 9289946 | 1100.0 | 335.3 | 140.4 | 42.8 |
| EVER LIVEN | 70 | 416481000 | 9595527 | 1099.0 | 335.0 | 150.2 | 45.8 |
| MSC VALENCIA | 70 | 255805558 | 9301471 | 1096.0 | 334.1 | 140.6 | 42.9 |
| CMA CGM TOSCA | 70 | 228335900 | 9299783 | 1095.8 | 334.0 | 140.8 | 42.9 |
| OOCL EUROPE | 1004 | 477214700 | 9300805 | 1059.6 | 323.0 | 140.4 | 42.8 |
| CMA CGM NABUCCO | 71 | 209920000 | 9299630 | 1053.1 | 321.0 | 140.4 | 42.8 |

NOTE: Vessel dimensions updated based on dimensions registered on the Coast Guard database (https://cgmix.uscg.mil/PSIX/PSIXSearch.aspx)

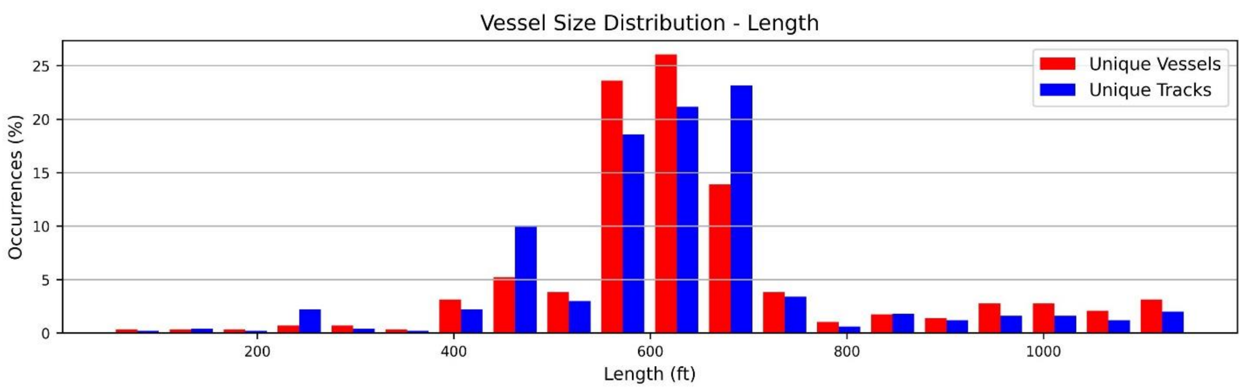



**Figure B.9: Histogram of dry cargo vessel size (LOA) transiting through the Lease Area**

Figure B.10 presents a plot of all tanker vessel tracks, which indicates that a majority of the tracks in the Lease Area have a course of west and west-northwest

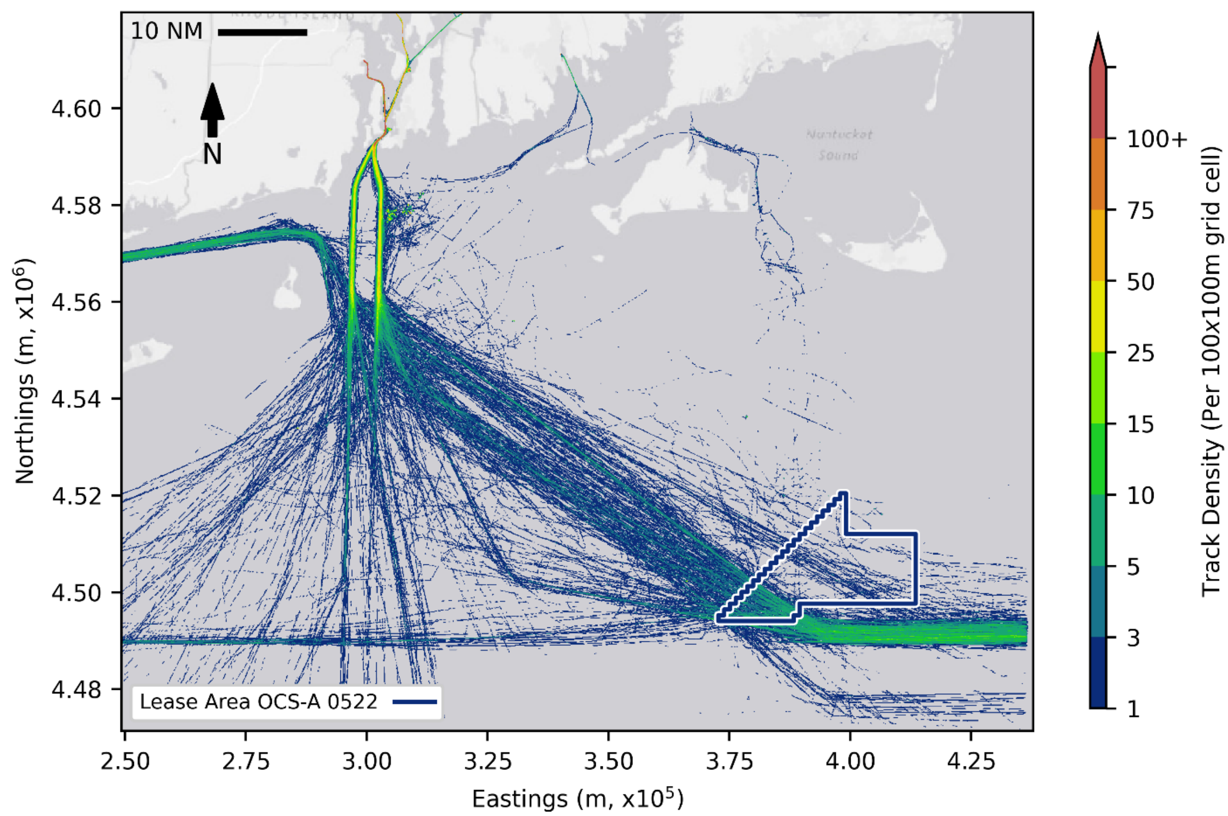



**Figure B.10: Total (2016-2021) Dry cargo vessel tracks through the Lease Area**

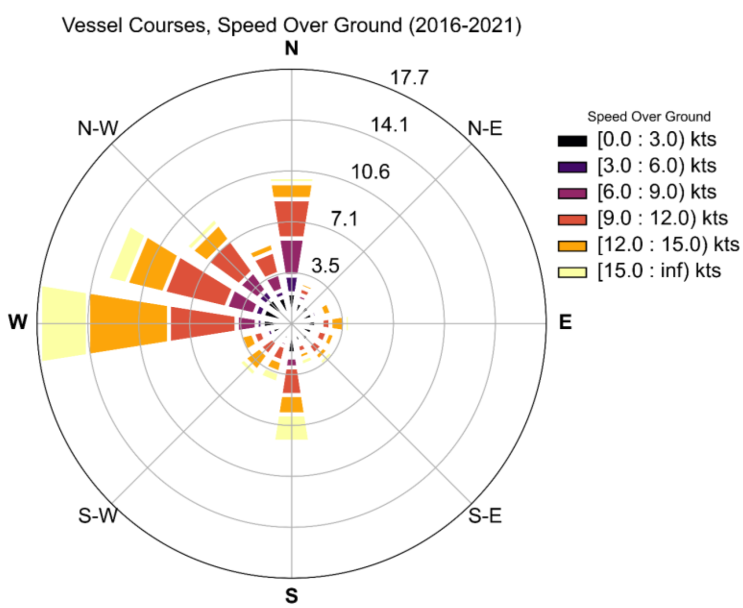



**Figure B.11: Cargo vessels' courses throughout and speed through the Lease Area**

### B.2.4 Tugs and Tug Tows

A total of 31 unique towing vessels transited through the Lease Area during the 5.75-year AIS data record. The total vessel tracks through the Lease Area was 64. Table B.8 summarizes the vessel details for the 10 largest unique towing tracks and their towing vessels that transited through the Lease Area. The longest tug and tow vessel reported in the AIS dataset was 170 ft (52 m), and the histogram of vessel length reported in the AIS dataset is presented in Figure B.12.

Figure B.13 presents a plot of all towing tracks, and Figure B.14 presents a polar histogram of the course directions which indicates that a majority of the tracks follow east and west courses.

**Table B.8: Vessel details –10 largest towing tracks and their towing vessel which transited through the Lease Area**

| Vessel Name | AIS Code | MMSI Number | IMO Number | LOA (ft) | LOA (m) | Beam (ft) | Beam (m) |
|---|---|---|---|---|---|---|---|
| BENYAURD | 31 | 367111111 | | 170.0 | 51.8 | - | - |
| FREEPORT | 1025 | 367690000 | 9447249 | 144.0 | 43.9 | 46.0 | 14.0 |
| ATLANTIC ENTERPRISE | 1025 | 367313240 | 7417240 | 140.7 | 42.9 | 40.0 | 12.2 |
| SAPPHIRE COAST | 1025 | 367002660 | 8109723 | 131.0 | 39.9 | 40.0 | 12.2 |
| CHRISTINE MCALLISTER | 1025 | 366902260 | 7390985 | 125.5 | 38.3 | - | - |
| GENESIS GLORY | 1025 | 367586910 | 7902051 | 120.1 | 36.6 | 34.0 | 10.4 |
| GENESIS PATRIOT | 1025 | 338708000 | 9117258 | 114.8 | 35.0 | 37.0 | 11.3 |
| LA CHEVAL | 31 | 367019880 | 7826910 | 113.3 | 34.5 | 34.0 | 10.4 |
| LA MADONNA | 31 | 367016310 | 7717030 | 113.3 | 34.5 | 34.0 | 10.4 |
| RUTH M REINAUER | 1025 | 367390130 | 9559779 | 112.9 | 34.4 | 35.0 | 10.7 |

NOTE: Vessel dimensions updated based on dimensions registered on the Coast Guard database (https://cgmix.uscg.mil/PSIX/PSIXSearch.aspx)

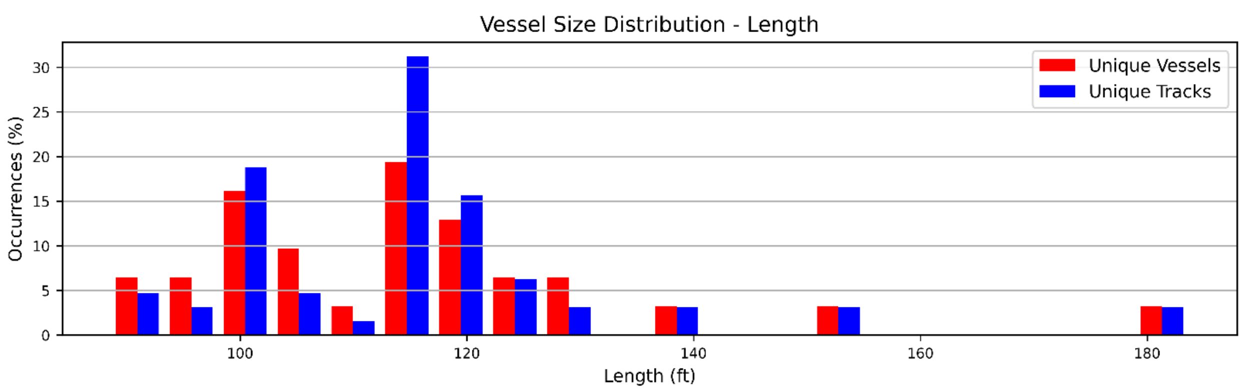



**Figure B.12: Histogram of towing vessel size (LOA including towed vessel reported in AIS) transiting through the Lease Area**

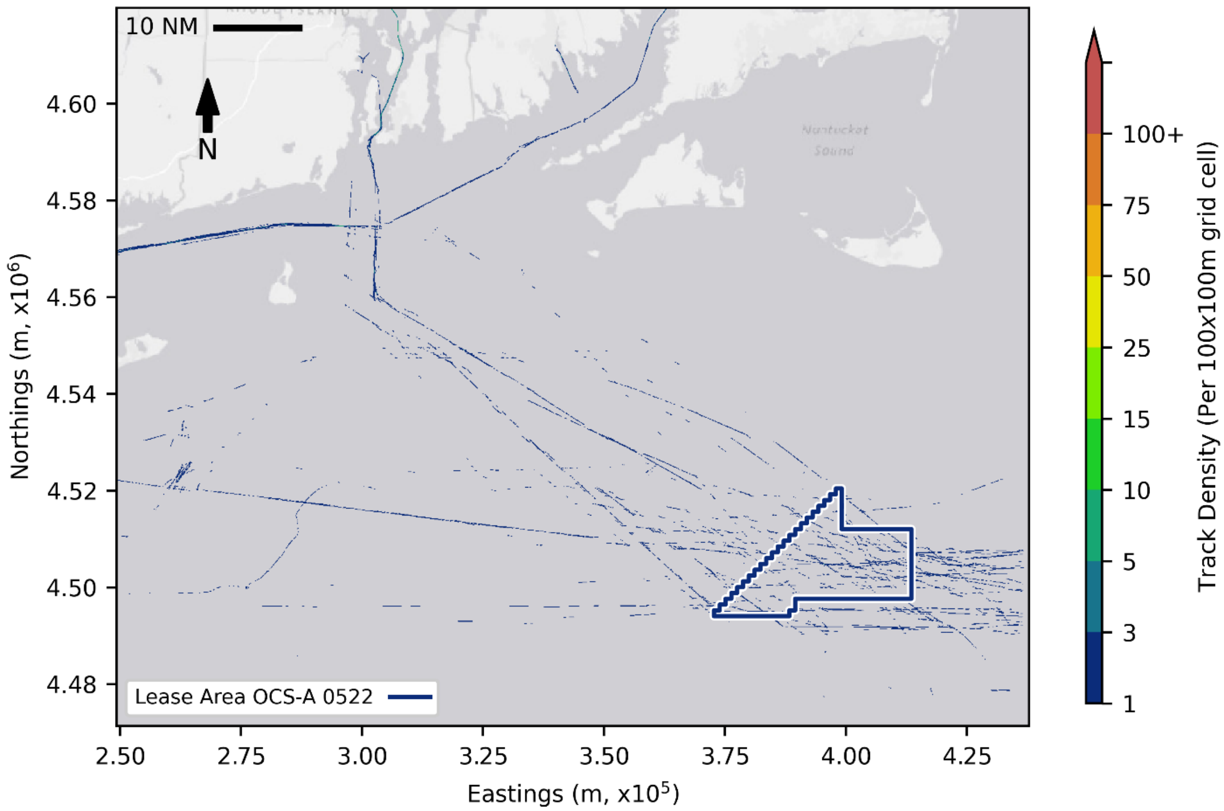



**Figure B.13: Total (2016-2021) Tug/towing vessel tracks through the Lease Area**

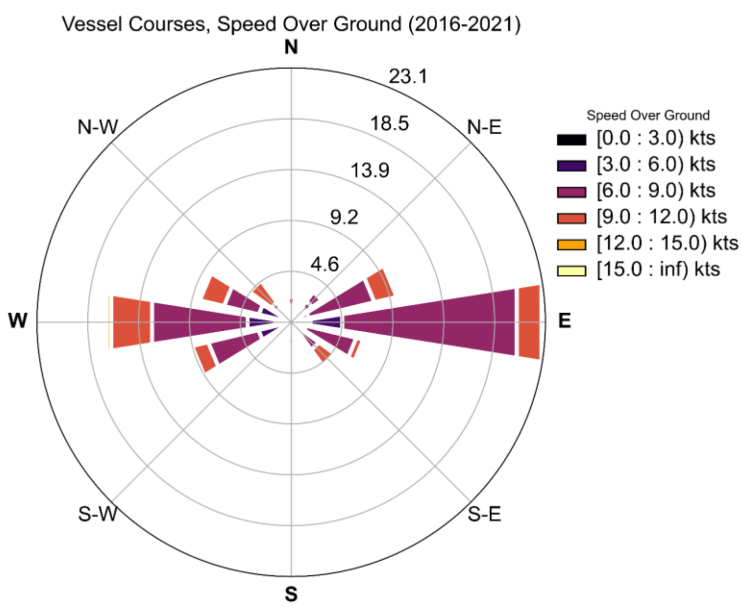



**Figure B.14: Tug-towing vessels' courses throughout and speed through the Lease Area**

### B.2.5 Other Vessels

A total of 68 unique vessels of various types not covered by previous non-fishing commercial categories transited through the Lease Area during the 5.75-year AIS data record. The 68 unique vessels are a range of different types including dredgers and survey vessels. The total vessel tracks through the Lease Area was 267. Table B.9 summarizes the vessel details for the 10 largest unique (other) commercial vessels that transited through the Lease Area. It should be noted that Coast Guard search and rescue vessels with an AIS reporting code of 51 are included in the other military vessel traffic. A histogram of vessel length is presented in Figure B.15 with the vessels ranging between 30 and 150 ft (9 and 46 m) LOA (approx.).

**Table B.9: Vessel details – 10 largest other vessels transiting the Lease Area**

| Vessel Name | AIS Code | MMSI Number | IMO Number | LOA (ft) | LOA (m) | Beam (ft) | Beam (m) |
|---|---|---|---|---|---|---|---|
| USS ZUMWALT | 1018 | 367698750 | - | 564.4 | 172.0 | 80.1 | 24.4 |
| USS NEW MEXICO | 1018 | 369970012 | - | 343.2 | 104.6 | 34.0 | 10.4 |
| USCGC EAGLE | 1022 | 303990000 | - | 295.0 | 89.9 | 39.0 | 11.9 |
| HORIZON GEOBAY | 99 | 354641000 | 7801556 | 280.3 | 85.4 | - | - |
| GEOSEA | 90 | 311063400 | 9242431 | 275.6 | 84.0 | 49.2 | 15.0 |
| ATLANTIS | 1020 | 367241000 | 9105798 | 273.2 | 83.3 | 52.5 | 16.0 |
| USCGC TAHOMA | 1018 | 367288000 | - | 270.0 | 82.3 | 38.0 | 11.6 |
| USCGC CAMPBELL | 1018 | 367289000 | - | 270.0 | | 38.0 | 11.6 |
| THOMAS G THOMPSON | 90 | 366345000 | 8814419 | 246.8 | 75.2 | 52.6 | 16.0 |
| CG ESCANABA | 1018 | 367262000 | - | 243.7 | 74.3 | - | - |

NOTE: Vessel dimensions updated based on dimensions registered on the Coast Guard database (https://cgmix.uscg.mil/PSIX/PSIXSearch.aspx)

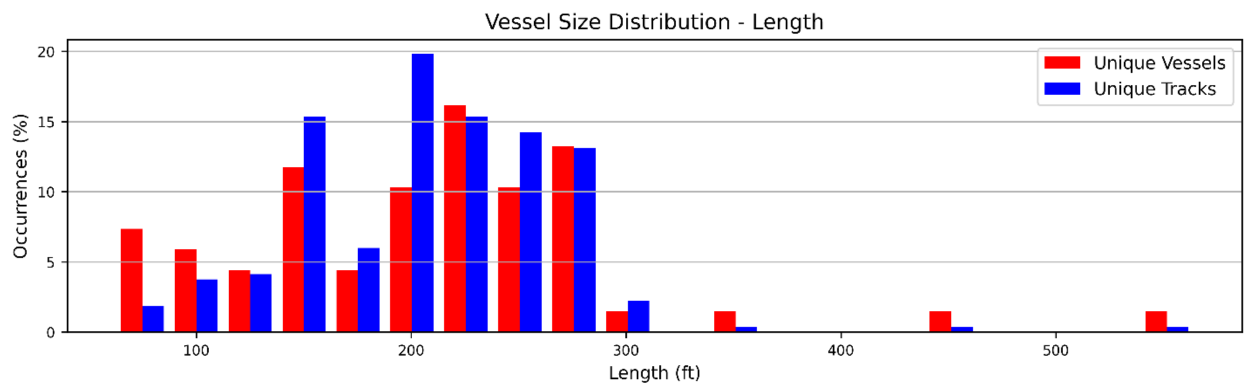



**Figure B.15: Histogram of other commercial vessel size (LOA) transiting through the Lease Area**

Figure B.16 presents a plot of all other non-fishing commercial vessel tracks. Grid like patterns with greater track density magnitudes indicate potential survey vessels. These survey vessels have likely skewed the courses presented in Figure B.17, which indicate south to be the dominant direction with north, west and east also being major courses.

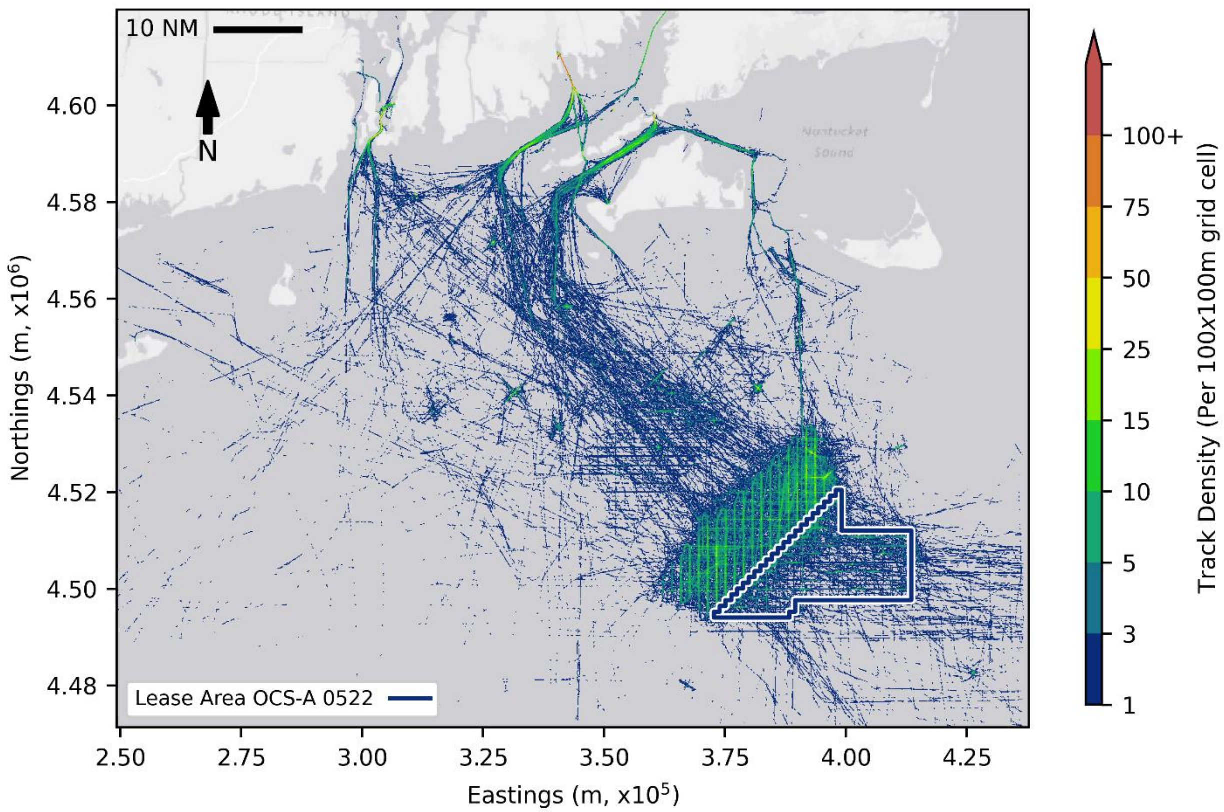



**Figure B.16: Total (2016-2021) Other vessel tracks through the Lease Area**

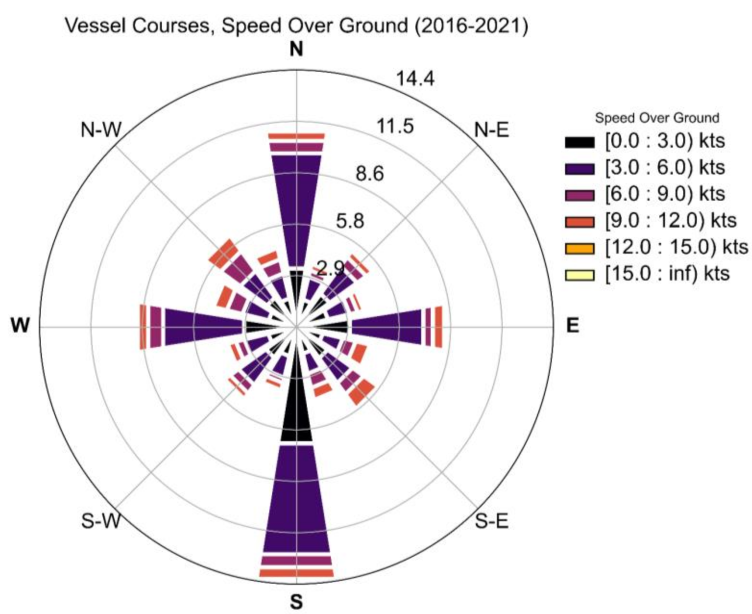



**Figure B.17: Other vessels' courses throughout and speed through the Lease Area**

# B.3 Recreational Vessels

A total of 340 unique recreational and sailing vessels of various types transited through the Lease Area during the 5.75-year AIS data record. These vessels were responsible for 773 unique vessel tracks transiting through the Lease Area Table B.10 summarizes the vessel details for the 10 largest (LOA) recreational and sailing vessels that transited through the Lease Area. A histogram of vessel length is presented in Figure B.18, the vessels typically 45 to 60 ft (13 to 18 m), and a small number of vessels 150 ft (45 m) LOA or longer.

It is noted that many recreational vessels, particularly smaller vessels, either do not carry AIS transceivers or transmit at lower power levels which may not be captured in the dataset.

**Table B.10: Vessel details – 10 largest recreational vessels transiting the Lease Area**

| Vessel Name | AIS Code | MMSI Number | IMO Number | LOA (ft) | LOA (m) | Beam (ft) | Beam (m) |
|---|---|---|---|---|---|---|---|
| LIMITLESS | 1019 | 368444000 | 8975940 | 315.8 | 96.3 | 39.4 | 12.0 |
| FOUNTAINHEAD | 1019 | 319028100 | 1010753 | 250.3 | 76.3 | 44.3 | 13.5 |
| ATHENA | 1019 | 319012000 | 1007237 | 212.1 | 64.6 | 39.4 | 12.0 |
| LADY KATHRYN V | 1019 | 319891000 | 1011068 | 200.1 | 61.0 | 11.7 | 3.6 |
| ROCK.IT | 1019 | 319072900 | 1012347 | 198.0 | 60.4 | - | - |
| LADY BRITT | 1019 | 319594000 | 1011056 | 184.5 | 56.2 | 36.1 | 11.0 |
| CALYPSO | 37 | 319868000 | 1006544 | 180.7 | 55.1 | 34.8 | 10.6 |
| MY LADY | 1019 | 538070743 | 1004819 | 164.0 | 50.0 | - | - |
| STEP ONE | 37 | 538071074 | 1010832 | 154.8 | 47.2 | 29.5 | 9.0 |
| GIGI | 1019 | 339396000 | 9557513 | 144.2 | 44.0 | 30.5 | 9.3 |

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

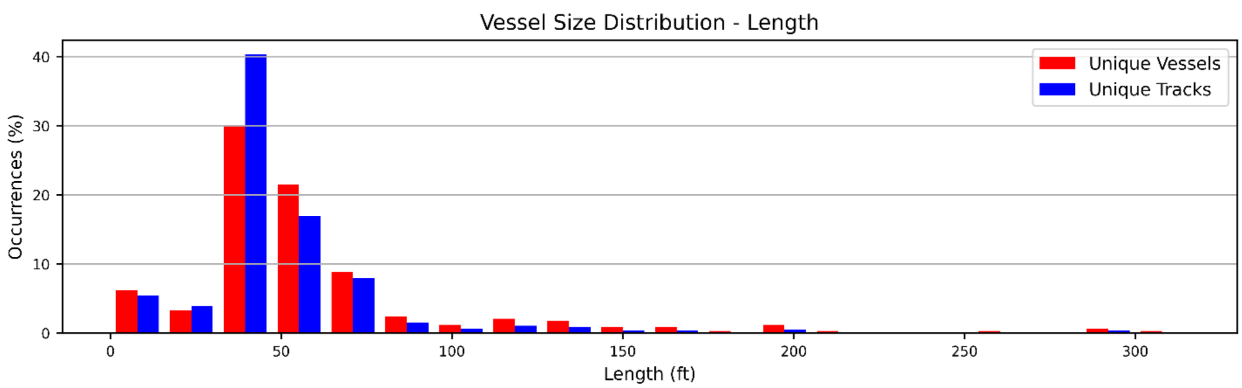



**Figure B.18: Histogram of recreational vessel size (LOA) transiting through the Lease Area**

Vessel transit routes for recreational vessels were investigated based on track density analyzed within the AIS analysis area and the surrounding area. Figure B.19 presents the vessel track density for sailing and recreational vessels across the Lease Area. The traffic density through the Lease Area is lower than the surrounding region, of which the annual average track density of the regional dataset is presented in Figure B.20. Although Figure B.19 indicates that the recreational vessels traffic is higher than many commercial vessel types, the tracks for the sailing and recreational vessels do not follow consistent transit consistent routes and corridors. Figure B.21 presents the course distribution of the tracks for vessels transiting through the Lease Area. The dominant courses are south to southeast and north to northwest. The remaining vessel tracks are distributed across the range of other directions.

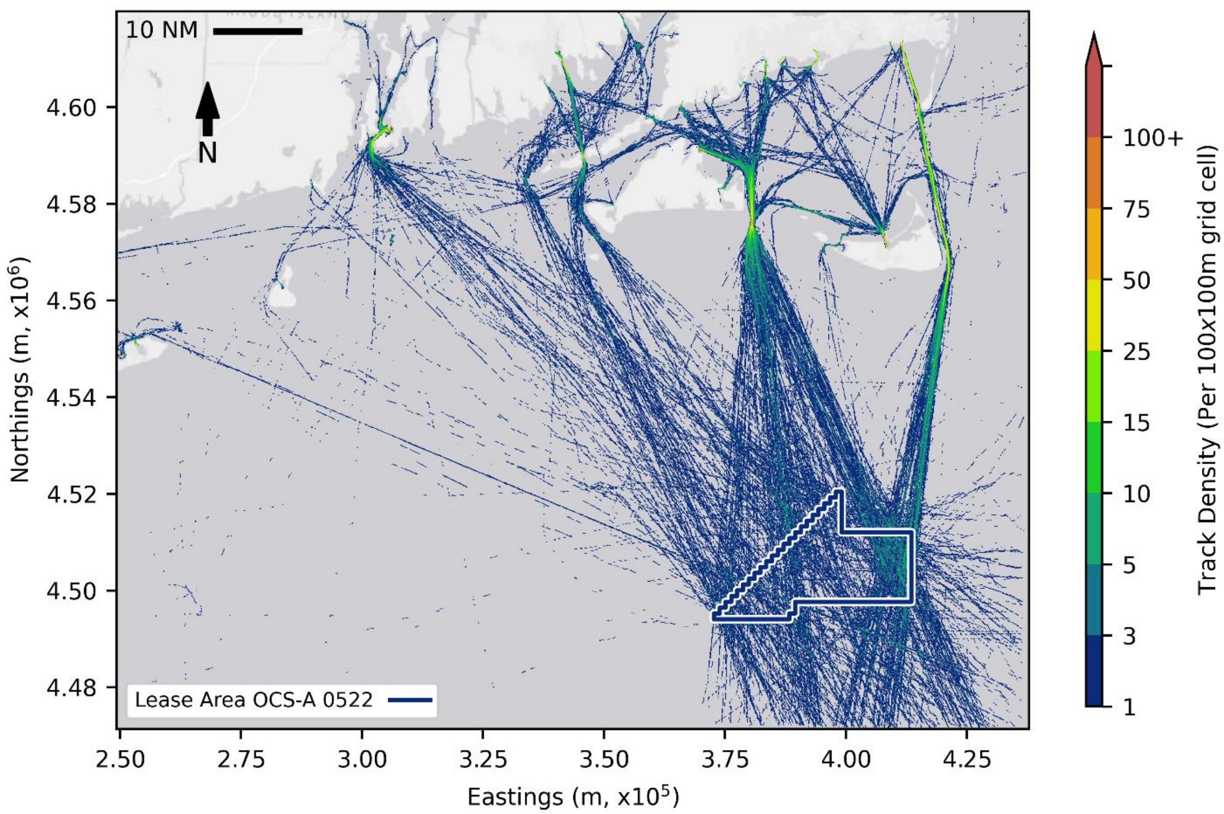



**Figure B.19: Total (2016-2021) Recreational vessel tracks through the Lease Area**

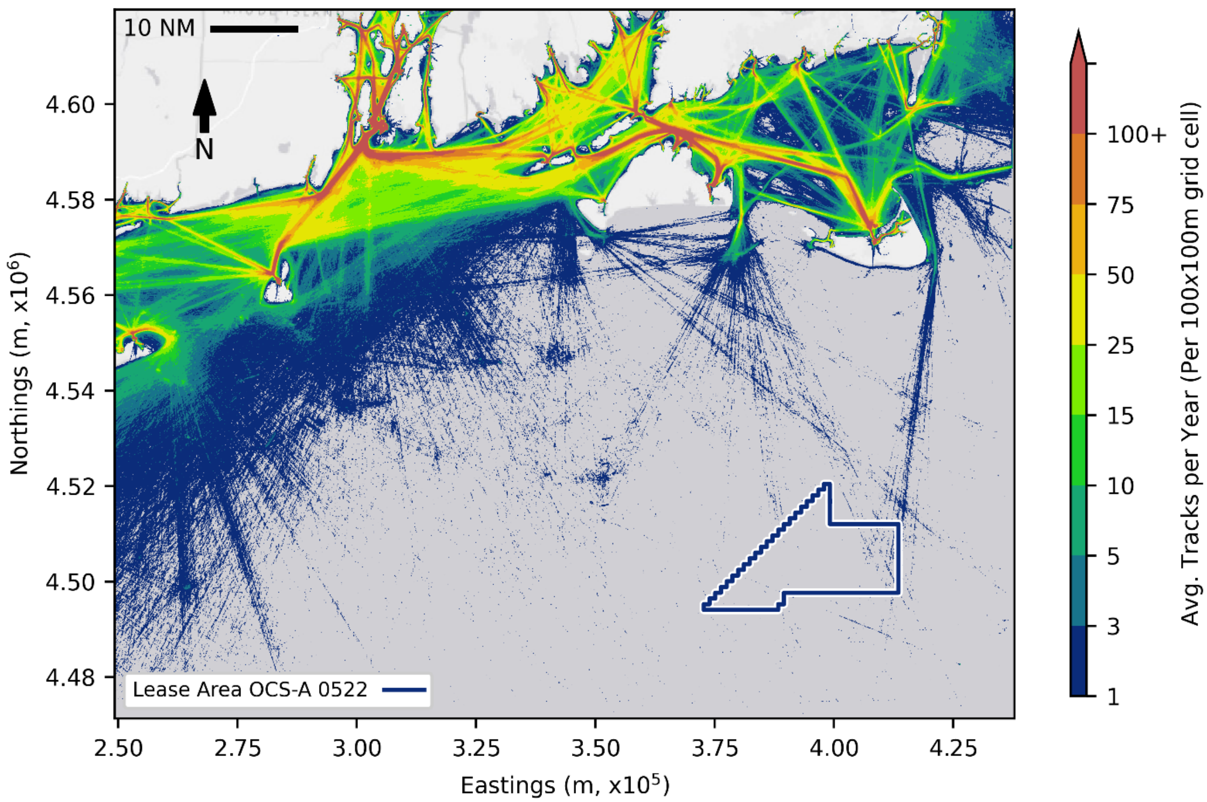



**Figure B.20: AIS vessel traffic average density for recreational vessels**

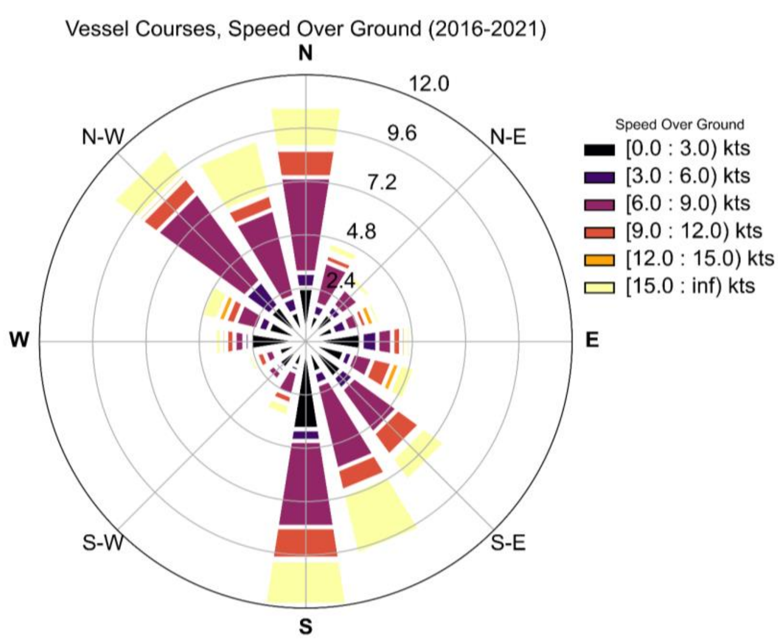



**Figure B.21: Recreational vessels' courses throughout and speed through the Lease Area**

# B.4 Fishing Vessels

The analysis of commercial fishing vessel traffic through the AIS analysis area is presented in the following sections. Analyses for fishing vessels include:

- Analysis of AIS vessel data including separation of traffic into transiting vessels (greater than 4 kts speed) and vessels that are likely to be fishing which has based on AIS data when vessel speed is less than 4 kts; and

## B.4.1 AIS Data

A total of 506 unique commercial fishing vessels of various types transited through the Lease Area during the 5.75-year AIS data record. The total commercial fishing vessel tracks through the Lease Area was 5,692 indicating that compared to other commercial vessels presented in previous sections, several fishing vessels regularly transit through the Lease Area. Table B.11 summarizes the vessel details for the 10 largest fishing vessels that transited through the Lease Area. It should be noted that there were some vessels in the AIS data set that were reporting erroneous length and beam data or could not have their dimensions verified on a ship database, and those have been excluded from the table. A histogram of vessel length is presented in Figure B.22 with the majority of vessels between 35 and 100 ft (11 and 31 m) LOA (approx.).

Figure B.23 presents a plot of all fishing vessel tracks which indicates that vessel tracks were typically distributed throughout the Lease Area.

**Table B.11: Vessel details – 10 largest fishing vessels transiting and/or fishing within the Lease Area**

| Vessel Name | AIS Code | MMSI Number | IMO Number | LOA (ft) | LOA (m) | Beam (ft) | Beam (m) |
|---|---|---|---|---|---|---|---|
| DYRSTEN | 1001 | 367016390 | 8687983 | 145.9 | 44.5 | 30.0 | 9.1 |
| ESS PURSUIT | 1001 | 367411970 | 8983480 | 145.5 | 44.3 | 42.8 | 13.0 |
| ESS PRIDE | 1001 | 367411950 | 8960256 | 145.0 | 44.2 | 42.8 | 13.1 |
| RELENTLESS | 1001 | 367394060 | 8704092 | 137.5 | 41.9 | 31.0 | 9.4 |
| PERSISTENCE | 1001 | 367717970 | 8516421 | 128.2 | 39.1 | 31.0 | 9.4 |
| SEA WATCHER I | 1001 | 367010820 | 8988973 | 120.8 | 36.8 | 34.0 | 10.4 |
| STARLIGHT | 1001 | 367674070 | 8988961 | 110.5 | 33.7 | 30.0 | 9.1 |
| ENDURANCE | 1001 | 366850380 | 8322222 | 107.2 | 32.7 | 28.0 | 8.5 |
| LADY BRITTANY | 1001 | 366983260 | 8983533 | 104.0 | 31.7 | 30.0 | 9.1 |
| NORDIC EXPLORER | 1001 | 367444970 | 8418021 | 98.9 | 30.1 | 30.0 | 9.1 |

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

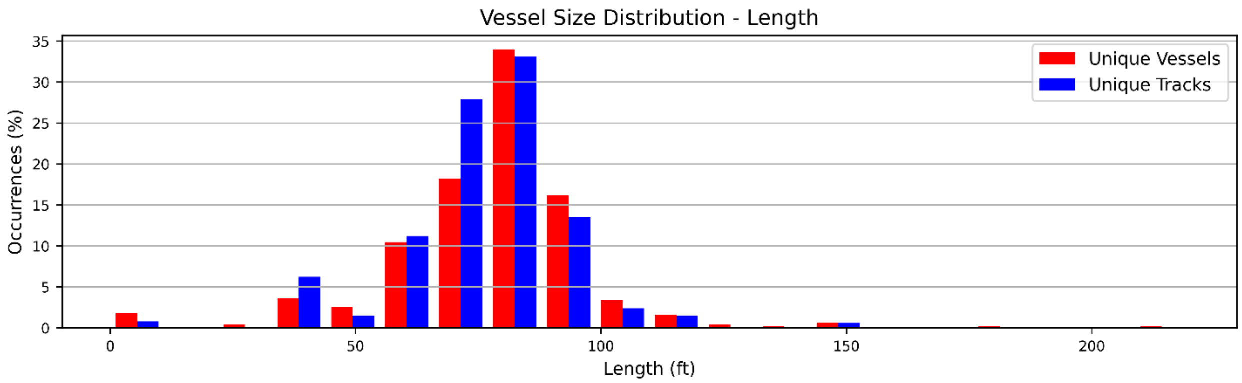



**Figure B.22: Histogram of fishing vessel size (LOA) transiting through the Lease Area**

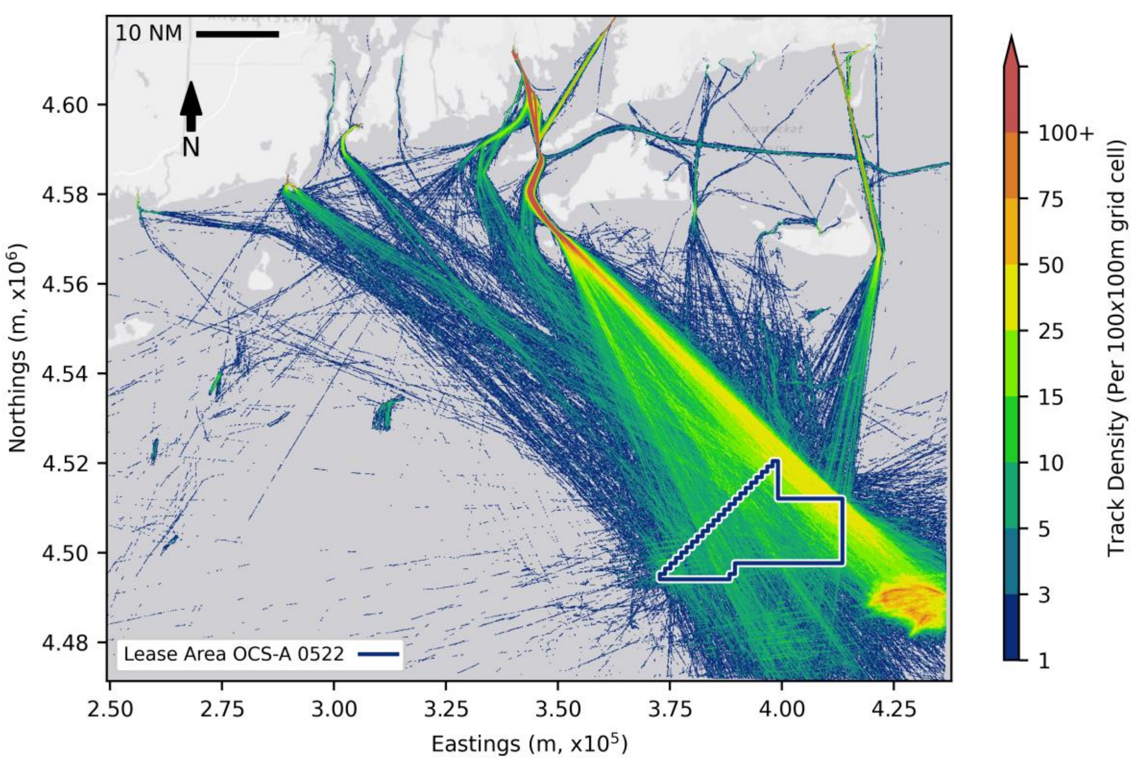



**Figure B.23: Total (2016-2021) Fishing vessel tracks through the Lease Area for all transit speeds**

Analyses have been completed to separate transiting fishing vessels and those fishing vessels that are likely to be fishing. This separation was based a speed threshold of 4 kts (< 4 kts fishing, > 4 kts transiting). Figure B.24 presents the vessel tracks for fishing vessels that transected the Lease Area while fishing track. The tracks of transiting fishing vessels are spread across a range of directions through Lease Area. Figure B.25 presents the vessel tracks for fishing vessels that transected the Lease Area during their transit.

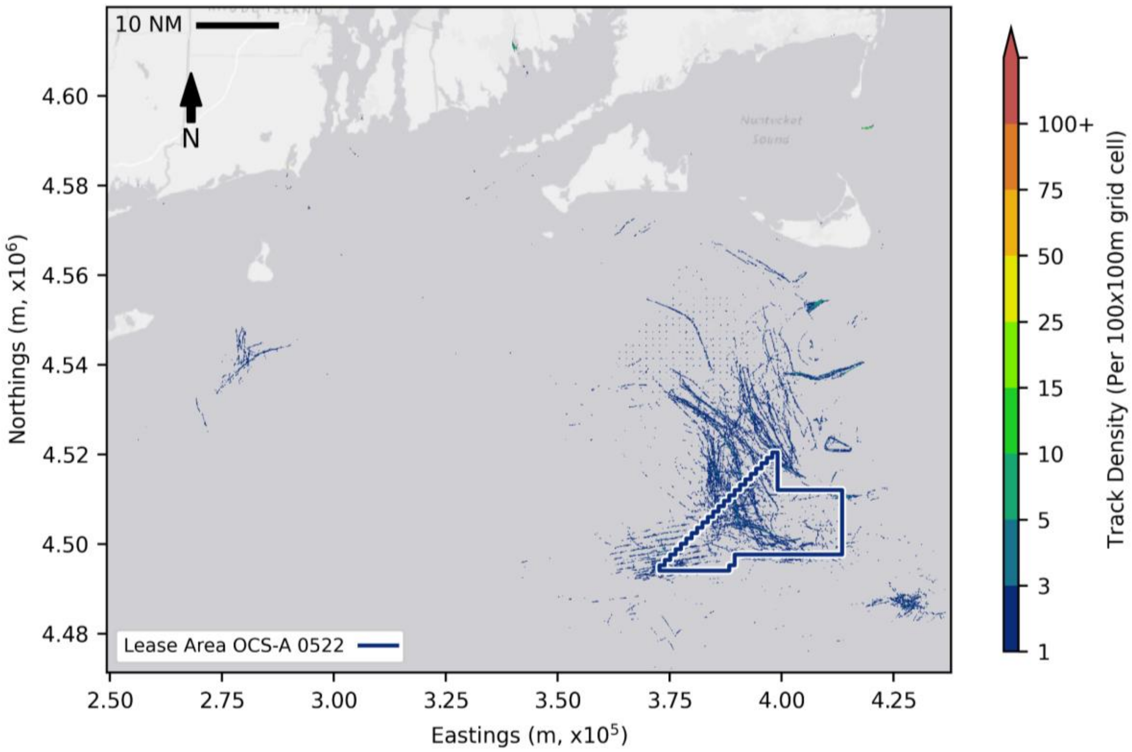



**Figure B.24: Total (2016-2021) Vessel track density for fishing vessel tracks in the Lease Area (<4 kts)**

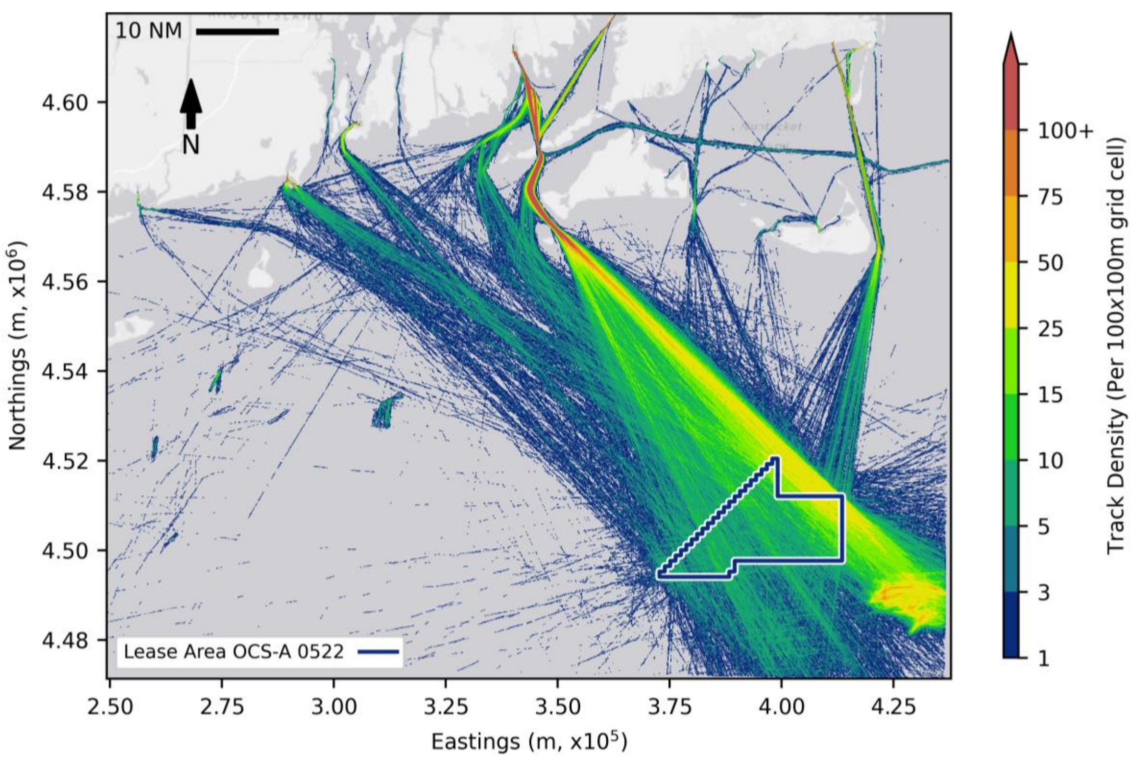



**Figure B.25: Total (2016-2021) Fishing vessel tracks transiting through the Lease Area (>4 Kts)**

As there are significantly more transiting tracks than actively fishing tracks intersecting the Lease Area, the fishing vessel (all speeds) courses distribution presented in Figure B.26 would be an indicator for dominant transiting vessel courses. The dominant courses are northwest and southeast.

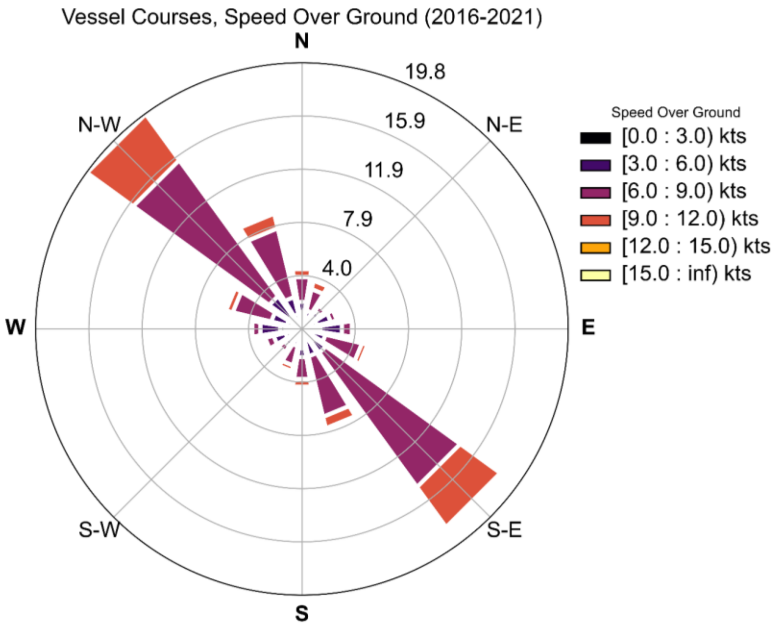



**Figure B.26: Fishing vessels' courses throughout and speed through the Lease Area**

Table B.12 gives a summary by month and year of fishing vessel traffic in the Lease Area. The fishing vessel traffic is highly seasonal, with most traffic occurring in the spring and summer months. A summary of the monthly AIS fishing vessel traffic averaged across the 5.75-years of data is presented in Table B.13.

**Table B.12: AIS fishing vessel traffic through the Lease Area**

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2016** | | | | | | | | | | | | | |
| Number of Unique Vessels (fishing) | - | - | - | 1 | - | 2 | 2 | 3 | 4 | 3 | 3 | - | 9 |
| Number of Unique Vessel Tracks (fishing) | - | - | - | 1 | - | 2 | 4 | 4 | 6 | 4 | 4 | - | 25 |
| Number of Unique Vessels (transiting) | 4 | 6 | 11 | 14 | 15 | 20 | 21 | 15 | 13 | 9 | 12 | 10 | 63 |
| Number of Unique Vessel Tracks (transiting) | 7 | 15 | 31 | 31 | 36 | 36 | 41 | 37 | 33 | 18 | 27 | 19 | 331 |
| Number of Unique Vessels (all) | 4 | 6 | 11 | 14 | 15 | 20 | 21 | 15 | 13 | 10 | 13 | 10 | 64 |
| Number of Unique Vessel Tracks (all) | 7 | 15 | 31 | 31 | 36 | 36 | 42 | 37 | 34 | 19 | 29 | 19 | 336 |
| **2017** | | | | | | | | | | | | | |
| Number of Unique Vessels (fishing) | - | - | 1 | - | - | 1 | 1 | 2 | 8 | 2 | 1 | - | 12 |
| Number of Unique Vessel Tracks (fishing) | - | - | 1 | - | - | 2 | 8 | 7 | 11 | 5 | 1 | - | 35 |
| Number of Unique Vessels (transiting) | 11 | 13 | 9 | 13 | 21 | 23 | 27 | 29 | 19 | 19 | 11 | 13 | 87 |
| Number of Unique Vessel Tracks (transiting) | 25 | 28 | 19 | 29 | 39 | 42 | 63 | 72 | 41 | 40 | 22 | 20 | 440 |
| Number of Unique Vessels (all) | 11 | 13 | 9 | 13 | 21 | 23 | 27 | 29 | 21 | 19 | 11 | 13 | 89 |
| Number of Unique Vessel Tracks (all) | 25 | 28 | 19 | 29 | 39 | 43 | 65 | 76 | 46 | 42 | 22 | 20 | 454 |
| **2018** | | | | | | | | | | | | | |
| Number of Unique Vessels (fishing) | - | - | - | - | 5 | 1 | 4 | 5 | 10 | 7 | 3 | 7 | 32 |
| Number of Unique Vessel Tracks (fishing) | - | - | - | - | 5 | 1 | 6 | 10 | 19 | 8 | 4 | 9 | 62 |
| Number of Unique Vessels (transiting) | 10 | 8 | 9 | 22 | 50 | 64 | 77 | 70 | 45 | 55 | 48 | 52 | 254 |
| Number of Unique Vessel Tracks (transiting) | 16 | 11 | 11 | 31 | 114 | 123 | 152 | 155 | 94 | 99 | 79 | 83 | 968 |
| Number of Unique Vessels (all) | 10 | 8 | 9 | 22 | 50 | 64 | 78 | 70 | 45 | 55 | 48 | 53 | 255 |
| Number of Unique Vessel Tracks (all) | 16 | 11 | 11 | 31 | 114 | 123 | 154 | 157 | 102 | 100 | 81 | 86 | 986 |
| **2019** | | | | | | | | | | | | | |
| Number of Unique Vessels (fishing) | 5 | - | 2 | 6 | 6 | 8 | 8 | 5 | 12 | 6 | 1 | - | 52 |
| Number of Unique Vessel Tracks (fishing) | 6 | - | 2 | 6 | 8 | 14 | 9 | 7 | 22 | 11 | 4 | - | 89 |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Unique Vessels (transiting) | 33 | 19 | 29 | 131 | 147 | 136 | 110 | 99 | 75 | 58 | 35 | 13 | 330 |
| Number of Unique Vessel Tracks (transiting) | 70 | 44 | 66 | 354 | 377 | 315 | 279 | 246 | 149 | 123 | 68 | 25 | 2,116 |
| Number of Unique Vessels (all) | 34 | 19 | 29 | 131 | 147 | 136 | 110 | 99 | 80 | 60 | 35 | 13 | 334 |
| Number of Unique Vessel Tracks (all) | 72 | 44 | 66 | 354 | 378 | 319 | 279 | 247 | 167 | 131 | 70 | 25 | 2,152 |
| **2020** | | | | | | | | | | | | | |
| Number of Unique Vessels (fishing) | - | 1 | 5 | 4 | 3 | 3 | 3 | 11 | 18 | 1 | 2 | 1 | 37 |
| Number of Unique Vessel Tracks (fishing) | - | 3 | 6 | 6 | 3 | 5 | 13 | 41 | 50 | 1 | 3 | 1 | 132 |
| Number of Unique Vessels (transiting) | 15 | 27 | 41 | 51 | 65 | 65 | 85 | 63 | 34 | 21 | 19 | 12 | 233 |
| Number of Unique Vessel Tracks (transiting) | 25 | 42 | 72 | 96 | 125 | 151 | 197 | 191 | 75 | 37 | 35 | 18 | 1,064 |
| Number of Unique Vessels (all) | 15 | 27 | 41 | 51 | 65 | 65 | 85 | 63 | 39 | 21 | 19 | 12 | 236 |
| Number of Unique Vessel Tracks (all) | 25 | 42 | 72 | 96 | 125 | 151 | 204 | 207 | 99 | 37 | 35 | 18 | 1,111 |
| **2021** | | | | | | | | | | | | | |
| Number of Unique Vessels (fishing) | 4 | 1 | 1 | - | 7 | 4 | 5 | 6 | 6 | - | - | - | 25 |
| Number of Unique Vessel Tracks (fishing) | 4 | 3 | 1 | - | 10 | 7 | 5 | 11 | 14 | - | - | - | 55 |
| Number of Unique Vessels (transiting) | 15 | 13 | 20 | 17 | 32 | 50 | 56 | 68 | 62 | - | - | - | 175 |
| Number of Unique Vessel Tracks (transiting) | 30 | 31 | 43 | 30 | 65 | 102 | 95 | 121 | 120 | - | - | - | 637 |
| Number of Unique Vessels (all) | 15 | 13 | 21 | 17 | 32 | 50 | 56 | 70 | 62 | - | - | - | 177 |
| Number of Unique Vessel Tracks (all) | 30 | 32 | 44 | 30 | 69 | 104 | 95 | 126 | 123 | - | - | - | 653 |
| **Average: 2016-2021** | | | | | | | | | | | | | |
| Number of Unique Vessels (fishing) | 1.5 | 0.3 | 1.5 | 1.8 | 3.5 | 3.2 | 3.8 | 5.3 | 9.7 | 3.8 | 2.0 | 1.6 | 29.0 |
| Number of Unique Vessel Tracks (fishing) | 1.7 | 1.0 | 1.7 | 2.2 | 4.3 | 5.2 | 7.5 | 13.3 | 20.3 | 5.8 | 3.2 | 2.0 | 69.2 |
| Number of Unique Vessels (transiting) | 14.7 | 14.3 | 19.8 | 41.3 | 55.0 | 59.7 | 62.7 | 57.3 | 41.3 | 32.4 | 25.0 | 20.0 | 198.6 |
| Number of Unique Vessel Tracks (transiting) | 28.8 | 28.5 | 40.3 | 95.2 | 126.0 | 128.2 | 137.8 | 137.0 | 85.3 | 63.4 | 46.2 | 33.0 | 966.3 |
| Number of Unique Vessels (all) | 14.8 | 14.3 | 20.0 | 41.3 | 55.0 | 59.7 | 62.8 | 57.7 | 43.3 | 33.0 | 25.2 | 20.2 | 200.9 |
| Number of Unique Vessel Tracks (all) | 29.2 | 28.7 | 40.5 | 95.2 | 126.8 | 129.3 | 139.8 | 141.7 | 95.2 | 65.8 | 47.4 | 33.6 | 989.9 |

NOTE: Transiting and actively fishing tracks can be doubly counted

**Table B.13: Summary of AIS fishing vessel traffic through the Lease Area**

| | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Tracks (2016-2021) | | | | | | | | | | | | |
| Fishing | 10 | 10 | 6 | 10 | 13 | 26 | 31 | 45 | 80 | 122 | 29 | 16 |
| Transiting | 165 | 173 | 171 | 242 | 571 | 756 | 769 | 827 | 822 | 512 | 317 | 231 |
| All Vessels | 168 | 175 | 172 | 243 | 571 | 761 | 776 | 839 | 850 | 571 | 329 | 237 |
| Average Tracks per Day | | | | | | | | | | | | |
| Fishing | 0.1 | 0.1 | 0.0 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.4 | 0.7 | 0.2 | 0.1 |
| Transiting | 1.1 | 0.9 | 1.0 | 1.3 | 3.2 | 4.1 | 4.3 | 4.4 | 4.4 | 2.8 | 2.0 | 1.5 |
| All Vessels | 1.1 | 0.9 | 1.0 | 1.3 | 3.2 | 4.1 | 4.3 | 4.5 | 4.6 | 3.2 | 2.1 | 1.6 |

| Seasonal Average Tracks per Day | Winter | Spring | Summer | Autumn |
|---|---|---|---|---|
| Fishing | 0.1 | 0.1 | 0.3 | 0.3 |
| Transiting | 1.0 | 2.8 | 4.4 | 2.1 |
| All Vessels | 1.0 | 2.9 | 4.5 | 2.3 |

NOTE: Transiting and actively fishing tracks can be doubly counted

# B.5 Vessel Traffic across the OECC

The OECCs connect the Lease Area to landfall sites in Massachusetts and Connecticut. An AIS data analysis was carried out for the OECCs to evaluate the location and frequency of vessel crossings. Table B.14 summarizes the vessels that have crossed the Massachusetts OECC by year and type for the January 2016 to September 2021 period. The majority of the vessels were either fishing or recreational. Table B.15 summarizes the vessels that have crossed the Connecticut OECC by year and type for the January 2016 to September 2021 period. Unlike the Massachusetts OECC, the majority of the vessels were either passenger or recreational.

Table B.16 and Table B.17 further summarize the OECC crossings by month and by season. The Massachusetts OECC has less average seasonal crossings for all seasons except summer, where it has only an average of 20 more crossings than the Connecticut OECC.

**Table B.14: Massachusetts OECC vessel crossings by vessel type and year**

| Vessel Type | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|
| Fishing | 4,863 | 5,192 | 5,803 | 6,203 | 6,005 | 4,147 |
| Passenger | 420 | 421 | 404 | 318 | 145 | 249 |
| Cargo | 66 | 63 | 62 | 55 | 92 | 84 |
| Tanker | 35 | 49 | 61 | 85 | 97 | 77 |
| Recreational | 3,490 | 3,974 | 4,541 | 5,194 | 4,694 | 6,033 |
| Military | 0 | 0 | 0 | 0 | 0 | 2 |
| Tug-Tow | 1,828 | 1,904 | 2,004 | 1,666 | 1,205 | 842 |
| Other | 336 | 388 | 446 | 479 | 314 | 337 |
| Unspecified | 881 | 1,521 | 1,256 | 1,391 | 1,099 | 946 |
| Total | **11,919** | **13,512** | **14,577** | **15,391** | **13,651** | **12,717** |
| Average Crossings per Day | **32.6** | **37.0** | **39.9** | **42.2** | **37.3** | **34.8** |

**Table B.15: Connecticut OECC vessel crossings by vessel type and year**

| Vessel Type | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|
| Fishing | 2,904 | 2,449 | 1,911 | 2,247 | 2,790 | 1,998 |
| Passenger | 3,805 | 4,208 | 3,870 | 4,336 | 3,058 | 2,501 |
| Cargo | 487 | 528 | 510 | 523 | 453 | 377 |
| Tanker | 255 | 236 | 219 | 269 | 223 | 225 |
| Recreational | 3,342 | 3,300 | 3,573 | 4,413 | 4,435 | 5,334 |
| Military | 104 | 115 | 24 | 14 | 10 | 12 |
| Tug-Tow | 2,378 | 2,442 | 2,473 | 2,222 | 1,636 | 1,079 |
| Other | 620 | 550 | 531 | 633 | 468 | 425 |
| Unspecified | 747 | 1,226 | 1,093 | 1,392 | 1,344 | 988 |
| **Total** | **14,642** | **15,054** | **14,204** | **16,049** | **14,417** | **12,939** |
| **Average Crossings per Day** | **40.0** | **41.2** | **38.9** | **44.0** | **39.4** | **35.4** |

**Table B.16: Massachusetts OECC crossings by month and season**

| Vessel Type | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishing | 1,488 | 1,508 | 1,604 | 1,798 | 2,760 | 3,607 | 3,948 | 4,236 | 4,136 | 2,960 | 2,243 | 1,925 |
| Passenger | 47 | 43 | 33 | 42 | 69 | 168 | 296 | 399 | 353 | 258 | 168 | 81 |
| Cargo | 25 | 38 | 32 | 40 | 31 | 38 | 22 | 41 | 37 | 48 | 30 | 40 |
| Tanker | 27 | 25 | 24 | 44 | 41 | 35 | 42 | 38 | 45 | 42 | 17 | 24 |
| Recreational | 60 | 18 | 1 | 17 | 169 | 1,325 | 3,590 | 8,092 | 8,854 | 4,231 | 1,238 | 331 |
| Military | - | - | - | - | - | - | - | - | 2 | - | - | - |
| Tug-Tow | 803 | 989 | 799 | 815 | 742 | 735 | 725 | 797 | 775 | 731 | 769 | 769 |
| Other | 125 | 139 | 105 | 135 | 169 | 203 | 276 | 354 | 297 | 197 | 177 | 123 |
| Unspecified | 222 | 216 | 212 | 255 | 370 | 629 | 867 | 1,299 | 1,402 | 847 | 511 | 264 |
| **Total** | **2,797** | **2,976** | **2,810** | **3,146** | **4,351** | **6,740** | **9,766** | **15,256** | **15,901** | **9,314** | **5,153** | **3,557** |
| **Avg. Crossings per Year** | **559.4** | **496.0** | **468.3** | **524.3** | **725.2** | **1,123.3** | **1,627.7** | **2,542.7** | **2,650.2** | **1,552.3** | **1,030.6** | **711.4** |
| Season | Winter | | | Spring | | | Summer | | | Autumn | | |
| Seasonal Average Tracks per Year | 507.9 | | | 790.9 | | | 2,273.5 | | | 1,098.1 | | |

**Table B.17: Connecticut OECC crossings by month and season**

| Vessel Type | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishing | 292 | 426 | 559 | 762 | 1,195 | 1,460 | 1,938 | 2,054 | 2,117 | 1,910 | 1,009 | 577 |
| Passenger | 1,135 | 1,013 | 957 | 1,085 | 1,309 | 1,883 | 2,409 | 2,884 | 2,999 | 2,613 | 2,066 | 1,425 |
| Cargo | 187 | 255 | 231 | 275 | 213 | 282 | 218 | 260 | 265 | 270 | 213 | 209 |
| Tanker | 106 | 112 | 92 | 117 | 118 | 111 | 132 | 151 | 141 | 133 | 106 | 108 |
| Recreational | 48 | 10 | 4 | 14 | 212 | 1,541 | 4,097 | 6,449 | 6,558 | 3,910 | 1,259 | 295 |
| Military | 4 | 11 | 18 | 6 | 6 | 25 | 36 | 59 | 53 | 38 | 17 | 6 |
| Tug-Tow | 1,045 | 1,297 | 1,005 | 1,099 | 1,005 | 1,023 | 848 | 999 | 950 | 929 | 1,036 | 994 |
| Other | 122 | 173 | 156 | 187 | 219 | 316 | 411 | 512 | 423 | 350 | 206 | 152 |
| Unspecified | 214 | 229 | 185 | 183 | 285 | 548 | 951 | 1,300 | 1,351 | 910 | 395 | 239 |
| **Total** | **3,153** | **3,526** | **3,207** | **3,728** | **4,562** | **7,189** | **11,040** | **14,668** | **14,857** | **11,063** | **6,307** | **4,005** |
| **Avg. Crossings per Year** | **630.6** | **587.7** | **534.5** | **621.3** | **760.3** | **1,198.2** | **1,840.0** | **2,444.7** | **2,476.2** | **1,843.8** | **1,261.4** | **801.0** |
| Season | Winter | | | Spring | | | Summer | | | Autumn | | |
| Seasonal Average Tracks per Year | 584.3 | | | 859.9 | | | 2,253.6 | | | 1,302.1 | | |

Figure B.27 and Figure B.28 show the average annual tracks crossing the Massachusetts OECC and Connecticut OECC, respectively. The Massachusetts OECC has relatively stable crossings until it approaches the shore. The Connecticut OECC has significantly less crossings on the portion closest to the Lease Area and increases significantly closer to the shore. Due to the estimates being made with respect to three potential landfall sites, it is possible that the Connecticut OECC could experience less traffic if only observing one approach.

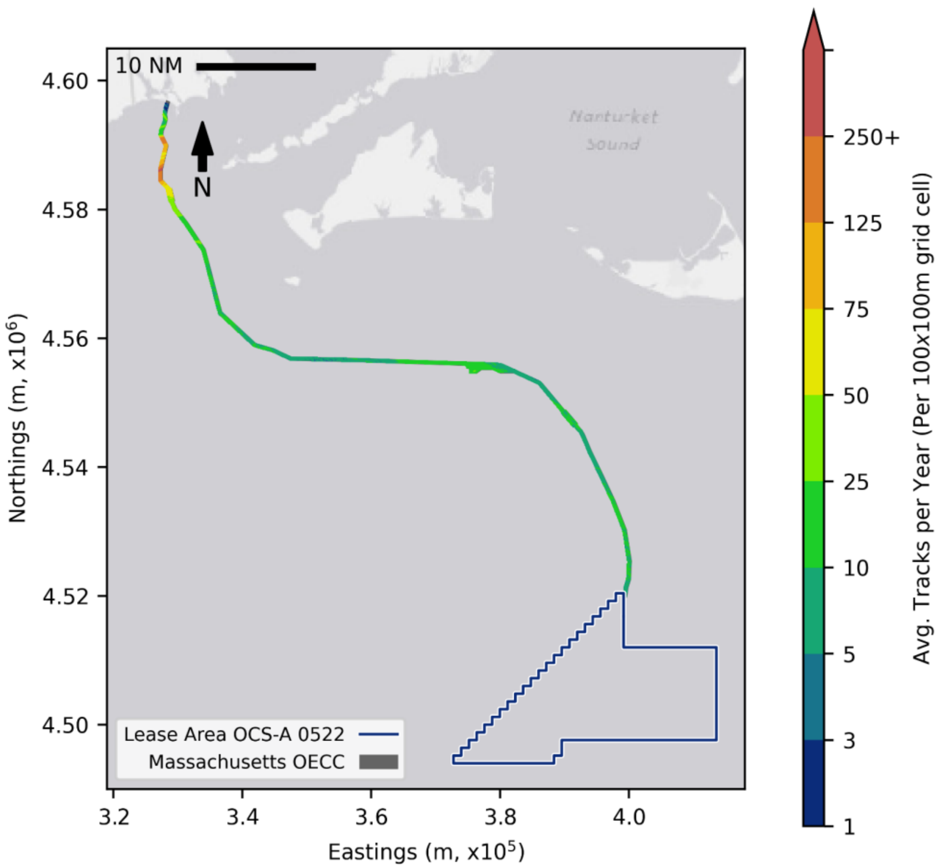



**Figure B.27: Vessel traffic average density map for vessels crossing Massachusetts OECC**

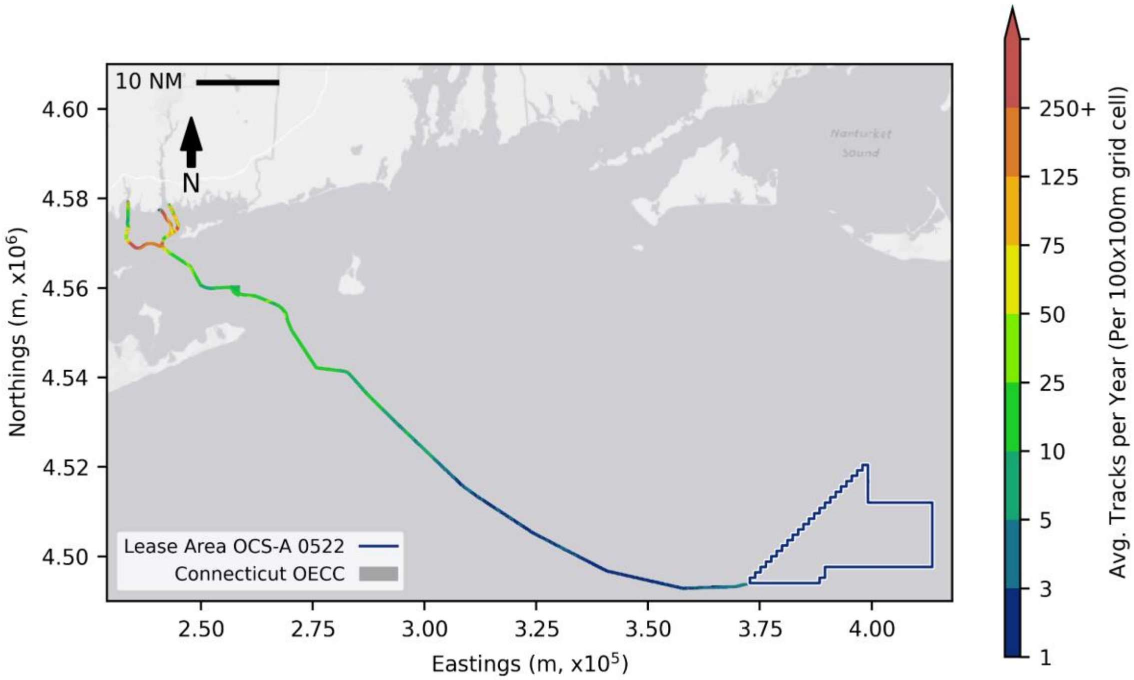



**Figure B.28: Vessel traffic average density map for vessels crossing Connecticut OECC**

# B.6 Vessel Proximity Analysis

The AIS data from 2016 to 2021 has been analyzed to assess the vessel proximity and vessel density within the 10 NM NORM area. Analysis of the AIS data set indicated that the time interval between consecutive data points captured in the dataset for maneuvering vessels was typically 15 minutes. The vessel proximity analysis for the NORM area utilized a 15-minute time interval to assess the number of all vessels maneuvering within the NORM area. It is important to note that the vessel proximity analysis is reporting the closest proximity for two AIS equipped vessels within a 15-minute window and it is likely that the calculated closest proximity of vessels is from AIS data pings that were transmitted at different times within that 15-minute window. It is also possible that two vessels transited closer to each other along their respective tracks at a time when one or neither vessel reported a position through their AIS transmitter.

In this analysis, the number of unique vessels found within the confines of the NORM area was counted over each five-minute time interval in the 5.75-year data set. The analysis was completed based on all vessel types in the AIS dataset. Across the 5.75-year data set, the average cumulative time there were two or more unique AIS vessels in the NORM area was 14,130 hours per year. Figure B.29 presents a histogram for the unique vessels in the NORM area.

It should be noted that smaller vessels not equipped with AIS could be present in the analysis region and their interaction with other non-AIS and AIS vessels were not considered in this analysis.

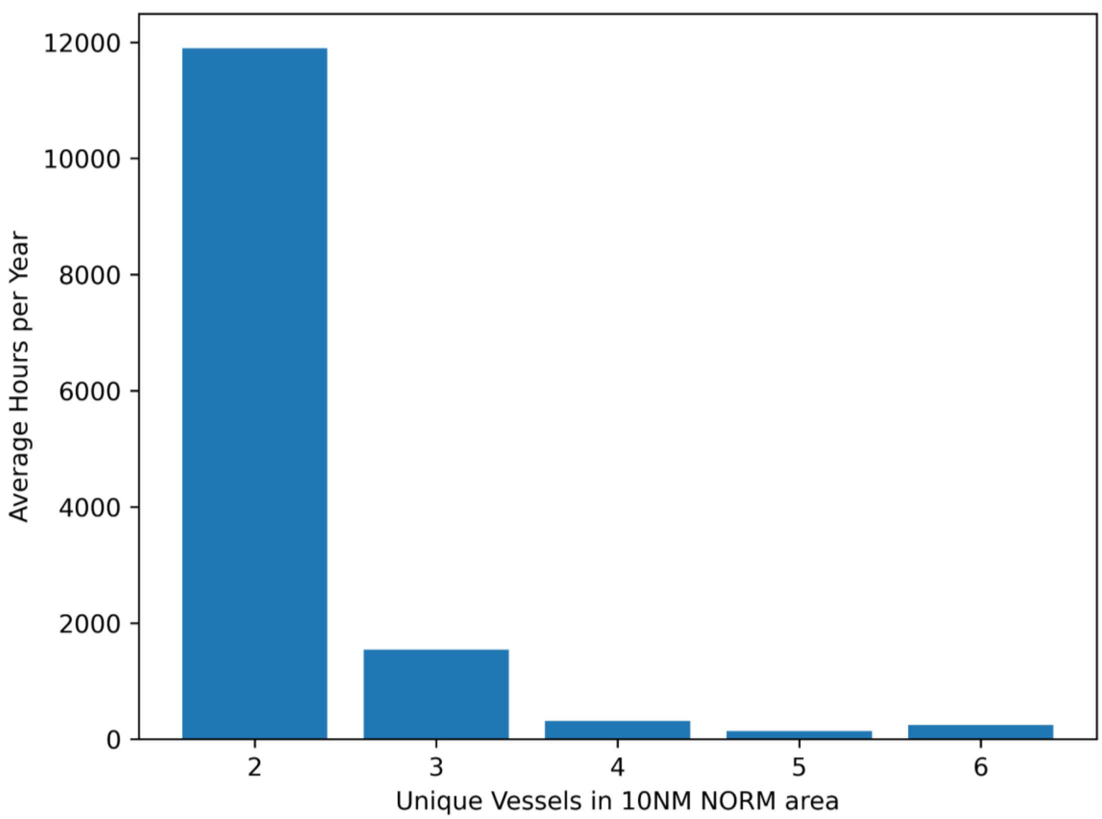



**Figure B.29: Histogram of unique vessels in the NORM area per year**

# Appendix C

## VMS and VTR Data Maps and Polar Histograms

# C.1 VMS Fishing Density Maps

The NMFS Office of Law Enforcement Vessel Monitoring System (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 Lease Area OCS-A 0522. The following Appendix subsection will present the Fishing Density plots for Lease Area OCS-A 0522.

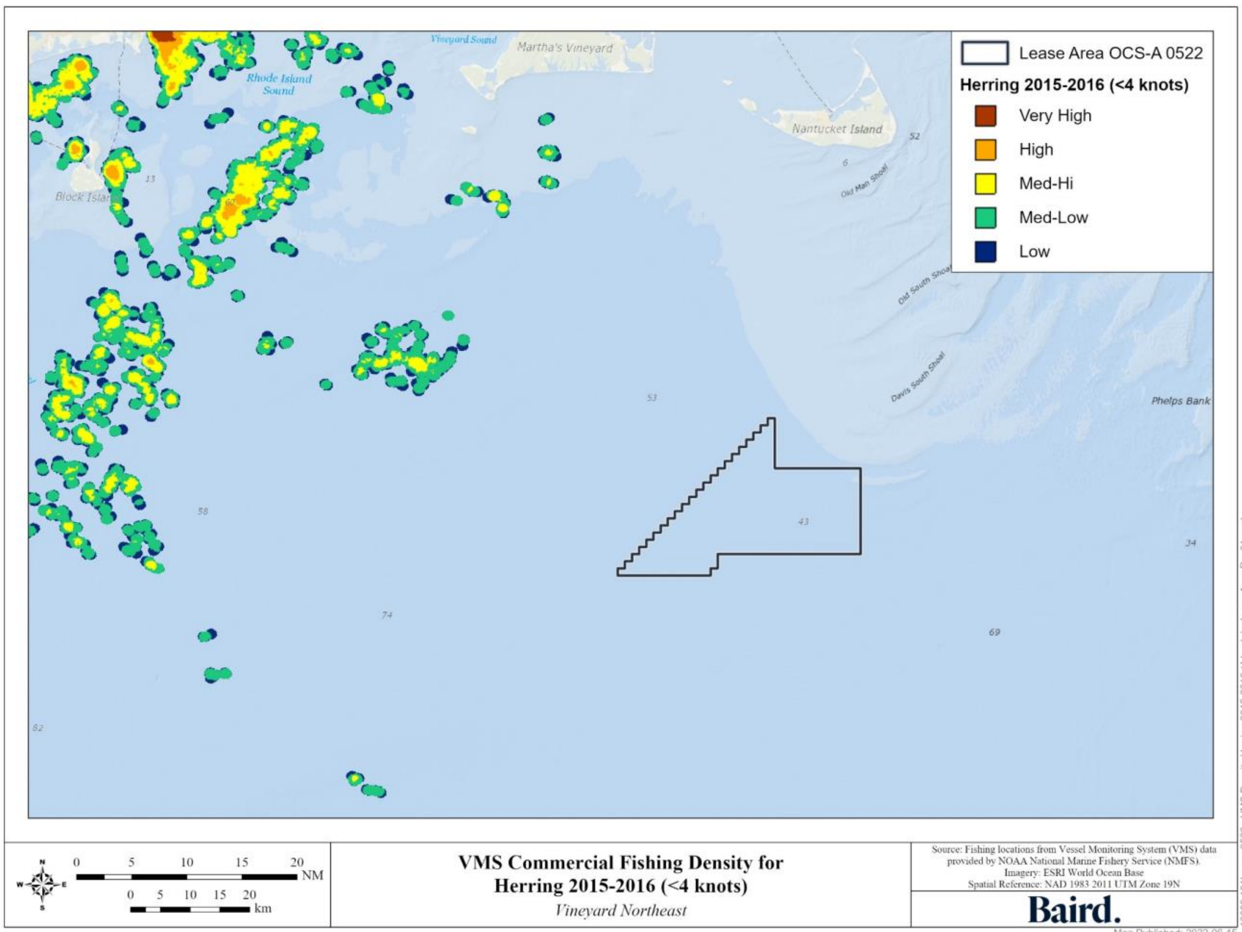



**Figure C.1: VMS Commercial Fishing Density for Herring 2015-2016 (<4 kts)**

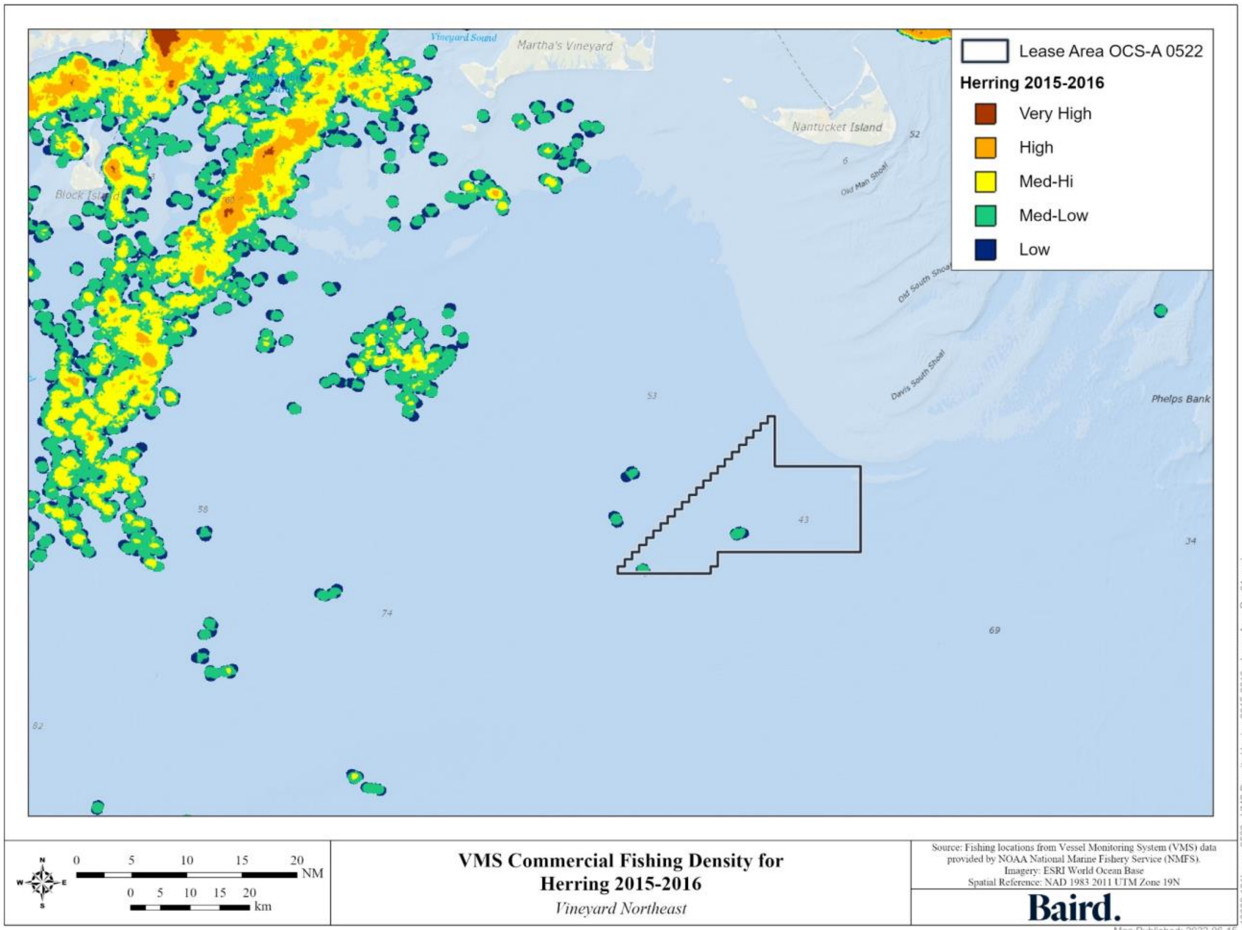



**Figure C.2: VMS Commercial Fishing Density for Herring 2015-2016**

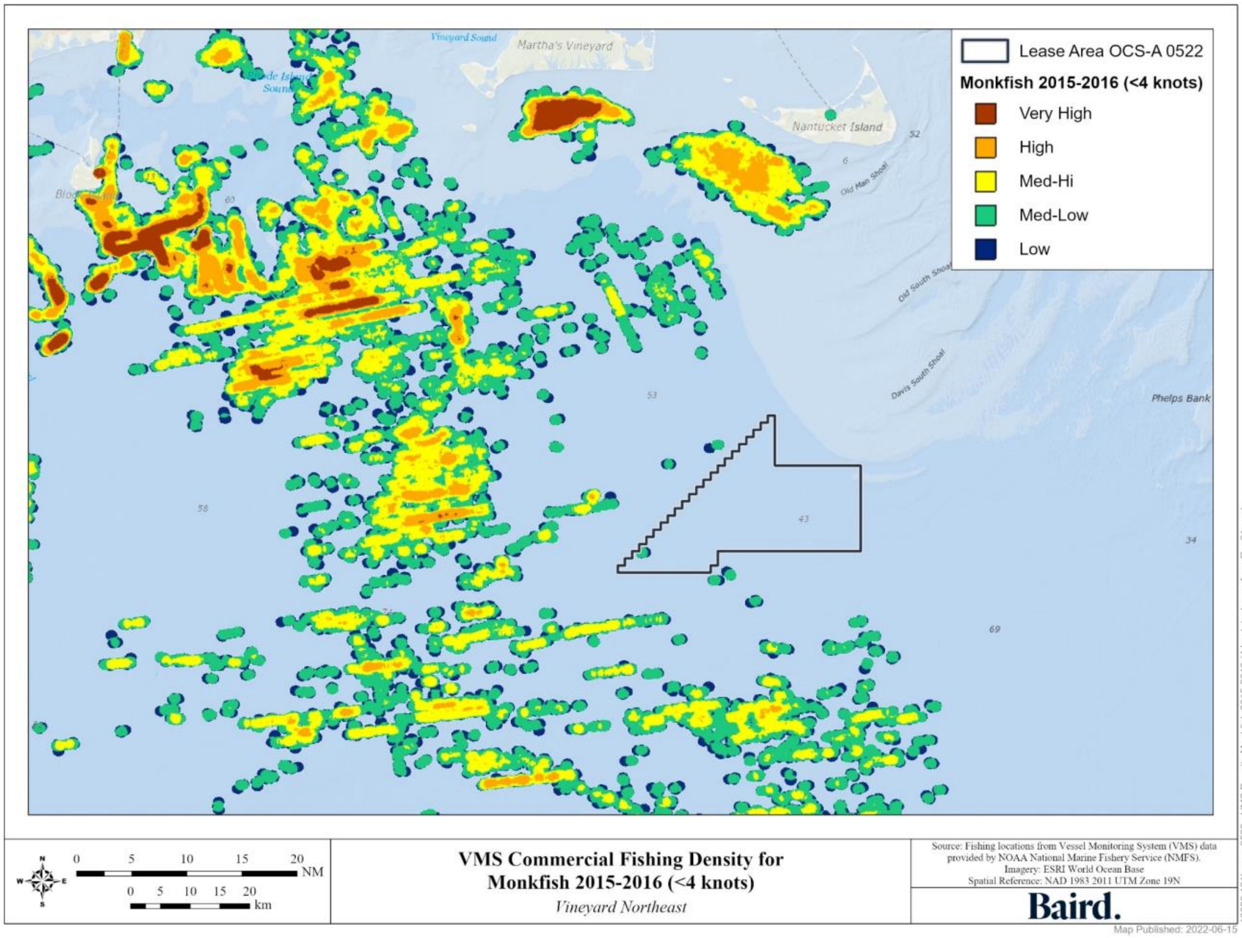



**Figure C.3: VMS Commercial Fishing Density for Monksfish 2015-2016 (<4 kts)**

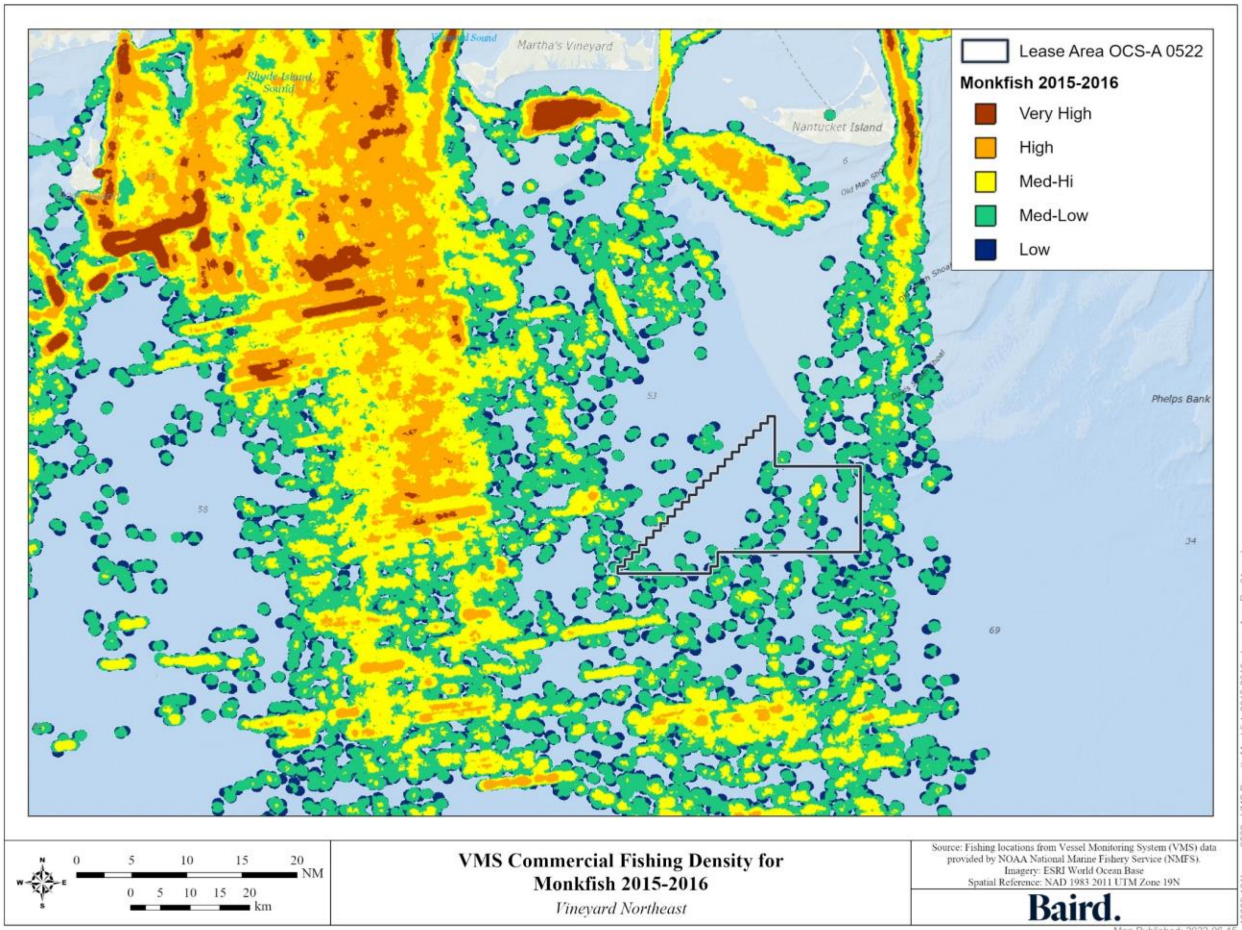



**Figure C.4: VMS Commercial Fishing Density for Monkfish 2015-2016**

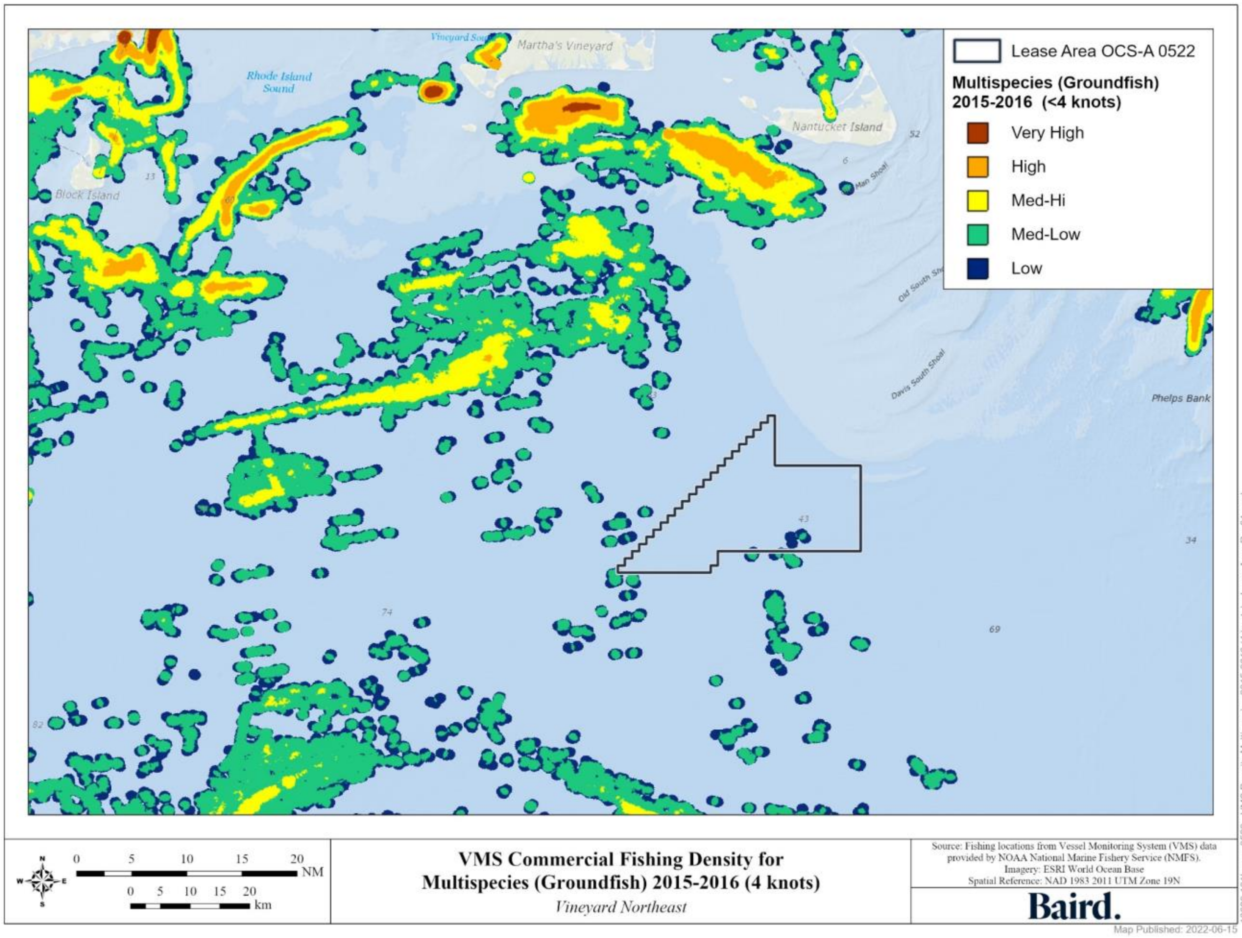



**Figure C.5: VMS Commercial Fishing Density for Multispecies 2015-2016 (<4 kts)**

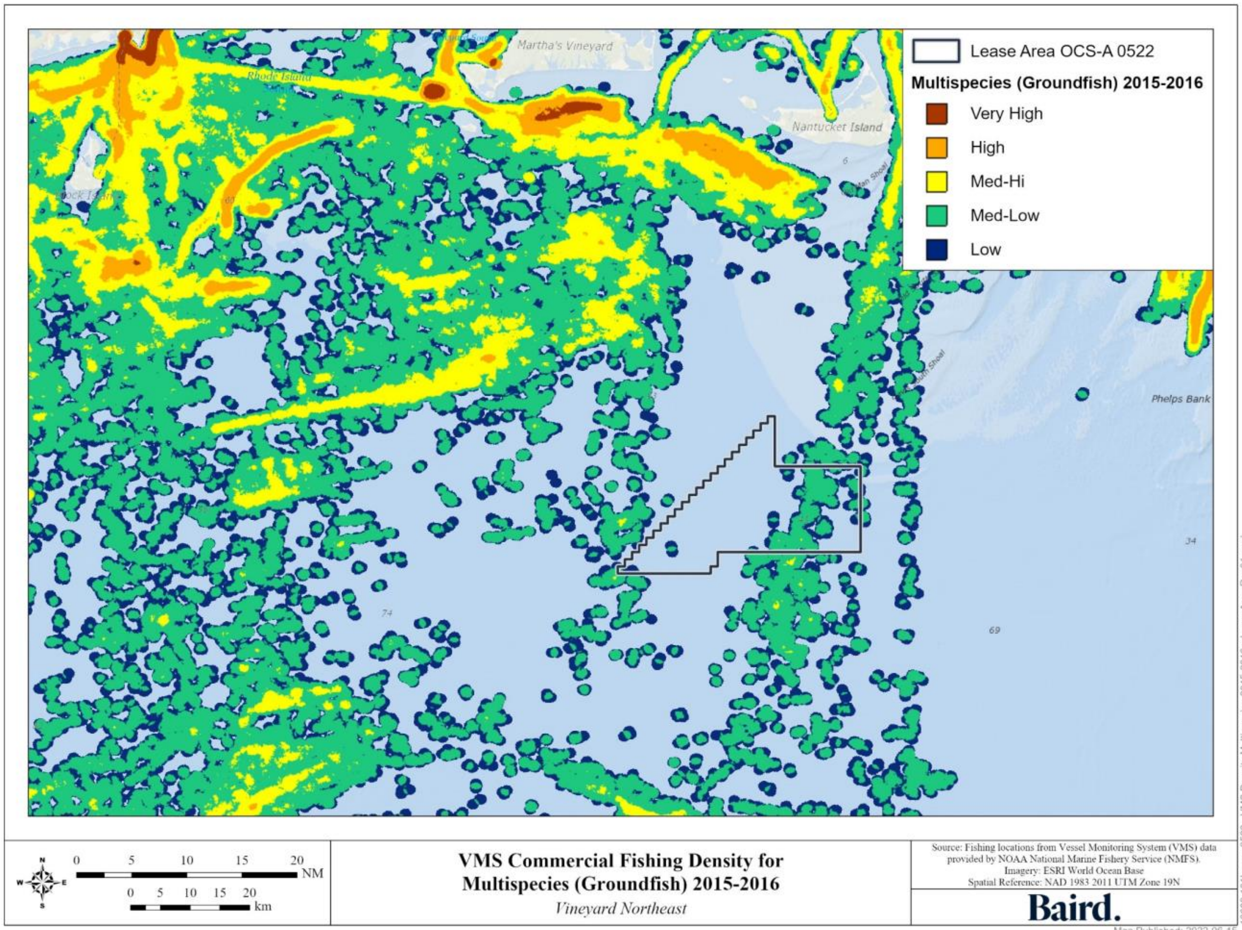



**Figure C.6: VMS Commercial Fishing Density for Multispecies 2015-2016**

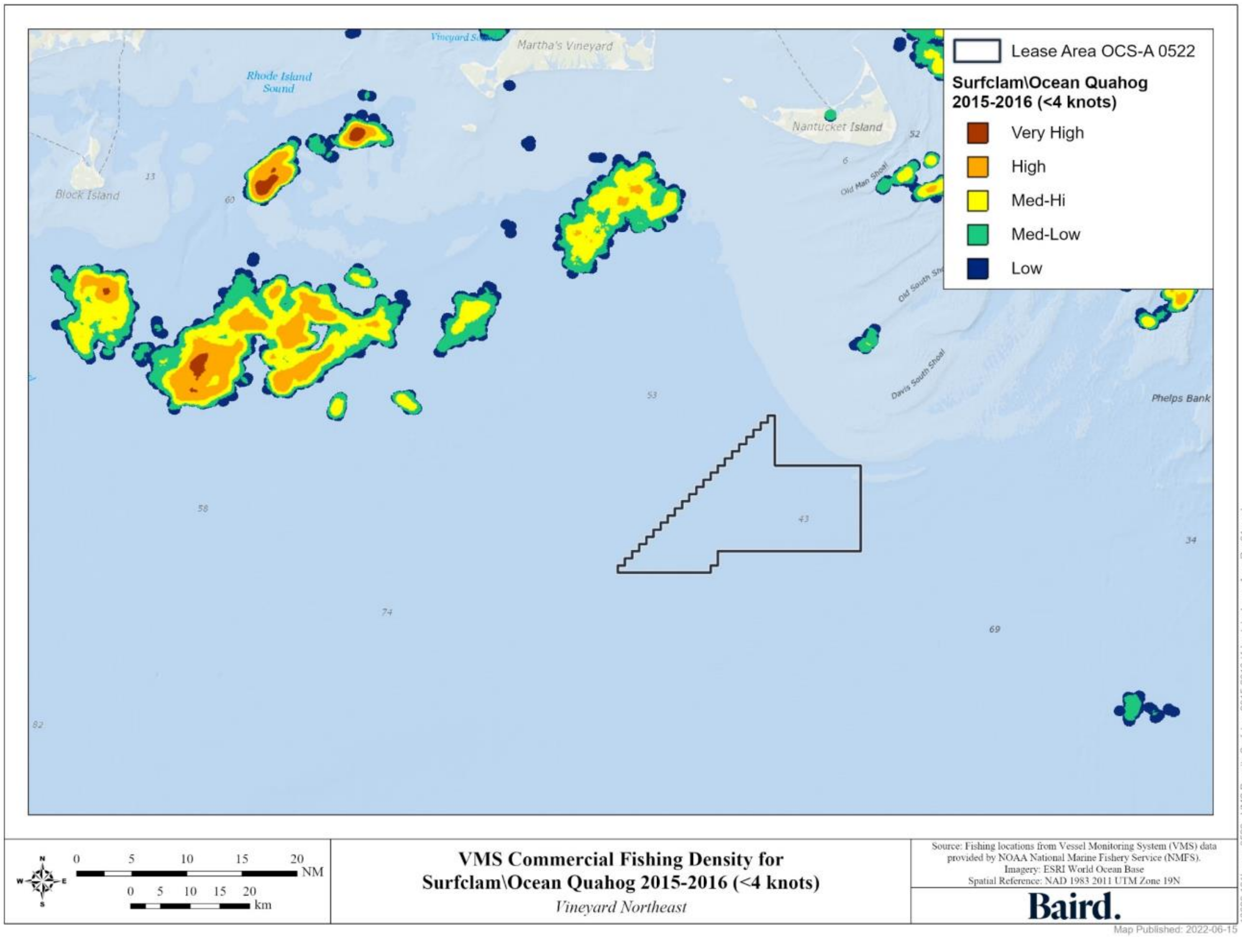



**Figure C.7: VMS Commercial Fishing Density for Surfclam/Quahog 2015-2016 (<4 kts)**

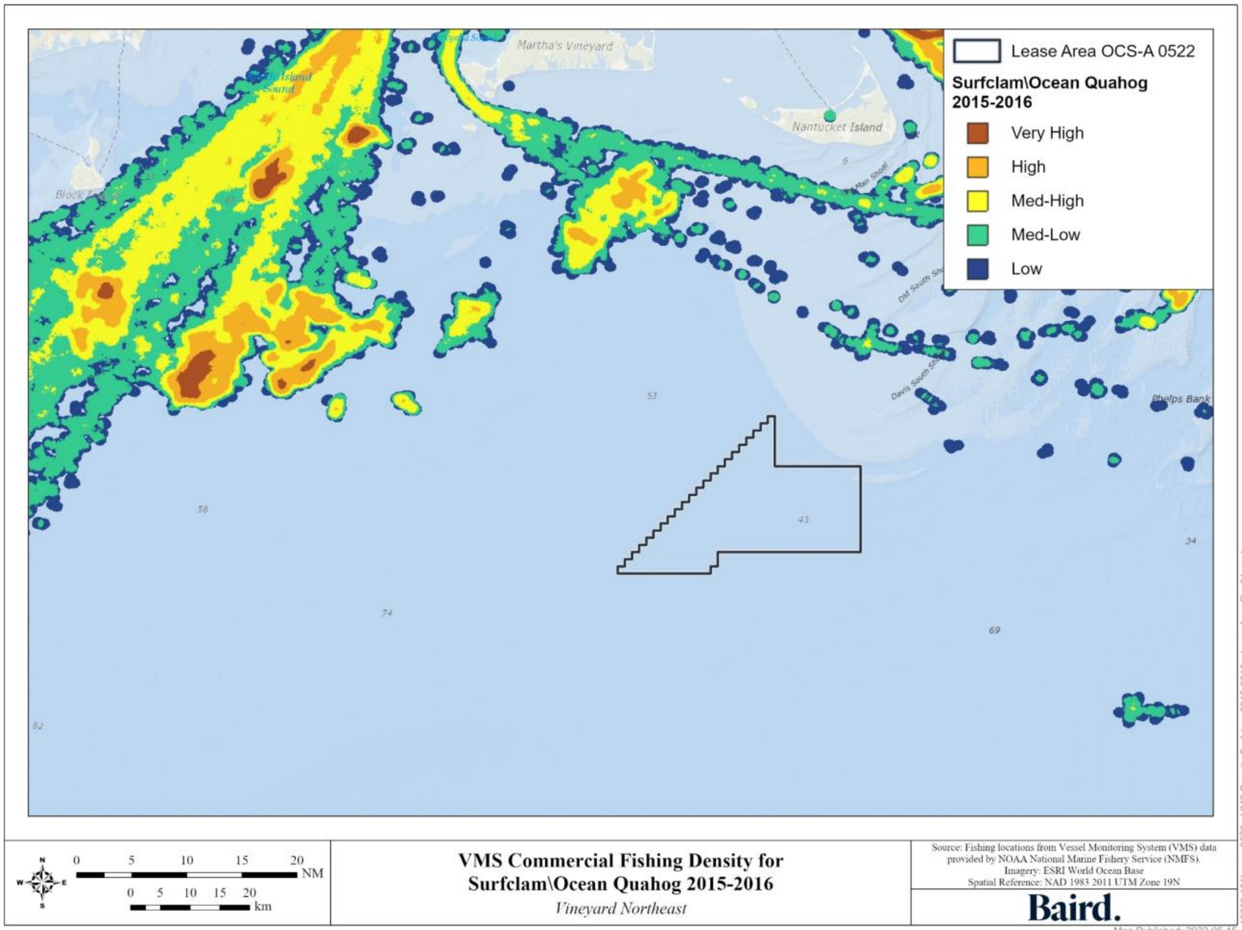



**Figure C.8: VMS Commercial Fishing Density for Surfclam/Quahog 2015-2016**

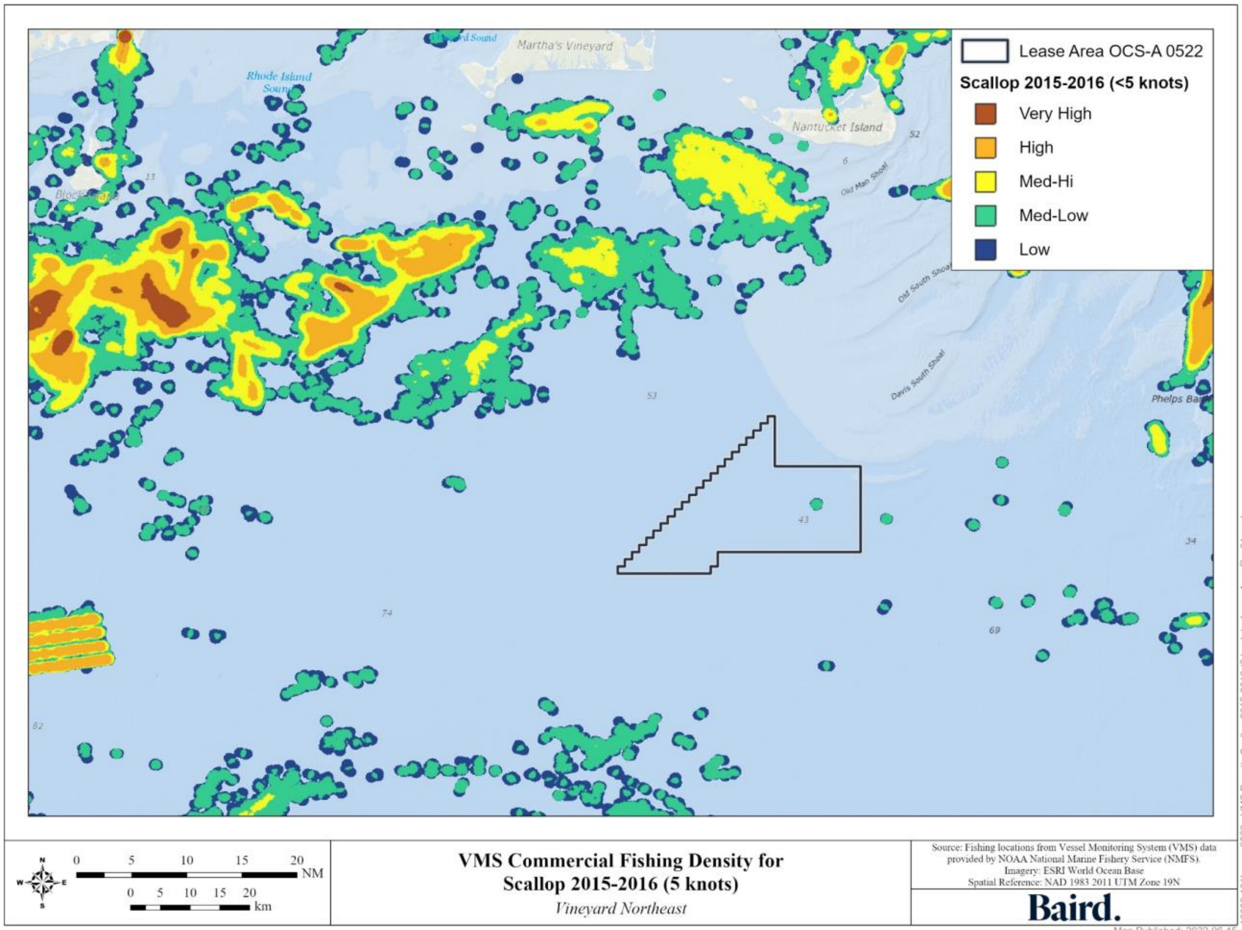



**Figure C.9: VMS Commercial Fishing Density for Atlantic Sea Scallop 2015-2016 (<5 kts)**

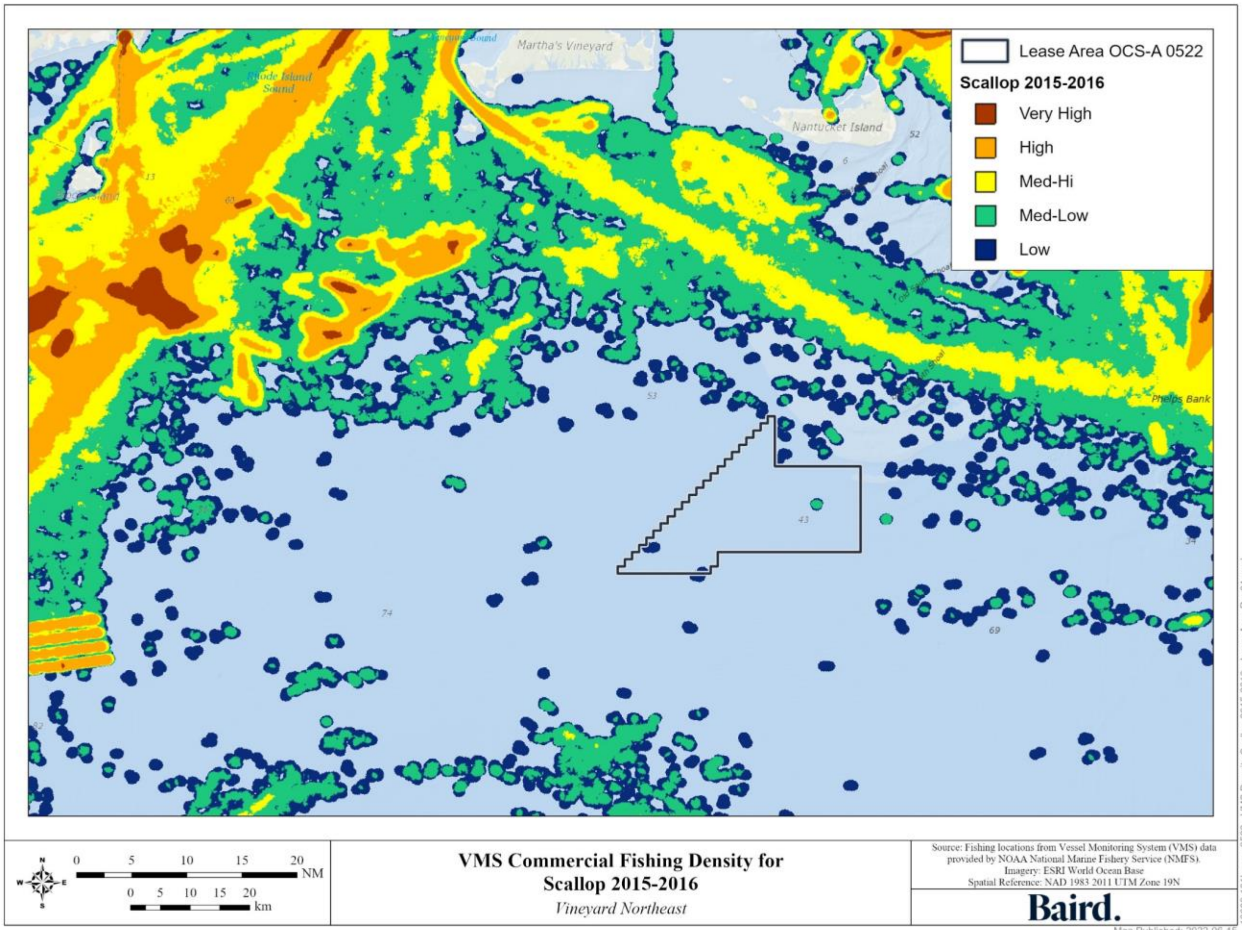



**Figure C.10: VMS Commercial Fishing Density for Atlantic Sea Scallop 2015-2016**

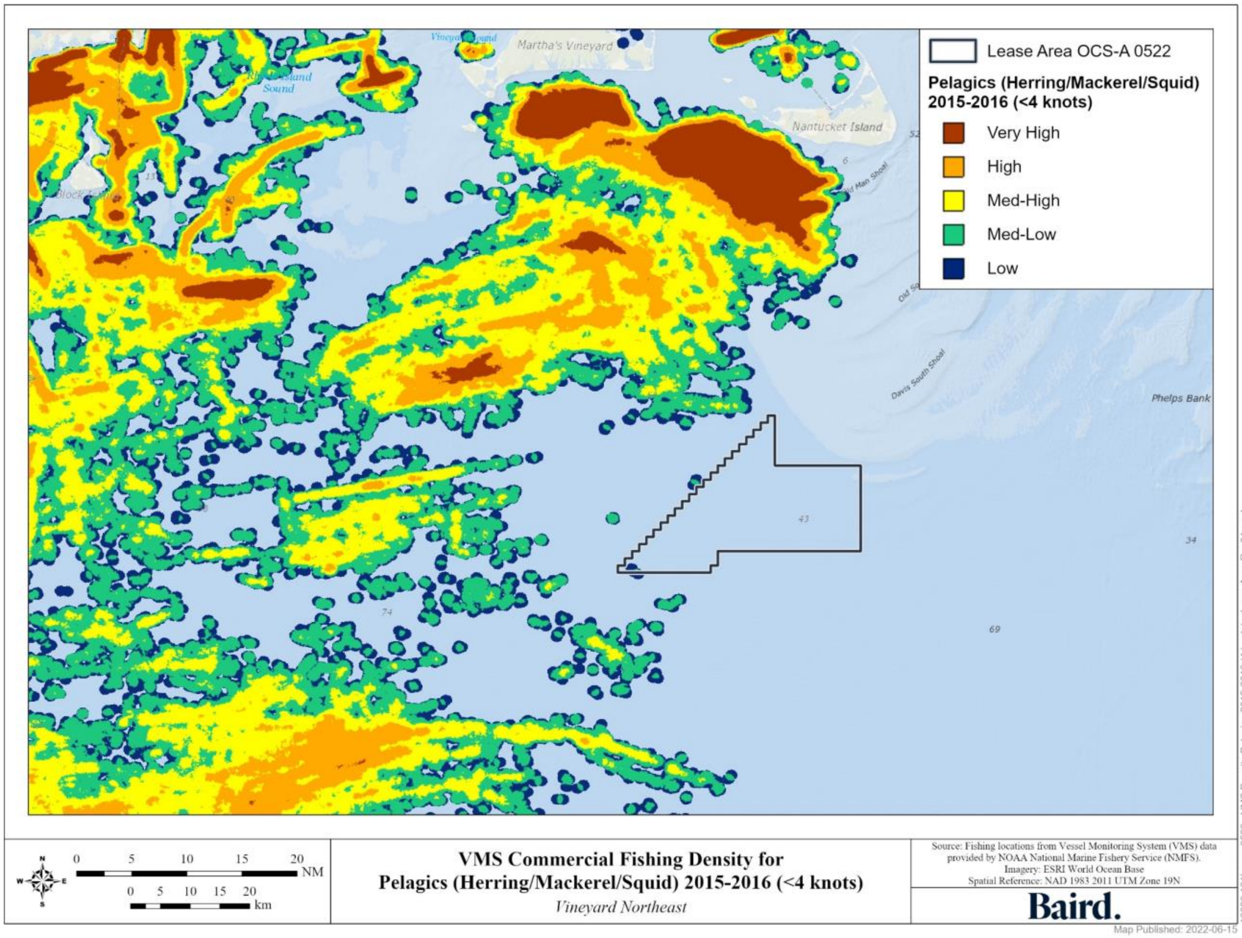



**Figure C.11: VMS Commercial Fishing Density for Pelagics 2015-2016 (<4 kts)**

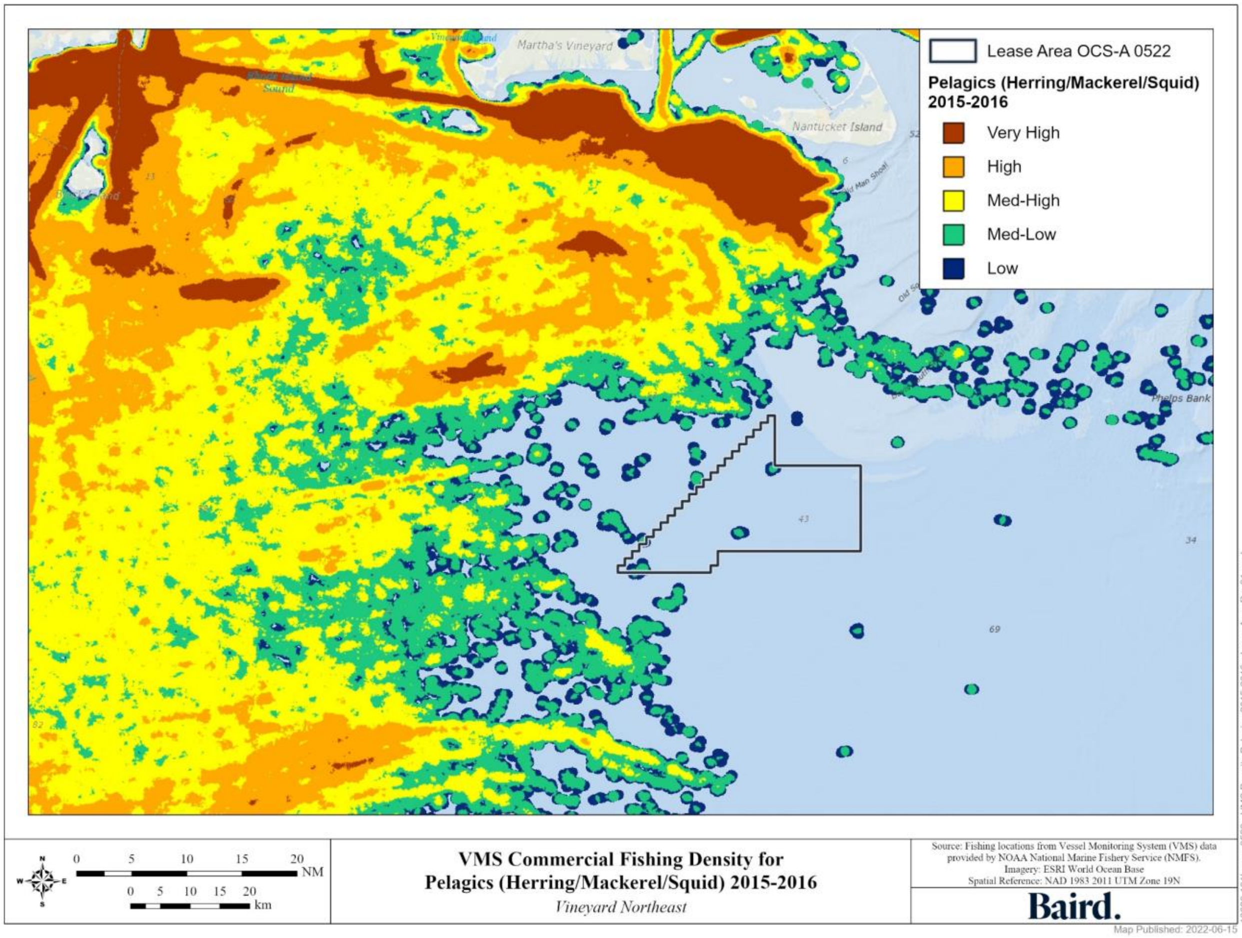



**Figure C.12: VMS Commercial Fishing Density for Pelagics 2015-2016**

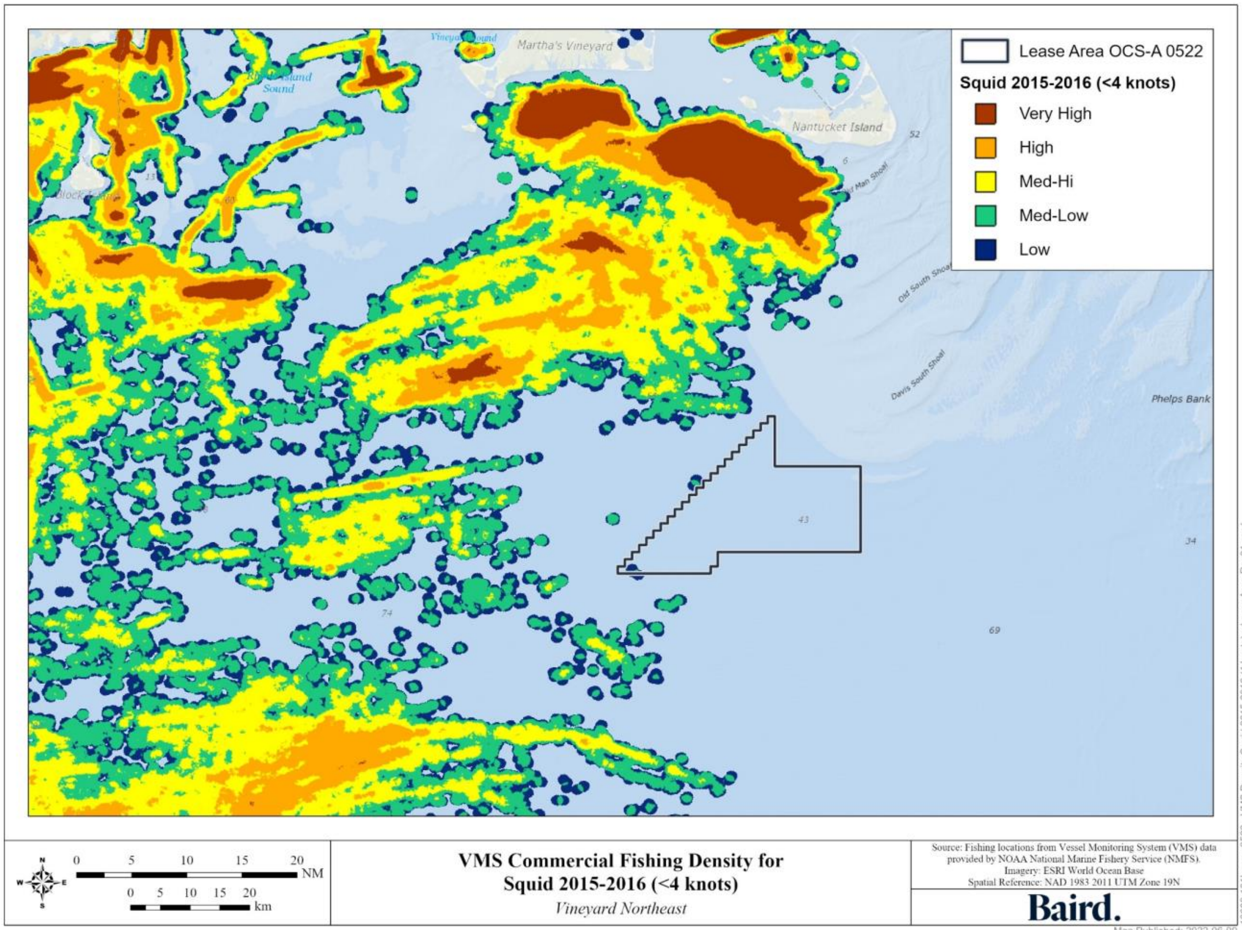



**Figure C.13: VMS Commercial Fishing Density for Squid 2015-2016 (<4 kts)**

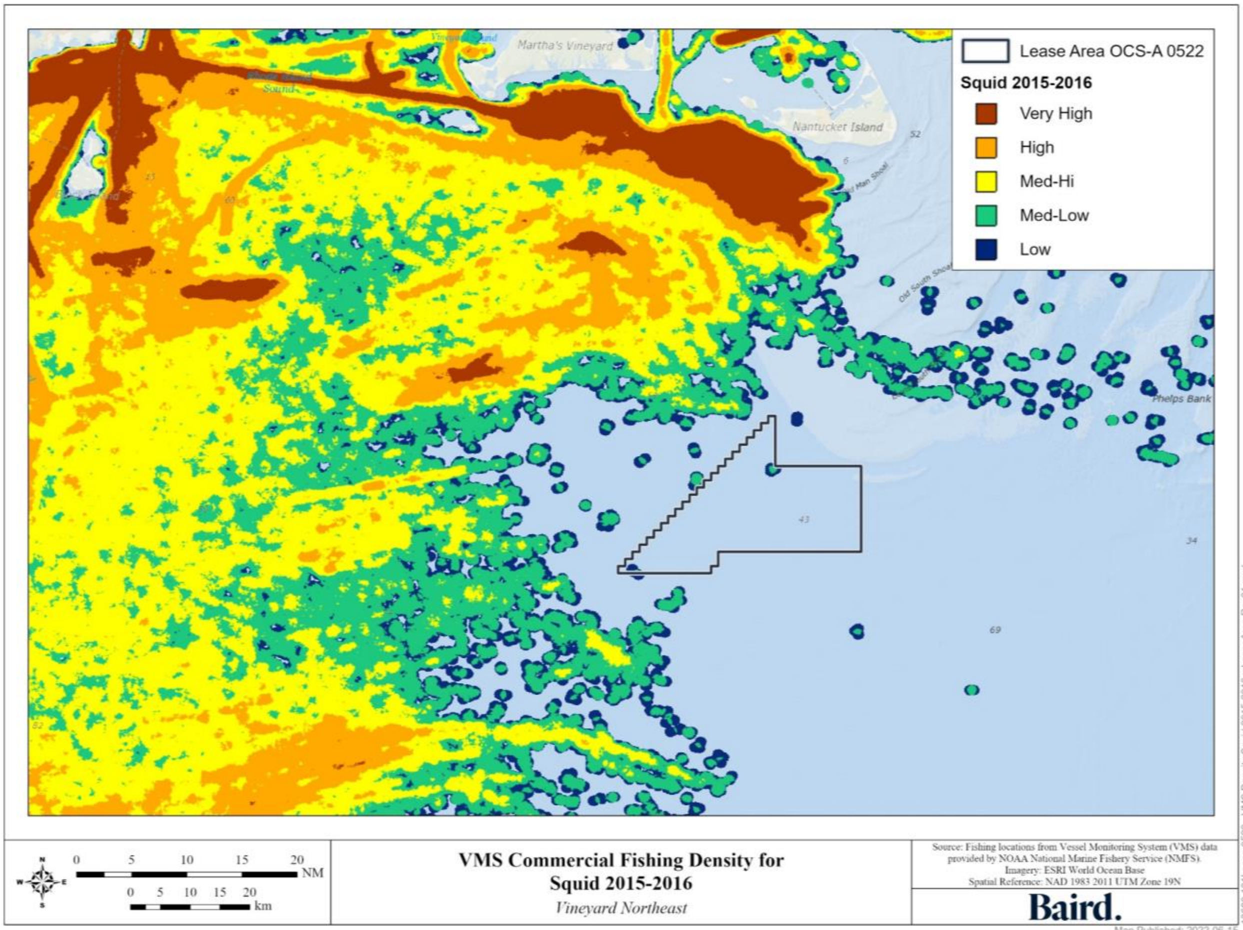



**Figure C.14: VMS Commercial Fishing Density for Squid 2015-2016**

# C.2 VMS Polar Histograms

From the data processed by BOEM, polar histogram plots and vessel count data were developed by BOEM and provided to Epsilon. This appendix section presents the polar histogram plots for Lease Area OCS-A 0522.

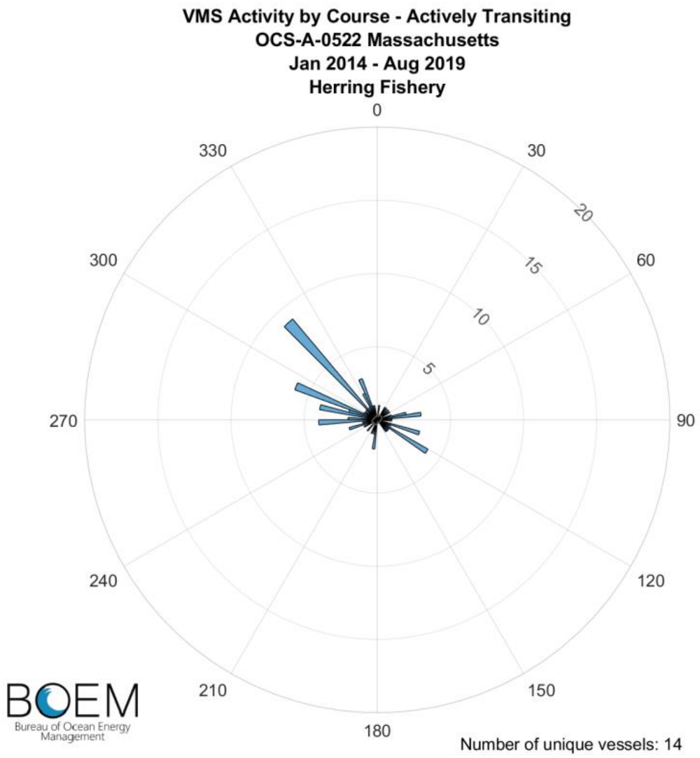
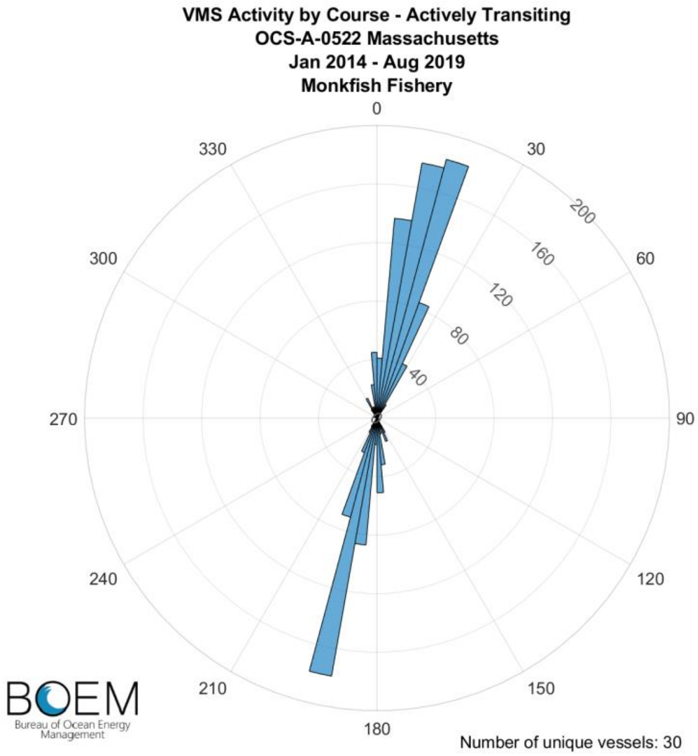



Figure C.15: Polar Histogram for Herring Fishing When Transiting



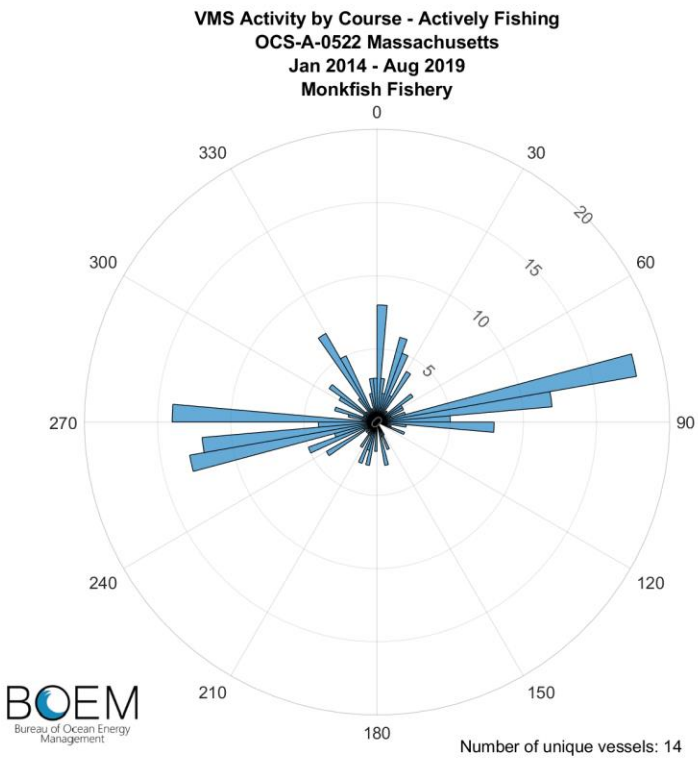
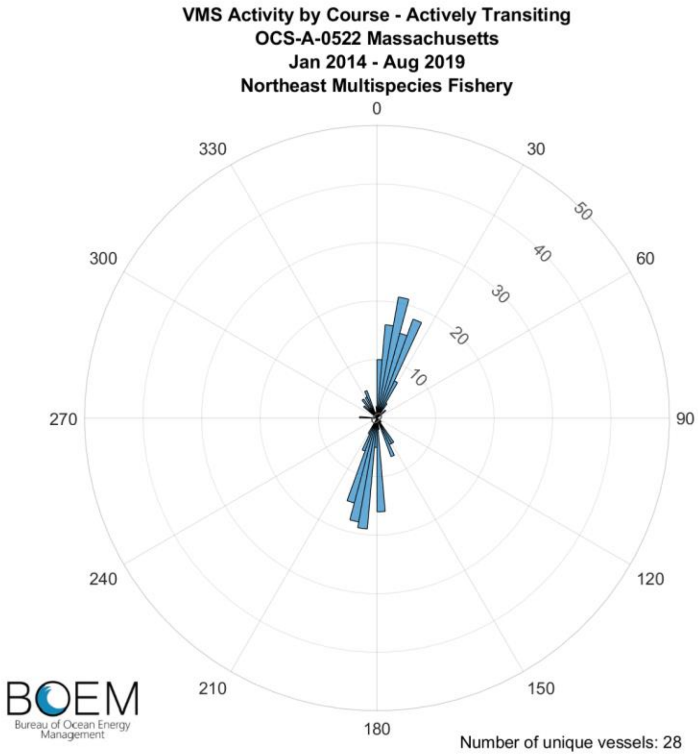




**Figure C.16: Polar Histogram for Monkfish Fishing When Transiting (top) and Actively Fishing (bottom)**



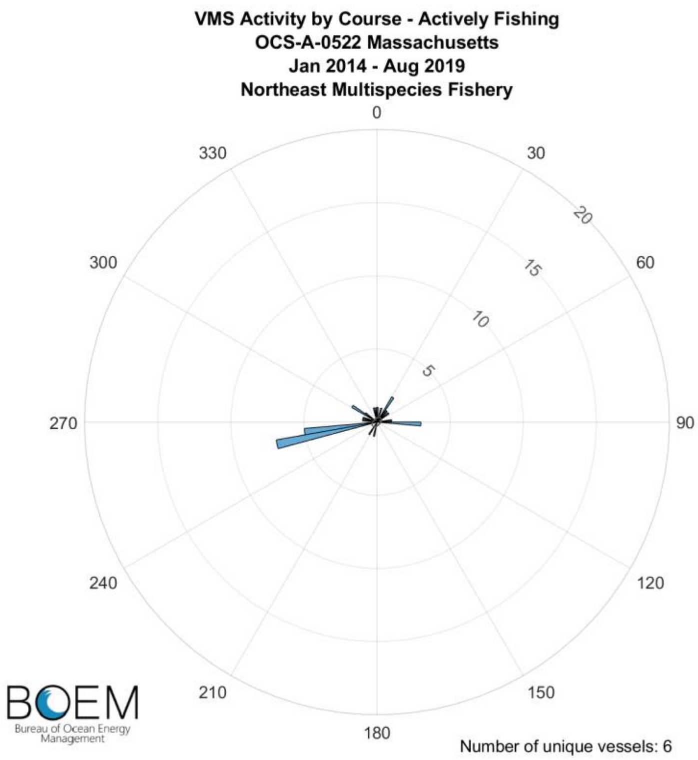
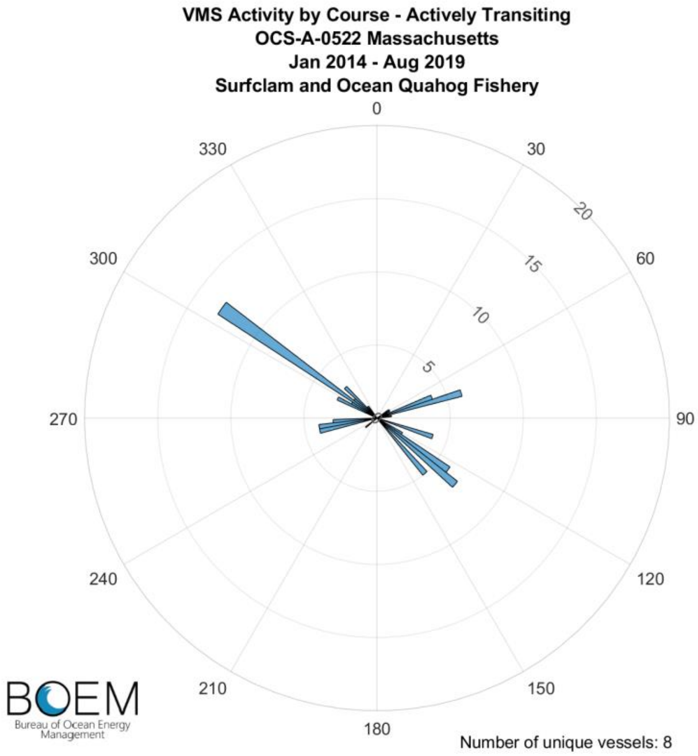




**Figure C.17: Polar Histogram for Multispecies Fishing When Transiting (top) and Actively Fishing (bottom)**



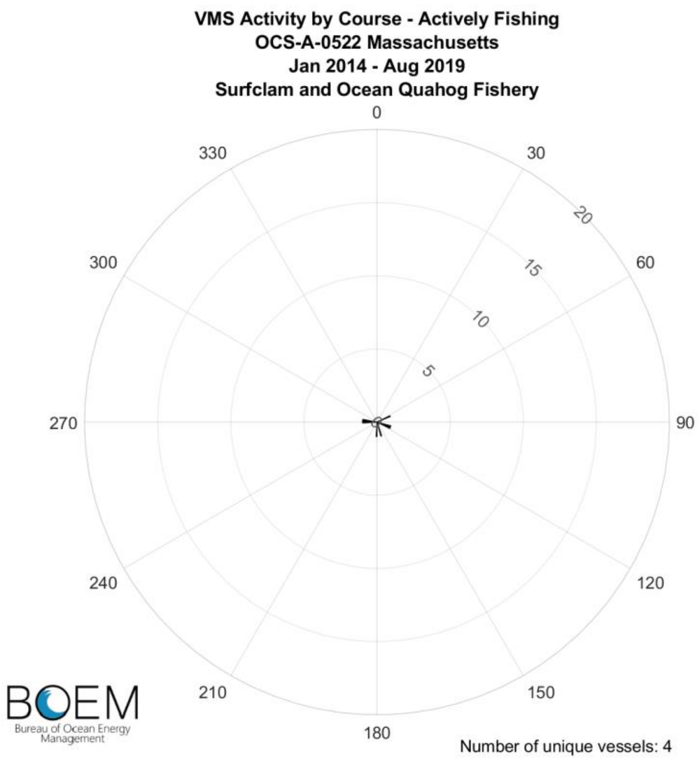
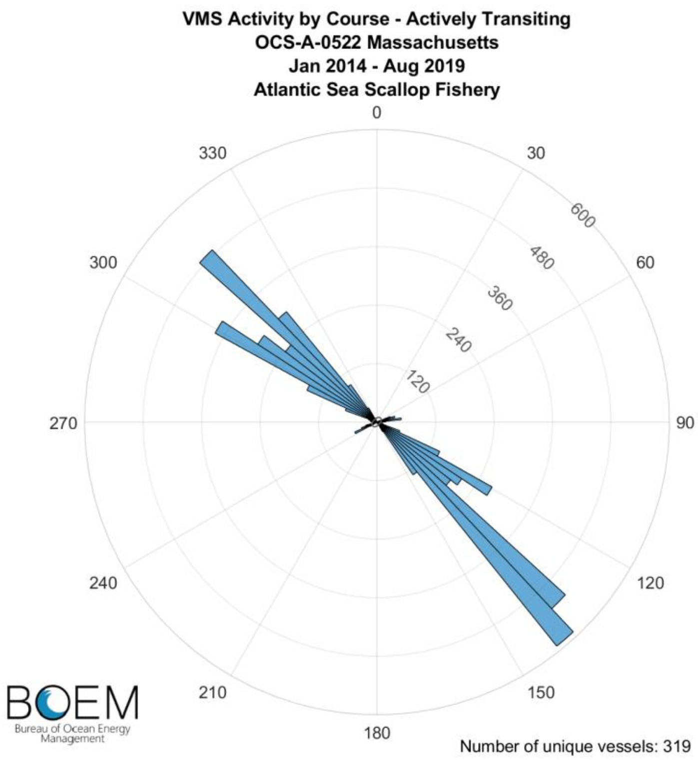




**Figure C.18: Polar Histogram for Surfclam/Quahog Fishing When Transiting (top) and Actively Fishing (bottom)**

/ely Fishing (bottom)



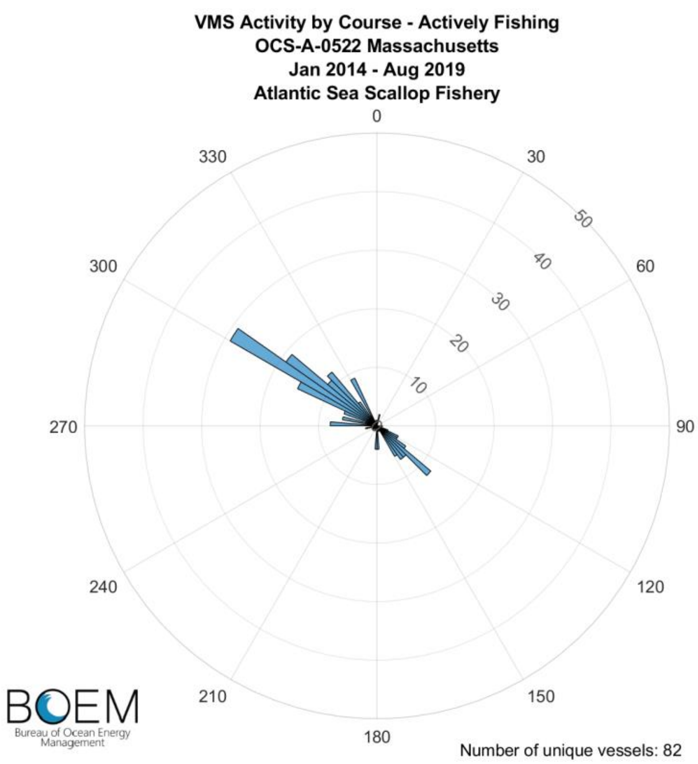
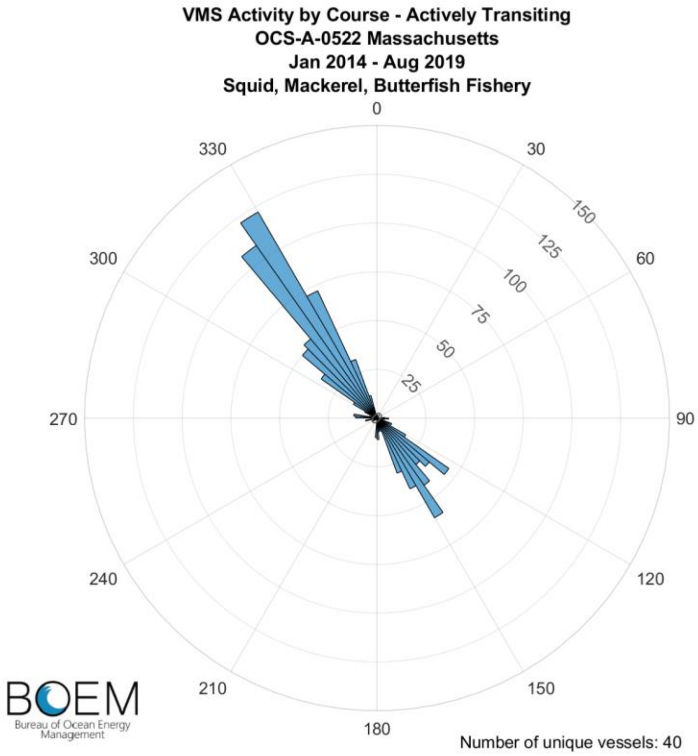




Figure C.19: Polar Histogram for Scallop Fishing When Transiting (top) and Actively Fishing (bottom)



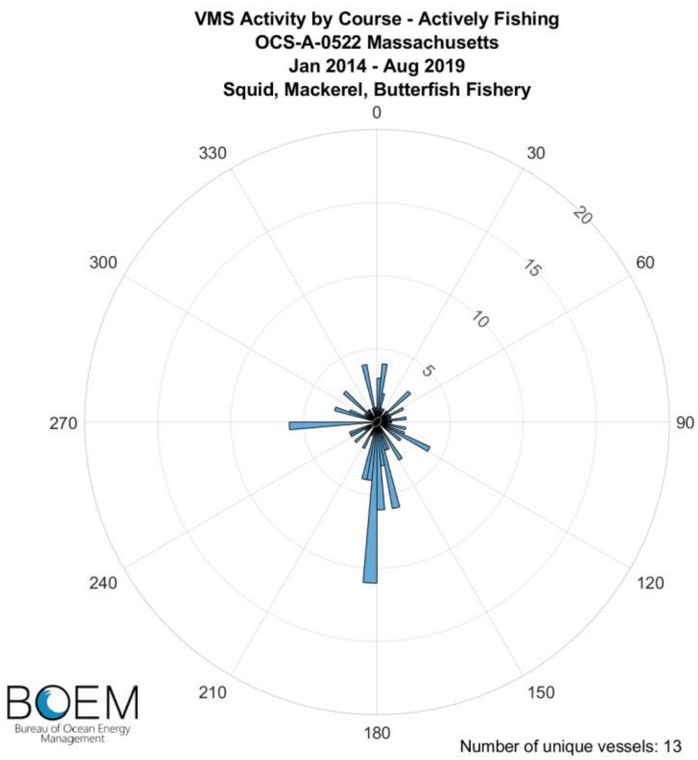




**Figure C.20: Polar Histogram for Squid, Mackerel and Butterfish Fishing When Transiting (top) and Actively Fishing (bottom)**

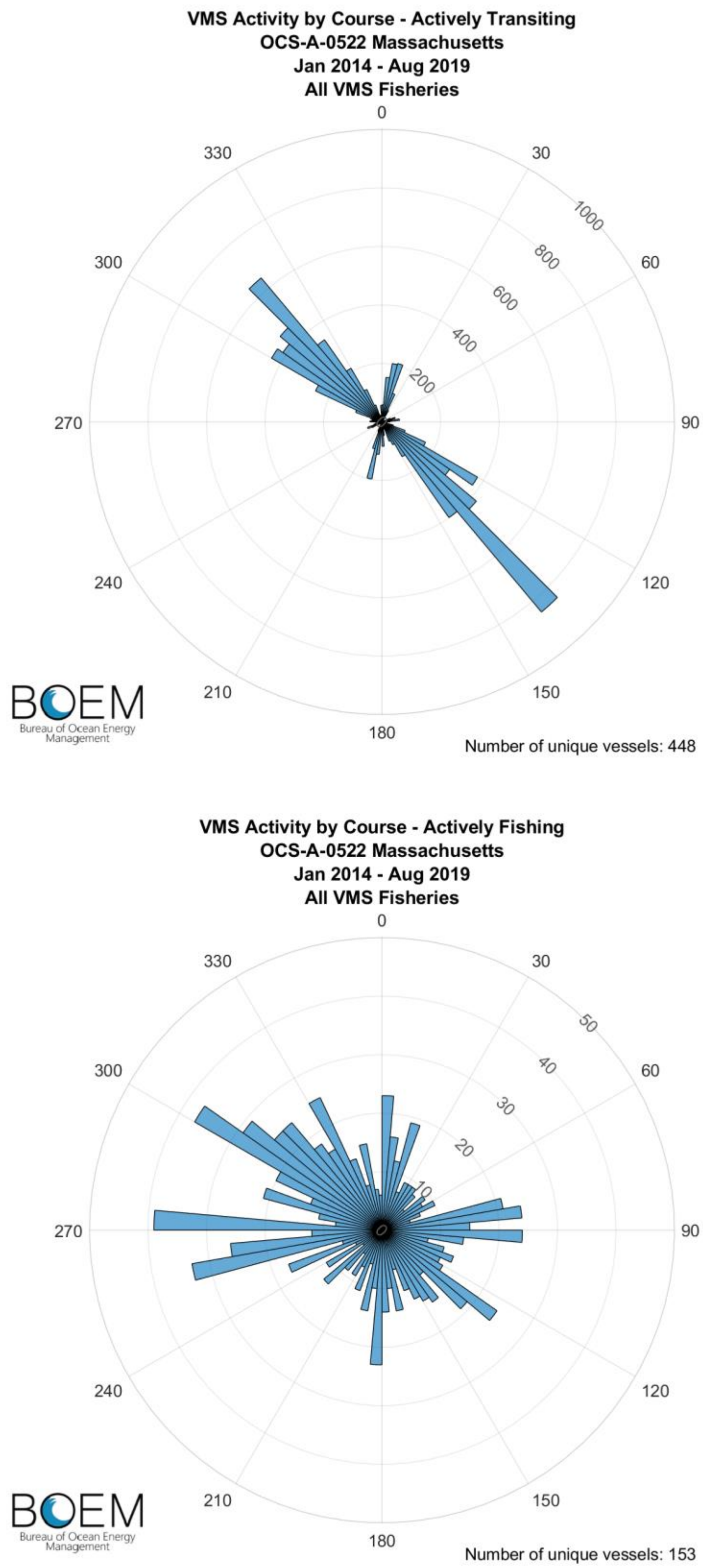
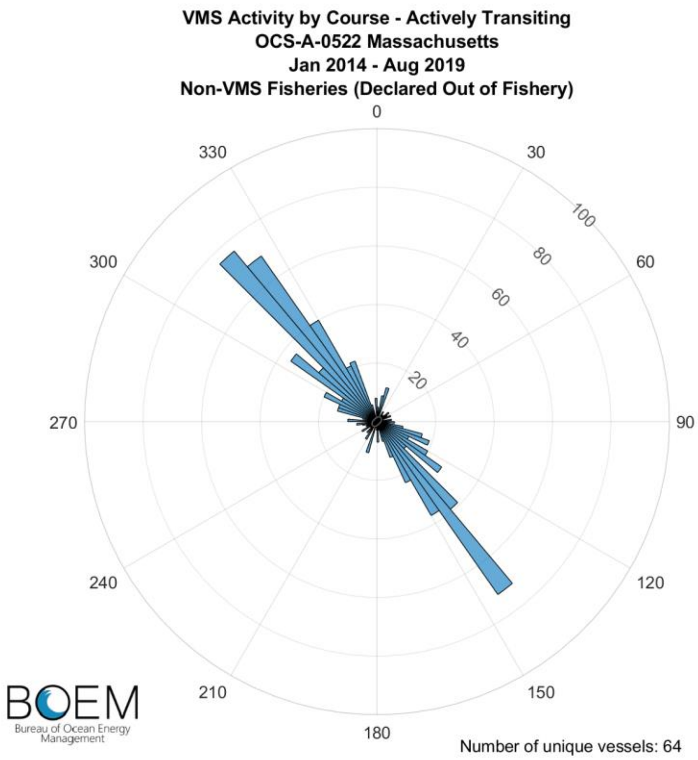



**Figure C.21: Polar Histogram for All Vessels When Transiting (top) and Actively Fishing (bottom)**



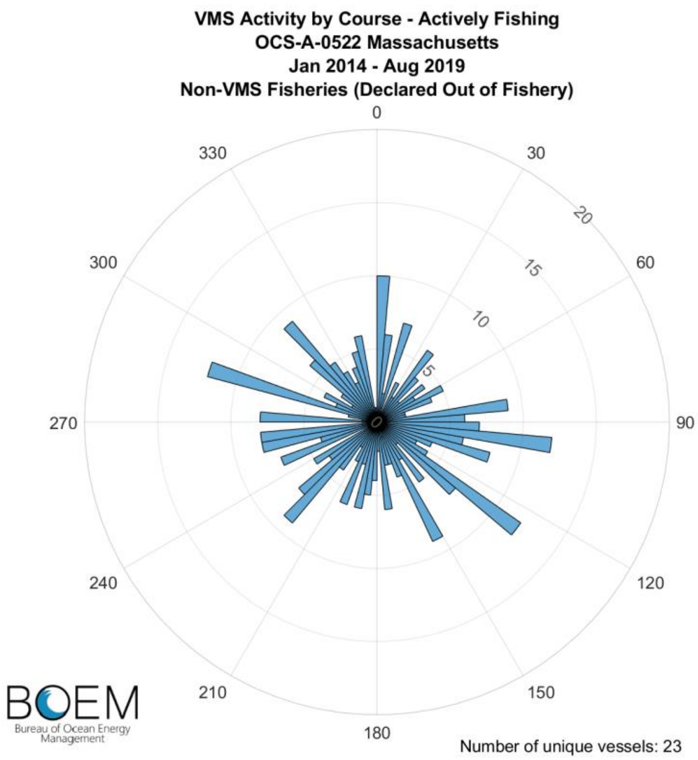




**Figure C.22: Polar Histogram for Non-VMS Fishery Vessels When Transiting (top) and Actively Fishing (bottom)**

# C.3 Vessel Trip Report (VTR) Maps

NOAA Fisheries 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 Fisheries 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) online.

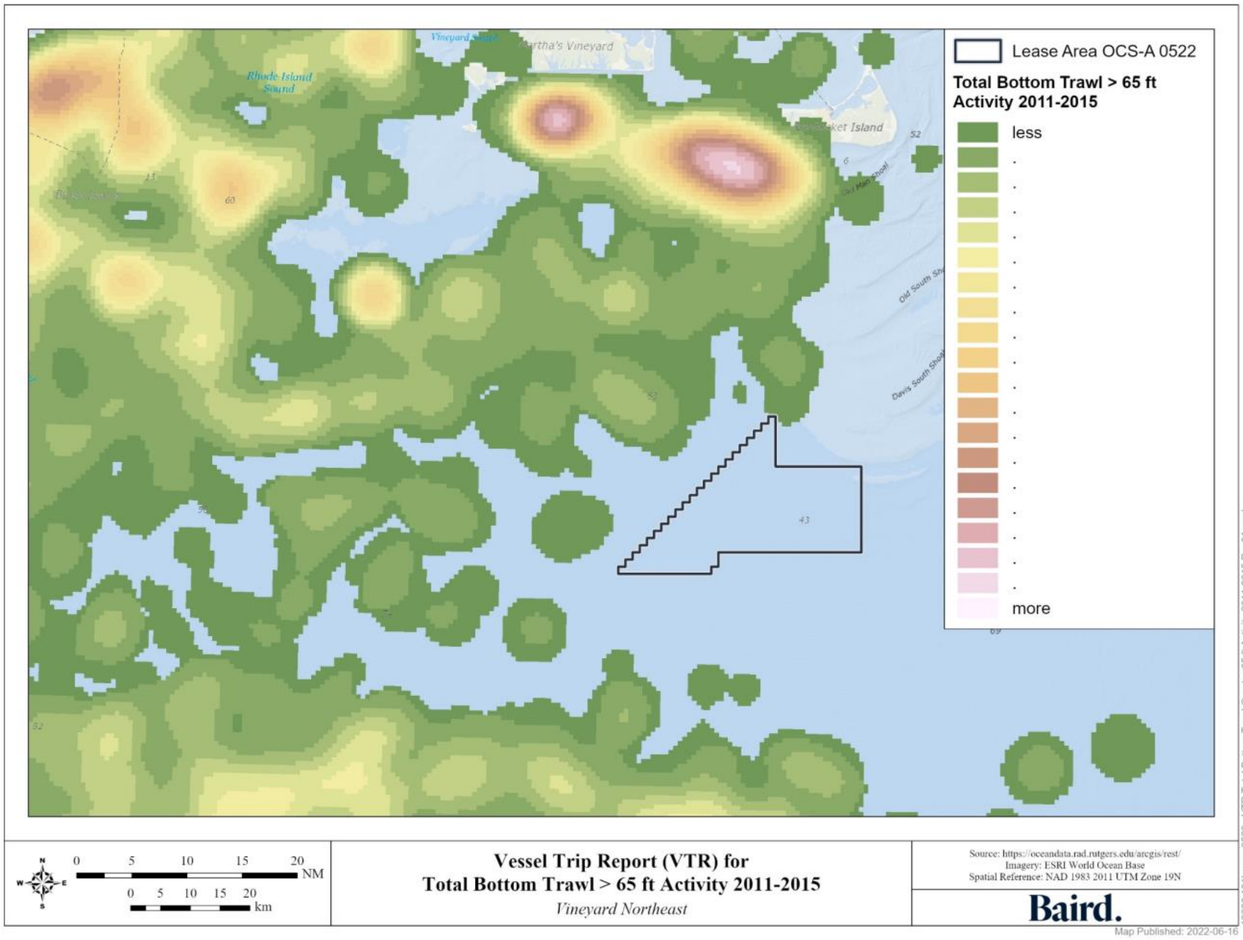



**Figure C.23: Vessel Trip Report for Total Bottom Trawl Activity for Vessels Greater than 65 ft (2011-2015)**

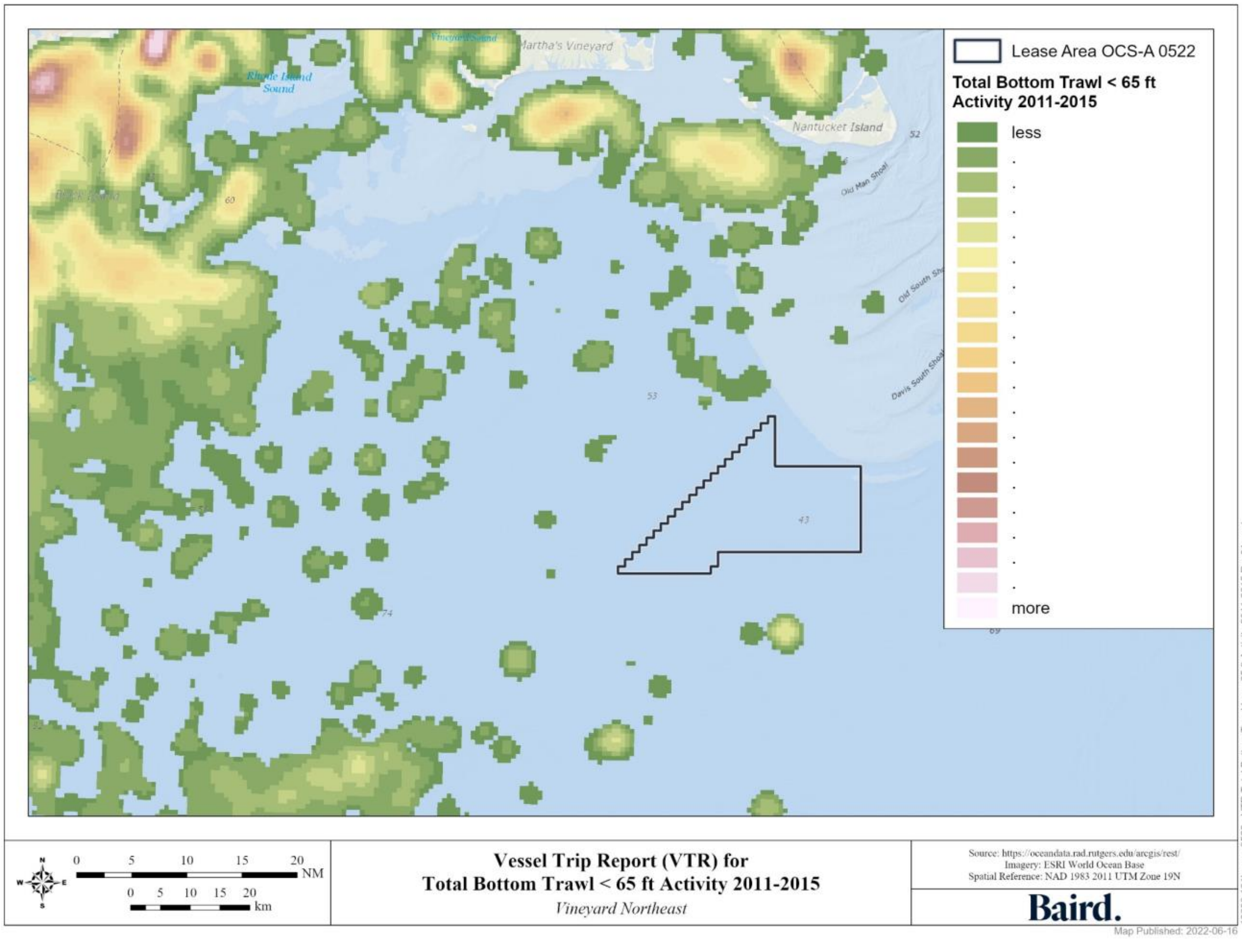



**Figure C.24: Vessel Trip Report for Total Bottom Trawl Activity for Vessels Less than 65 ft (2011-2015)**

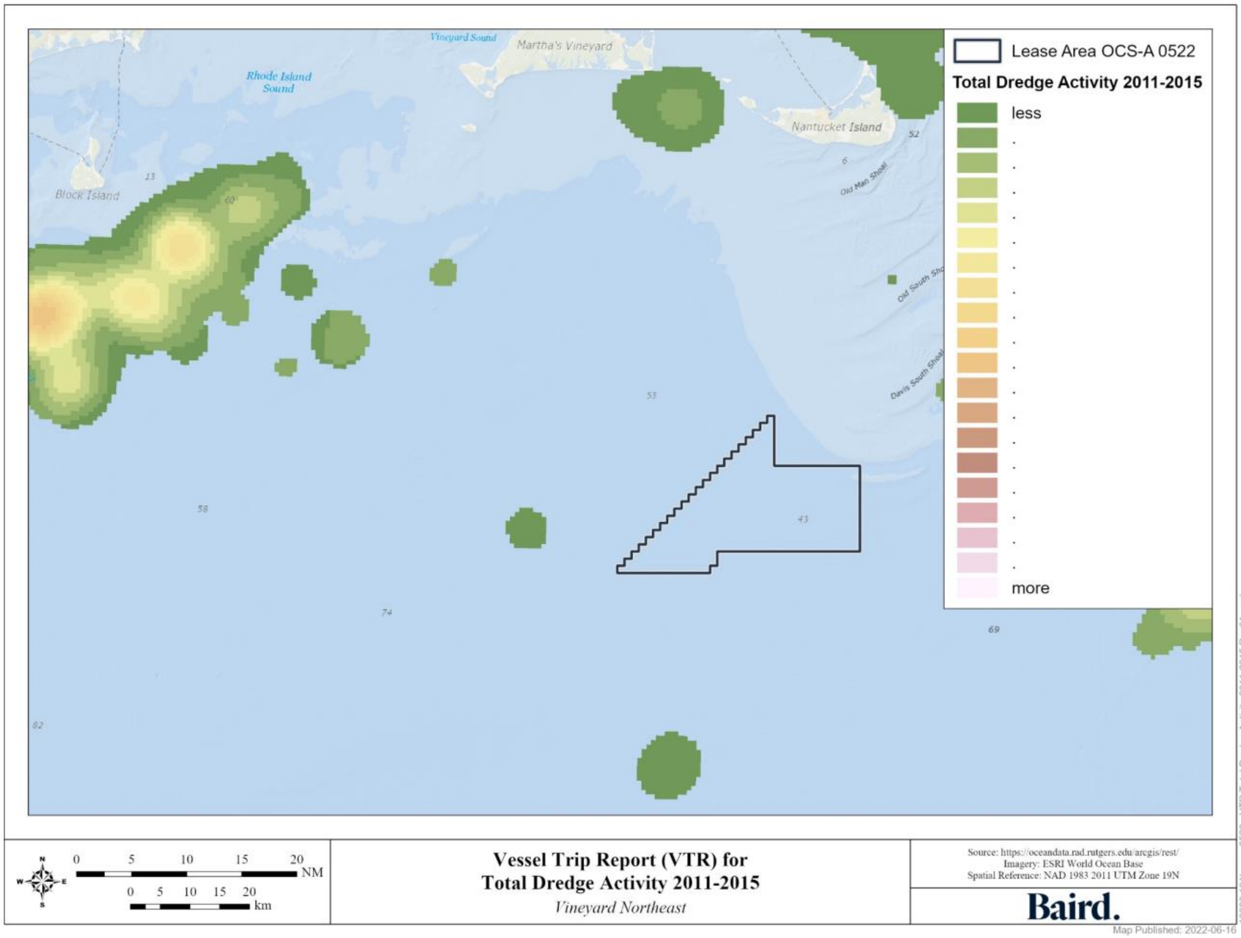



**Figure C.25: Vessel Trip Report for Total Dredge Activity (2011-2015)**

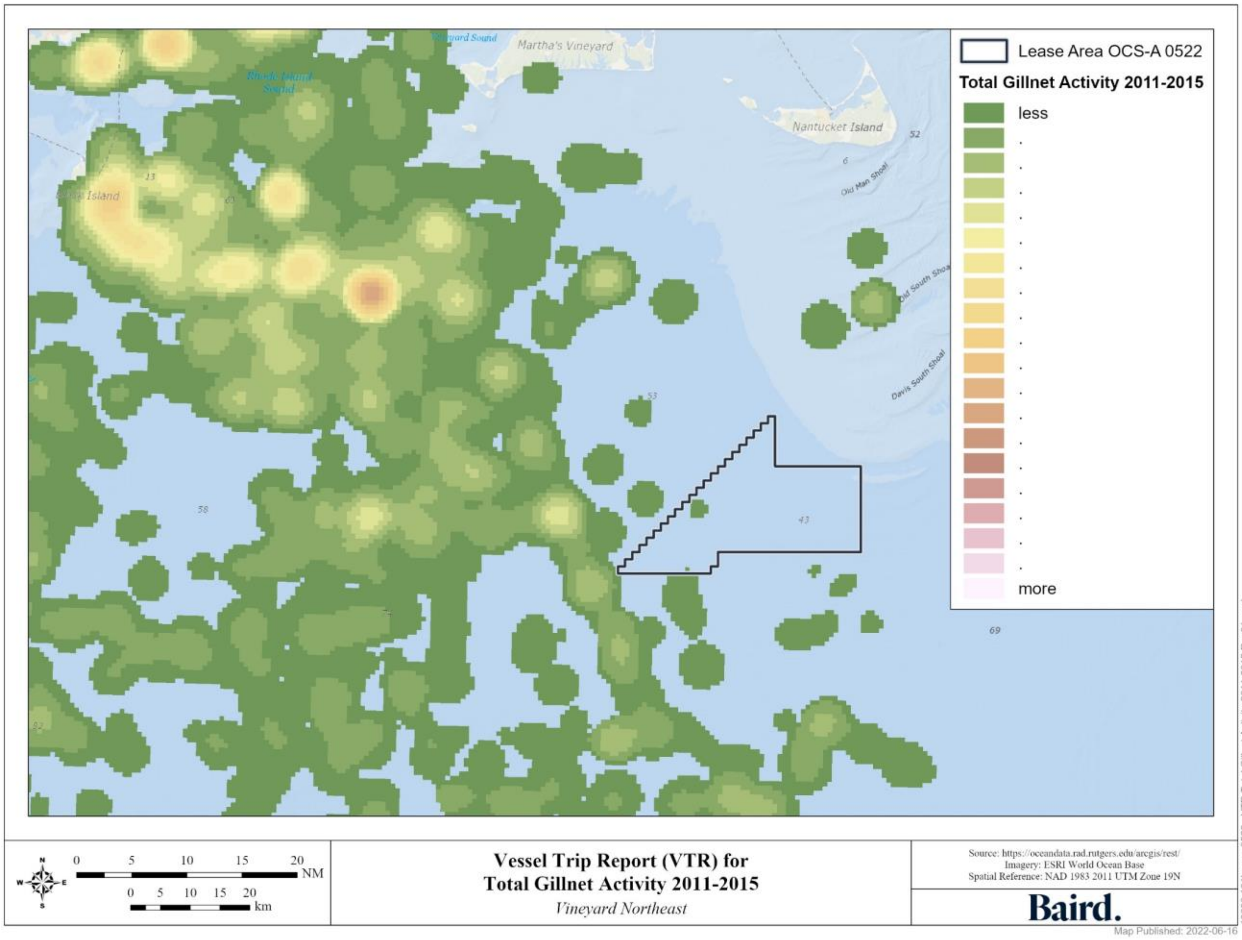



**Figure C.26: Vessel Trip Report for Total Gillnet Activity (2011-2015)**

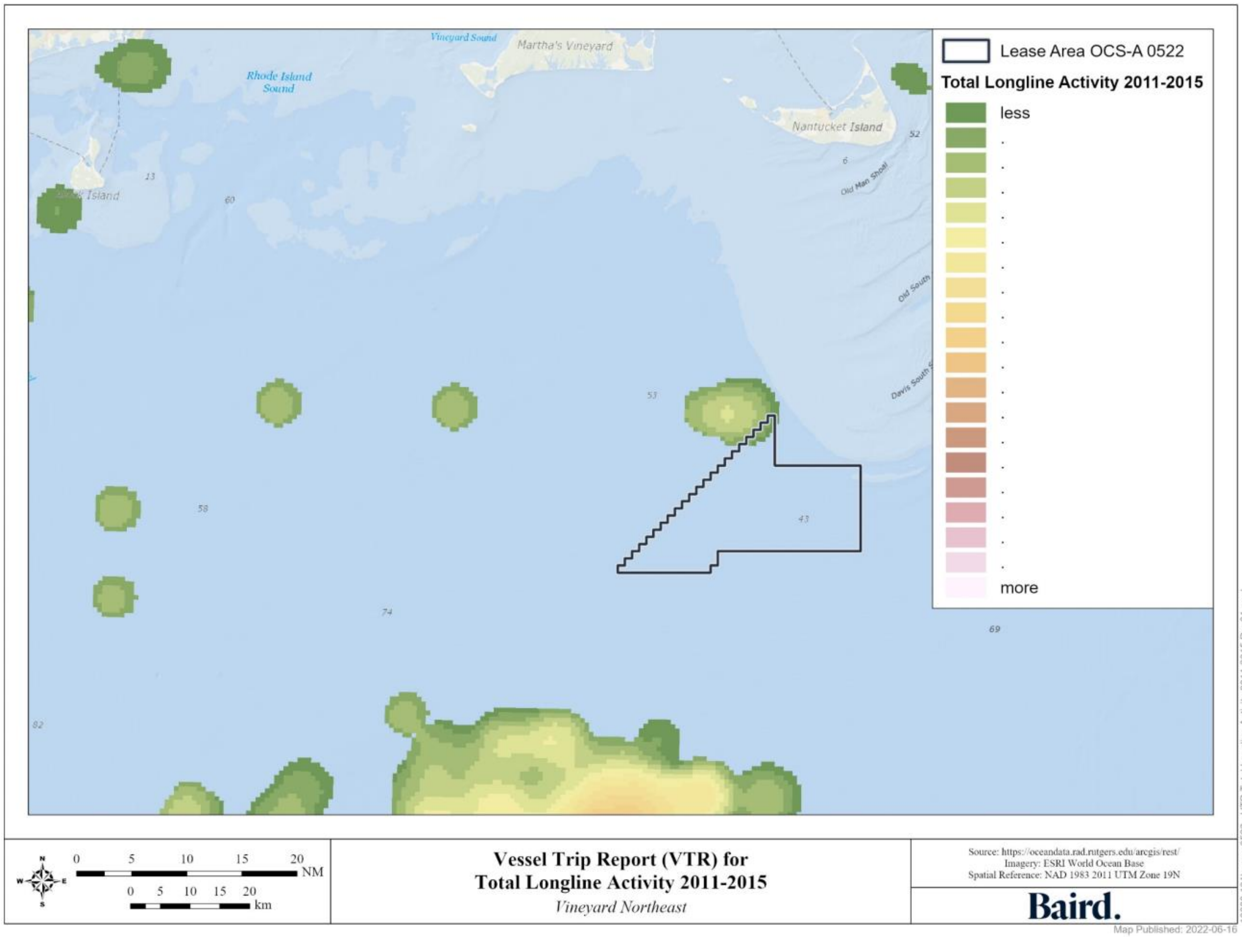



**Figure C.27: Vessel Trip Report for Total Longline Activity (2011-2015)**

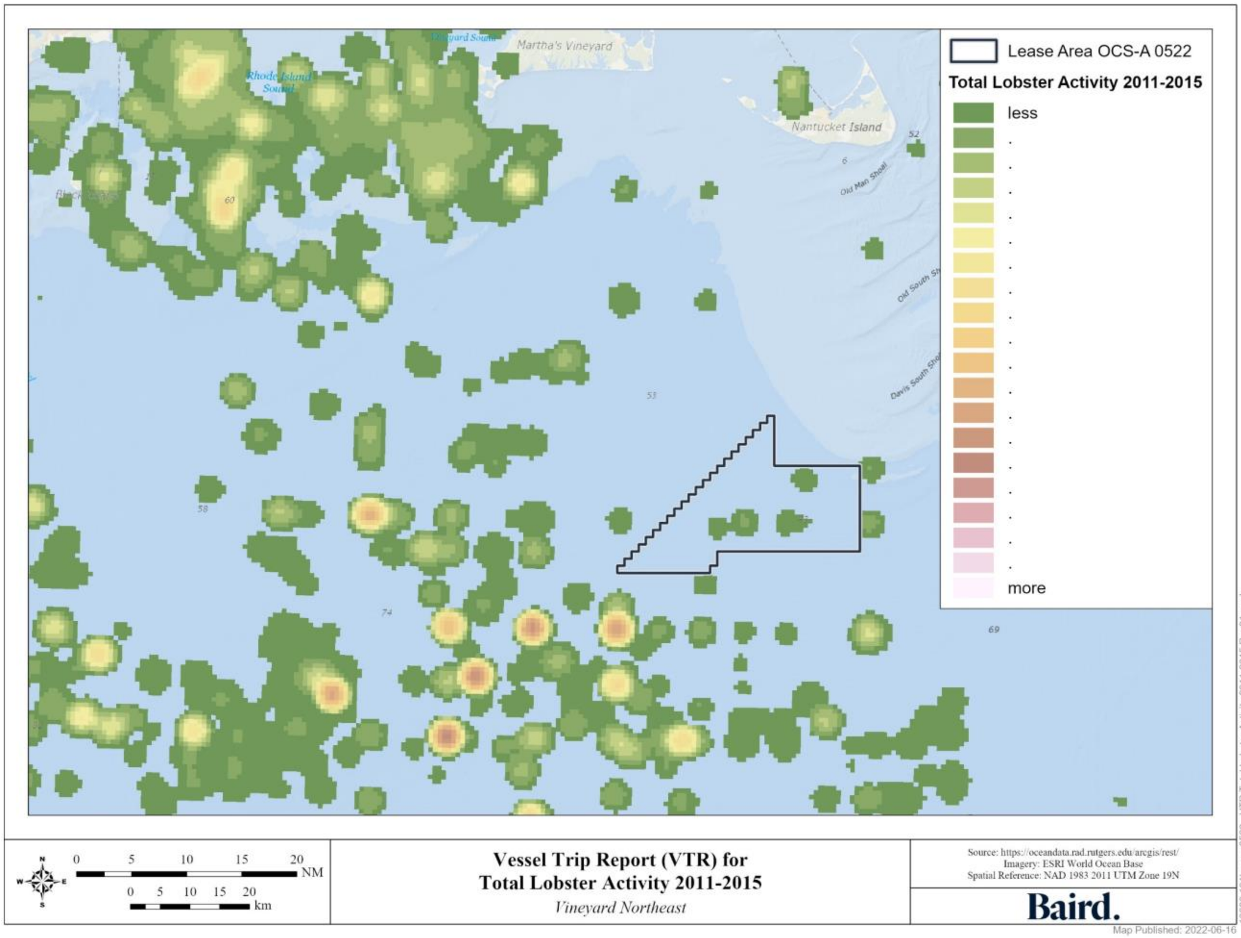



**Figure C.28: Vessel Trip Report for Total Lobster Activity (2011-2015)**

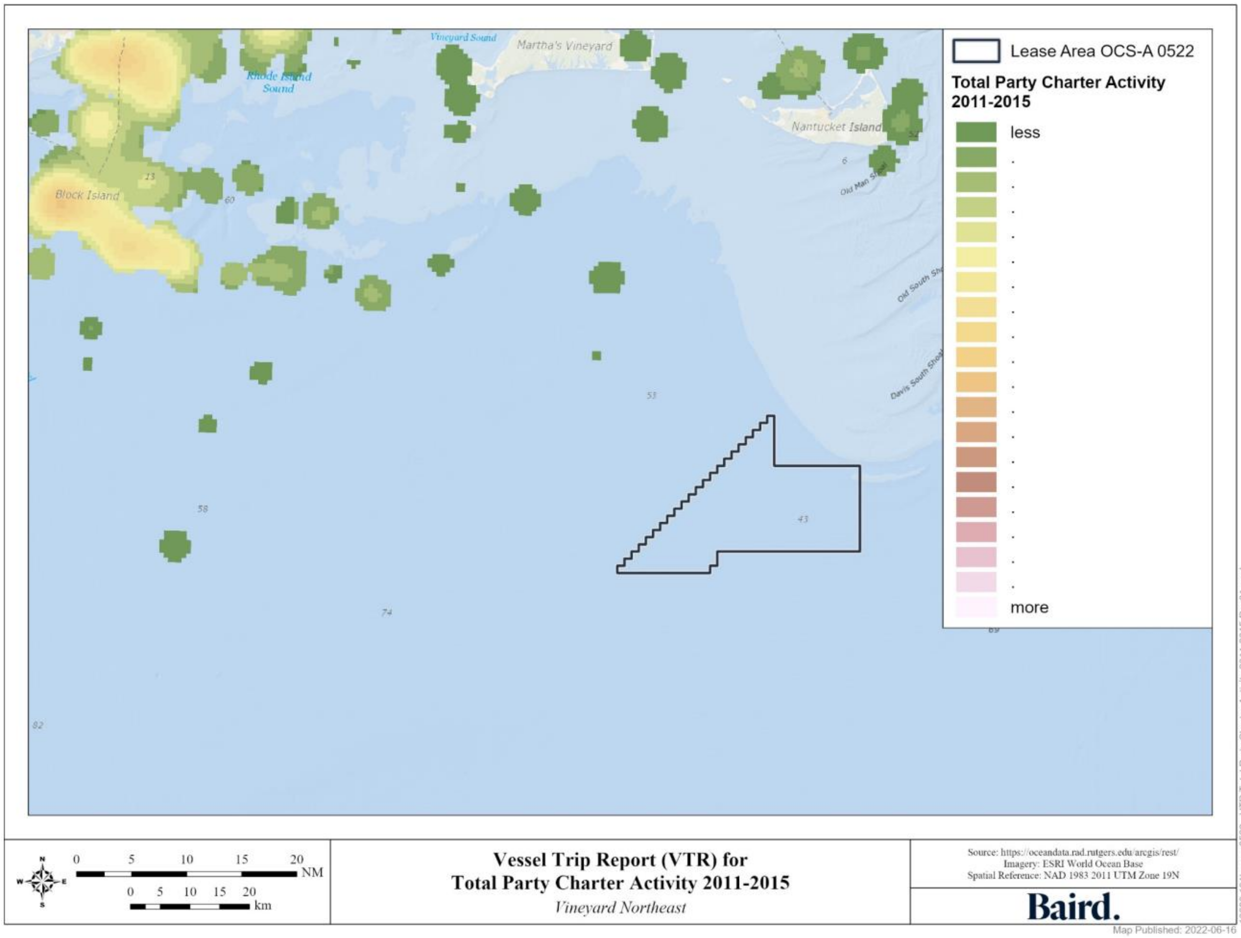



**Figure C.29: Vessel Trip Report for Total Party Charter Activity (2011-2015)**

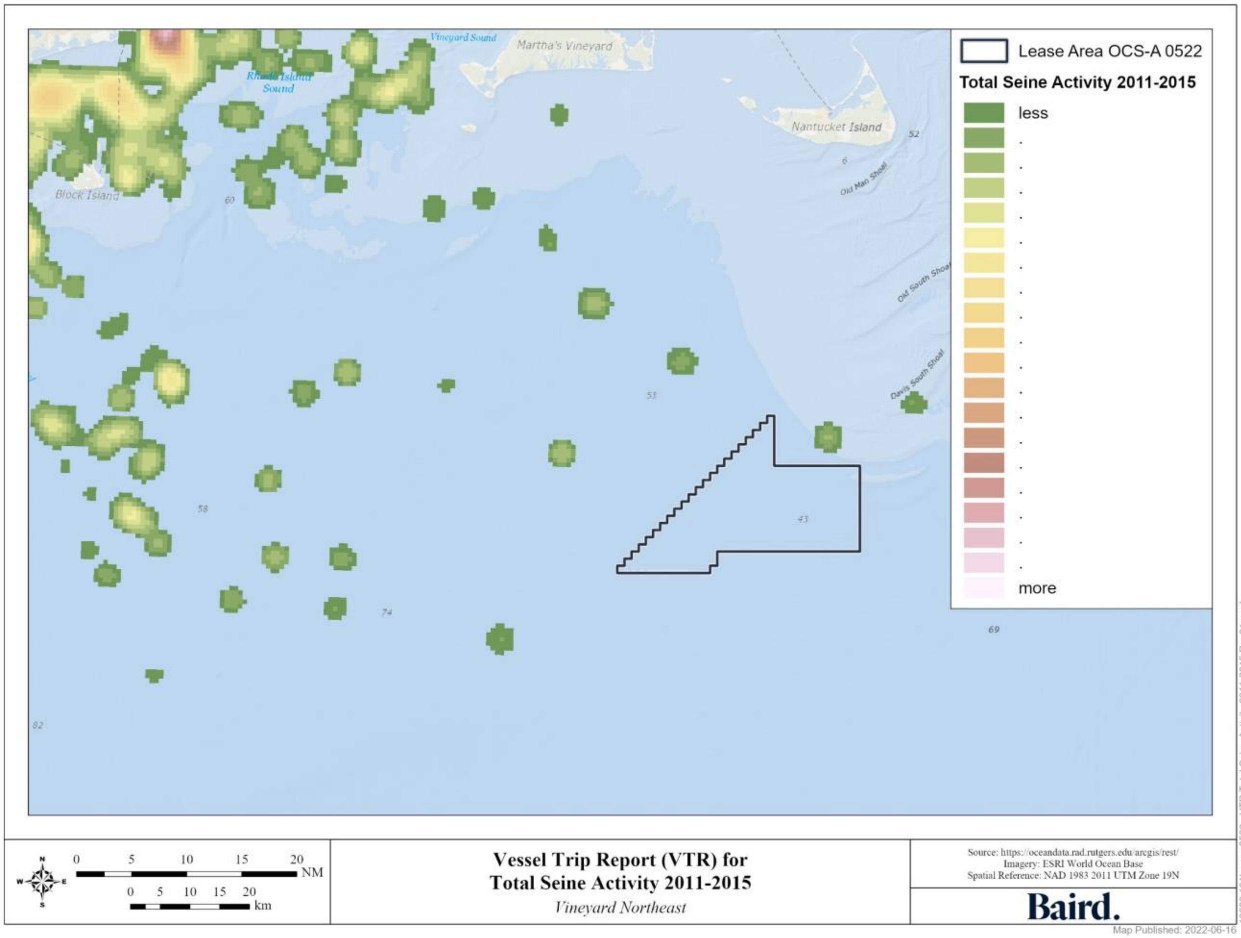



**Figure C.30: Vessel Trip Report for Total Seine Activity (2011-2015)**

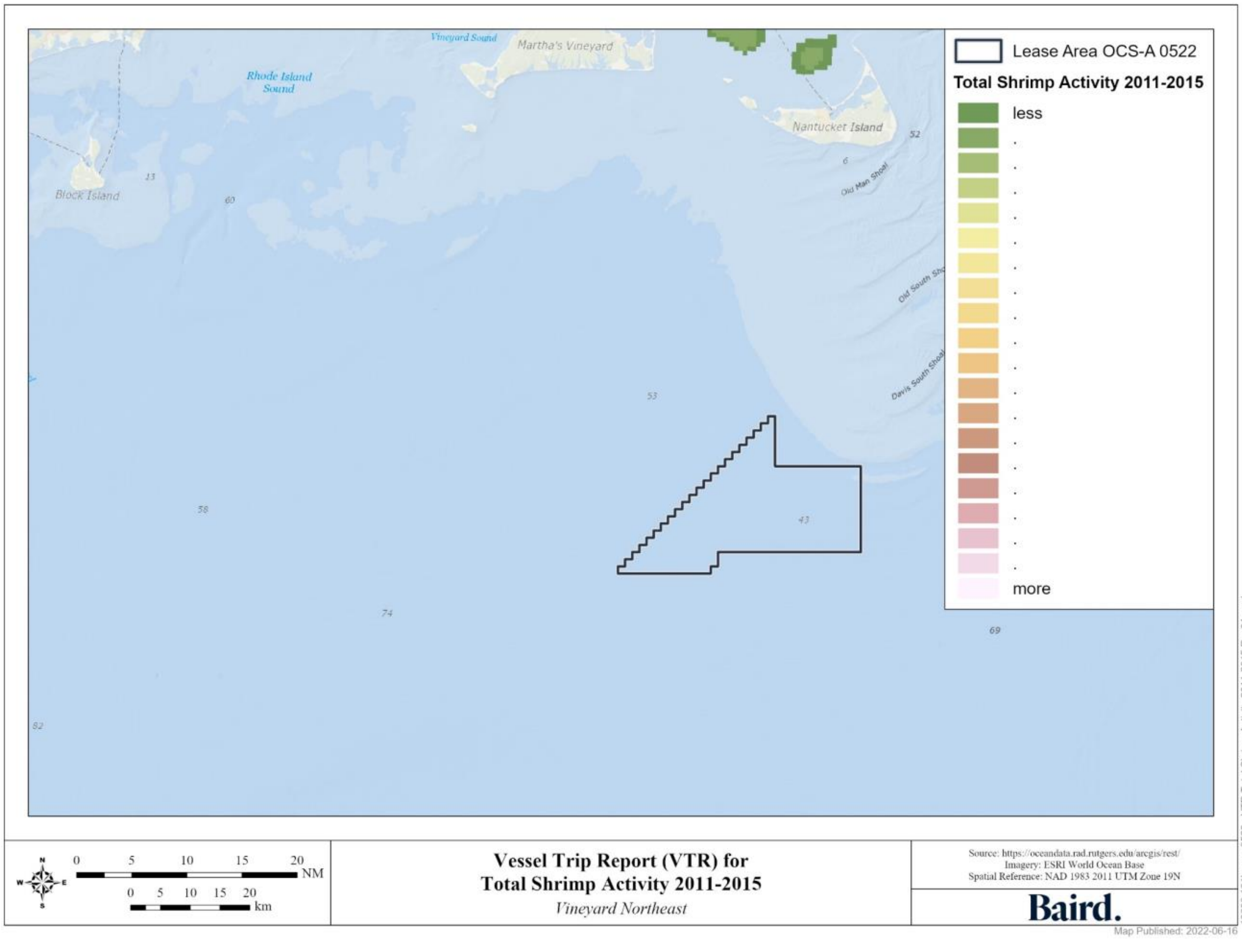



**Figure C.31: Vessel Trip Report for Total Shrimp Activity (2011-2015)**

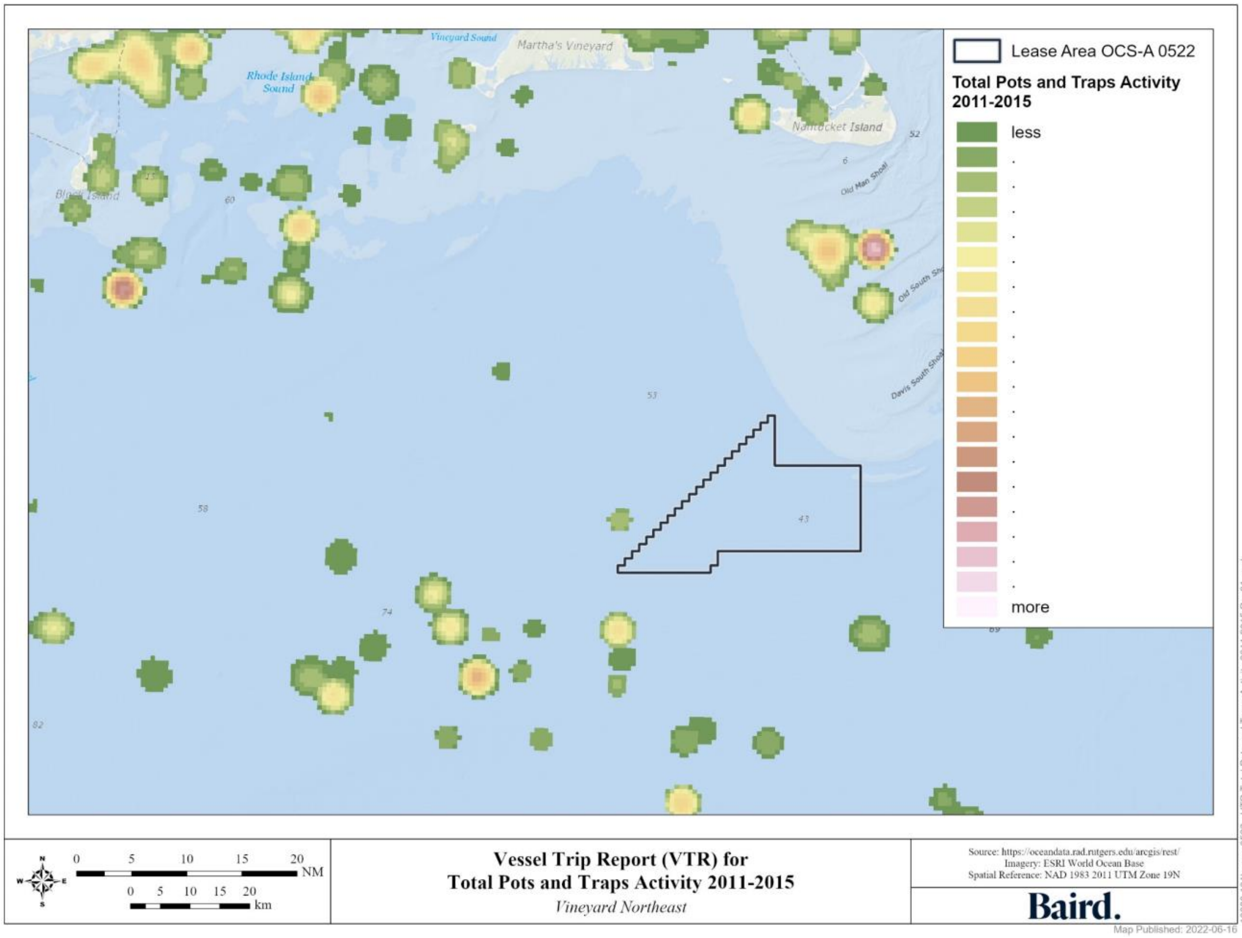



**Figure C.32: Vessel Trip Report for Pots and Traps Activity (2011-2015)**

# Appendix D

## NORM Model Summary

# D.1 NORM Model Summary

Navigational and Operational Risk Model (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 D.1. These include an input step (where all relevant input data in collected), a pre-processing step (where the input data is processed into meaningful inputs for the risk calculations), and the actual risk calculation step.

Overview of NORM modeling procedure

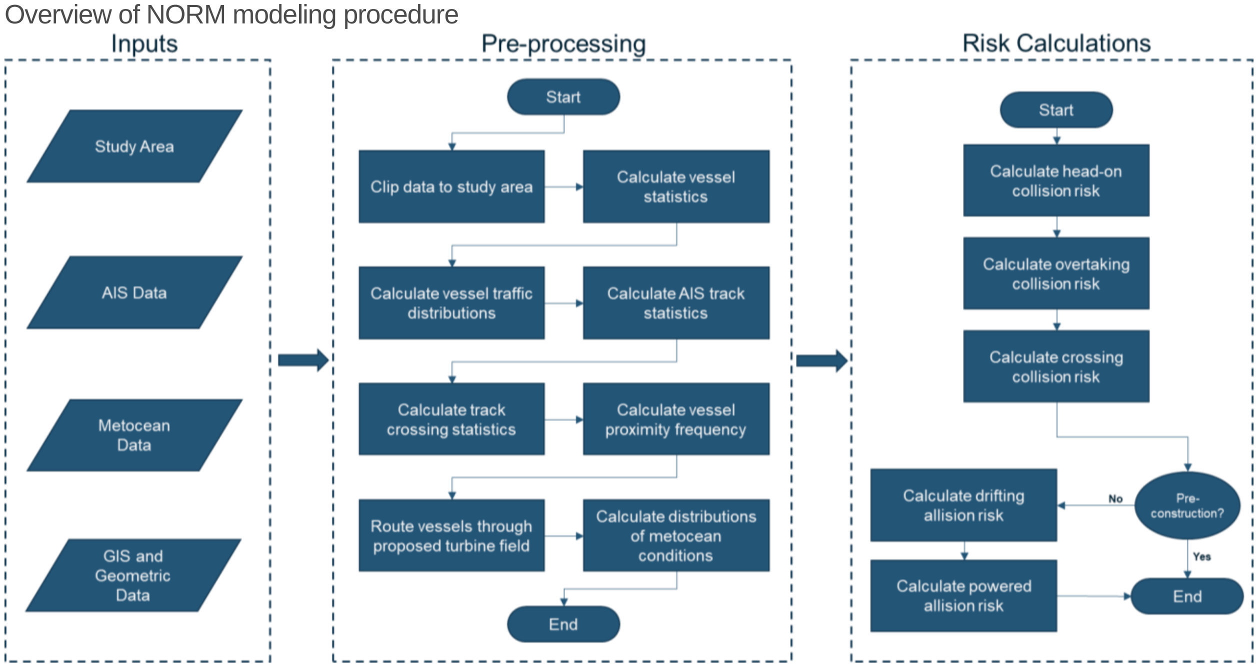



**Figure D.1: Overview of NORM modeling procedure**

## D.1.2 Inputs

### D.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 under-estimated. 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.

#### D.1.2.2 AIS Data

NORM uses raw AIS data as inputs into the model, mainly for the pre-processing steps outlined in Section D.1.3. 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.

#### D.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 has the ability to 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 D.1.4.1.

#### D.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.

### D.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:

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

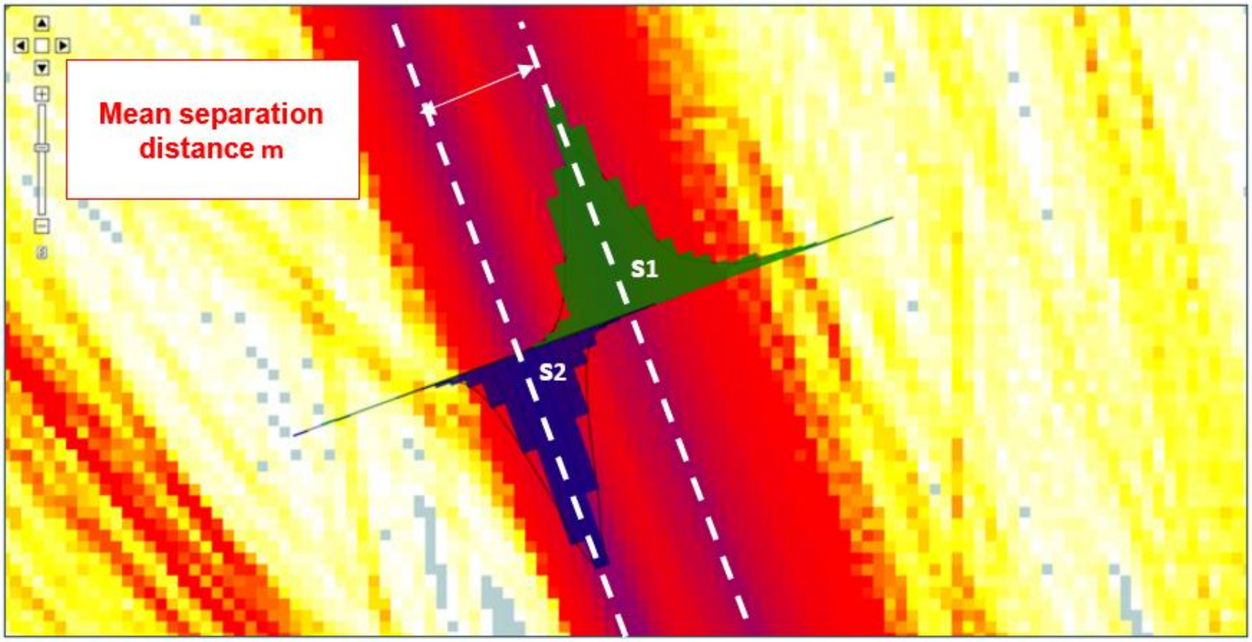



**Figure D.2: Spatial distribution of traffic concentration and vessel traffic distribution**

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

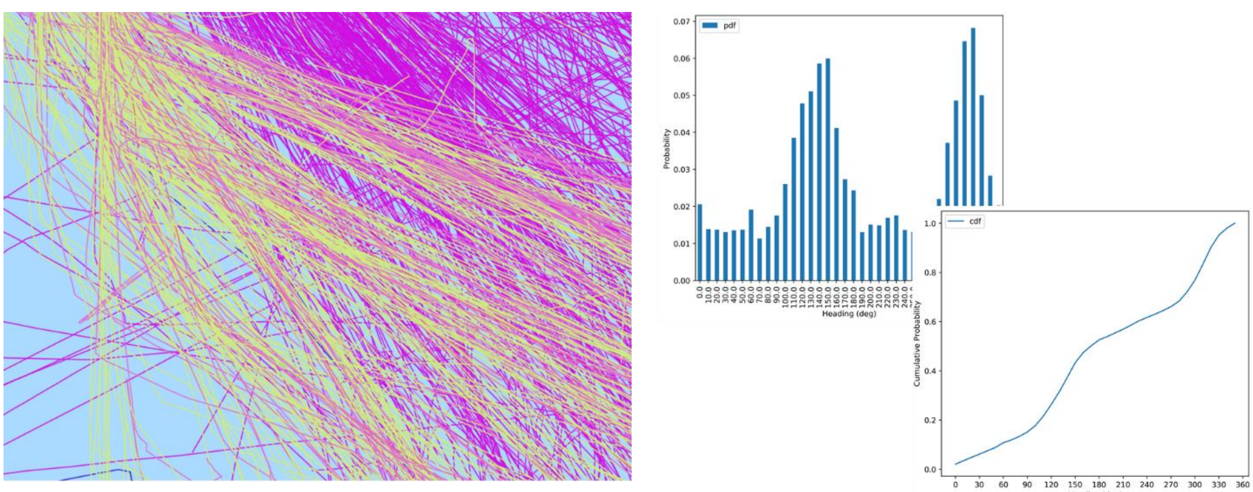



**Figure D.3: AIS tracks, and track length and heading distributions**

4. 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 (Figure D.4)

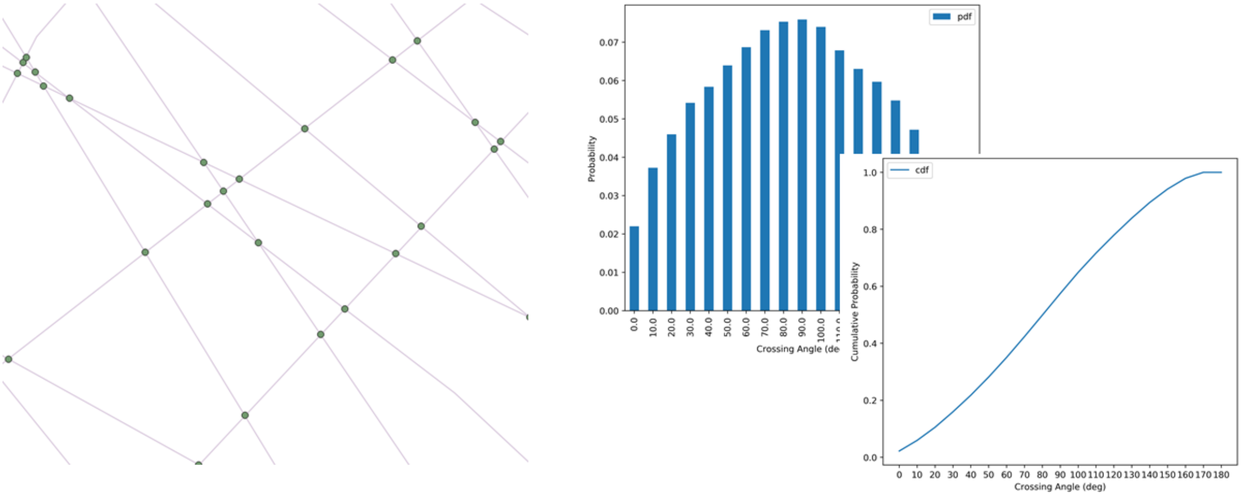



**Figure D.4: AIS tracks, and track intersection angle distribution**

5. Vessel proximity frequencies
    - AIS tracks used to establish a relationship between vessel proximity and recurrence interval, done on an inter-class and intra-class basis
6. 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 (Figure D.5).

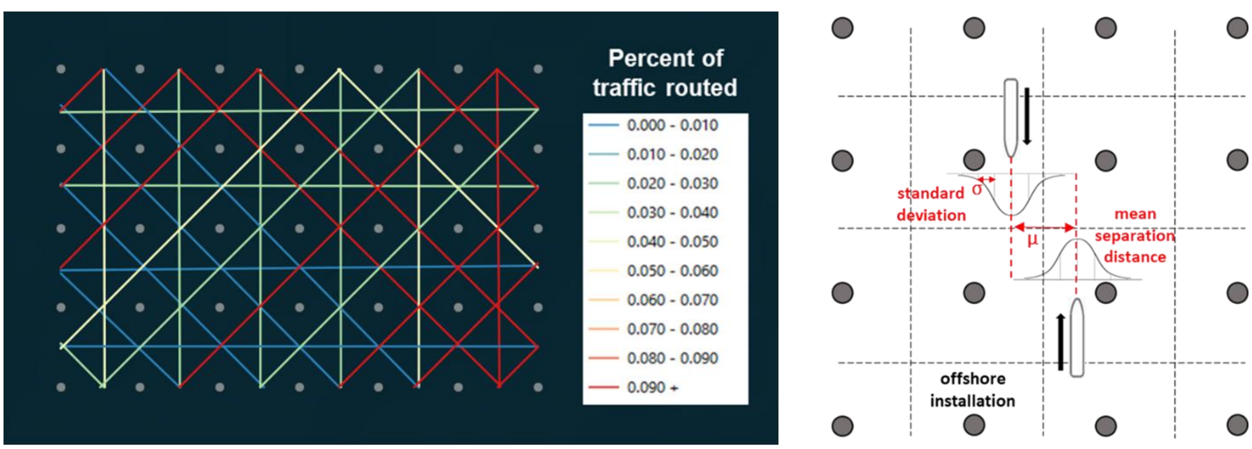



**Figure D.5: Traffic routed through turbine field (left), assumed future traffic (right)**

- 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 (Figure D.6).

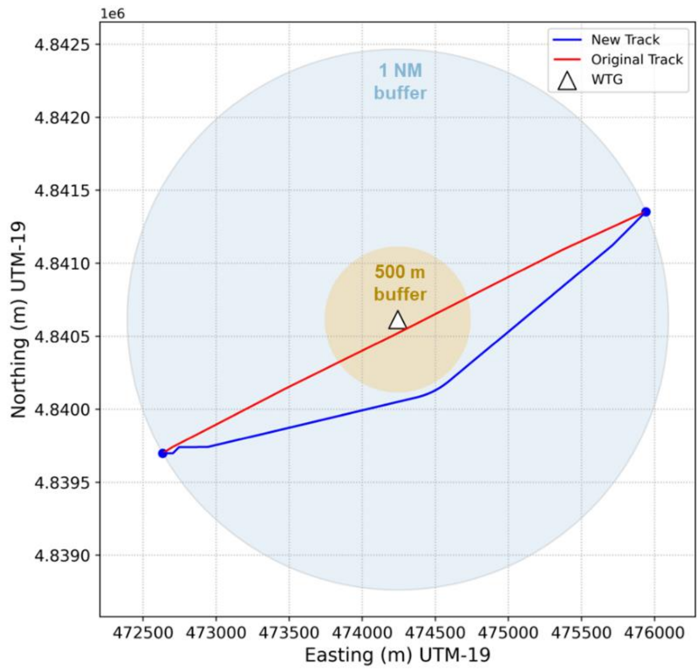



Figure D.6: Traffic routed around turbine

### D.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. 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).

#### D.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 D.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 | 2.8E-04 |
| Powered Allision | 1.556E-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.

### D.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 D.7.

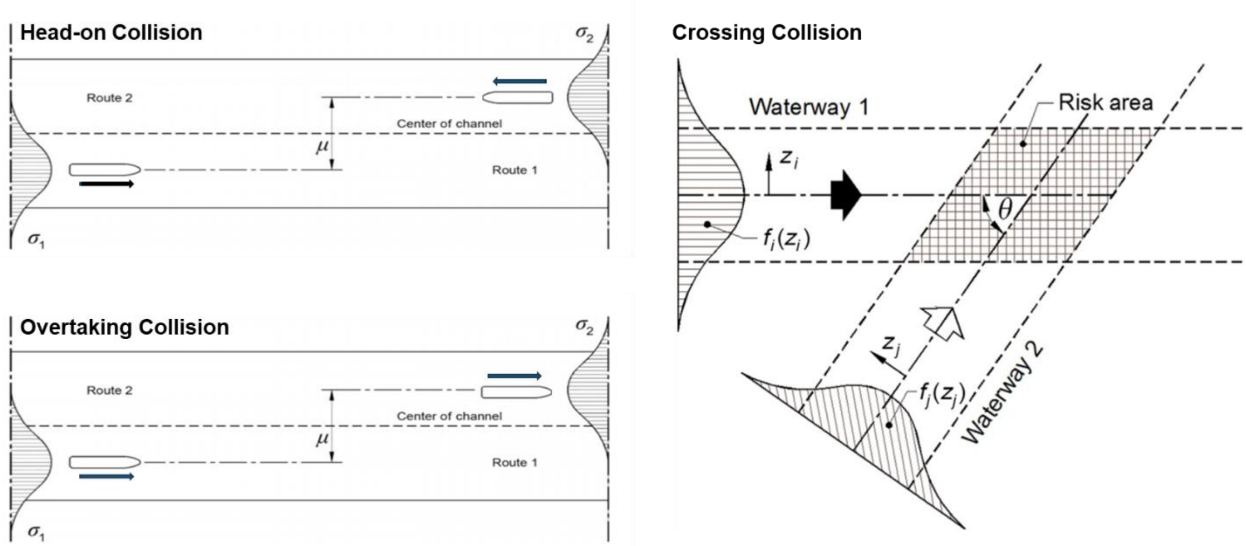



**Figure D.7: Collision scenarios considered by NORM (images adopted from Zhang et al., 2019)**

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 headings, 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.

### D.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 D.8.

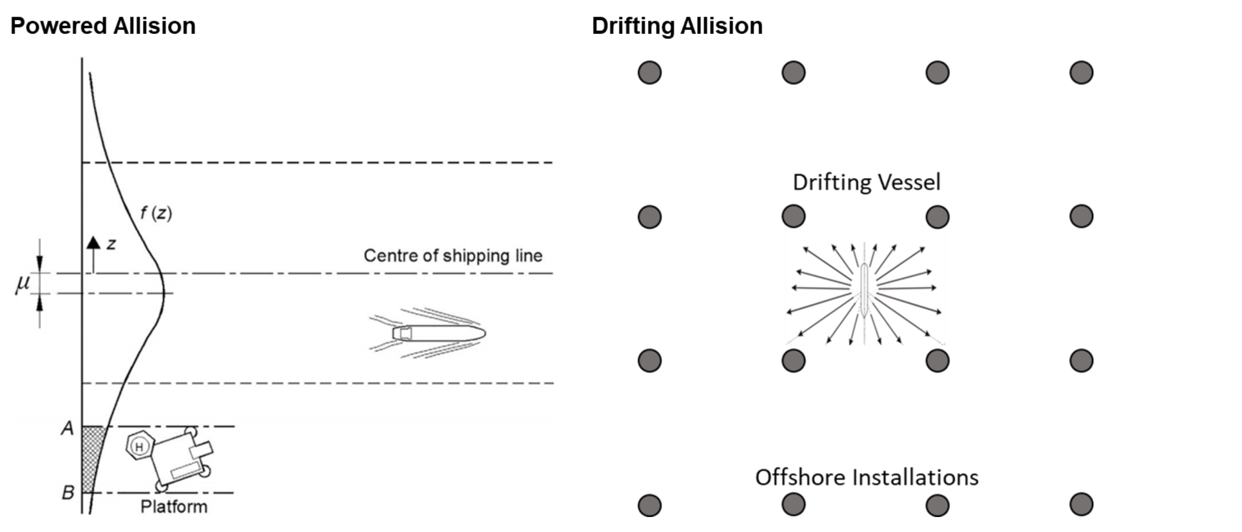



**Figure D.8: Allision scenarios considered by NORM (powered allision image adopted from Zhang et al., 2019)**

Powered allisions are similar to 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 (Figure D.5 left), while the traffic distributions are dependent on the geometric constraints of the turbines and their placement (GIS and geometric inputs, Figure D.5 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 D.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. That is to say, it is assumed that after 10 hours, all vessels will have been repaired or rescued. This repair function is illustrated in Figure D.9.

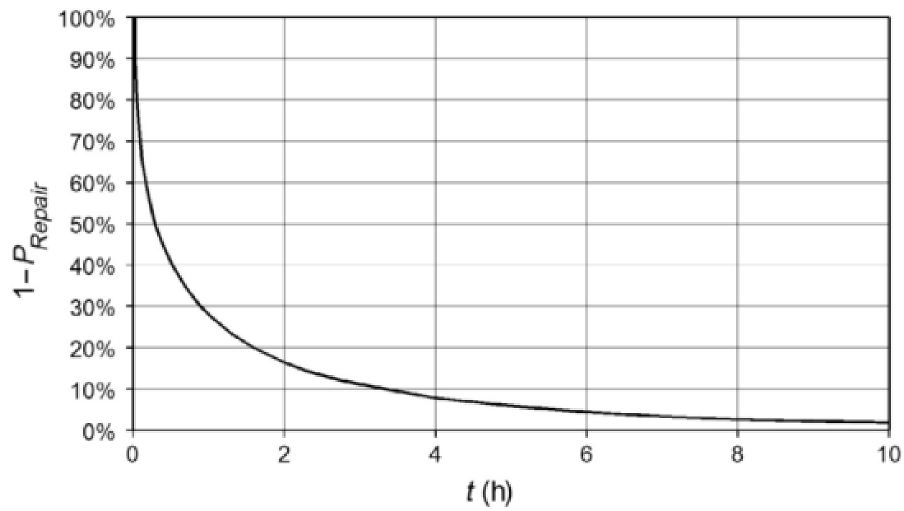



**Figure D.9: Drift-repair function used in NORM (image adopted from Zhang et al., 2019)**

For the purposes of drifting allision risk calculations, NORM assumes a drift speed of 2 kts (literature suggests typical is 1-6 kts) 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 of 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.

### D.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 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 D.10.

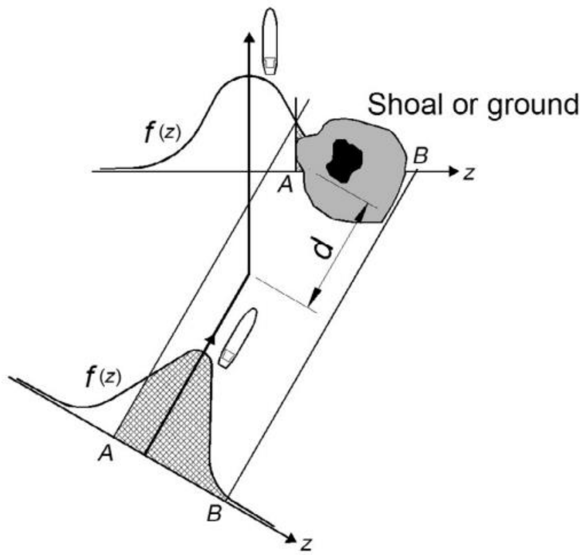



**Figure D.10: Powered grounding scenario considered by NORM (powered grounding image adopted from Zhang et al., 2019)**

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.

# Appendix E

## Wind Turbine Generator, Electrical Service Platform, and Booster Station Coordinates

# D.2 Wind Turbine Generator, Electrical Service Platform, and Booster Station Coordinates

Coordinates and water depths for Vineyard Northeast's wind turbine generator (WTG), electrical service platform (ESP), and booster station positions are provided in the table below. All WTG/ESP positions are within Lease Area OCS-A 0522. The booster station position is within the northwestern aliquot[29] of Lease Area OCS-A 0534. Coordinates provided are referenced to North American 1983 (NAD83) and Universal Transverse Mercator (UTM) Zone 19.

| Identifier | Name | Position Type | Easting (m) | Northing (m) | Longitude (degrees) | Latitude (degrees) | Water Depth |
|---|---|---|---|---|---|---|---|
| 1 | BU-38 | WTG/ESP | 377138 | 4495859 | -70.4522 | 40.60443 | 61.1 |
| 2 | BT-38 | WTG/ESP | 377138 | 4497670 | -70.4526 | 40.62074 | 60.3 |
| 3 | BT-54 | WTG/ESP | 406770 | 4497670 | -70.1023 | 40.62461 | 51.2 |
| 4 | BT-55 | WTG/ESP | 408622 | 4497670 | -70.0804 | 40.62482 | 51.5 |
| 5 | BT-56 | WTG/ESP | 410474 | 4497670 | -70.0585 | 40.62502 | 51.9 |
| 6 | BT-57 | WTG/ESP | 412326 | 4497670 | -70.0366 | 40.62522 | 52.3 |
| 7 | BG-48 | WTG/ESP | 395658 | 4517960 | -70.237 | 40.80603 | 43.0 |
| 8 | BG-49 | WTG/ESP | 397510 | 4517960 | -70.2151 | 40.80626 | 41.8 |
| 9 | BH-48 | WTG/ESP | 395658 | 4516108 | -70.2367 | 40.78935 | 43.1 |
| 10 | BH-49 | WTG/ESP | 397510 | 4516108 | -70.2148 | 40.78958 | 42.3 |
| 11 | BJ-47 | WTG/ESP | 393806 | 4514256 | -70.2584 | 40.77243 | 44.4 |
| 12 | BJ-48 | WTG/ESP | 395658 | 4514256 | -70.2364 | 40.77267 | 43.5 |
| 13 | BJ-49 | WTG/ESP | 397510 | 4514256 | -70.2145 | 40.7729 | 42.9 |
| 14 | BK-46 | WTG/ESP | 391954 | 4512404 | -70.28 | 40.75551 | 46.1 |
| 15 | BK-47 | WTG/ESP | 393806 | 4512404 | -70.258 | 40.75575 | 44.9 |
| 16 | BK-48 | WTG/ESP | 395658 | 4512404 | -70.2361 | 40.75599 | 43.6 |
| 17 | BK-49 | WTG/ESP | 397510 | 4512404 | -70.2142 | 40.75622 | 43.0 |
| 18 | BL-45 | WTG/ESP | 390102 | 4510552 | -70.3016 | 40.73859 | 47.9 |
| 19 | BL-46 | WTG/ESP | 391954 | 4510552 | -70.2797 | 40.73883 | 47.0 |
| 20 | BL-47 | WTG/ESP | 393806 | 4510552 | -70.2577 | 40.73907 | 45.9 |
| 21 | BL-48 | WTG/ESP | 395658 | 4510552 | -70.2358 | 40.73931 | 44.6 |
| 22 | BL-49 | WTG/ESP | 397510 | 4510552 | -70.2139 | 40.73954 | 43.7 |
| 23 | BL-50 | WTG/ESP | 399362 | 4510552 | -70.1919 | 40.73977 | 43.1 |
| 24 | BL-51 | WTG/ESP | 401214 | 4510552 | -70.17 | 40.73999 | 41.7 |
| 25 | BL-52 | WTG/ESP | 403066 | 4510552 | -70.1481 | 40.74021 | 41.0 |

[29] An aliquot is 1/64th of a BOEM Outer Continental Shelf (OCS) Lease Block.

| Identifier | Name | Position Type | Easting (m) | Northing (m) | Longitude (degrees) | Latitude (degrees) | Water Depth |
|---|---|---|---|---|---|---|---|
| 26 | BL-53 | WTG/ESP | 404918 | 4510552 | -70.1261 | 40.74043 | 40.0 |
| 27 | BL-54 | WTG/ESP | 406770 | 4510552 | -70.1042 | 40.74064 | 38.9 |
| 28 | BL-55 | WTG/ESP | 408622 | 4510552 | -70.0823 | 40.74085 | 38.0 |
| 29 | BL-56 | WTG/ESP | 410474 | 4510552 | -70.0604 | 40.74105 | 37.0 |
| 30 | BL-57 | WTG/ESP | 412326 | 4510552 | -70.0384 | 40.74125 | 34.9 |
| 31 | BM-47 | WTG/ESP | 393806 | 4508700 | -70.2574 | 40.72239 | 46.3 |
| 32 | BM-48 | WTG/ESP | 395658 | 4508700 | -70.2355 | 40.72263 | 45.3 |
| 33 | BM-49 | WTG/ESP | 397510 | 4508700 | -70.2136 | 40.72286 | 44.6 |
| 34 | BM-50 | WTG/ESP | 399362 | 4508700 | -70.1916 | 40.72309 | 44.1 |
| 35 | BM-51 | WTG/ESP | 401214 | 4508700 | -70.1697 | 40.72331 | 43.3 |
| 36 | BM-52 | WTG/ESP | 403066 | 4508700 | -70.1478 | 40.72353 | 42.7 |
| 37 | BM-53 | WTG/ESP | 404918 | 4508700 | -70.1259 | 40.72375 | 41.2 |
| 38 | BM-54 | WTG/ESP | 406770 | 4508700 | -70.1039 | 40.72396 | 41.1 |
| 39 | BM-55 | WTG/ESP | 408622 | 4508700 | -70.082 | 40.72417 | 41.0 |
| 40 | BM-56 | WTG/ESP | 410474 | 4508700 | -70.0601 | 40.72437 | 40.6 |
| 41 | BM-57 | WTG/ESP | 412326 | 4508700 | -70.0382 | 40.72457 | 40.2 |
| 42 | BN-49 | WTG/ESP | 397510 | 4506848 | -70.2133 | 40.70618 | 45.1 |
| 43 | BN-50 | WTG/ESP | 399362 | 4506848 | -70.1913 | 40.70641 | 44.8 |
| 44 | BN-51 | WTG/ESP | 401214 | 4506848 | -70.1694 | 40.70663 | 44.5 |
| 45 | BN-52 | WTG/ESP | 403066 | 4506848 | -70.1475 | 40.70685 | 44.0 |
| 46 | BN-53 | WTG/ESP | 404918 | 4506848 | -70.1256 | 40.70707 | 42.7 |
| 47 | BN-54 | WTG/ESP | 406770 | 4506848 | -70.1037 | 40.70728 | 42.7 |
| 48 | BN-55 | WTG/ESP | 408622 | 4506848 | -70.0817 | 40.70749 | 42.7 |
| 49 | BN-56 | WTG/ESP | 410474 | 4506848 | -70.0598 | 40.70769 | 42.5 |
| 50 | BN-57 | WTG/ESP | 412326 | 4506848 | -70.0379 | 40.70789 | 42.4 |
| 51 | BP-51 | WTG/ESP | 401214 | 4504996 | -70.1691 | 40.68995 | 44.8 |
| 52 | BP-52 | WTG/ESP | 403066 | 4504996 | -70.1472 | 40.69017 | 44.8 |
| 53 | BP-53 | WTG/ESP | 404918 | 4504996 | -70.1253 | 40.69039 | 44.8 |
| 54 | BP-54 | WTG/ESP | 406770 | 4504996 | -70.1034 | 40.6906 | 44.8 |
| 55 | BP-55 | WTG/ESP | 408622 | 4504996 | -70.0815 | 40.69081 | 44.6 |
| 56 | BP-56 | WTG/ESP | 410474 | 4504996 | -70.0596 | 40.69101 | 44.4 |
| 57 | BP-57 | WTG/ESP | 412326 | 4504996 | -70.0376 | 40.69121 | 44.3 |
| 58 | BQ-51 | WTG/ESP | 401214 | 4503144 | -70.1688 | 40.67327 | 45.4 |
| 59 | BQ-52 | WTG/ESP | 403066 | 4503144 | -70.1469 | 40.67349 | 44.8 |
| 60 | BQ-53 | WTG/ESP | 404918 | 4503144 | -70.125 | 40.67371 | 44.5 |
| 61 | BQ-54 | WTG/ESP | 406770 | 4503144 | -70.1031 | 40.67392 | 44.2 |

| Identifier | Name | Position Type | Easting (m) | Northing (m) | Longitude (degrees) | Latitude (degrees) | Water Depth |
|---|---|---|---|---|---|---|---|
| 62 | BQ-55 | WTG/ESP | 408622 | 4503144 | -70.0812 | 40.67413 | 44.9 |
| 63 | BQ-56 | WTG/ESP | 410474 | 4503144 | -70.0593 | 40.67433 | 44.6 |
| 64 | BQ-57 | WTG/ESP | 412326 | 4503144 | -70.0374 | 40.67453 | 45.7 |
| 65 | BR-53 | WTG/ESP | 404918 | 4501292 | -70.1247 | 40.65703 | 46.7 |
| 66 | BR-54 | WTG/ESP | 406770 | 4501292 | -70.1028 | 40.65724 | 46.7 |
| 67 | BR-55 | WTG/ESP | 408622 | 4501292 | -70.0809 | 40.65744 | 46.8 |
| 68 | BR-56 | WTG/ESP | 410474 | 4501292 | -70.059 | 40.65765 | 47.0 |
| 69 | BR-57 | WTG/ESP | 412326 | 4501292 | -70.0371 | 40.65785 | 47.6 |
| 70 | BS-53 | WTG/ESP | 404918 | 4499481 | -70.1245 | 40.64071 | 48.8 |
| 71 | BS-54 | WTG/ESP | 406770 | 4499481 | -70.1026 | 40.64093 | 48.8 |
| 72 | BS-55 | WTG/ESP | 408622 | 4499481 | -70.0807 | 40.64113 | 49.2 |
| 73 | BS-56 | WTG/ESP | 410474 | 4499481 | -70.0588 | 40.64134 | 49.6 |
| 74 | BS-57 | WTG/ESP | 412326 | 4499481 | -70.0369 | 40.64153 | 49.9 |
| 75 | BT-46 | WTG/ESP | 391954 | 4497670 | -70.2774 | 40.62281 | 53.9 |
| 76 | BT-45 | WTG/ESP | 390102 | 4497670 | -70.2993 | 40.62256 | 55.2 |
| 77 | BT-47 | WTG/ESP | 393806 | 4497670 | -70.2555 | 40.62305 | 53.4 |
| 78 | BT-48 | WTG/ESP | 395658 | 4497670 | -70.2337 | 40.62329 | 53.1 |
| 79 | BT-49 | WTG/ESP | 397510 | 4497670 | -70.2118 | 40.62352 | 52.2 |
| 80 | BT-50 | WTG/ESP | 399362 | 4497670 | -70.1899 | 40.62374 | 51.8 |
| 81 | BT-51 | WTG/ESP | 401214 | 4497670 | -70.168 | 40.62397 | 51.6 |
| 82 | BT-52 | WTG/ESP | 403066 | 4497670 | -70.1461 | 40.62419 | 51.3 |
| 83 | BT-53 | WTG/ESP | 404918 | 4497670 | -70.1242 | 40.6244 | 51.1 |
| 84 | BM-44 | WTG/ESP | 388250 | 4508700 | -70.3232 | 40.72166 | 47.6 |
| 85 | BM-45 | WTG/ESP | 390102 | 4508700 | -70.3013 | 40.72191 | 47.2 |
| 86 | BM-46 | WTG/ESP | 391954 | 4508700 | -70.2793 | 40.72215 | 47.1 |
| 87 | BN-43 | WTG/ESP | 386398 | 4506848 | -70.3448 | 40.70472 | 49.3 |
| 88 | BN-44 | WTG/ESP | 388250 | 4506848 | -70.3229 | 40.70498 | 48.5 |
| 89 | BN-45 | WTG/ESP | 390102 | 4506848 | -70.3009 | 40.70523 | 47.6 |
| 90 | BN-46 | WTG/ESP | 391954 | 4506848 | -70.279 | 40.70547 | 46.9 |
| 91 | BN-47 | WTG/ESP | 393806 | 4506848 | -70.2571 | 40.70571 | 46.0 |
| 92 | BN-48 | WTG/ESP | 395658 | 4506848 | -70.2352 | 40.70595 | 45.3 |
| 93 | BP-42 | WTG/ESP | 384546 | 4504996 | -70.3663 | 40.68779 | 51.4 |
| 94 | BP-43 | WTG/ESP | 386398 | 4504996 | -70.3444 | 40.68804 | 50.2 |
| 95 | BP-44 | WTG/ESP | 388250 | 4504996 | -70.3225 | 40.6883 | 49.6 |
| 96 | BP-45 | WTG/ESP | 390102 | 4504996 | -70.3006 | 40.68855 | 48.7 |
| 97 | BP-46 | WTG/ESP | 391954 | 4504996 | -70.2787 | 40.68879 | 47.9 |

| Identifier | Name | Position Type | Easting (m) | Northing (m) | Longitude (degrees) | Latitude (degrees) | Water Depth |
|---|---|---|---|---|---|---|---|
| 98 | BP-47 | WTG/ESP | 393806 | 4504996 | -70.2568 | 40.68903 | 46.5 |
| 99 | BP-48 | WTG/ESP | 395658 | 4504996 | -70.2349 | 40.68927 | 45.3 |
| 100 | BP-49 | WTG/ESP | 397510 | 4504996 | -70.213 | 40.6895 | 45.1 |
| 101 | BP-50 | WTG/ESP | 399362 | 4504996 | -70.191 | 40.68973 | 45.0 |
| 102 | BQ-41 | WTG/ESP | 382694 | 4503144 | -70.3879 | 40.67085 | 53.2 |
| 103 | BQ-42 | WTG/ESP | 384546 | 4503144 | -70.366 | 40.67111 | 52.4 |
| 104 | BQ-43 | WTG/ESP | 386398 | 4503144 | -70.3441 | 40.67136 | 51.8 |
| 105 | BQ-44 | WTG/ESP | 388250 | 4503144 | -70.3222 | 40.67162 | 50.5 |
| 106 | BQ-45 | WTG/ESP | 390102 | 4503144 | -70.3003 | 40.67187 | 49.9 |
| 107 | BQ-46 | WTG/ESP | 391954 | 4503144 | -70.2784 | 40.67211 | 49.3 |
| 108 | BQ-47 | WTG/ESP | 393806 | 4503144 | -70.2565 | 40.67235 | 48.1 |
| 109 | BQ-48 | WTG/ESP | 395658 | 4503144 | -70.2346 | 40.67259 | 47.1 |
| 110 | BQ-49 | WTG/ESP | 397510 | 4503144 | -70.2127 | 40.67282 | 46.4 |
| 111 | BQ-50 | WTG/ESP | 399362 | 4503144 | -70.1907 | 40.67305 | 46.2 |
| 112 | BR-40 | WTG/ESP | 380842 | 4501292 | -70.4095 | 40.6539 | 55.7 |
| 113 | BR-41 | WTG/ESP | 382694 | 4501292 | -70.3876 | 40.65417 | 55.1 |
| 114 | BR-42 | WTG/ESP | 384546 | 4501292 | -70.3657 | 40.65443 | 54.5 |
| 115 | BR-43 | WTG/ESP | 386398 | 4501292 | -70.3438 | 40.65468 | 53.5 |
| 116 | BR-44 | WTG/ESP | 388250 | 4501292 | -70.3219 | 40.65494 | 52.9 |
| 117 | BR-45 | WTG/ESP | 390102 | 4501292 | -70.3 | 40.65519 | 51.8 |
| 118 | BR-46 | WTG/ESP | 391954 | 4501292 | -70.2781 | 40.65543 | 50.8 |
| 119 | BR-47 | WTG/ESP | 393806 | 4501292 | -70.2562 | 40.65567 | 50.1 |
| 120 | BR-48 | WTG/ESP | 395658 | 4501292 | -70.2343 | 40.65591 | 49.2 |
| 121 | BR-49 | WTG/ESP | 397510 | 4501292 | -70.2124 | 40.65614 | 48.3 |
| 122 | BR-50 | WTG/ESP | 399362 | 4501292 | -70.1905 | 40.65637 | 47.9 |
| 123 | BR-51 | WTG/ESP | 401214 | 4501292 | -70.1685 | 40.65659 | 47.4 |
| 124 | BR-52 | WTG/ESP | 403066 | 4501292 | -70.1466 | 40.65681 | 47.0 |
| 125 | BS-39 | WTG/ESP | 378990 | 4499481 | -70.431 | 40.63732 | 58.4 |
| 126 | BS-40 | WTG/ESP | 380842 | 4499481 | -70.4091 | 40.63759 | 57.2 |
| 127 | BS-41 | WTG/ESP | 382694 | 4499481 | -70.3872 | 40.63786 | 56.8 |
| 128 | BS-42 | WTG/ESP | 384546 | 4499481 | -70.3653 | 40.63812 | 55.8 |
| 129 | BS-43 | WTG/ESP | 386398 | 4499481 | -70.3434 | 40.63837 | 55.0 |
| 130 | BS-44 | WTG/ESP | 388250 | 4499481 | -70.3215 | 40.63863 | 53.9 |
| 131 | BS-45 | WTG/ESP | 390102 | 4499481 | -70.2996 | 40.63888 | 53.3 |
| 132 | BS-46 | WTG/ESP | 391954 | 4499481 | -70.2777 | 40.63912 | 52.8 |
| 133 | BS-47 | WTG/ESP | 393806 | 4499481 | -70.2559 | 40.63936 | 51.6 |

| Identifier | Name | Position Type | Easting (m) | Northing (m) | Longitude (degrees) | Latitude (degrees) | Water Depth |
|---|---|---|---|---|---|---|---|
| 134 | BS-48 | WTG/ESP | 395658 | 4499481 | -70.234 | 40.6396 | 51.1 |
| 135 | BS-49 | WTG/ESP | 397510 | 4499481 | -70.2121 | 40.63983 | 50.3 |
| 136 | BS-50 | WTG/ESP | 399362 | 4499481 | -70.1902 | 40.64006 | 49.7 |
| 137 | BS-51 | WTG/ESP | 401214 | 4499481 | -70.1683 | 40.64028 | 49.4 |
| 138 | BS-52 | WTG/ESP | 403066 | 4499481 | -70.1464 | 40.6405 | 49.0 |
| 139 | BT-39 | WTG/ESP | 378990 | 4497670 | -70.4307 | 40.62101 | 59.2 |
| 140 | BT-40 | WTG/ESP | 380842 | 4497670 | -70.4088 | 40.62128 | 58.8 |
| 141 | BT-41 | WTG/ESP | 382694 | 4497670 | -70.3869 | 40.62155 | 58.2 |
| 142 | BT-42 | WTG/ESP | 384546 | 4497670 | -70.365 | 40.62181 | 57.3 |
| 143 | BT-43 | WTG/ESP | 386398 | 4497670 | -70.3431 | 40.62206 | 56.9 |
| 144 | BT-44 | WTG/ESP | 388250 | 4497670 | -70.3212 | 40.62232 | 55.7 |
| 145 | BU-39 | WTG/ESP | 378990 | 4495859 | -70.4303 | 40.6047 | 60.6 |
| 146 | BU-40 | WTG/ESP | 380842 | 4495859 | -70.4084 | 40.60497 | 60.2 |
| 147 | BU-41 | WTG/ESP | 382694 | 4495859 | -70.3866 | 40.60524 | 59.3 |
| 148 | BU-42 | WTG/ESP | 384546 | 4495859 | -70.3647 | 40.6055 | 58.8 |
| 149 | BU-43 | WTG/ESP | 386398 | 4495859 | -70.3428 | 40.60575 | 58.4 |
| 150 | BU-44 | WTG/ESP | 388250 | 4495859 | -70.3209 | 40.60601 | 57.5 |
| 151 | BU-37 | WTG/ESP | 375286 | 4495859 | -70.4741 | 40.60415 | 61.9 |
| 152 | BV-44 | WTG/ESP | 388250 | 4494048 | -70.3206 | 40.5897 | 58.9 |
| 153 | BV-43 | WTG/ESP | 386398 | 4494048 | -70.3425 | 40.58944 | 59.3 |
| 154 | BV-42 | WTG/ESP | 384546 | 4494048 | -70.3643 | 40.58919 | 60.2 |
| 155 | BV-41 | WTG/ESP | 382694 | 4494048 | -70.3862 | 40.58893 | 60.6 |
| 156 | BV-40 | WTG/ESP | 380842 | 4494048 | -70.4081 | 40.58866 | 61.1 |
| 157 | BV-39 | WTG/ESP | 378990 | 4494048 | -70.43 | 40.58839 | 62.0 |
| 158 | BV-38 | WTG/ESP | 377138 | 4494048 | -70.4519 | 40.58812 | 62.4 |
| 159 | BV-37 | WTG/ESP | 375286 | 4494048 | -70.4737 | 40.58784 | 62.8 |
| 160 | BV-36 | WTG/ESP | 373434 | 4494048 | -70.4956 | 40.58756 | 63.2 |
| 161 | AL-37 | Booster Station | 375286 | 4555000 | -70.4860 | 41.13673 | 37.7 |

Notes:
1. Grid coordinates referenced to UTM Zone 19 north in meters, NAD 1983 (2011) datum.
2. Lease Area background bathymetry is sourced from National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) Continuously Updated Digital Elevation Model (CUDEM). The vertical datum elevation is referenced to NAVD88.