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Appendix S: Navigation Safety Risk Assessment

Coastal Virginia Offshore Wind Commercial Project

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Coastal Virginia Offshore Wind Commercial OCS-A 0483

Navigation Safety Risk Assessment

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Revision Number	Date	Summary of Change
00	12/08/2020	Initial Draft
01	12/15/2020	Updates following internal review
02	06/10/2021	Updates following first USCG / BOEM review
03	06/15/2021	Additional internal updates.
04	09/27/2021	Additional updates following further USCG review.
05	10/19/2021	Updated Offshore Export Cable Route Corridor.

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Abbreviations Table

Abbreviation	Definition
ACPARS	Atlantic Coast Port Access Route Study
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ANPRM	Advanced Notice of Proposed Rulemaking
AWO	American Waterways Operators
AWOIS	Automated Wreck and Obstruction Information System
BOEM	Bureau of Ocean Energy Management
BTS	Bureau of Transport Statistics
CBRA	Cable Burial Risk Assessment
CFR	Code of Federal Regulations
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea
COMDTINST	Commandant Instruction
COP	Construction and Operations Plan
CVOW	Coastal Virginia Offshore Wind
dB	Decibel
DE	Delaware
DF	Direction Finding
DfT	Department for Transport
DoD	Department of Defense
DSC	Digital Selective Calling
DWR	Deep Water Route
ECMWF	European Centre for Medium Range Weather Forecast
FL	Florida
FSA	Formal Safety Assessment
ft	Foot
GA	Georgia
GPS	Global Positioning System
GVSU	Grand Valley State University
HAT	Highest Astronomical Tide
IPS	Intermediate Peripheral Structure
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IRPA	Individual Risk per Annum
ITAP	Institut für technische und angewandte Physik
ITOPF	International Tanker Owners Pollution Federation
km	Kilometer
Loran	Long Range Navigation

Abbreviation	Definition
m	Meter
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MD	Maryland
MEC	Munitions and Explosives of Concern
MGN	Marine Guidance Note
MISLE	Marine Information for Safety and Law Enforcement
MLLW	Mean Lower Low Water
µPa	Micropascal
MSL	Mean Sea Level
MW	Megawatt
NAD 83	North American Datum of 1983
NAVTEX	Navigational Telex
NC	North Carolina
NEODP	Northeast Ocean Data Portal
NJ	New Jersey
nm	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NSRA	Navigation Safety Risk Assessment
NUC	Not Under Command
NVIC	Navigation and Vessel Inspection Circular
ODAS	Ocean Data Acquisition System
OPAREA	Operating Area
OREI	Offshore Renewable Energy Installation
PATON	Private Aid to Navigation
PDE	Project Design Envelope
PLL	Potential Loss of Life
POB	People on Board
Racon	Radar Beacon
Radar	Radio Detection and Ranging
RAF	Royal Air Force
RBDM	Risk Based Decision Making
REZ	Renewable Energy Zone
SAR	Search and Rescue
SC	South Carolina
SMC	Search and Rescue Mission Coordinator
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea

Abbreviation	Definition
SPS	Significant Peripheral Structure
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
US	United States
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
UXO	Unexploded Ordnance
VA	Virginia
VPA	Virginia Port Authority
VHF	Very High Frequency
VMA	Virginia Maritime Association
VMS	Vessel Monitoring System
VTS	Vessel Traffic Service
WSC	World Shipping Council
WTG	Wind Turbine Generator

Glossary

Term	Description
Allision	Contact between a moving and stationary object.
As Low As Reasonably Practicable (ALARP)	Reduction of residual risk, post assessment, as far as reasonably practicable with consideration for people, environment, business and property. For a risk to be ALARP, it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained.
Automatic Identification System (AIS)	A system by which vessels automatically broadcast their identity, key statistics including location, destination, length, speed and current status, e.g., under power. Most commercial vessels are required to carry AIS.
Base case	Assessment of risk based upon current vessel traffic levels and types.
Base Port	Port associated with operations and maintenance activities
Cable Burial Risk Assessment (CBRA)	Risk assessment to determine suitable burial depths for cables, based upon hazards such as anchor strike, fishing gear interaction and seabed mobility.

Term	Description
Cable Landing Location	Area where the offshore export cable is spliced and connected to the onshore export cable in a duct bank. Includes Firing Range, Croatan Beach/SMR, and Croatan Beach alternatives
Cable Protection	Measures to protect cable in instances where sufficient burial is not feasible and/or at existing submarine asset crossings, which can include placement of material, typically stone or rocks on and around the cable.
Collision	Contact between two moving objects.
COLLRISK	Anatec's industry leading collision and allision risk modelling software, recommended as best practice by the International Association of Oil & Gas Producers.
Commercial fishing vessel	A fishing vessel engaged in commercial fishing activity, where that activity forms the primary commercial means of those vessels.
Encounter	An instance of multiple vessels (i.e., two or more) being in close proximity within a short time period. Anatec's quantitative models assume a definition of multiple vessels being within one nautical mile within the same minute.
Foundation	Structure required to secure the wind turbine generator, Offshore Substation, and other offshore structures vertically.
Future case	Assessment of risk based upon the predicted growth of future vessel traffic levels and types.
In isolation	Assessment of a development on a standalone basis without (or before) considering other developments within the region.
Inter-Array Cable	Submarine cable interconnecting the Wind Turbine Generators (WTGs) and Offshore Substation.
International Maritime Organization (IMO) routing measure	An internationally recognized shipping route established by IMO.
Lease	Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0483)
Lease Area	BOEM-designated Renewable Energy Lease Area OCS-A 0483
Main route	Defined transit routes (mean position) of commercial vessels identified within the region.

Term	Description
Marine Coordinator	An individual responsible for monitoring of the Project, including third party vessel and Project vessel traffic within the array. The Marine Coordinator is also responsible for monitoring weather conditions and controlling Project personnel accessing offshore wind farm structures.
Marine Guidance Note (MGN)	A system of guidance notes issued by the United Kingdom (UK) Maritime and Coastguard Agency which provide significant advice relating to the improvement of the safety of shipping and of life at sea, and to present or minimize pollution from shipping.
Maximum design scenario	The set of parameters under realistic consideration (based on the Project Design Envelope) that would result in the maximum impact to shipping and navigation users.
Mean Lower Low Water (MLLW)	The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch (a 19-year period adopted by the National Ocean Service).
Metocean Facilities	Floating light and detection ranging buoys (FLiDARs) installed in the Lease Area
Navigation Safety Risk Assessment (NSRA)	A document which assesses the overall impact to shipping and navigation of a proposed Offshore Renewable Energy Installation based upon formal risk assessment (also known as a Navigation Risk Assessment (NRA).
Nearshore Trenchless Installation Area	Area between the Offshore Punch-Out location and the Cable Landing location that includes the beach and dune
Neopanamax	A vessel which satisfies the requirements for travelling through the Panama Canal.
Not Under Command (NUC)	Under Part A of the International Regulations for Preventing Collisions at Sea, the term ‘vessel not under command’ refers to a vessel which through some exceptional circumstance is unable to maneuver as required by these rules and is therefore unable to keep out of the way of another vessel.
Offshore Export Cable Route	Export cable route from the Offshore Substation in the Lease Area to Point of Interconnection (POI)
Offshore Export Cable Route Corridor	The overall corridor within which the 9 Offshore Export Cables will be installed
Offshore Export Cable(s)	Cable connecting the Offshore Substation to the transition bay at the onshore landing location.

Term	Description
Offshore Trenchless Installation Punch-Out	Location where Nearshore Trenchless Installation punches out on the seafloor located approximately 2,953 to 3,281 ft (900 to 1,000 m) from shore
Offshore Project Area	Lease Area and Export Cable Route Corridor to the Offshore Punch-Out.
Offshore Project Components	The offshore portion of the Project Area to be developed for commercial operation, comprised of176 to 205 WTGs, up to 3 Offshore Substations, and Inter-Array cables located in the Lease Area, and the Offshore Export Cables located within the Offshore Export Cable Corridor.
Offshore Renewable Energy Installation (OREI)	A facility placed in the navigable waters of the United States (US) that creates electricity by using sources other than oil or gas.
Offshore Substation	Structure that receives the power from the WTGs through the Inter-Array cables.
Point of Interconnection (POI)	Location(s) where the Project connects into the grid in Virginia Beach, Virginia.
Preferred Alternative	Portion of Project Design Envelope that are the preferred options to move forward.
Project	The Coastal Virginia Offshore Wind (CVOW) Commercial Project
Project Design Envelope (PDE)	A series of maximum extents of a development for which the significant effects are established. The detailed design of the Project can then vary within this 'envelope' without rendering the assessment undertaken inadequate.
Radio Detection and Ranging (Radar)	An object detection system which uses radio waves to determine the range, altitude, direction or speed of objects.
Regular Operator	Commercial operator whose vessel(s) are observed to transit through a particular region on a regular basis.
Risk Based Decision Making (RBDM)	An iterative process within which risks are identified, assessed and managed with communication with stakeholders undertaken throughout.
Safety zone	An area around facilities within 12 nautical miles Territorial Sea limits which are being constructed maintained or operated. Safety zones may be established to prevent or control specific activities and access by vessels or persons and include measures to protect the living resources of the sea from harmful agents.
Scour Protection	Material, typically stone or rocks, placed around/on top of a structure to prevent seabed sediment from being flushed away as a result of water flow.

Term	Description
Surface Offshore Project Components	WTGs and Offshore Substations.
Traffic Separation Scheme (TSS)	Area where vessel traffic is regulated by Rule 10 of the International Regulations for Preventing Collisions at Sea and traffic direction is dictated.
Vessel Traffic Services (VTS)	Shore-side systems which range from the provision of simple information messages to vessels, such as the position of other traffic or meteorological hazard warnings, to extensive management of traffic within a port or waterway.
Wind Turbine Generator (WTG)	A machine consisting of a rotor with three blades connected to the nacelle, which contains an electrical generator and other equipment. WTGs transform the kinetic energy created by the rotation of the blades (due to wind energy), into electricity.

Executive Summary

This Navigation Safety Risk Assessment (NSRA) includes an assessment of the impact of the major navigational hazards associated with the development of the Coastal Virginia Offshore Wind (CVOW) Commercial Project (hereby referred to as 'the Project') being developed by Dominion Energy. The surface Offshore Project Components associated with the Project are located within Bureau of Ocean Energy Management (BOEM) offshore Lease Area OCS-A 0483 (the 'Lease Area'). Aspects of the Project relevant to shipping and navigation have been described and the maximum design scenario from a shipping and navigation perspective has been outlined. As required, the main guidance considered throughout this NSRA is Navigation and Vessel Inspection Circular (NVIC) No. 01-19 (United States Coast Guard [USCG], 2019) and Commandant Instruction (COMDTINST) 16003.2B (USCG, 2019).

To ensure the impact assessment is fully informed, a range of relevant information has been gathered and processed, and subsequently presented in this NSRA. This includes waterway, maritime traffic and vessel, and facility characteristics, as well as key responses received during consultation with stakeholders. Lessons learned from trials and existing offshore wind farms have been considered where appropriate, and collision, allision and grounding risk modelling has been undertaken in order to provide assessment of the relevant receptors and impacts on both a qualitative and (where appropriate) quantitative basis. Historical incident response data provided by the USCG has also been considered.

Vessel traffic data has been collected over a 12 month period, with Automatic Identification System (AIS) data collected from both terrestrial and satellite receivers. This has been used to establish the existing maritime traffic behavior and patterns within and surrounding the Project. The majority of traffic in the area was observed to be comprised of cargo vessels (notably containerized), with smaller vessel types being much less frequent noting the distance offshore. A total of 19 main routes were identified, with a total of nine of these expected to deviate as a result of the Project. An average of six unique vessels per day were recorded as intersecting the Lease Area.

Using the information gathered, an assessment of shipping and navigation impacts for the Project in isolation was undertaken using a Risk Based Decision Making (RBDM) approach., and it was determined that all impacts associated with commercial vessels were within tolerable limits. However further consultation will be needed post submission to ascertain the need for additional mitigation to bring the risks associated with commercial vessels to within As Low as Reasonably Practicable (ALARP) parameters (see Section 2.1.2). All other impacts were assessed as Broadly Acceptable and ALARP with the embedded mitigation measures in place.

All impacts were considered Broadly Acceptable when considered on a cumulative level.

1 Guidance and Data Sources

The following section considers the guidance used to undertake this Navigation Safety Risk Assessment (NSRA).

1.1 Main Guidance Documents

This NSRA for the Project has been undertaken to comply with the requirements set out in the main guidance documents outlined in this section. However, where appropriate, the other supplementary references outlined in Section 1.2 have also been taken into consideration.

1.1.1 Navigation and Vessel Inspection Circular No. 01-19

The NVIC No. 01-19 (USCG, 2019) forms the primary guidance document in relation to this NSRA. The NVIC sets out the guidance relevant to the factors which the USCG will consider when reviewing an application for a permit to build and operate an Offshore Renewable Energy Installation (OREI) within United States (US) navigable waters.

To ensure the NSRA fulfils all requirements as set out within the NVIC, a version of the checklist for NSRA development and review that is incorporated into the NVIC (Enclosure 6) has been completed and is provided in Appendix A.

1.1.2 Commandant Instruction 16003.2B

The Commandant Instruction (COMDTINST) 16003.2B (USCG, 2019) sets out USCG policy, roles and responsibilities in relation to ongoing and future marine planning and operations. The document outlines the methodology and topics which should be covered in a formal risk assessment of a development, sets out guidelines for marine planning and provides the methodology by which traffic routing measures should be determined.

1.2 Other Guidance Documents

Although NVIC No. 01-19 is the primary guidance document considered in this NSRA (see Section 1.1.1), it does note that “guidelines from other recognized sources such as governmental agencies or classification societies that may be applicable” should also be considered and referenced. Therefore, other guidance documents considered in this NSRA on this basis are outlined in Sections 1.2.1 to 1.2.4.1.

1.2.1 Information Guidelines for a Renewable Energy Construction and Operations Plan

The Information Guidelines for a Renewable Energy Construction and Operations Plan (COP) (Bureau of Ocean Energy Management (BOEM), 2020) provides details of the information that should be included within any COP. This includes requirements that are of relevance to the NSRA, including survey requirements and other project-specific information. It also provides details as to the need for an NSRA, and how the general NSRA process should be conducted. The NSRA will be reviewed by the USCG in line with the contents of NVIC No. 01-19.

1.2.2 Atlantic Coast Port Access Route Study Final Report

The Atlantic Coast Port Access Route Study (ACPARS) Final Report (USCG, 2016) is of relevance given the proximity of the Lease Area to routing measures recommended as part of the output of the study.

The ACPARS Working Group was given three objectives to complete within the limits of available resources:

1. Determine whether the USCG should initiate actions to modify or create safety fairways, Traffic Separation Scheme (TSS) lanes or other routing measures;

2. Provide data, tools and/or methodology to assist in future determinations of waterways suitable for proposed projects; and

3. Develop, in the near term, AIS products and provide other support necessary to assist USCG Districts will all emerging coastal and offshore energy projects.

It is noted that the USCG is currently undertaking a set of associated studies of routes used by vessels to access ports on the Atlantic coast of the US. These new studies are intended to supplement and build on the ACPARS were expected to be completed by May 2021, however, at the time of publication of this document, the studies have not been released. Given the location of the Lease Area, the Port Access Route Study: Approaches to the Chesapeake Bay, Virginia (VA) is considered particularly relevant. However, given the stage of these more recent studies, it is too early to identify any impacts associated with the outputs.

1.2.3 Lighting and Marking

Proposed lighting and marking of offshore structures associated with the Project (the 'surface Offshore Project Components') has been determined in line with guidance provided in COMDTINST M16500.7A (Aids to Navigation Manual) (USCG, 2015), International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Wind Structures[1] (IALA, 2013), and North Carolina (NC), VA, Maryland (MD), Delaware (DE), New Jersey (NJ)-Atlantic Ocean-Offshore Structure Private Aids to Navigation (PATON) Marking Guidance (USCG, 2020).

The Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development (BOEM, 2021) have also been considered.

1.2.4 Revised Guidelines for Formal Safety Assessment for Use in the Rule-Making Process

The Revised Guidelines for Formal Safety Assessment (FSA) for Use in the Rule-Making Process (International Maritime Organization (IMO), 2018) has been adapted for the risk assessment process since there is no defined methodology provided in NVIC No. 01-19. The FSA process is iterative in nature and closely follows the RBDM basis detailed in NVIC No. 01-19. It is an internationally recognized standard and considered best practice for marine risk assessment.

1.2.4.1 Marine Guidance Note 543

Marine Guidance Note (MGN) 543 (Merchant & Fishing) Safety of Navigation Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Responses (Maritime and Coastguard Agency (MCA), 2016) is the key guidance utilized for offshore wind facilities within the United Kingdom (UK).

[1] USCG is a member of IALA.

The UK is currently the world's leading nation for offshore wind, both in terms of total megawatt (MW) capacity and number of operational Wind Turbine Generators (WTGs) (WindEurope, 2020). The associated guidance is therefore well established, and MGN 543 is considered a useful resource, noting that both it and the MCA's closely related Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREIs) (MCA, 2013) are explicitly referenced in NVIC No. 01-19, and described as a "well-regarded source".

1.3 Consultees and Stakeholders

A number of key marine and navigation stakeholders have been consulted during the NSRA process. Full details of consultation undertaken is provided in Section 3, with the stakeholders including:

- USCG;
- BOEM;
- American Waterways Association (AWO);
- World Shipping Council (WSC);
- Virginia Maritime Association (VMA);
- Virginia Port Authority (VPA); and
- Virginia Pilot's Association.

Regular operators identified via assessment of vessel traffic data (see Section 6) were also approached for comments and feedback on the Project (see Section 3.2) and a Fisheries Liaison Officer has been utilized to ensure feedback from the commercial and recreational fisheries sector is considered. It is noted in this regard that impacts relating to fishing vessels engaged in fishing activities have not been considered within this NSRA, but rather are assessed as part of the commercial fisheries assessment (see Section 4.4.6 of the COP).

1.4 Lessons Learned

Any lessons learned from the existing Pilot Project (see Section 5.1.5) will be considered and applied as necessary, however in general the domestic lessons learned to date are relatively limited noting the early stage of offshore wind development in the US. Therefore, given the UK's status as the global leader in offshore wind production, a number of UK based research papers and data sources have been considered on a supplementary basis, in addition to the available US sources. These papers and data sources are clearly referenced where appropriate throughout this NSRA, and are as follows:

- Results of the Electromagnetic Investigations 2nd Edition (MCA and QinetiQ, 2004);
- Guidelines for Health and Safety in the Wind Energy Industry (Renewables UK, 2014 issue 2);
- Offshore Wind Farm Helicopter Search and Rescue – Trials Undertaken at the North Hoyle Wind Farm Report of Helicopter Search and Rescue (SAR) Trials Undertaken with Royal Air Force (RAF) Valley "C" Flight 22 Squadron on March 22, 2005 (MCA, 2005);
- Interference to Radar Imagery from Offshore Wind Farms (Port of London Authority, 2005);
- Strategic Assessment of Impacts on Navigation of Shipping and Related Effects on Other Marine Activities Arising from the Development of Offshore Wind Farms in the UK Renewable Energy Zone (REZ) (The Crown Estate and Anatec, 2012); and
- Influence of UK Offshore Wind Farm Installation on Commercial Vessel Navigation: A Review of Evidence (Anatec, 2016).

Offshore wind farm technology has advanced significantly since many of the sources above were published. Foundation and turbine technology has allowed for much larger WTGs, which in turn means a larger spacing between WTGs than is able to be facilitated than was achievable for older projects. This has had a beneficial effect in terms of reducing impacts on communications and position fixing equipment. This is considered further in Section 8.

1.5 Data Sources

This subsection summarizes the main data sources used to assess the existing environment in terms of waterway characteristics (Section 5) and baseline shipping activities (Section 6) relative to the Project. These are as follows:

- Vessel traffic data:
  - AIS Data collected during entirety of 2019 from both satellite and terrestrial receivers.
- Fishing specific data:
  - National Oceanic and Atmospheric Administration (NOAA) Vessel Monitoring System (VMS) Transit Counts recorded during 2015-16 - Northeast Ocean Data Portal (NEODP, 2018).
- Maritime incident data:
  - USCG Marine Information for Safety and Law Enforcement (MISLE) database (2010 to 2019); and
  - Marine Accident Investigation Branch (MAIB) collision and allision incident data (1995 to 2014)[2].
- Navigational features:
  - NOAA Nautical Charts 12200, 12207, 12208, 12221 (accessed November 2020);
  - United States Coast Pilot 3 (NOAA, 2020) and United States Coast Pilot 4 (NOAA, 2019)
  - United Kingdom Hydrographic Office (UKHO) Admiralty Sailing Directions NP69 (UKHO, 2017);
  - Automated Wreck and Obstruction Information System (AWOIS) (NOAA, 2016)
  - Multipurpose Marine Cadastre (MMC) US Navy Military Operating Area Boundaries: Atlantic/Gulf of Mexico (accessed July 2020); and
  - MMC US Navy Military Submarine Transit Lanes: Atlantic/Gulf of Mexico (accessed July 2020).
- Meteorological & Oceanographic (Metocean) data:
  - Dominion Energy MetOcean Assessment CVOW 1_4_8-001; and
  - Ocean Data Acquisition Systems (ODAS) Buoy 44014 (NOAA, 2020).

[2] Historical incident data provided by the MAIB under the Freedom of Information Act. This data is used by Anatec for the purpose of comprehensive calibration of the CollRisk allision and collision models and has therefore not been presented directly within this NSRA.

2 NSRA Methodology

2.1 Methodology for Assessing the Project in Isolation

Using a RBDM approach, this NSRA identifies the impacts to shipping and navigation users that may arise from the construction, operation and maintenance, and decommissioning of the Project. Given that the construction of the Project will represent a similar scenario to that of decommissioning (e.g., increased Project vessel presence on-site, partially complete structures), impacts have only been assessed for the construction, and operation and maintenance phases. However, a separate NSRA specific to decommissioning may be produced prior to the start of the decommissioning phase to reflect any changes in the baseline conditions that may have occurred, and to provide an up to date understanding of decommissioning requirements.

The NSRA primarily addresses safety-based impacts to third parties (e.g., vessels, operators, emergency response resources), rather than impacts to the Project itself. Shipping and navigation users which may be affected by the Project (and thus considered within the impact assessment introduced in Section 11) have been identified and assessed on this basis. Impacts associated with Project vessels will be mitigated by the processes put in place to control transits to / from the Lease Area.

Impacts are identified via the results of the baseline characteristics assessment for waterway and maritime characteristics, and consideration of the outputs of the consultation process.

Impact assessment has been undertaken with due consideration of the request for an RBDM approach noted in NVIC No. 01-19 (USCG, 2019) and the methodology provided in COMDTINST 16003.2B (USCG, 2019). In line with this, an FSA approach has been adopted as per the internationally recognized standard in the FSA process published by the IMO (IMO, 2018). The FSA process requires a systematic review of impacts applying mitigations until they are brought within As Low As Reasonably Practicable (ALARP) levels, and represents the standard approach to maritime risk assessment. On this basis, the approach used within this NSRA is aligned with the FSA approach.

2.1.1 Significance

Once identified, those effects for which the sensitivity level is determined to be low (i.e., there is no anticipated impact) are screened out of the impact assessment as part of the NSRA process. Any impacts which carry some degree of sensitivity are considered further in the impact assessment (see Section 11).

The assessment considers the following NSRA elements and where applicable a citation for the source of the information will be included:

- Baseline data and statistical analysis;
- Expert opinion;
- Level of stakeholder concern and feedback;
- Number of transits of a specific vessel and/or type;
- Magnitude of any vessel deviation;
- Outputs of collision, allision and grounding risk modelling; and
- Lessons learned from existing offshore developments (primarily UK based).

The impact assessment takes account of embedded mitigation which will be implemented for the Project (see Section 20), and qualitatively determines the significance of each individual impact reviewed as either Broadly Acceptable, Tolerable, or Unacceptable.

The definitions of these significance rankings are given in Table 2.1, noting that the definitions are based on the IMO's FSA process for the qualification of ALARP (see Section 2.1.2). This terminology is used throughout the NSRA to identify where impacts are considered ALARP, or whether further mitigation is required.

Table 2.1 Significance Definitions

Significance	Definition
Broadly Acceptable	A level of risk that is managed by standard mitigations in place for offshore wind farms. No further assessment required.
Tolerable or Tolerable with Mitigation	The level of risk is tolerable only with further controls in place, i.e., additional mitigation other than those that are considered standard for offshore wind farms. This additional mitigation can take the form of modification, control measures or monitoring. Following further assessment with additional mitigation in place the risk is determined to be ALARP and can be reduced to Broadly Acceptable. Note the mitigations must be secured; if they are not secured then the impact remains as Tolerable with Mitigation.
Unacceptable	The level of risk cannot be managed through mitigation (modification, control measures or monitoring) and the Project requires significant change(s) followed by re-assessment to bring the risk to within ALARP parameters.

2.1.2 As Low As Reasonably Practicable

The ALARP principle is considered in the IMO's FSA process which is illustrated in Figure 2.1, which indicates that there is a risk level above the upper threshold of what is considered "tolerable", and therefore the significance of the risk is deemed unacceptable. This level of risk "*cannot be justified and must be reduced, irrespectively of costs.*"

In contrast, Figure 2.1 also indicates there is a risk level below which the risk is negligible and therefore the significance of the risk is deemed broadly acceptable. For this level of risk there is "*no risk reduction required*."

For risk levels between the two thresholds – the ALARP risk region – the level of risk "*should be reduced to meet economic responsibility"* and when this has been achieved is considered to be acceptable.

Figure 2.1 ALARP Principle (IMO, 2018)

2.1.3 Risk to People and the Environment

In addition to assessing the tolerability of impacts on a qualitative basis, a risk evaluation with regard to people and the environment has also been undertaken.

In the case of risk to people, this involves determining the annual fatality rate when frequency and fatality are combined into a one-dimensional measure of societal risk known as Potential Loss of Life (PLL).

In the case of risk to the environment, this involves a numerical estimate of the amount of oil spilled from a vessel involved in an incident relating to the Project, based upon historical spill data. It is recognized that there are other potential sources of pollution (e.g. hazardous containerized cargoes), but oil is considered to be the most likely pollutant.

The output of this assessment is summarized in Section 10.3, with further details provided in Appendix B.

2.1.4 Modelling Software

The risks associated with the Project have been assessed on a qualitative basis (see Section 11 where the impact assessment is introduced). However, the qualitative assessment has been informed via a comprehensive quantitative assessment undertaken using Anatec's suite of collision and allision risk models. These models have each been used in many successful offshore wind farm applications within the UK, and are refined and improved on a continuous basis. Key models within this suite include:

- **Encounters** – identifies instances of vessel encounters within an AIS dataset;
- **COLLRISK vessel to vessel collision** – estimates the frequency at which two passing vessels (head on, crossing, or overtaking encounters) may collide within a pre-defined area;
- **COLLRISK vessel to structure allision (powered)** – estimates the frequency at which a passing vessel may allide with a surface Offshore Project Component while under power;
- **COLLRISK vessel to structure allision (drifting)** – estimates the frequency at which a passing vessel may allide with a surface Offshore Project Component while Not Under Command (NUC); and

- **COLLRISK fishing vessel to structure allision** – estimates the frequency at which a fishing vessel either passing or operating internally within an offshore wind farm may allide with a surface Offshore Project Component.

Further details pertaining to the inputs and methodology of the models used are provided in the relevant subsections within Section 10.

2.2 Methodology for Assessing Cumulative Effects

2.2.1 Other Wind Farm Projects

The identified impacts (identified as per the methodology outlined in Section 2.1) are also assessed for cumulative effects with the inclusion of other planned offshore wind farms in the region. Given the varying development status of current US renewables developments, a tiered approach to cumulative assessment has been undertaken, which splits developments into tiers depending on:

- Development status[3];
- Level to which they are anticipated to cumulatively impact relevant users;
- Proximity to the Project; and
- Data confidence levels.

The tiers are summarized in Table 2.2. The screening of cumulative developments is provided prior to the cumulative effect assessment in Section 19.

Precedent is given to the distance from the Lease Area when determining the relevant tier of a development, e.g., a development greater than 150 nautical miles (nm) from the Lease Area is screened out (Tier 4) irrespective of the development status, the anticipated extent of cumulative impacts to relevant users, and data confidence level.

Table 2.2 Cumulative development tiering summary

Tier	Status of Lease Area	Status of Development	Description (Specific to Shipping and Navigation)	Data Confidence Level	Assessment within NSRA
1	Active	Operational, approved, submitted or not submitted	▪ Within 100 nm (185 km) of the Lease Area; **and** ▪ May impact a main route which transits through or within 1 nm (1.9 km) of the Lease Area and/or interacts with traffic that may be directly displaced by the Lease Area.	High or medium	Consideration of potential cumulative impact in terms of deviation, collision, and allision risk.

[3] At the time of the NSRA being undertaken.

Tier	Status of Lease Area	Status of Development	Description (Specific to Shipping and Navigation)	Data Confidence Level	Assessment within NSRA
2	Active	Submitted or not submitted	▪ Within 150 nm (278 km) of the Lease Area, **and** ▪ May impact a main route which transits through or within 1 nm of the Lease Area and/or interacts with traffic that may be directly displaced by the Lease Area.	High or medium	Consideration of potential cumulative impact in terms of deviations and collision risk.
3	Identified but not yet auctioned	Not submitted	▪ Within 150 nm (278 km) of the Lease Area; **and** ▪ May impact a main route which transits through or within 1 nm (1.9 km) of the Lease Area and/or interacts with traffic that may be directly displaced by the Lease Area.	Low	Qualitative assumptions of routing only given low confidence in future definition of planning area.
4	Any	Any	▪ Greater than 150 nm (278 km) from the Lease Area; or ▪ Within 150 nm (278 km) of the Lease Area but does not impact a main route which transits through or within 1 nm (1.9 km) of the Lease Area and does not interact with traffic that may be directly displaced by the Lease Area.	Any	Screened out.

2.2.2 Routing Measures

All established IMO routing measures (see Section 5.1.1 for those local to the Project) are considered in the assessment of the Project in isolation (and therefore are also considered in the cumulative effect assessment). Additionally, although not yet implemented, the outputs of the ACPARS (USCG, 2016) have been considered when determining the position of post wind farm main routes and therefore are also considered in the assessment of the Project in isolation. It is noted that the ACPARS have only been incorporated into the post wind farm routing where this was observed to represent a worst case in terms of vessel density within the Study Area. Further details are provided in 10.2.1.

It is noted that a review of the *Advanced Notice of Proposed Rulemaking (ANPRM) for Shipping Safety Fairways Along the US Atlantic Coast* (USCG, 2020) shows no changes in routing of relevance to that of the ACPARS. The USCG's upcoming *Port Access Route Study: Approaches to the Chesapeake Bay, Virginia* (USCG, 2019) has not been considered given the limited information available on this initiative at the time of writing.

2.2.3 Third Party Activities (non-transit)

Vessel movements relating to military operations, commercial fishing and marine aggregate dredging are considered within the baseline assessment in Section 6, noting that there are no known planned areas of use for these receptors in the future.

2.2.4 Cumulative Development Screening

Table 2.3 presents details of the cumulative developments including assigned tiers based on the methodology outlined in Table 2.2. Following this, Figure 2.2 presents the location of the cumulative developments relative to the Project, color-coded by tier.

Table 2.3 Cumulative Project Screening

Development	Lease Area	Lease Area Status	Development Status[4]	Distance from Lease Area (nm)	Data Confidence	Tier
Kittyhawk	OCS-A 0508	Active	Submitted	20	High	1
US Wind	OCS-A 0490	Active	Submitted	78	High	1
Skipjack	OCS-A 0490	Active	Submitted	94	High	1
Garden State Offshore Energy	OCS-A 0482	Active	Not submitted	100	High	1
Ocean Wind	OCS-A 0498	Active	Submitted	120	High	2
Atlantic Shores	OCS-A 0499	Active	Not submitted	140	High	2

[4] As of 06/15/2020.

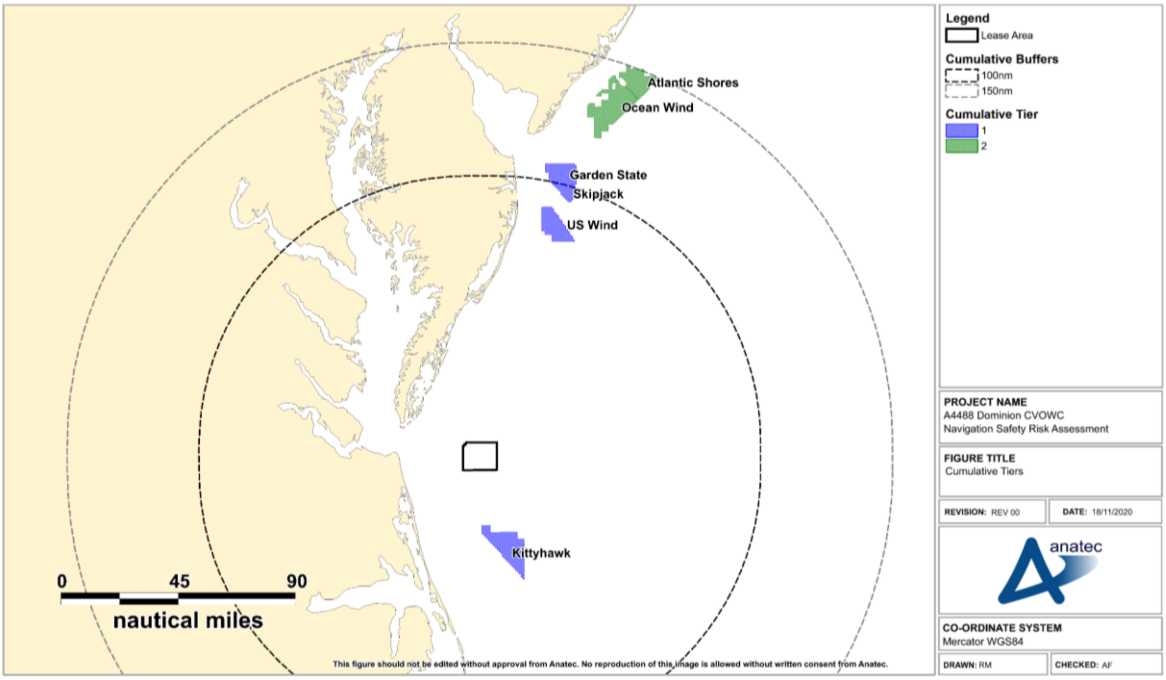

Figure 2.2 Cumulative Tiering

2.3 Study Areas

Assessment within this NSRA has primarily been undertaken within 10 nm (18.5 km) of Lease Areas OCS-A 0483, associated with the Commercial CVOW Project, and OCS-A0497, associated with the Pilot CVOW Project. This is hereafter referred to as the 'Study Area'. The 10 nm (18.5 km) area has been chosen to ensure all passing traffic relevant to the Lease Area is captured, in particular traffic utilizing the nearby TSS lanes, while still ensuring the assessment remains site specific to the Project. The Study Area is shown in Figure 2.3.

To ensure appropriate impact assessment is included for the Offshore Export Cables within this NSRA, additional assessment at a high level has been undertaken within an area defined as an approximate[5] 2 nm (3.7 km) around the Offshore Export Cable Route Corridor. This area (hereafter referred to as the 'Export Cable Corridor Study Area') is illustrated in Figure 2.3.

[5] 2nm buffer is based on a previous iteration of the Offshore Export Cable Route Corridor. However, the current iteration still sits entirely within the Export Cable Corridor Study Area (only small sections at landfall and in the area of the telecom cable crossings have changed). Therefore the study area is considered suitable for the purposes of the NSRA.

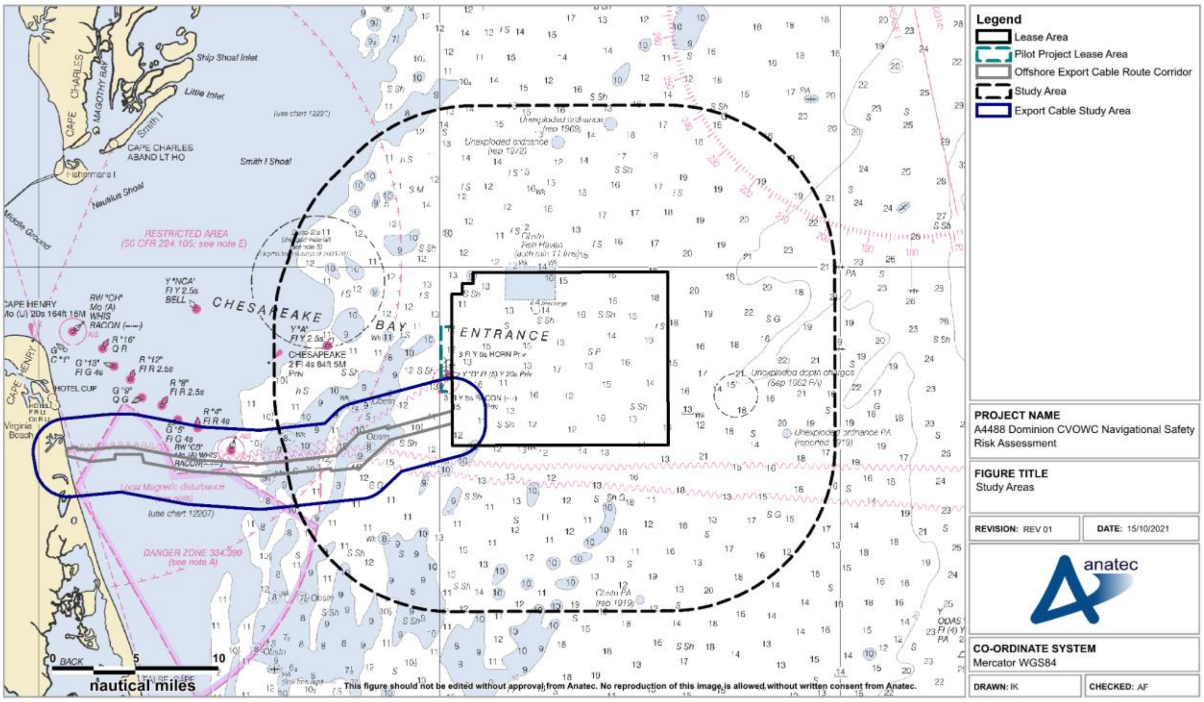

Figure 2.3 Study Areas

2.4 Assumptions

The shipping and navigation baseline and impact assessment has been undertaken conservatively (a realistic worst-case scenario), based upon the information available and responses received at the time of preparation. It has assessed a conservative scenario selected from within the Project Design Envelope (PDE), noting that the final location of structures will not be finalized until acceptance of the CoP, but should still fall within the PDE and maximum design scenario as assessed. The maximum design scenario assessed within this NSRA is discussed in detail in Section 4.7.

It is assumed that any notable changes to the baseline (e.g., changes in traffic patterns) will be re-assessed and re-modelled if and when required.

Any key assumptions made are stated within the relevant sections of this NSRA. Similarly, any limitations associated with the referenced data sources are highlighted within the appropriate sections.

3 Consultation

3.1 Summary of Issues Raised

Table 3.1 summarizes the issues raised during stakeholder consultation for the Project deemed of relevance to shipping and navigation. For each issue raised, a response is provided, and (if applicable) a link shows where the issue has been addressed in this NSRA. A list of the key parties consulted with to date is provided in Section 1.3. Details of engagement with stakeholders specific to commercial and recreational fisheries is detailed in Section 4.4.6 of the COP.

Table 3.1 Consultation Meeting Summary

Meeting Details	Issues Raised	Response to Issue and/or where Addressed in NSRA
USCG and BOEM – Sept 17th, 2020	Queried whether effects on commercial fishing will be assessed within NSRA.	Navigation safety impacts to commercial fishing vessels in transit are assessed in Section 15. Commercial impacts are considered in Section 4.4.6 of the COP.
	Queried effects of the layout on SAR operations.	Impacts on emergency response are assessed in Section 17.
	Queried effect of the 2020 COVID-19 pandemic on shipping volumes / patterns, and how this would be addressed within the NSRA.	As per Section 6 and as presented at this meeting, the most recent year of pre-pandemic data (2019) has been assessed.
	Queried activity associated with the fish haven area located within the Lease Area.	The fish haven area is discussed within Section 5.1.10, and fishing vessel activity is assessed within Section 6.3.4.5.
AWO, WSC, VMA, VPA, Virginia Pilot's Association – Sept 28th, 2020	Queried plans to develop within the fish haven area.	As per Section 4.2.1, the positions under consideration within the fish haven area are optional (i.e., alternate to the preferred positions). The preferred base case layout does not include development (i.e., structures) within the fish haven area.
	Queried whether any priority will be given to certain spare locations.	Spare locations are discussed in Section 4.2.1.
	Suggested future case traffic increases of 5-10% would be appropriate for container ships.	As per Section 6.5, and as discussed at this meeting, increases of 10 and 20% have been modelled to ensure future case assessment is conservative.
	Concern raised over the three WTG positions in the north west of the Lease Area adjacent to the ACPARS lane.	Following this meeting, the three referenced positions were changed to spare locations as per Section 4.2.1.

Meeting Details	Issues Raised	Response to Issue and/or where Addressed in NSRA
	Attendees noted vessels will likely get larger, and as such were concerned over the width of the ACPARS lane at the point it passes the Lease Area.	Navigational safety impacts to commercial vessels are assessed in Section 12.

3.2 Regular Operator Consultation

The 12 months of AIS data recorded via coastal and satellite receivers between January and December 2019 (see Section 6.1) has been used to identify any regular operators within the vicinity of the Lease Area. For the purposes of this process, a regular operator was defined as an operator overseeing multiple vessels observed as utilizing the area on a regular basis and on defined routes.

The operators that were identified on this basis were subsequently contacted and provided with information pertaining to the Project and a request for a consultation response. For reference, Appendix C includes the regular operator letter (redacted as appropriate) which was sent to the identified regular operators.

The following vessel operators were contacted directly through this process:

- Anglo-Eastern Ship Management;
- CMA CGM International Shipping;
- CPO Containerschiffreederi;
- Danaos Shipping;
- Evergreen;
- Fleet Ship Management;
- Grimaldi Compagnia di Navigazione;
- Hapag-Lloyd;
- Hiong Guan Navegacion Japan Co;
- Hoegh;
- Inarme (Industria Armamento Meridionale);
- Marine Transport Management;
- MOL;
- MSC Mediterranean Shipping;
- MSC Shipmanagement;
- New Asian Shipping Co. Ltd;
- Norddeutche Reederi Schuldt;
- Optimum Marine Management;
- Reinauer Transportation
- Royal Caribbean Cruises;
- Seaspan;
- Spliethoff's Bevrachtingskantoor;
- Yang Ming Marine Transport;
- ZIM Integrated Shipping; and
- Zodiac Maritime Ltd

No feedback has been received with regards to the Project to date by the regular operators contacted. It is noted that while this does not necessarily mean there are no concerns, historical experience demonstrates that operators do typically respond where significant concerns exist with respect to an offshore development. Additionally, as per Section 1.3, the VMA as a representational organization has been consulted.

4 Project Description

The project description within this NSRA presents those aspects of the PDE deemed relevant to shipping and navigation, and the associated impact assessment. The following subsections outline the maximum extent of the Project parameters for which any impacts identified are assessed.

4.1 Development Boundaries

An overview of the location of the Lease Area is shown in Bounding coordinates (given in North American Datum of 1983 [NAD83]) of the Lease Area are then shown in Table 4.1, the positions of which are illustrated in Figure 4.2. Note that these coordinates provide an area bounding the Lease Area, rather than the precise Lease Area itself.

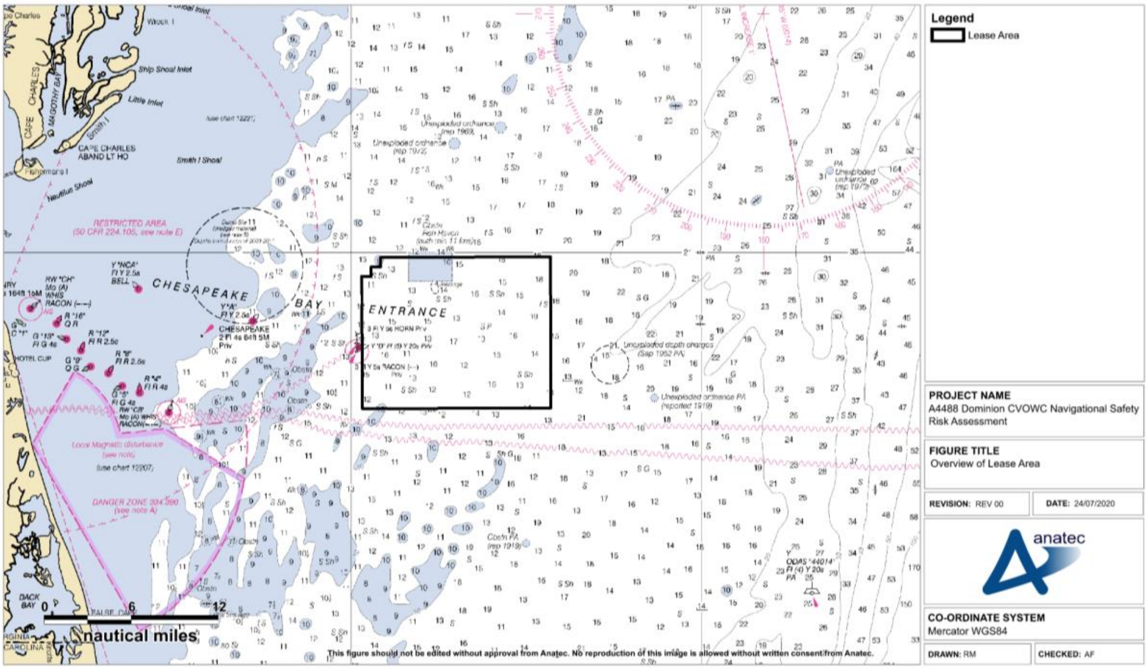

Figure 4.1 Lease Area Overview

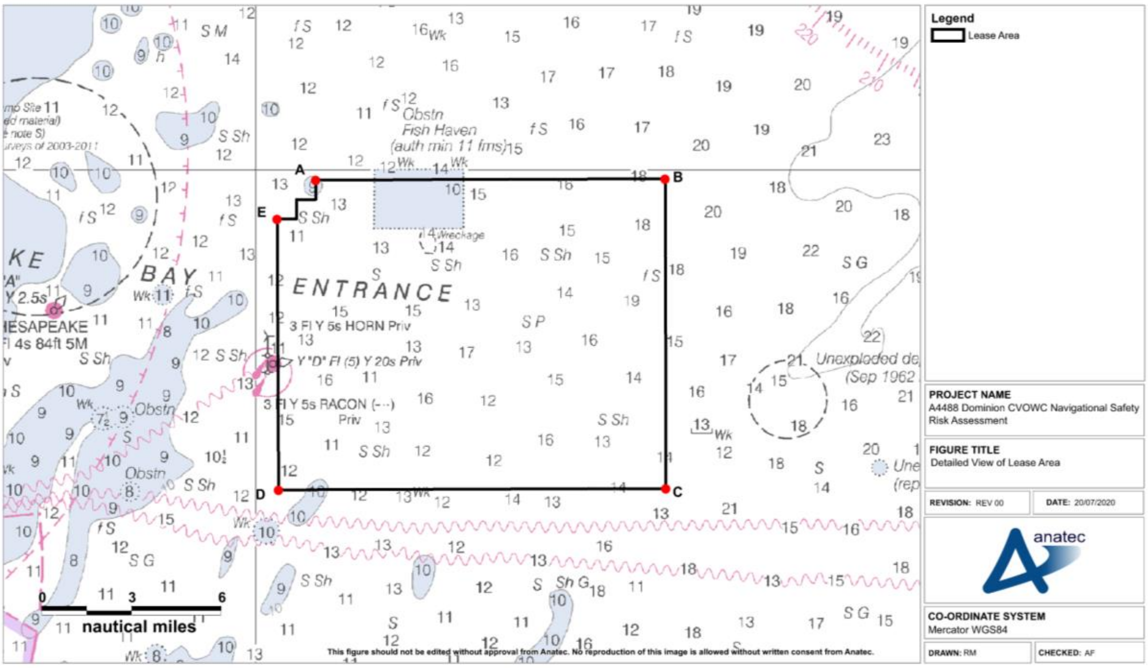

Figure 4.2 Detailed View of Lease Area

Table 4.1 Bounding Coordinates of the Lease Area (NAD 83)

Point	Latitude	Longitude
A	36° 59’ 41.48” N	075° 27’ 30.66” W
B	36° 59’ 43.97” N	075° 12’ 56.79” W
C	36° 49’ 20.88” N	075° 12’ 55.04” W
D	36° 49’ 18.03” N	075° 29’ 03.81” W
E	36° 58’ 23.21” N	075° 29’ 07.26” W

4.2 Array Structures

4.2.1 Layout

Given that the array layout is influenced by various constraints in addition to those associated with shipping and navigation (e.g., geology, offtake, wind resource, other environmental and social impacts), the final location of the surface Offshore Project Components will not be determined until approval of the COP. However, for reference, the preferred base case layout at the time of writing is presented in Figure 4.3. This includes 176 WTG positions, and three Offshore Substation locations.

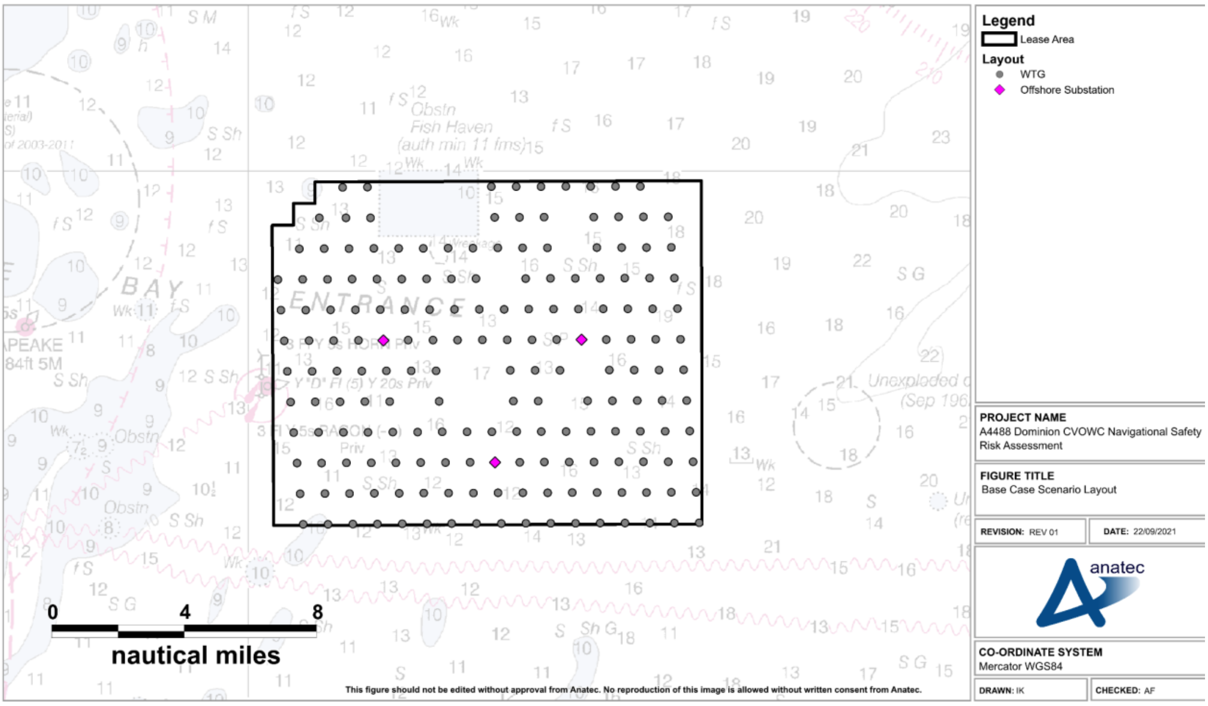

Figure 4.3 Base Case Scenario Layout

The WTGs within the preferred base case maintain a grid style layout, with spacing of 0.93 x 0.75nm (center to center). This allows for two primary lines of orientation through the wind farm as follows:

- 090° / 270°; and
- 174° / 354°.

This layout is included within the NSRA given it represents the preferred base case at the time of writing. However, for the purposes of this NSRA, the maximum design scenario (from a shipping and navigation perspective) has been assessed, as detailed in Section 4.7. This layout comprises 205 total WTG positions across the whole Lease Area as shown in Figure 4.4 and has been modeled to ensure maximum allision and displacement can be assessed. It must be considered when viewing this layout that it is utilized purely to model a worst case for the purposes of the NRA. The additional positions represent spares or alternates under consideration in the event that a preferred base case position proves unviable.

It is noted that this includes alternative positions within the fish haven area that intersects the Lease Area (see Section 5.1.7.1).

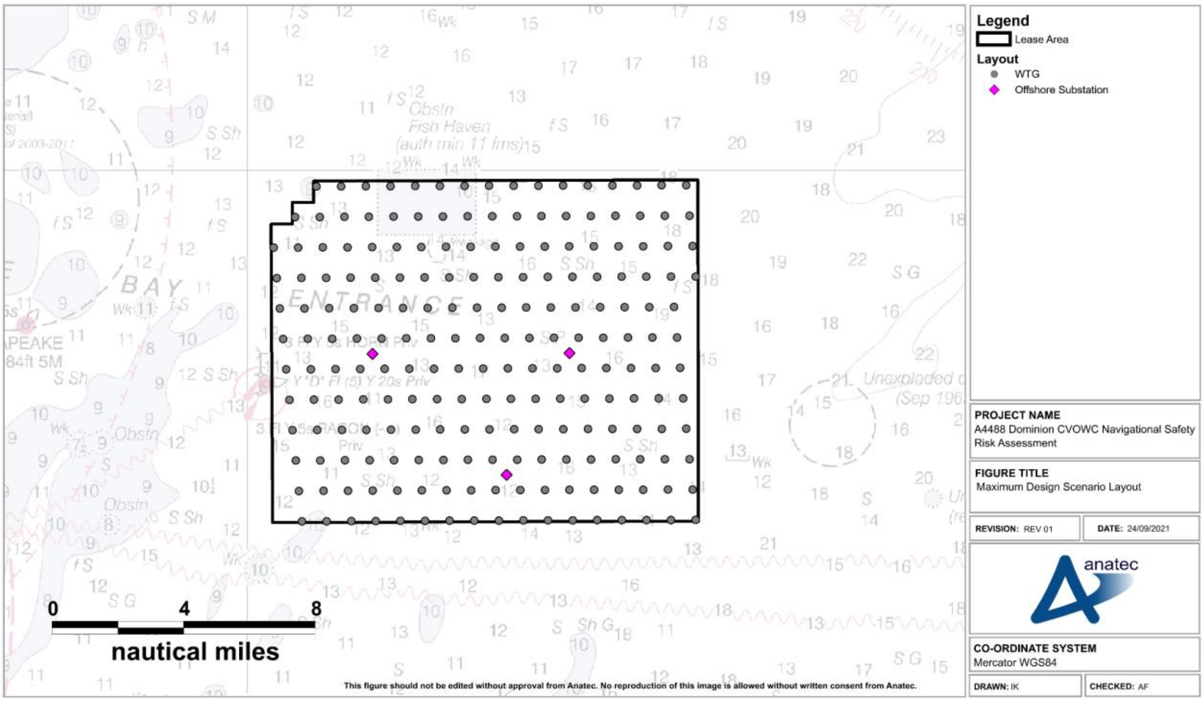

Figure 4.4 Maximum Design Scenario Layout

4.2.2 Wind Turbine Generators

Key WTG parameters are presented in Table 4.2. As per Section 4.2.1, the preferred base case layout includes 176 WTGs, noting the maximum design scenario includes a maximum of 205 positions (see Section 4.7). All WTGs will be installed on monopile foundations.

Table 4.2 WTG Parameters

Parameter	Value
Capacity	Up to 16 MW
Turbine tip height from mean sea level (MSL)	Up to 869 ft (265 m)
Rotor diameter	Up to 761 ft (232 m)
Minimum Blade Clearance above Highest Astronomical Tide (HAT)	82 ft (25 m)
Foundation	Monopile
Dimensions at Sea Level	Up to 36 ft (11 m) diameter
Nacelle Height (excluding antenna) above MSL	Up to 512 ft (156m)

4.2.3 Offshore Substations

As per Section 4.2.1, up to three Offshore Substations will be installed as part of the project. All Offshore Substations will be installed on piled jacket foundations. Maximum surface dimensions of the jacket are 118 x 167 ft (36 x 51 m), noting that the maximum topside dimensions are 230 x 203 ft (70 x 62 m).

4.2.4 Shut Down Procedures

Where technically possible, the WTG design will satisfy the requirements of NVIC No. 01-19 (USCG, 2019), which sets out standards and procedures for OREI shutdown in the event of an emergency situation which requires SAR intervention. The contents of the Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response (MCA, 2016) (Annex 5 of MGN 543) will also be considered with regard to WTG control for SAR assets.

In particular, it will be possible for the WTGs to be shut down, either individually, in a string or across the complete array from the Project's operation and maintenance facilities (noting local shutdown will also be possible). The control mechanisms will also allow the operations center personnel to fix and maintain the position of the WTG blades, nacelles, and other appropriate moving parts. This is in order to reduce visual distraction, physical collision, and turbulence risk to SAR helicopters and/or rescue vessels during SAR operations.

Full details of shutdown capability and procedures will be provided with the Safety Management System (SMS) which will be produced by the Project. Both the shutdown of WTGs and the SMS are included as embedded mitigation measures (see Section 20).

All shut down procedures will be tested at least twice a year.

4.3 Cables

4.3.1 Export Cables

The nine Offshore Export Cables will transfer energy from three Offshore Substations to the Cable Landing Location in Virginia Beach, VA. The Offshore Export Cables will be installed within the Offshore Export Cable Route Corridor, which varies in width between 0.4 nm (.74 km) and 1.5 nm (2.8 km), as shown in Figure 4.5. The Offshore Export Cable Route Corridor has a total length of 24.0 nm (44.5 km), and up to 671km of Offshore Export Cable will be installed.

The electricity generated by the WTGs will be transferred to the Offshore Substations via a series of Inter-Array cables (see Section 4.3.2). The WTG strings would be connected to each other via a link/switch to provide redundancy in the event of an Inter-Array cable failure.

It is anticipated that burial depth of the Offshore Export Cables will be between 1 and 5m. If target burial depth cannot be achieved, either due to seabed conditions or crossings with existing subsea assets the Cable Burial Risk Assessment (CBRA) prepared for the project will be consulted to determine the potential risk to mariners and/or the cables. If additional protection is deemed necessary, methods to provide this additional protection (e.g., rock placement) will be considered. When assessing additional protection solutions, potential hazards to navigation that may arise will be considered as part of the CBRA process (and it is noted that the potential for gear snag is considered further in Section 4.4.6 of the COP).

Horizontal Directional Drilling (HDD) will be utilized near the Cable Landing Location, with the Offshore HDD Punch-Out anticipated to be between 2,950 and 3,280 ft (900 and 1,000 m) from shore.

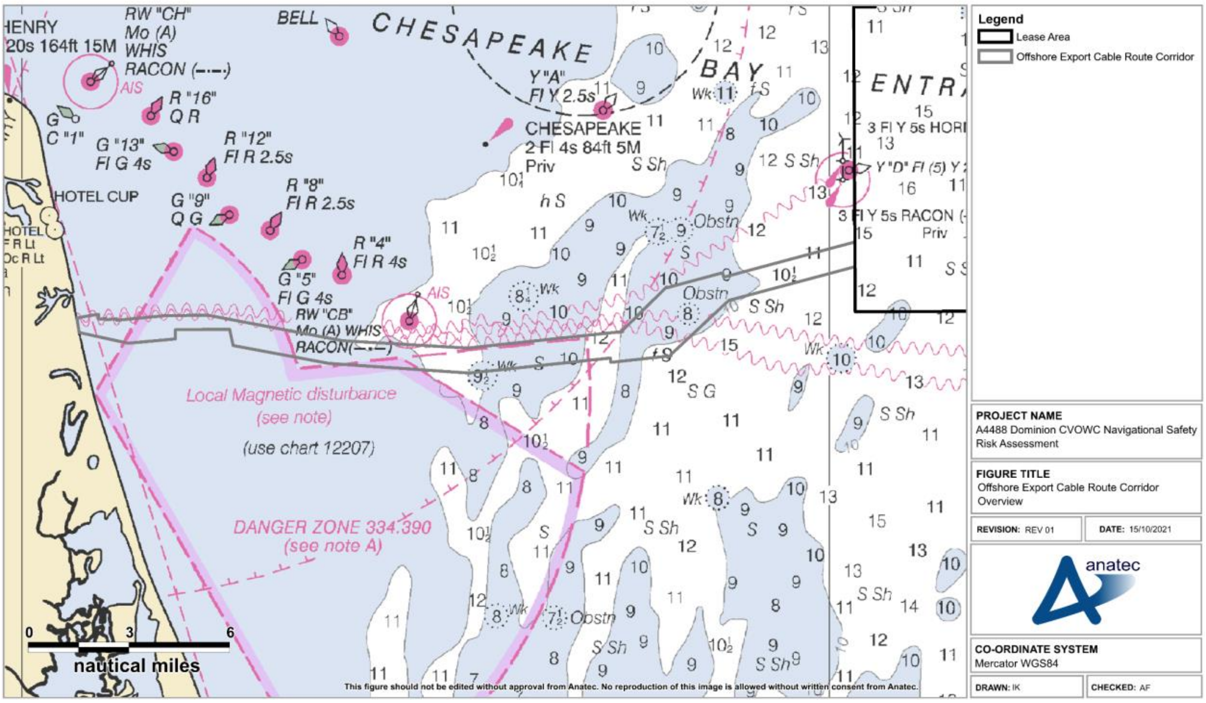

Figure 4.5 Offshore Export Cable Route Corridor Overview

4.3.2 Inter Array Cables

The number and arrangement of Inter-Array cables will depend on the final WTG layout, with the maximum length required estimated to be up to 216 nm (400 km).

It is anticipated that burial depth of the Inter-Array cables will be between 3.3 and 6.6 ft (1 and 2 m).

4.4 Marine Coordination

The Project will establish Marine Coordination procedures prior to the commencement of construction to ensure Project vessel movements are managed. A "Marine Coordinator" will be appointed, who will be responsible for:

- General monitoring of the wind farm and surrounding area;
- Monitoring of third-party vessel traffic within the wind farm;
- Monitoring and coordinating project vessel traffic within the wind farm;
- Monitoring weather conditions and advise on changing weather patterns;
- Monitoring and controlling project personnel accessing WTGs; and
- Conducting personnel offshore certification checks.

The SMS produced by the Project will define emergency procedures, including who would take the role as Operations Section Chief (and what qualifications they are required to hold under the National Incident Management System) in the event of an incident. In coordination and cooperation with the relevant authorities, they would be responsible for the management of all operations directly applicable to the site of the incident, to maintain contact and support the allocation of resources where required.

4.5 Supporting Facilities

It is currently anticipated that the base construction port will be the Portsmouth Marine Terminal, VA. However, additional supporting / storage ports may be used within Hampton Roads area.

The Base Port during the operations and maintenance phase is anticipated to be Hampton Roads and the facility will be manned 24 hours a day. Personnel at the facility will be equipped with charts indicating the position and unique identification number of each surface Offshore Project Component. This information will also be provided to the USCG along with the contact telephone number for the O&M facilities.

4.6 Timescales

An indicative offshore construction schedule for the Project is provided in Table 4.3. This schedule is subject to various factors, such as state and federal permitting, financial investment decisions, power purchase contracts and supply chain considerations. It is therefore subject to change.

Table 4.3 Indicative Construction Schedule

Activity	2023		2024				2025				2026				2027	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Scour Protection Pre-Installation																
Monopile and transition piece transport and onshore staging																
Monopile Installation (piling between May 1 and October 31)																
Scour Protection Post-Installation																
Transition Piece Installation																
WTG pre-assembly and Installation																
Inter-Array Cable Installation																
Offshore Substation Installation (piling between May 1 and October 31)																
Offshore Export Cable Installation																
Onshore Export and Interconnection Cable Installation																
Collector Station Construction																
Onshore Substation Upgrade Construction																
Commissioning																

4.7 Maximum Design Scenario

Table 4.4 outlines the maximum design scenario under consideration in the NSRA for the Lease Area and Offshore Export Cable Route Corridor in each phase of the Project. The application of a maximum design scenario ensures that any refinement / changes to the PDE will not increase the significance of the impacts identified.

It is noted that the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 authorizes a two-year pilot program under which the USCG may establish safety zones to address special activities in the exclusive economic zone, including offshore energy development activities on or near a fixed platform. However, unless current authority to establish safety zones is extended or made permanent, it is not anticipated that USCG will have the authority to establish safety zones more than 12 nm (22.2 km) offshore at time of construction. Discussions will be ongoing in this regard, and it has been assumed within this NSRA that they will be applied for if allowed at the relevant time prior to construction. However, should formal safety zones not be allowed, the Project still intends to utilize advisory safe passing distances as per Section 20.

Table 4.4 Maximum Design Scenario

Phase	Project Element	Maximum Design Scenario
Construction	Lease Area (WTGs, Offshore Substations, Inter Array cables)	▪ Buoyed construction area around the Lease Area for the full duration of the construction works, determined in consultation with the USCG and BOEM; ▪ Three year phased construction period; and ▪ Safety zones and safe passing distances of up to 1,640 ft (500 m) in radius around structures where work is ongoing (if applicable).
	Offshore Export Cable Route Corridor	▪ Cable installation within Offshore Export Cable Route Corridor by anchored vessel or dynamic positioning vessel; and ▪ Three year phased construction period.
Operation	Lease Area (WTGs, Offshore Substations, Inter Array cables)	▪ 205 WTGs on monopile foundations, 36 ft (11 m) diameter at surface level; ▪ Minimum spacing of 0.75 nm (1.39 km) between WTGs ▪ Three Offshore Substations on piled jacket foundations, topside dimensions of 230 x 203 ft (70 x 62 m); ▪ 400km of Inter Array cable, buried between 3.3 and 6.6 ft (1 and 2 m);
	Offshore Export Cable Route Corridor	▪ Nine Offshore Export Cables, up to 362 nm (671 km) in length ▪ Buried between 3.3 and 6.6 ft (1 and 2 m); and ▪ Use of external Cable Protection where necessary (e.g., cable crossings).

Phase	Project Element	Maximum Design Scenario
Decommissioning	Lease Area (WTGs, Offshore Substations, Inter Array cables)	▪ Buoyed decommissioning area around the Lease Area for the full duration of the construction works, determined in consultation with the USCG and BOEM; ▪ Decommissioning within two years of termination of the Lease; and ▪ Safety zones of up to 1,640 ft (500 m) in radius around structures where work is ongoing (if applicable).
	Offshore Export Cable Route Corridor	▪ Decommissioning within two years of termination of the Lease.

5 Waterway Characteristics

5.1 Navigational Features

5.1.1 International Maritime Organization Routing Measures

The IMO adopted routing measures within the vicinity of the Lease Area are shown in Figure 5.1. The Chesapeake Bay TSS was "*established to aid navigation and to prevent collisions"* (NOAA, 2020) consisting of a Southern Approach and an Eastern Approach converging on a precautionary area bounded by a circle of 2 nm (3.7 km) radius. On the Southern Approach, the inbound and outbound traffic lanes are separated by a two-way deep-water route (DWR) for vessels with drafts exceeding 42 ft (12.8 m) in fresh water, or naval aircraft carriers, as set out in federal regulation 33 CFR § 167.200.

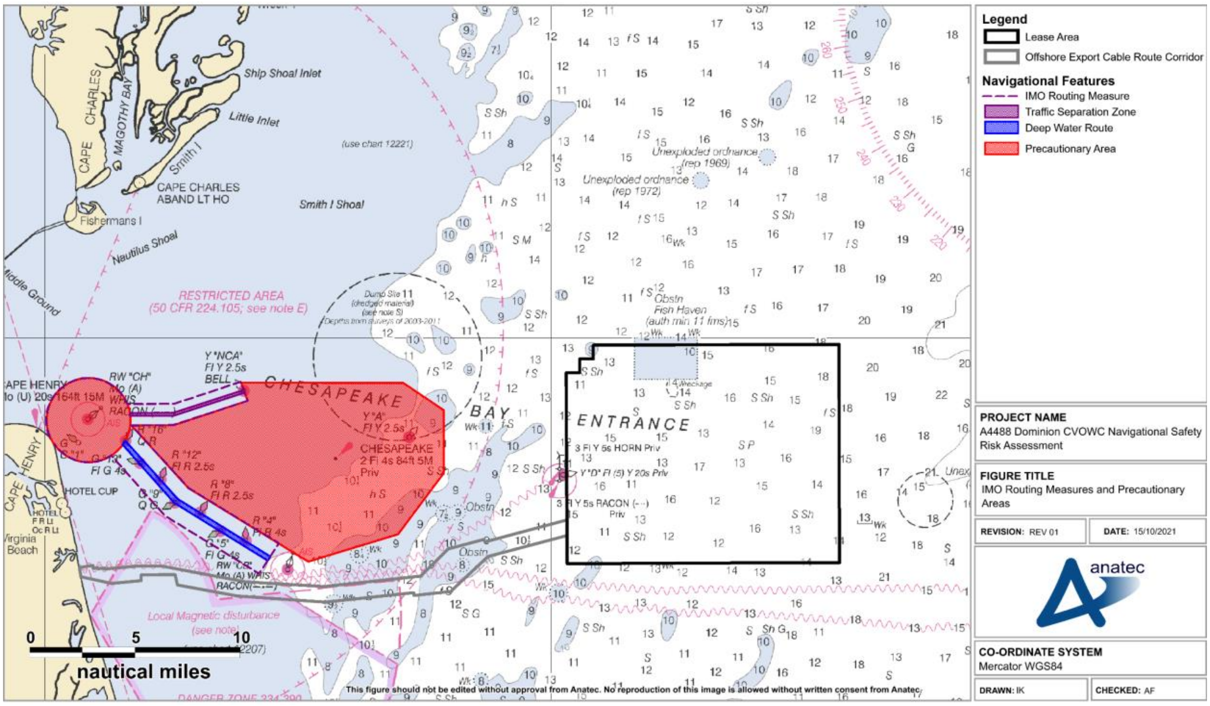

Figure 5.1 IMO Routing Measures and Precautionary Areas

The inbound and outbound traffic lanes on the Southern and Eastern Approaches to Chesapeake Bay are shown in Figure 5.2.

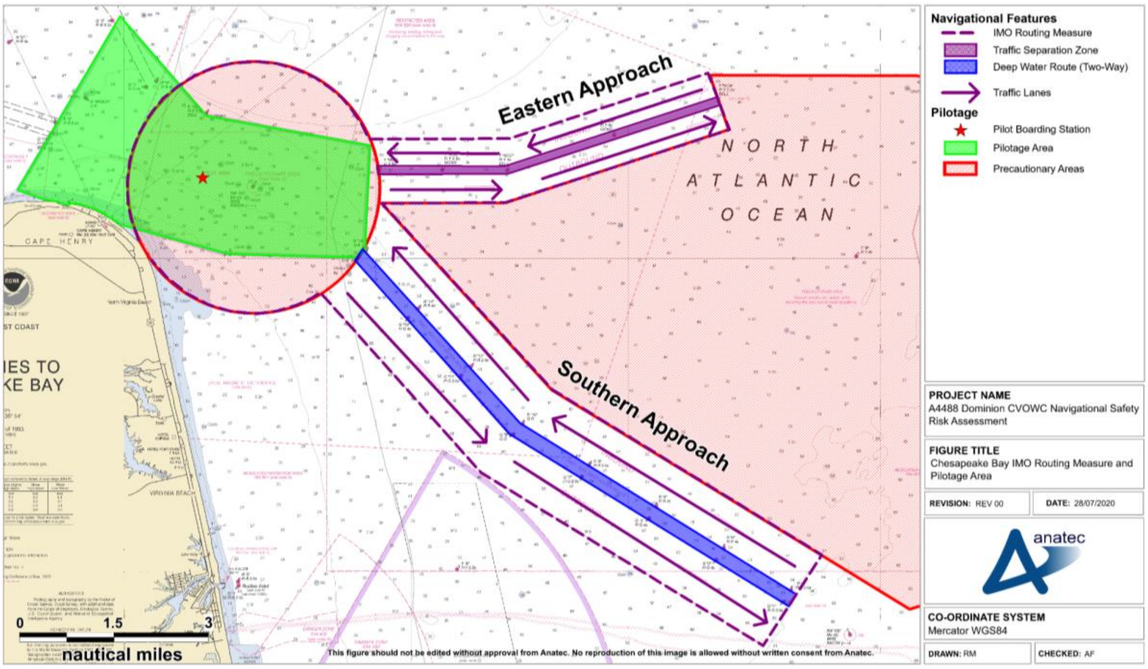

Figure 5.2 Chesapeake Bay IMO Routing Measure and Pilotage Area

5.1.2 Pilotage

There is a pilotage boarding area located off Cape Henry overlapping the precautionary area where the Southern and Eastern Approaches of the TSS converge, as shown in Figure 5.2. Pilotage is compulsory for all foreign vessels and US vessels under register in the foreign trade, and is "*optional for US vessels under enrolment in the coastwise trade if they have on board a pilot licensed by the Federal Government to operate in these waters*" (NOAA, 2020).

5.1.3 Regulated Navigation Area

There is an established Regulated Navigation Area in the region, the offshore portion of which is defined by a boundary beginning from the mean low water mark at the North Carolina and Virginia border as shown in Figure 5.3.

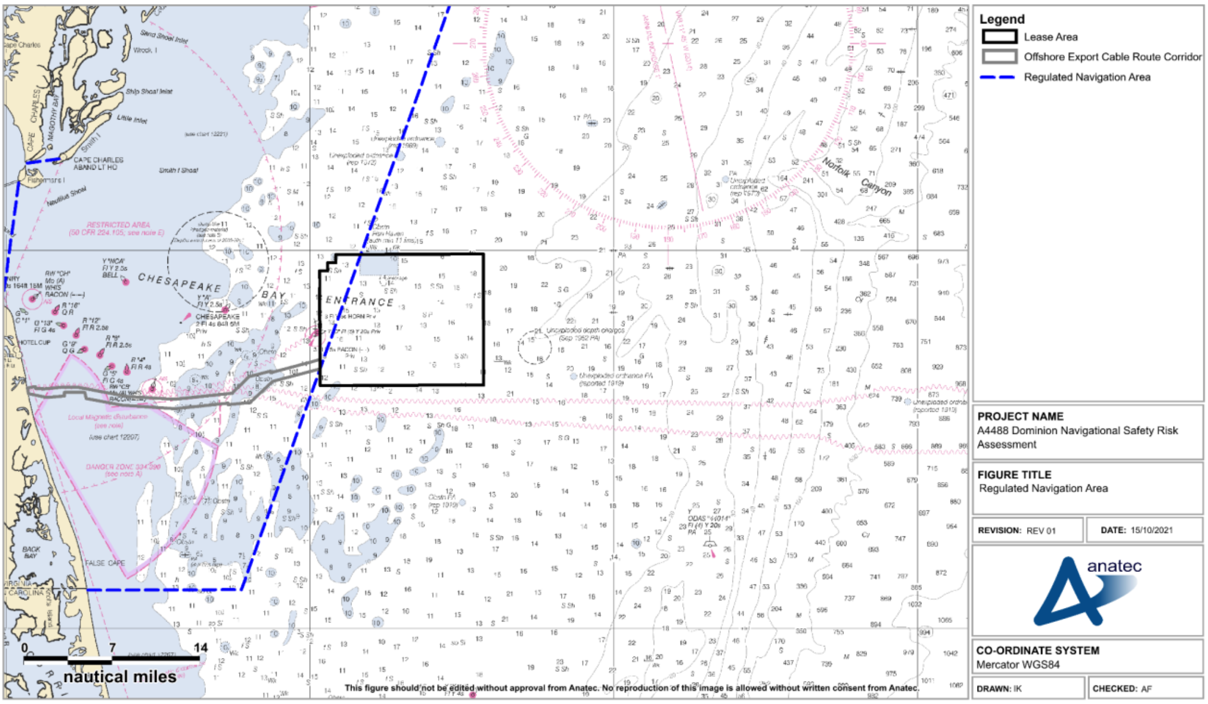

Figure 5.3 Regulated Navigation Area

It can be seen that the Regulated Navigation Area intersects the western extent of the Lease Area, while the Offshore Export Cable Route Corridor lies entirely within the Regulated Navigation Area.

Vessels transiting the Regulated Navigation Area must comply with regulations set out in federal regulation 33 CFR § 165.501, including (but not limited to):

- Vessels over 100 gross tons whose ability to maneuver is impaired by heavy weather, defective steering equipment, defective main propulsion machinery, or other damage, may not enter without permission of the Captain of the Port; and
- No vessel may enter unless it has on board corrected charts of the Regulated Navigation Area[6], an operative Radar during periods of reduced visibility, and (when in inland waters) a pilot or other person on board with previous experience navigating vessels on the waters of the Regulated Navigation Area.

5.1.4 Dredged Channels

Access to the Hampton Roads ports of Norfolk, Portsmouth and Newport News is gained via the Thimble Shoal Channel. The Thimble Shoal Channel is a dredged[7] channel approximately 0.3 nm (0.6 km) wide and is accessible from the TSS lanes described in Section 5.1.1. It is within a Regulated

[6] Instead of corrected paper charts, warships or other vessels owned, leased, or operated by the US Government and used only in non-commercial service may carry electronic charting and navigation systems meeting the applicable navigation safety regulations.
[7] Maintained minimum depth which varies along the channels.

Navigation Area (see Section 5.1.3), which vessels drawing less than 25 ft may not enter unless crossing the channel as set out in federal regulation 33 CFR §165.501.

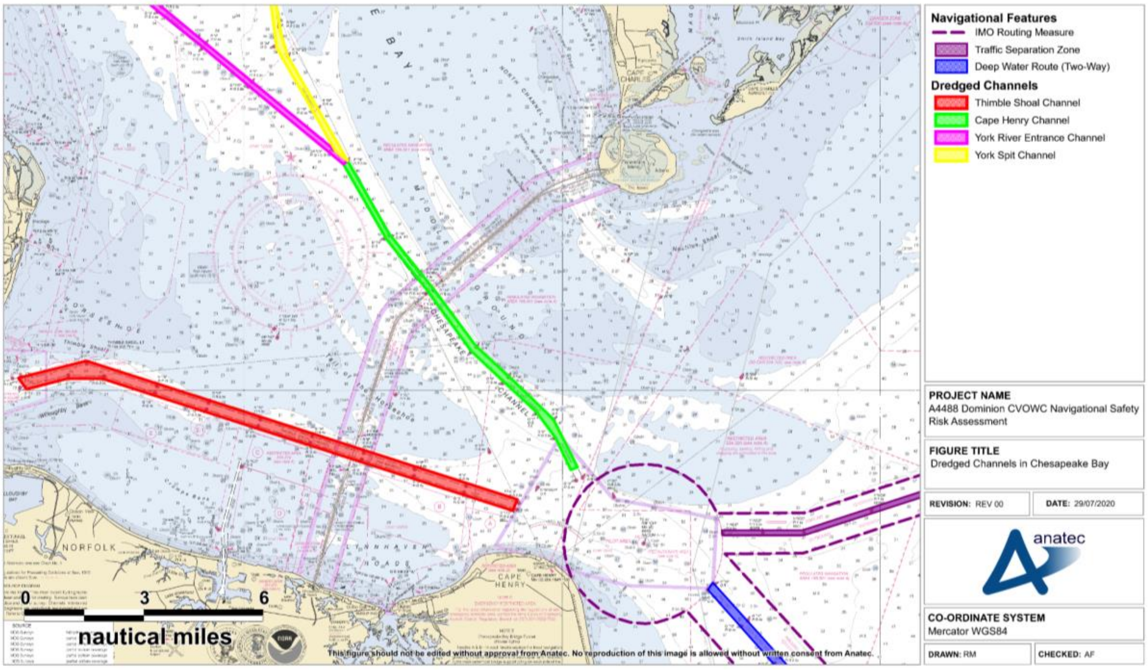

Figure 5.4 Dredged Channels in Chesapeake Bay

5.1.5 Existing Wind Farms

In advance of the commercial project, Dominion Energy has installed two 6 MW WTGs within Lease Area OCS A 0497, forming the CVOW Pilot Project. As shown in Figure 5.5, these WTGs are located adjacent to the Lease Area, and were installed in June 2020.

There are no other operational projects within the area. Proposed developments are considered on a cumulative basis in Section 2.2.4**.**

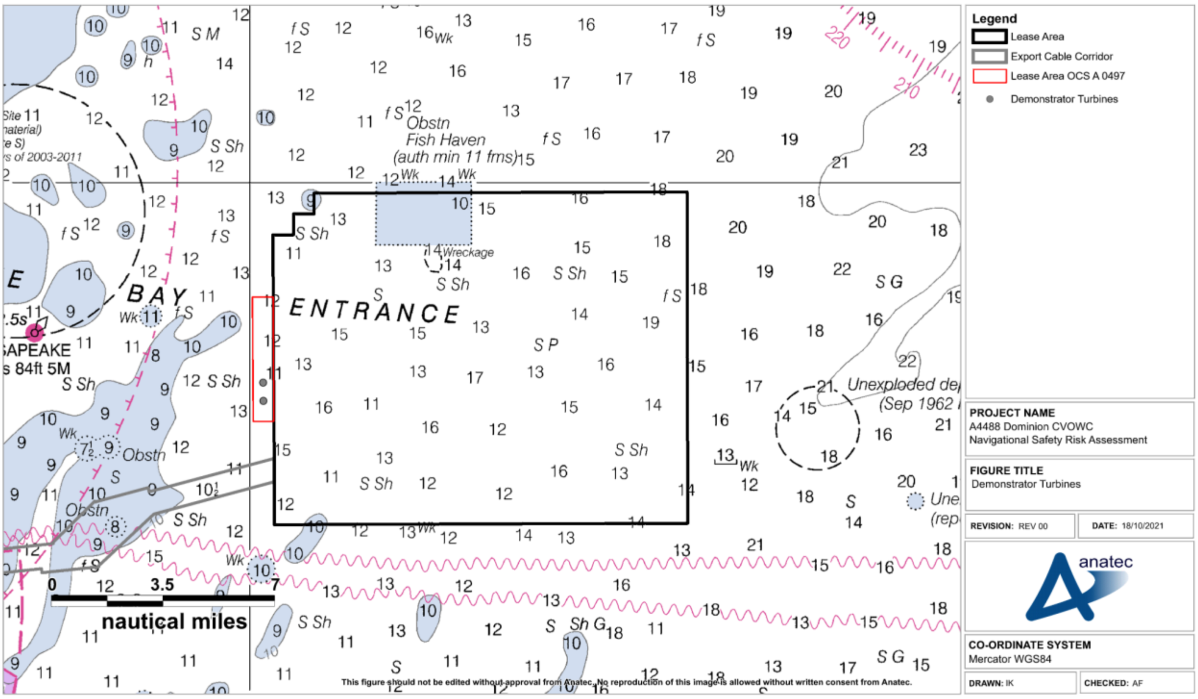

Figure 5.5 CVOW Pilot WTGs

5.1.6 Aids to Navigation

Aids to Navigation (AtoNs) identified within the vicinity of the Lease Area are shown in Figure 5.6.

The majority of AtoNs within the region are those marking the Chesapeake Bay TSS. These include lights, sound signals and other forms of electronic marking such as AIS and Radar beacon (Racon).

There are no Aids to Navigation within the Lease Area or the Offshore Export Cable Route Corridor. The closest Aid to Navigation to the Offshore Export Cable Route Corridor is a buoy near the approach to the landfall. This buoy is located approximately 0.6 nm (0.7 km) north of the cable alignment.

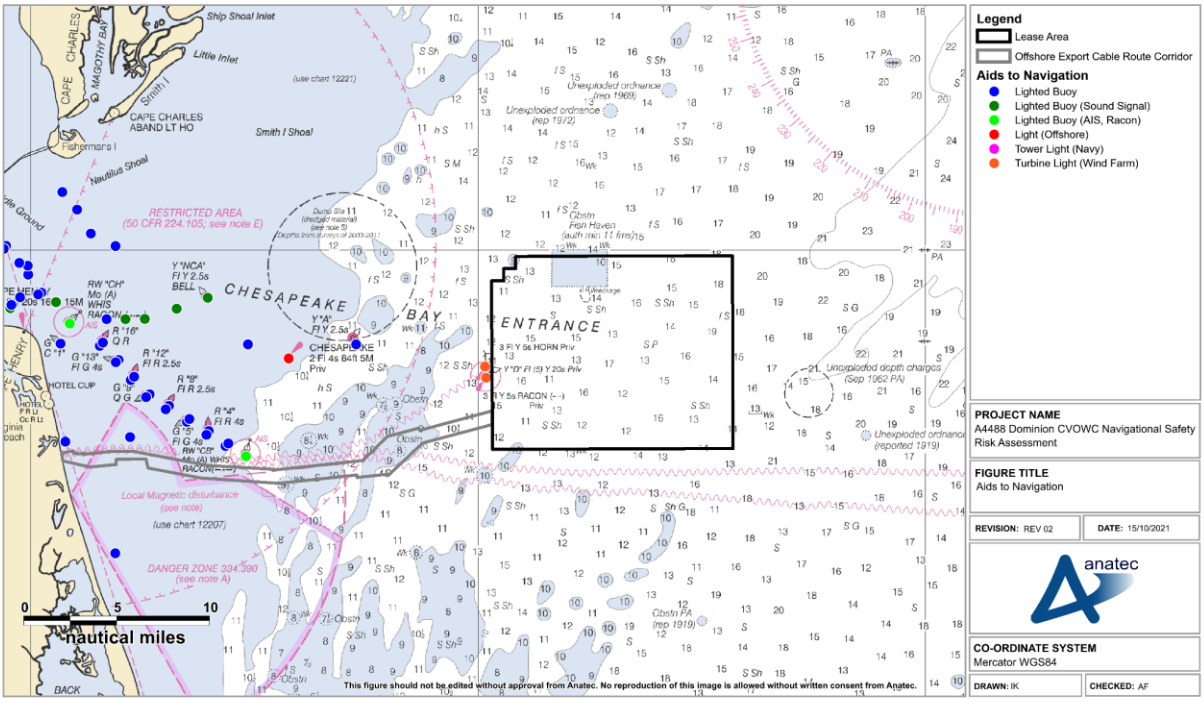

Figure 5.6 Aids to Navigation

5.1.7 Restricted and Danger Areas

Restricted areas identified in the vicinity of the Lease Area are shown in Figure 5.7, including deposit sites for dredged material.

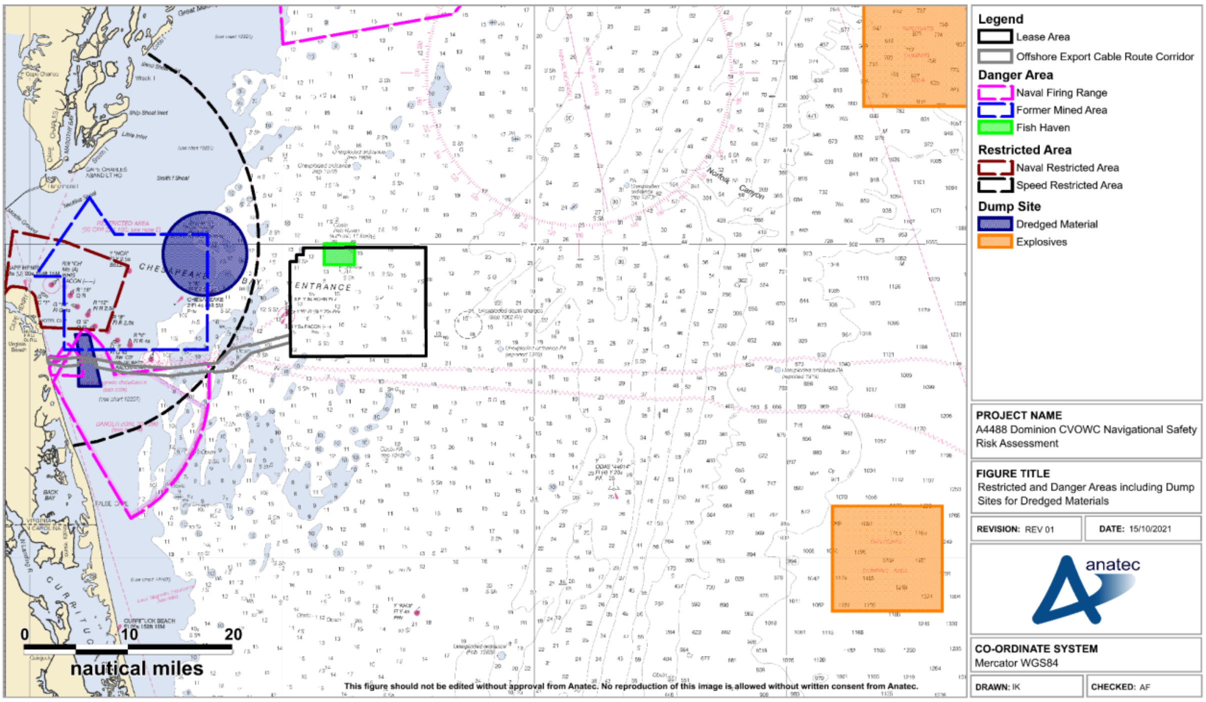

Figure 5.7 Restricted and Danger Areas including Deposit Sites for Dredged Material

The naval restricted area is located approximately 2.7 nm (5.0 km) north of the closest point of the Offshore Export Cable Route Corridor, and approximately 15 nm (28 km) west of the Lease Area. It is stated in 33 CFR § 334.320 that "*anchoring, trawling, crabbing, fishing and dragging in the [naval restricted] area are prohibited, and no object attached to a vessel or otherwise shall be placed on or near the bottom.*"

From 50 CFR § 224.105, a Seasonal Management Area (SMA) for the protection of North Atlantic right whales is defined by an area of radius 20 nm (37 km) centred on the entrance to Chesapeake Bay: "*vessels greater than or equal to 65 ft (19.8 m) in overall length … shall travel 10 knots or less over ground in the period November 1st to April 30th each year*".

A "former mined area" is charted north of the Offshore Export Cable Route Corridor near the Cable Landing Location. This area is open to unrestricted surface navigation, however all vessels are cautioned not to anchor, dredge, trawl, or lay cables due to residual dangers from mines at the bottom.

Throughout the danger areas marked as naval firing ranges (see Section 5.1.9), any anchoring, dredging, trawling or other bottom disturbing activities should be conducted with caution due to the potential of unexploded ordnance (UXO) and other munitions and explosives of concern (MEC) on the bottom[8]. The presence of UXO within the Study Area is considered in Section 5.1.8.

The spoil grounds are marked on charts on either side of the dredged channel in the Southern Approach of the Chesapeake Bay TSS, indicating areas where dredged materials are deposited. These areas present a hazard to navigation and should be avoided.

5.1.7.1 Fish Haven Area

It is noted that a fish haven also intersects the northern extent of the Lease Area. Objects may be added here up to a minimum depth of 66 ft (20.1 m). Associated fishing vessel activity is considered and assessed within Sections 6.3.4.5 and 6.3.4.6.

5.1.8 Unexploded Ordnance

There are a number of charted positions of UXO in the region. These include UXOs located approximately 7.5 nm (13.9 km) and 8.5 nm (15.7 km) north of the Lease Area, reported in 1972 and 1969 respectively, noting they remain unconfirmed. There are also unexploded depth charges (reported in 1962) 4 nm (7.4 km) east of the Lease Area, and an unconfirmed report (1919) of a UXO approximately 7 nm (13 km) east of the Lease Area.

5.1.9 Military Areas and Transit Routes

The Lease Area lies between two boundaries of the Virginia Capes Operating Area (VACAPES OPAREA), as shown in Figure 5.8. It can be seen that the Offshore Export Cable Route Corridor intersects the southern portion of the OPAREA. Westbound and Eastbound submarine transit lanes are located 22 nm (41 km) to the east of the Lease Area.

[8] As outlined for each respective danger zone in 33 CFR § 334.380/334.390/334.405.

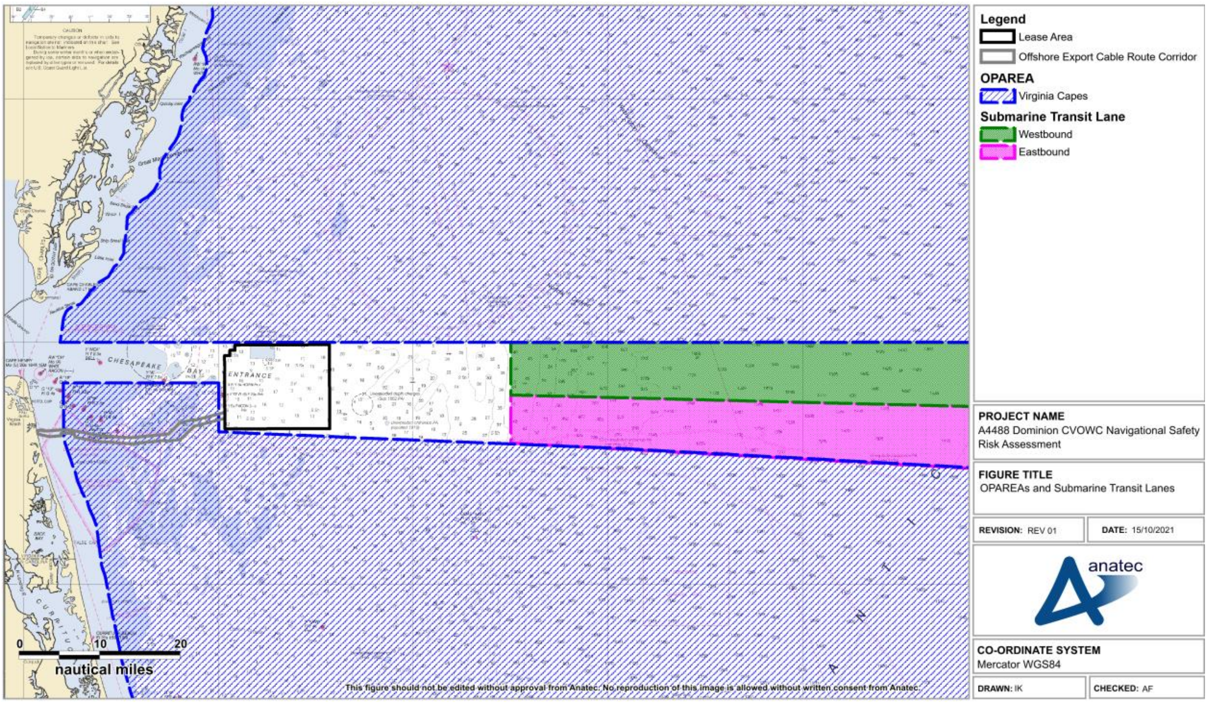

Figure 5.8 OPAREAs and Submarine Transit Lanes

The OPAREA is used for various surface, subsurface and air-to-surface military exercises. The submarine transit lanes between the VACAPES OPAREA boundaries are "*areas where submarines may navigate underwater, including transit corridors designated for submarine travel.*" (NOAA, 2019).

It is also noted that as per Section 5.1.7, the Offshore Export Cable Route Corridor intersects Naval Firing Ranges near the Cable Landing Location.

5.1.10 Wrecks and Obstructions

Subsurface wreck and obstruction data were available from the Office of Coast Survey's Automated Wreck and Obstruction Information System (AWOIS) (NOAA, 2013). NOAA provides both positions of wrecks and obstructions from within the AWOIS records, and also charted wreck positions.

Charted wrecks and obstructions available from the AWOIS within the Lease Area and Export Cable Corridor Study Areas are shown in Figure 5.9.

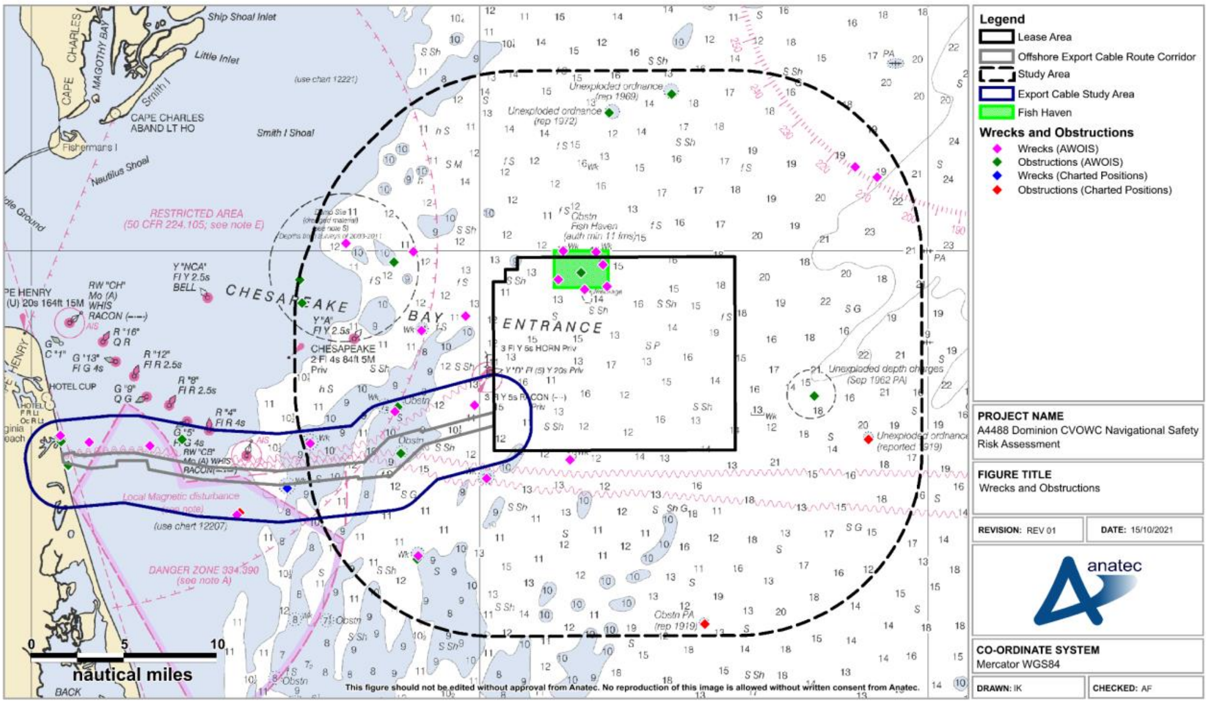

Figure 5.9 Wrecks and Obstructions

It is noted that the following limitations in relation to the AWOIS are highlighted by NOAA:

- AWOIS records are not comprehensive – there are wrecks in AWOIS that do not appear on the nautical chart and vice-versa;
- In 2016, the Office of Coast Survey stopped updating the AWOIS database; and
- Reported wrecks that have been salvaged or disproved by further investigation are not included in AWOIS.

Based on the available information, there are a total of 18 wrecks and 12 obstructions within the Study Area (of which four wrecks and one obstruction are within the Lease Area itself) and eight wrecks and three obstructions within the Export Cable Corridor Study Area.

The Triangle Reef fish haven, an artificial reef used for recreational wreck fishing (see Section 5.1.7.1), lies almost entirely within the northern part of the Lease Area and contains three wrecks and one obstruction, with a further three wrecks just outside the Triangle Reef limits. It is noted that the obstruction marked in the fish haven in Figure 5.9 denotes the fish haven itself.

Additional information on charted wrecks and obstructions can be found in Benthic Resources, Fishes, Invertebrates, and Essential Fish Habitat (Section 4.2.4 of the COP), Marine Archaeological Resources (Section 4.3.1 of the COP), Other Coastal and Marine Uses (Section 4.4.11 of the COP), and the Preliminary Cable Burial Risk Assessment (Appendix W of the COP).

5.1.11 Submarine Cables and Pipelines

The Lease Area is located approximately 1.2 nm (2.2 km) north of the MAREA and BRUSA submarine telecommunications cables, constructed after 2016, running east to west and broadly in alignment with the Offshore Export Cable Route Corridor as shown in Figure 5.10.

For reference, the export cable associated with the CVOW Pilot Project (see Section 5.1.5) is included in Figure 5.10.

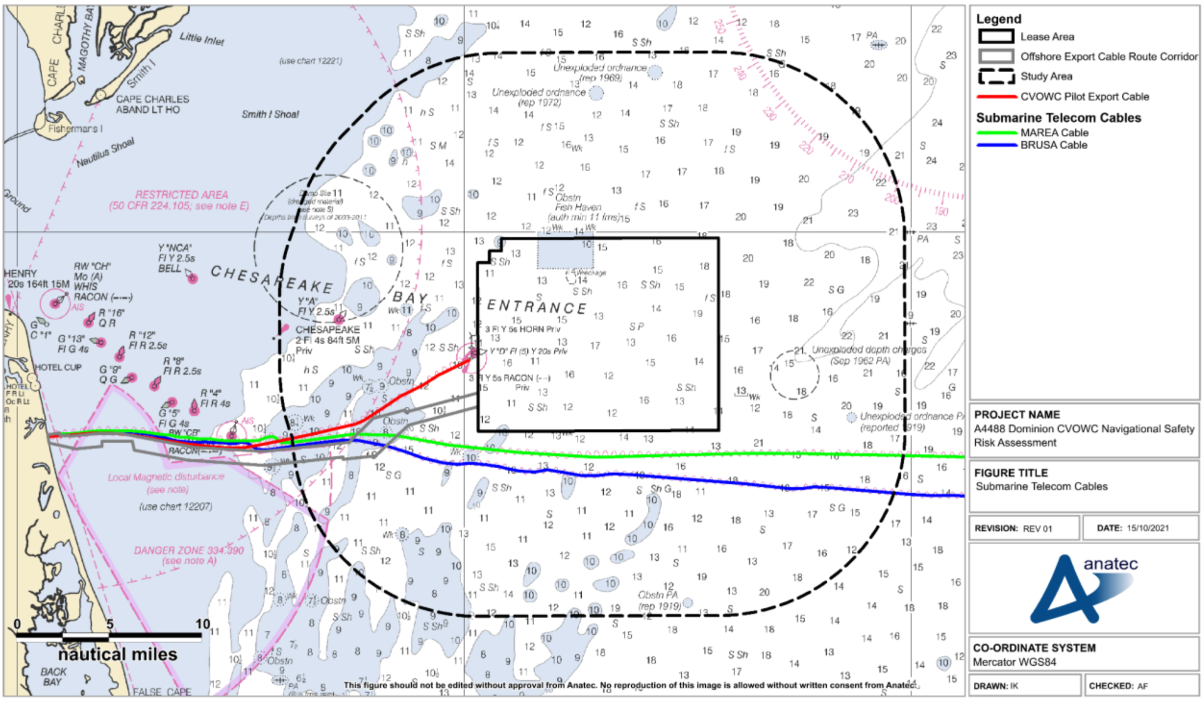

Figure 5.10 Submarine Telecom Cables

The nearest charted water depths to the offshore location where the MAREA cable crosses the Offshore Export Cable Route Corridor are 62 ft and 64 ft. The nearest charted depths to the offshore point at which the BRUSA cable crosses the Offshore Export Cable Route Corridor are 61 ft and 57 ft.

5.1.12 Ports and Related Services

A selection of US ports relevant to shipping and navigation (regular destinations for vessels broadcasting on AIS) for the Project are presented in Figure 5.11 followed by a detailed view in Figure 5.12. It is noted that on this basis, Figure 5.11 does not depict all ports in the region.

Of particular relevance to the Project is the Port of Virginia within Chesapeake Bay. This is a busy cargo port comprising six marine terminals as follows, capable of handling various commercial vessel types and sizes including deep draft vessels:

- Norfolk International Terminals (NIT);
- Portsmouth Marine Terminal;
- Virginia Inland Port;
- Virginia International Gateway;
- Newport News Marine Terminal; and
- Richmond Marine Terminal.

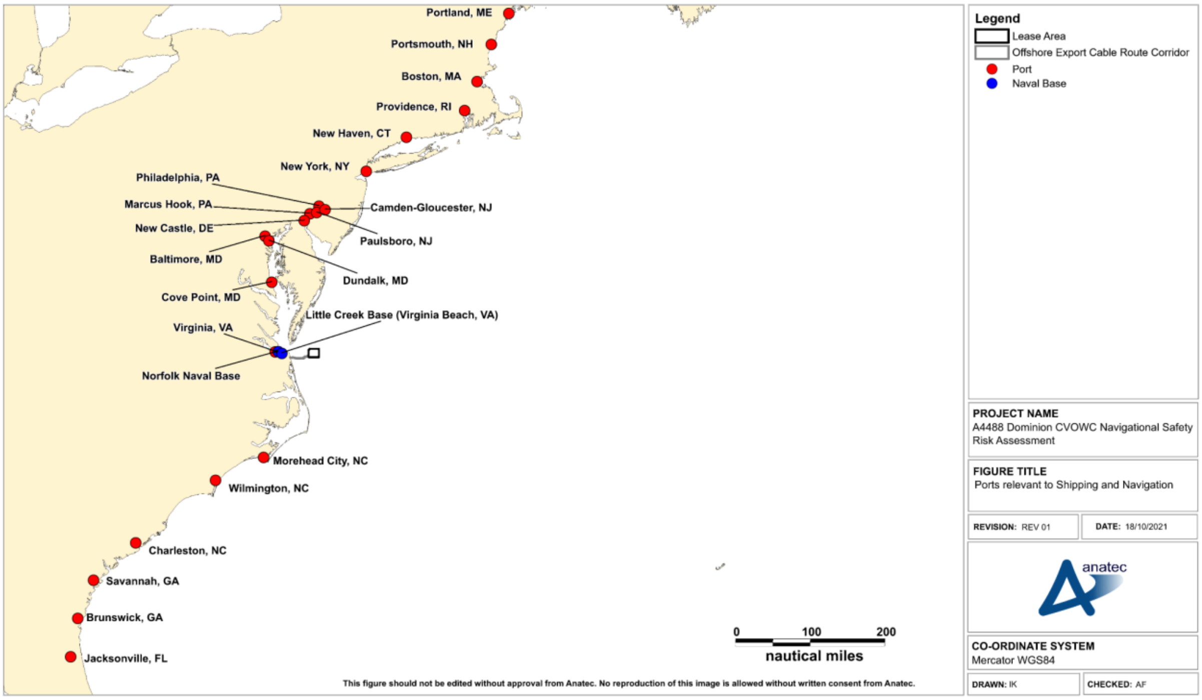

Figure 5.11 Ports relevant to Shipping and Navigation

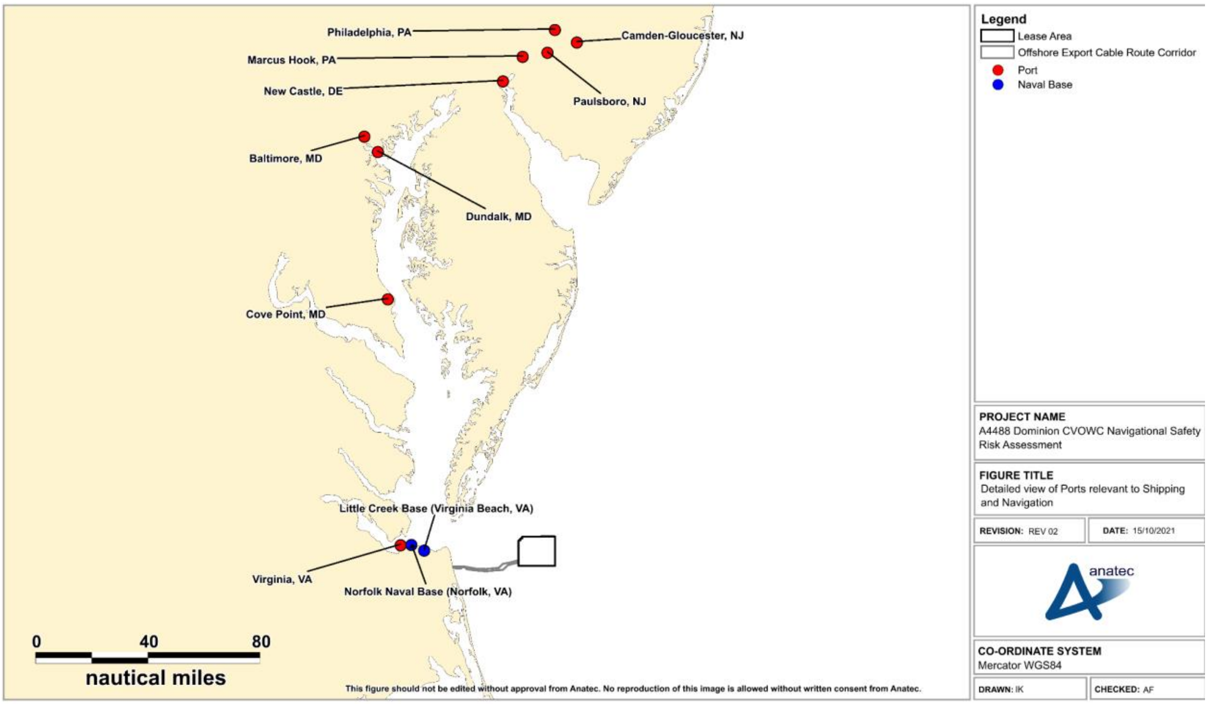

Figure 5.12 Detailed view of Ports relevant to Shipping and Navigation

The Little Creek Base – the major operating base for the Amphibious Forces in the US Navy's Atlantic Fleet – is located approximately 33 nm (61 km) west of the Lease Area. Located approximately 37 nm (69 km) west of the Lease area is the Norfolk Naval Station, the world's largest naval station, supporting 75 vessels and 134 aircraft. The closest port relevant to shipping and navigation is the Port of Virginia, VA located approximately 41.5 nm (77 km) west of the Lease Area. In terms of the destinations for vessel traffic broadcasting on AIS in proximity to the Project, the larger ports in the region include Baltimore, MD; Charleston, NC; Savannah, NC and Jacksonville, Florida (FL).

It is noted that the marine terminal locations belonging to the Port of Virginia are also regularly broadcast as destinations on AIS. The terminals are shown in Figure 5.13.

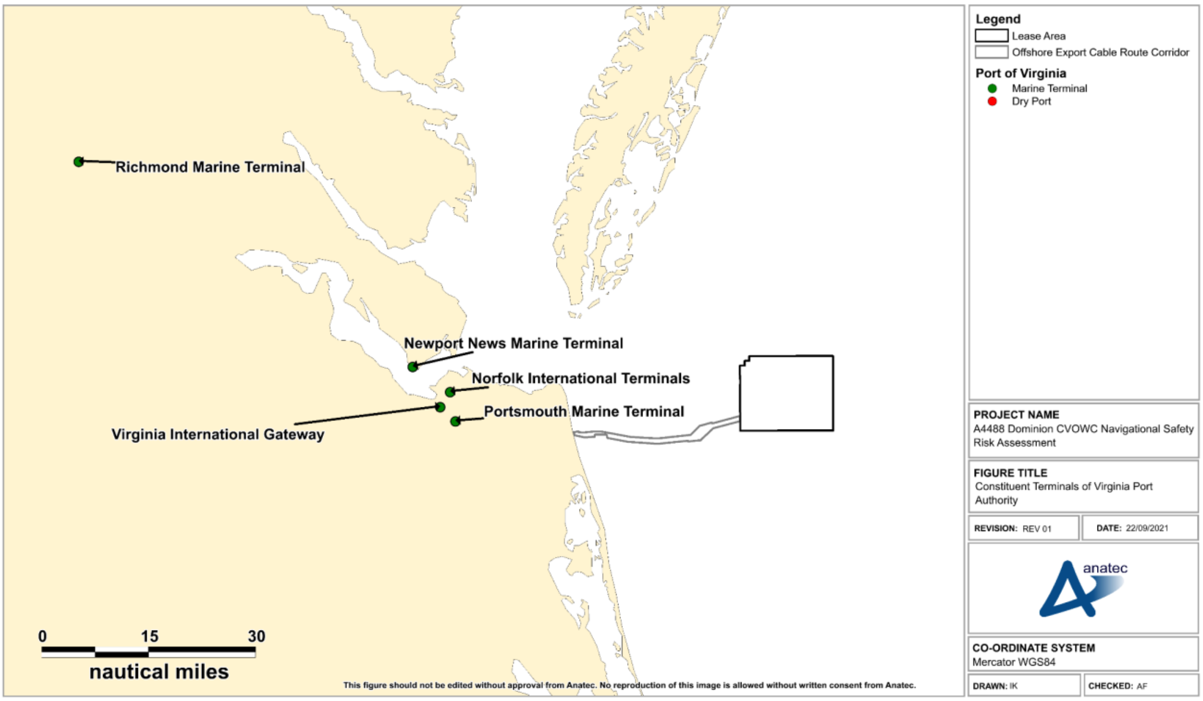

Figure 5.13 Constituent Marine Terminals of the Port of Virginia

5.2 Bathymetric Data

5.2.1 Lease Area

The charted water depths within the Lease Area are presented in Figure 5.14, based on NOAA chart 12200. It is noted that NOAA presents water depths in fathoms over Mean Lower Low Water (MLLW) and these values have therefore been overlaid with the depths in feet over MLLW in Figure 5.14 for clarity.

Water depths are shallowest towards the western end of the Lease Area (approximately 66 ft [20 m]) and increase to the east to a maximum of 114 ft (35 m).

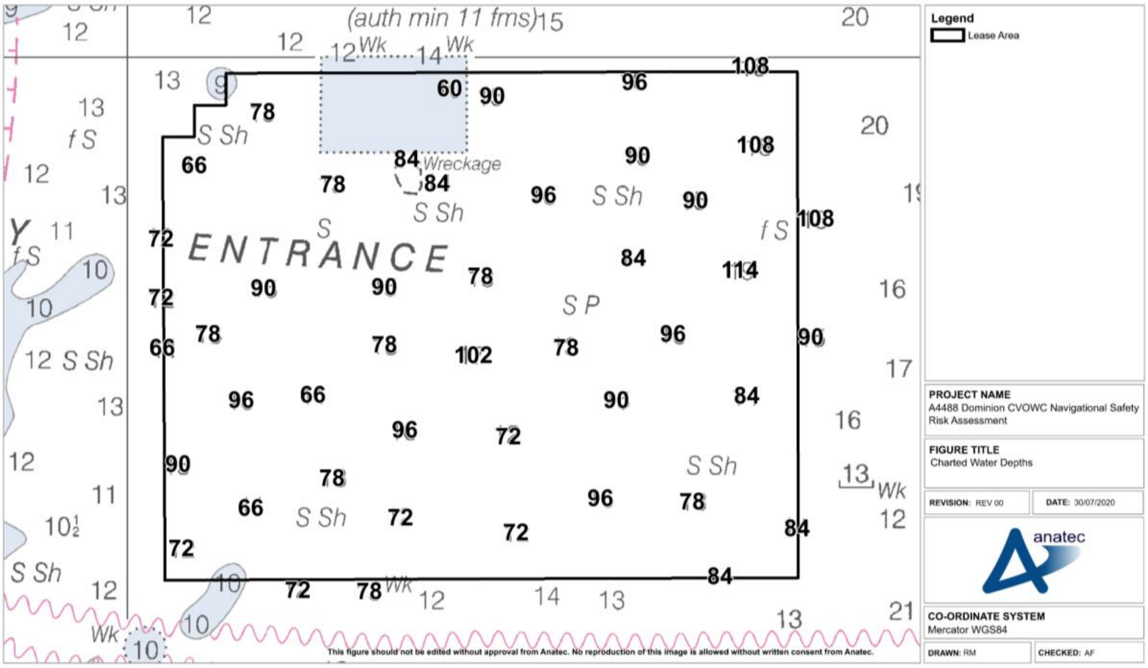

Figure 5.14 Charted Water Depths (ft over MLLW)

5.2.2 Offshore Export Cable Route Corridor

The charted water depths within the Offshore Export Cable Route Corridor are presented in Figure 5.15, based on NOAA charts 12207 and 12221. As discussed in Section 5.2.1, NOAA presents water depths in fathoms over MLLW and these values have therefore been overlaid with the depths in feet over MLLW for clarity.

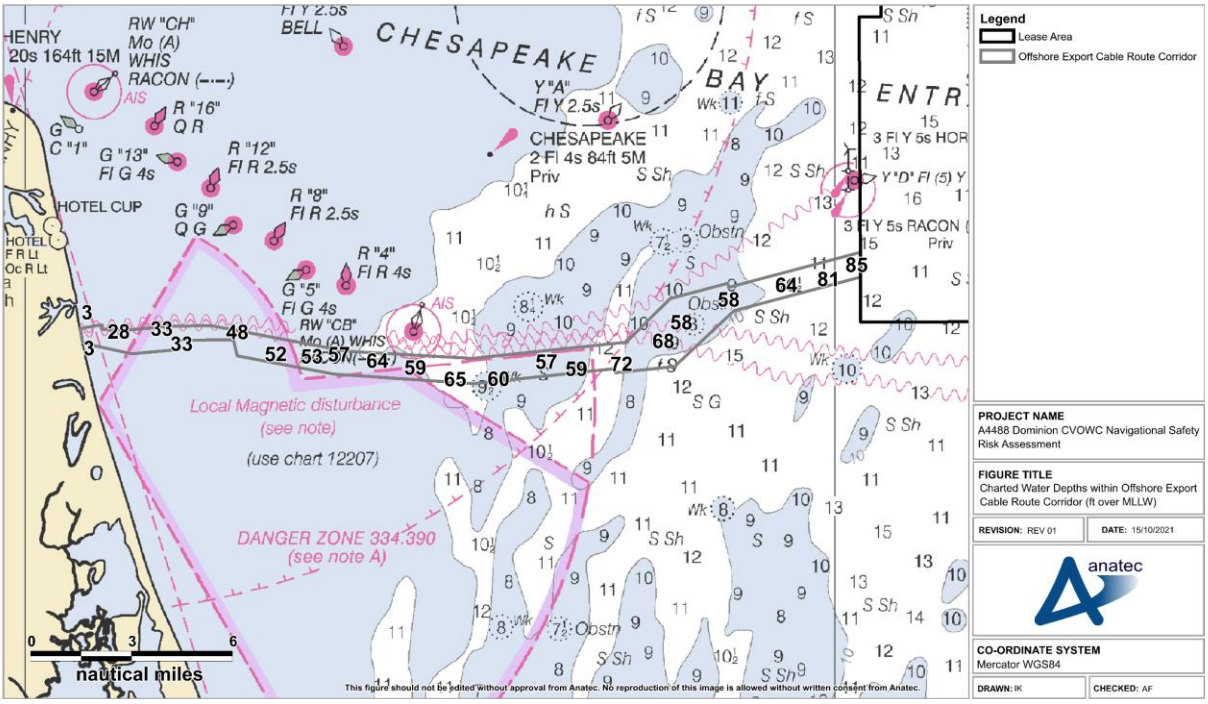

Figure 5.15 Charted Water Depths within Offshore Export Cable Route Corridor

Water depths are shallowest in the nearshore area (approximately 3 ft [0.9 m]), increasing in the seaward direction to a maximum of 85 ft (25.9 m) at the eastern extent where the Offshore Export Cable Route Corridor meets the Lease Area.

5.3 Meteorological Ocean Data

This section provides a high-level overview of the meteorological and oceanographic statistics within the study area. This data has been used as input for the collision, allision and grounding risk modelling in Section 10 as appropriate.

5.3.1 Wind

The wind data used as input to the collision and allision modelling is based upon metocean data from the Dominion Energy Metocean Assessment (COP Appendix X). The all-year wind rose is presented in Figure 5.16, showing the percentage of observations within each 30° sector.

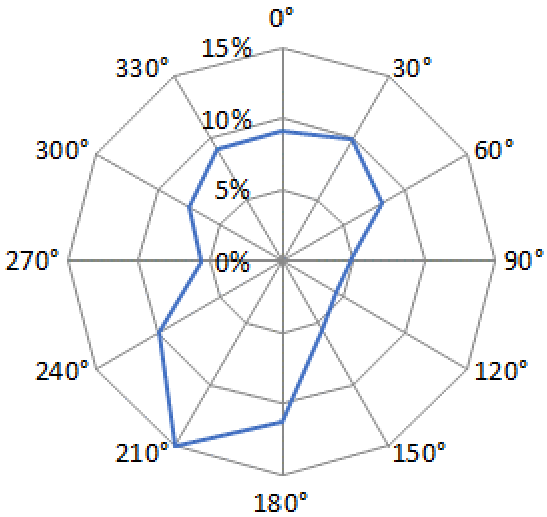

Figure 5.16 All-Year Wind Direction Breakdown (Dominion Energy Wind Assessment Report)

The predominant wind direction was observed to be from the southwest.

5.3.2 Wave

The sea state data used as input to the collision and allision modelling is based upon metocean data provided by the client within the Dominion Energy Metocean Assessment (Dominion Energy, 2020). The proportions of the sea state (based on significant wave height) at the Lease Area are presented in Table 5.1.

Table 5.1 Sea State Probabilities

Significant Wave Height (m)	Sea State	Proportion (%)
< 1	Calm	22.6
1 to 5	Moderate	76.7
≥ 5	Severe	0.7

5.3.3 Visibility

Based on information available in *Admiralty Sailing Directions NP69* (UKHO, 2017) the average probability of poor visibility within the area (defined as the proportion of the year where visibility can be expected to be less than 1 km) is 4 percent.

It is noted that United States Coast Pilot 4 (NOAA, 2019) also provides visibility details for the area, and indicates that the percentage of visibility being less than 2 nm (3.7 km) ranges between 1.3 percent and 5.2 percent with an average of 2.9 percent.

Given the CollRisk models (see Section 2.1.4) are calibrated against a definition of poor visibility being less than 1km, the 4 percent has been utilized, noting that is considered as aligning with the Coast Pilot values.

5.3.4 Tidal Streams

The tidal data used as input to the collision and allision risk modelling is based on ocean current data provided by the 44014 ODAS buoy located approximately 22 nm (41 km) southeast of the Lease Area. The peak flood and ebb tidal speed and direction is presented in Table 5.2.

Table 5.2 All-year peak flood and ebb tidal breakdown (ODAS Buoy 44014)

Tidal Scenario	Speed (knots)	Direction (°)
Flood	1.9	180
Ebb	1.9	045

Based on the available data and the distance offshore of the Lease Area, no impacts are expected at high water that would not also be expected at low water, and vice versa. The surface Offshore Project Components located within the Lease Area are expected to have no impact on the existing tidal streams.

5.3.5 Tropical Cyclones

NOAA defines a hurricane as a tropical cyclone with sustained surface wind of ≥ 64 knots (kn). The NOAA density grid illustrating tropical cyclone exposure (NOAA, 2018) is shown relative to the Lease Area in Figure 5.17, with levels of exposure quantitatively defined using intersecting storm tracks, overlapping wind intensity areas, and mathematical return intervals. Following this, Figure 5.18 provides an indication of the density at a more localized level (within 50 nm [92.6 km) of the Lease Area) with suitably refined density range brackets.

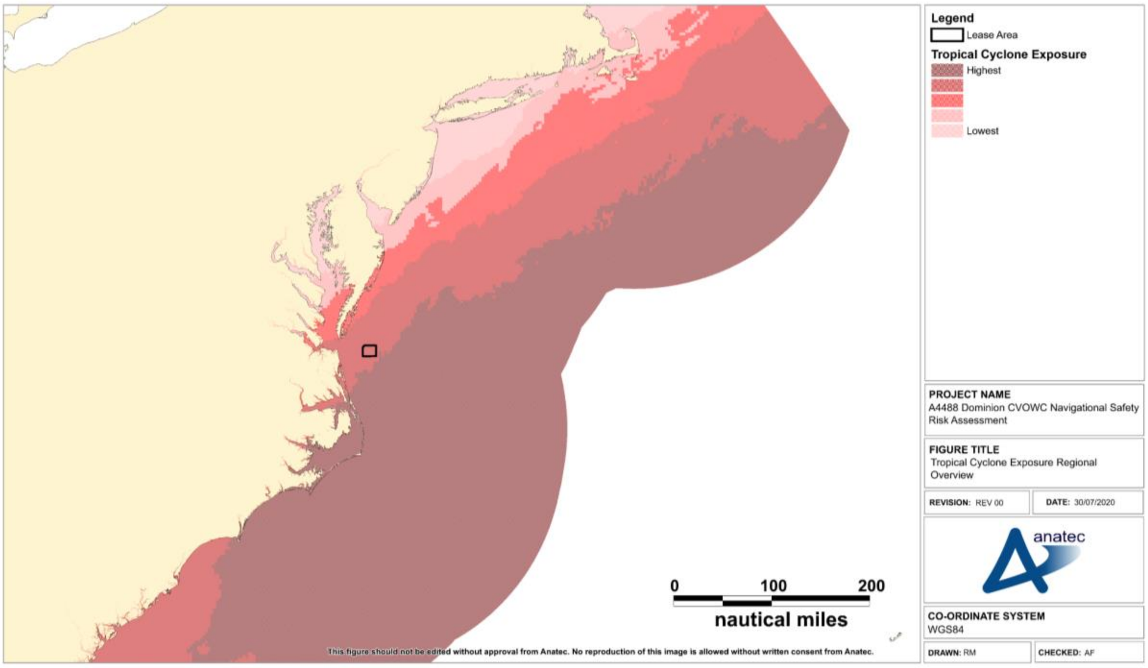

Figure 5.17 Tropical Cyclone Exposure Regional Overview

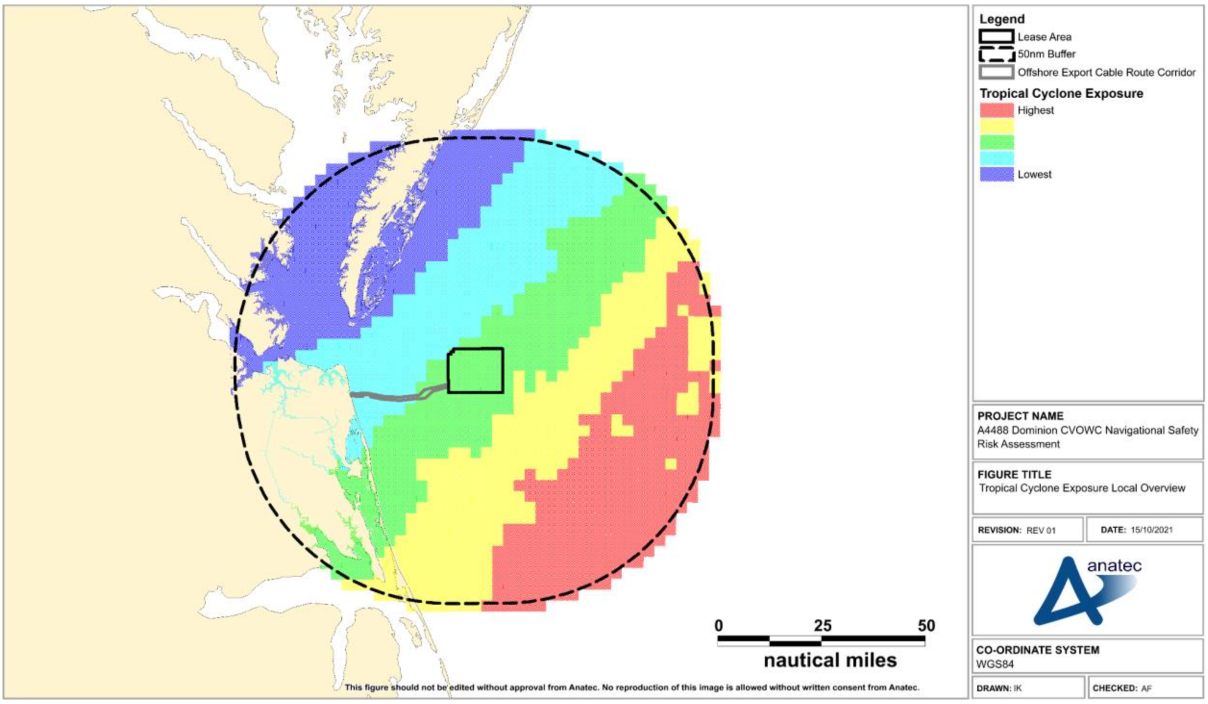

Figure 5.18 Tropical Cyclone Exposure Local Overview

The Lease Area is located in an area with high exposure to tropical cyclones. However, when considering a localized view, the exposure is relatively low owing to the proximity of the Lease Area to land, providing more shelter than areas further offshore with higher exposure.

Data provided by NOAA's Historical Hurricane Tracks database (NOAA, 2020) and plotted using data provided by the MMC is presented in Figure 5.19 within a 50 nm (92.6 km) area around the Lease

Area. These include one Category 2 storm (*Storm Gloria*, 1985) and two Category 1 storms (*Storm Belle*, 1976, and an unnamed storm in 1934) that intersected the Lease Area itself in a 120 year period from 1900 to 2020

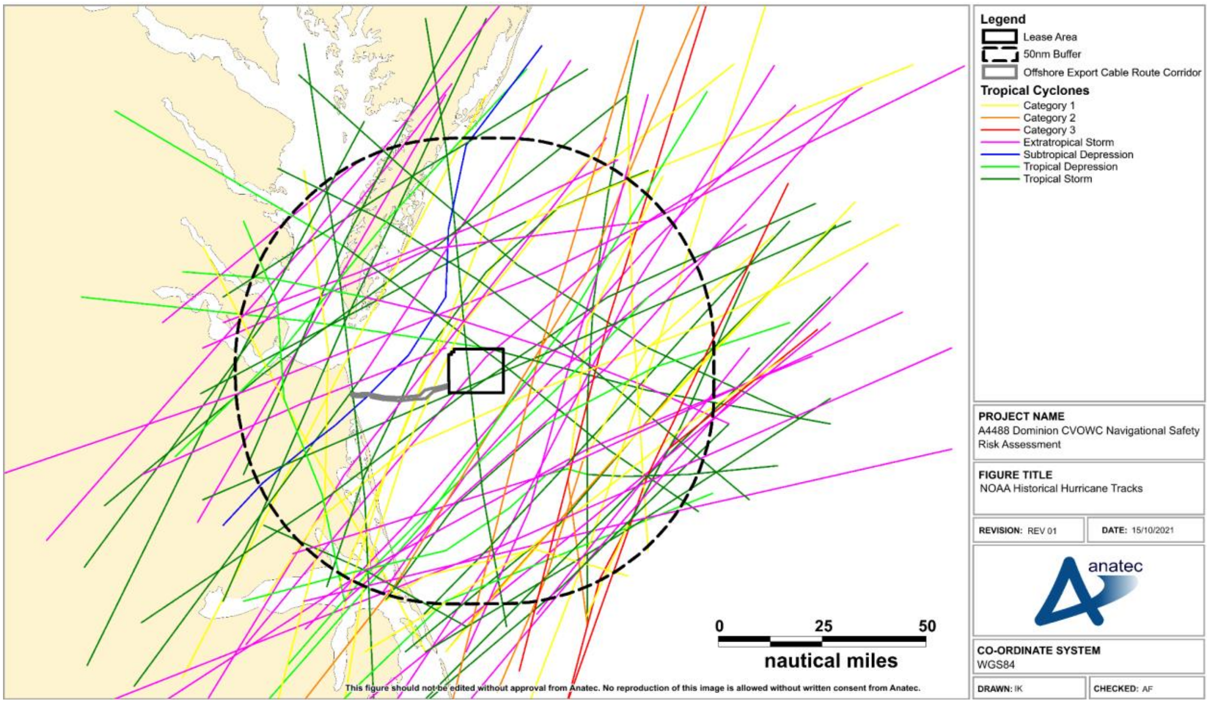

Figure 5.19 NOAA Historical Hurricane Tracks (1900 to 2020) (Geographical Locations from MMC)

A total of seven tropical cyclones were recorded intersecting the Lease Area, categorized as follows:

- *Hurricane Barbara* (Category 1) in August 1953;
- Five tropical storms with the latest in September 2000; and
- One extratropical storm in October 1956.

It is noted that no tropical cyclones have been recorded within the Lease Area since 2000. Given that NOAA's Historical Hurricane Tracks database covers 120 years and no major hurricanes (defined as Category 3 or higher) have been recorded within the Lease Area during that time the likelihood of such an instance is low. In terms of the wider 50nm area around the Lease Area, four Category 3 hurricanes have been recorded since 1900, all seaward of the Lease Area and with the latest occurring in September 1993, i.e., there has not been a major hurricane within 50nm of the Lease Area in the past 27 years.

Based on the low frequency of tropical cyclones at the Lease Area, particularly in recent years, and the generally low intensity of the few tropical cyclones which have been recorded, there is not anticipated to be any significant impacts on shipping and navigation relating to tropical cyclones, noting that in such circumstances vessels are less likely to be making passage in the area.

5.3.6 Ice

There is no note of sea ice in *United States Coast Pilot 3* (NOAA, 2020) for the region where the Project is located. The *Admiralty Sailing Directions NP69* (UKHO, 2017) makes the following statement:

"Even during severe seasons ice is extremely rare in the open seas within the area covered by this volume [Barnegat Inlet, NJ to Cape Canaveral, FL]. Pack ice usually lies well north of 40°N, the few icebergs which drift south of 40°N, are nearly always well east of the area, there being 11 such reports within the last hundred years or so."

This correlates with the findings of the MetOcean Assessment (Dominion Energy, 2020), which states that sea ice and icebergs are not expected to occur within the Lease Area.

In addition to sea ice, there is a possibility of icing of the WTG blades which may lead to ice throw during WTG operation, potentially striking vessels in proximity.

The paper *Icing Problems of Wind Turbines in Cold Climates* (Hudecz, A., Hansen, M.O.L., Battisti, L. & Villumsen, A., 2014) found that for a case study of South-Greenland low wind speeds, high relative humidity and sub-zero temperatures gave rise to the threat of WTG icing.

The distribution of air temperature from ODAS Buoy 44014, based upon data recorded over a 20-year period between 2000 and 2019, is presented in Figure 5.20. Humidity data was not available.

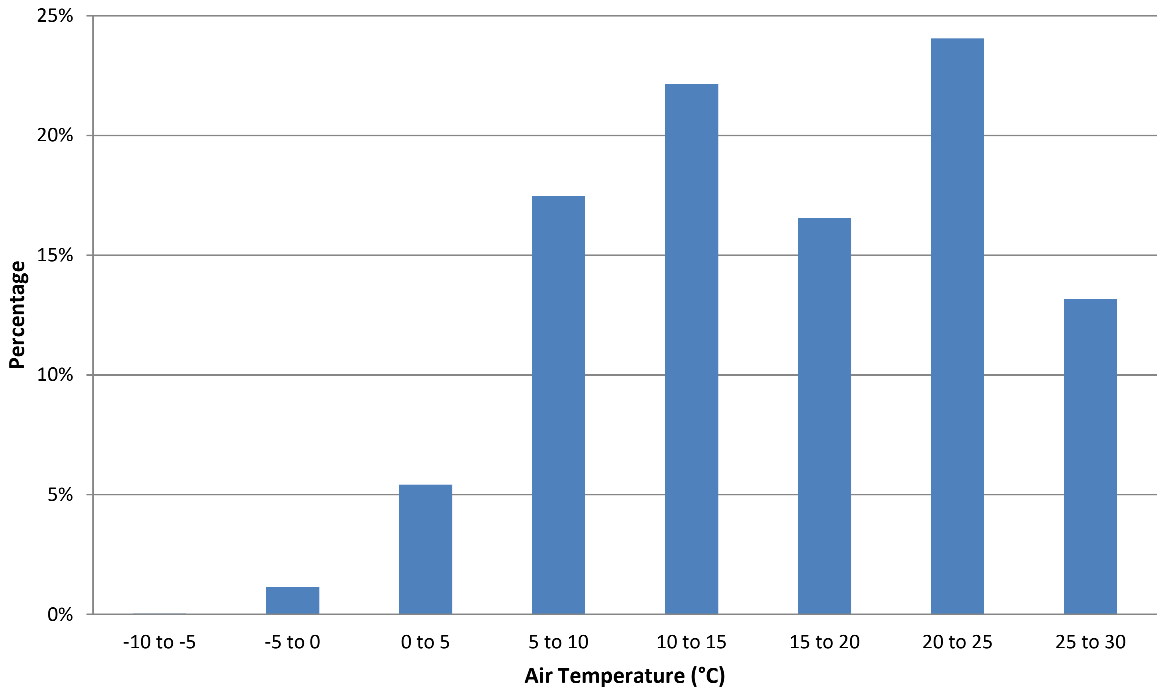

Figure 5.20 Air temperature distribution (ODAS Buoy 44014, 2000 to 2019)

The average air temperature during the 20-year period is 70°F (16.1°C). This is well in excess of conditions which could give rise to WTG icing. The air temperature fell below 32°F (0°C) approximately 1 percent of the time during this period.

The wind speed distribution at a height of 456 ft (139 m) MSL (hub height) as presented in the CVOWC Metocean Assessment (Dominion Energy, 2020) is presented in Figure 5.21.

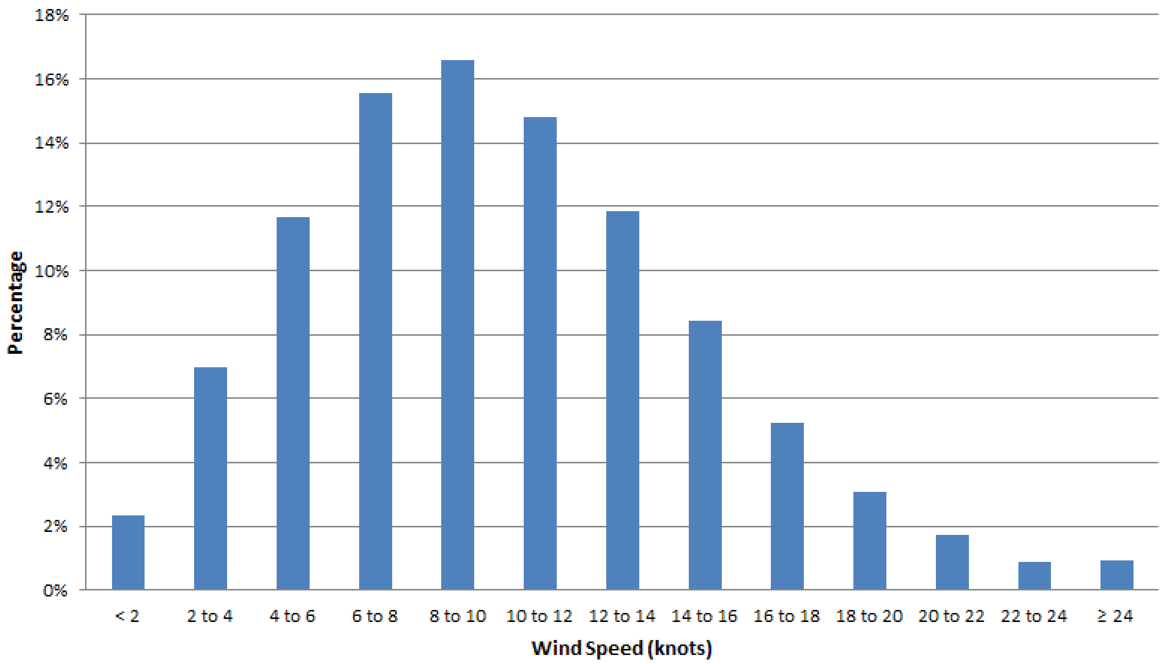

Figure 5.21 Wind Speed Distribution (139 m MSL)

Although approximately 50 percent of wind speed recordings were below 10 kn, only approximately 2 percent were 2 kn or less. From the data shown, it may be inferred that the number of occurrences in which all three climactic conditions specified by the Technical University of Denmark paper correlated was low. Given the low frequency of occurrence there is not anticipated to be any significant impacts on shipping and navigation relating to ice.

6 Maritime Traffic Characteristics

6.1 AIS Overview

AIS data collected during the entirety of 2019 has been assessed as per Section 1.5. To ensure coverage of the area is as comprehensive as practicable, this data has been commercially purchased from multiple sources, noting this includes AIS transmissions collected by both satellite and terrestrial receivers. The transmissions have then been combined into a single dataset, noting that this process includes means by which duplication of transmissions within the separate input data sets is detected and removed in the combined master data set. It is noted that this 12 month dataset predates the global impact on the shipping industry of the COVID-19 pandemic and represents the most recent period available that avoids any potential effects. It should also be considered that the data was recorded prior to the installation of the Pilot WTGs (see Section 5.1.5).

Any recorded data from vessels determined to be engaged in works considered as temporary (e.g. survey work) has been excluded from the analysis in this section.

6.2 Automatic Identification System Carriage Requirements

Regulation 19 of the International Regulations for the Safety of Life at Sea (SOLAS) Chapter V – Carriage requirements for vessel borne navigational systems and equipment, requires that AIS shall:

- Provide information – including the vessel's identity, type, position, course, speed, navigational status and other safety-related information – automatically to appropriately equipped shore stations, other vessels and aircraft; and
- Receive automatically such information from similarly fitted vessels; exchange data with shore-based facilities.

The SOLAS legislation has been translated in the US Flag State legislation by the Code of Federal Regulations (CFR). It requires that the following vessels shall carry an AIS Class A device:

I. A self-propelled vessel of 65 ft or more in length, engaged in commercial service;
II. A towing vessel of 26 ft or more in length and more than 600 horsepower (HP), engaged in commercial service;
III. A self-propelled vessel that is certified to carry more than 150 passengers;
IV. A self-propelled vessel engaged in dredging operations in or near a commercial channel or shipping fairway in a manner likely to restrict or affect navigation of other vessels; and
V. A self-propelled vessel engaged in the movement of:
    - Certain dangerous cargo as defined in 33 CFR § 160.204; or
    - Flammable or combustible liquid cargo in bulk that is listed in 46 CFR § 30.25-1.

Certain vessels may carry an AIS Class B device in lieu of an AIS Class A device if they are not subject to pilotage by a person other than the vessel Master or crew, including:

- Fishing industry vessels;
- Vessels identified in regulation I. above that are certificated to carry less than 150 passengers and that:

- Do not operate in a Vessel Traffic Service (VTS) or Vessel Movement Reporting System (VMRS); and
- Do not operate at speeds in excess of 14 kn.
- Vessels identified in regulation IV above engaged in dredging operations.

On this basis, it should be considered that certain vessel types (notably recreational vessels and fishing vessels of less than 65 ft in length) are not required to broadcast via AIS.

It should be noted that despite such vessels being exempt from AIS broadcast requirements, it is US Navy policy for its warships to transmit via AIS when within congested areas during peacetime.

6.2.1 Data Coverage

It should be considered that within the AIS data set used, the collection frequency of the satellite receivers was less than that of the onshore receivers, and therefore coverage further offshore was observed to drop when compared to nearshore areas. Additionally, it should also be considered that the following factors can affect AIS coverage:

- Weather;
- Atmospheric conditions;
- Size of the vessel carrying the AIS transmitter;
- Antenna height on the vessel carrying the AIS transmitter; and
- Height of the onshore antenna.

In terms of survey period, a total of 12 months of data has been assessed in this section to ensure any seasonal variations in traffic levels, types or behaviors are accounted for.

6.2.2 Vessel Dimension Units

The *USCG AIS Encoding Guide* (USCG, 2015) requires vessel dimensions transmitted via AIS to be in meters (m) (rather than ft). However, vessels transmitting their dimensions in ft were observed within the AIS data assessed in this NSRA. As far as is practicable, Anatec has made reasonable efforts to ensure that all vessel dimensions have been converted into a consistent unit system (dimensions within this report are presented primarily in ft, with metric units also included for reference in brackets where appropriate), however confirming the correct dimensions for every vessel recorded was not practical for the length and draft analysis undertaken given the high volume of data assessed.

6.3 Lease Area Automatic Identification System Data

Figure 6.1 presents a plot of the vessel tracks recorded within the Study Area throughout the survey period, color-coded by vessel type. Following this, Figure 6.2 presents the corresponding density grid for the same dataset.

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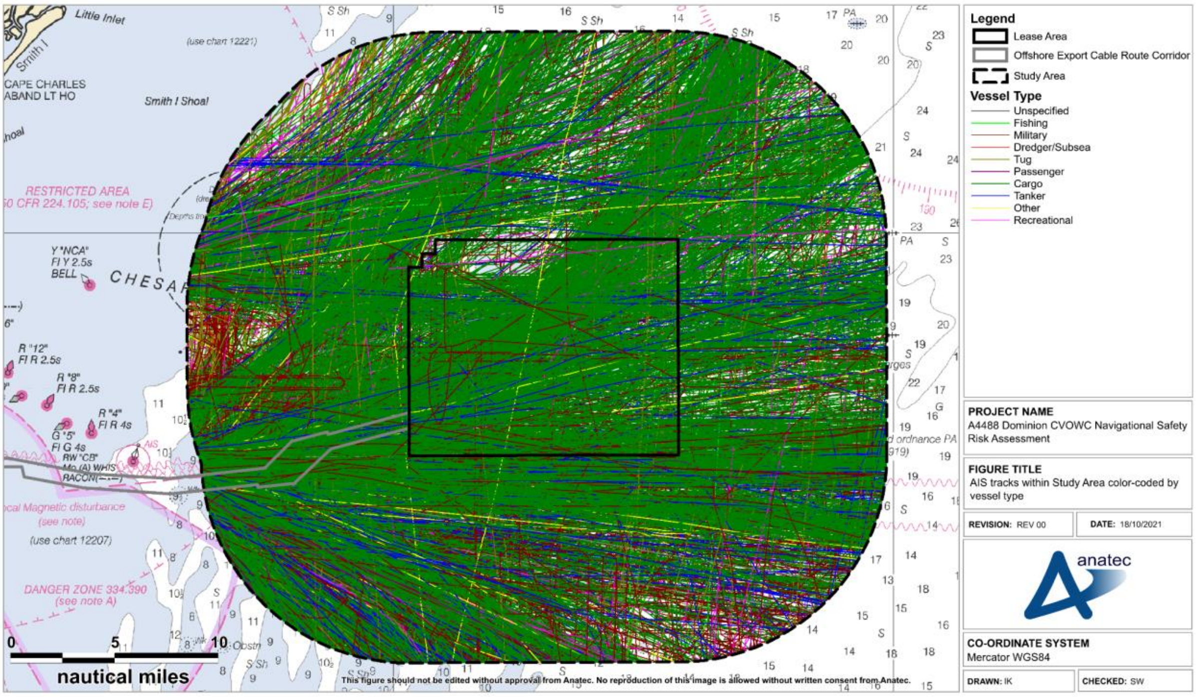

Figure 6.1 AIS tracks within Study Area color-coded by vessel type (12 months January to December 2019)

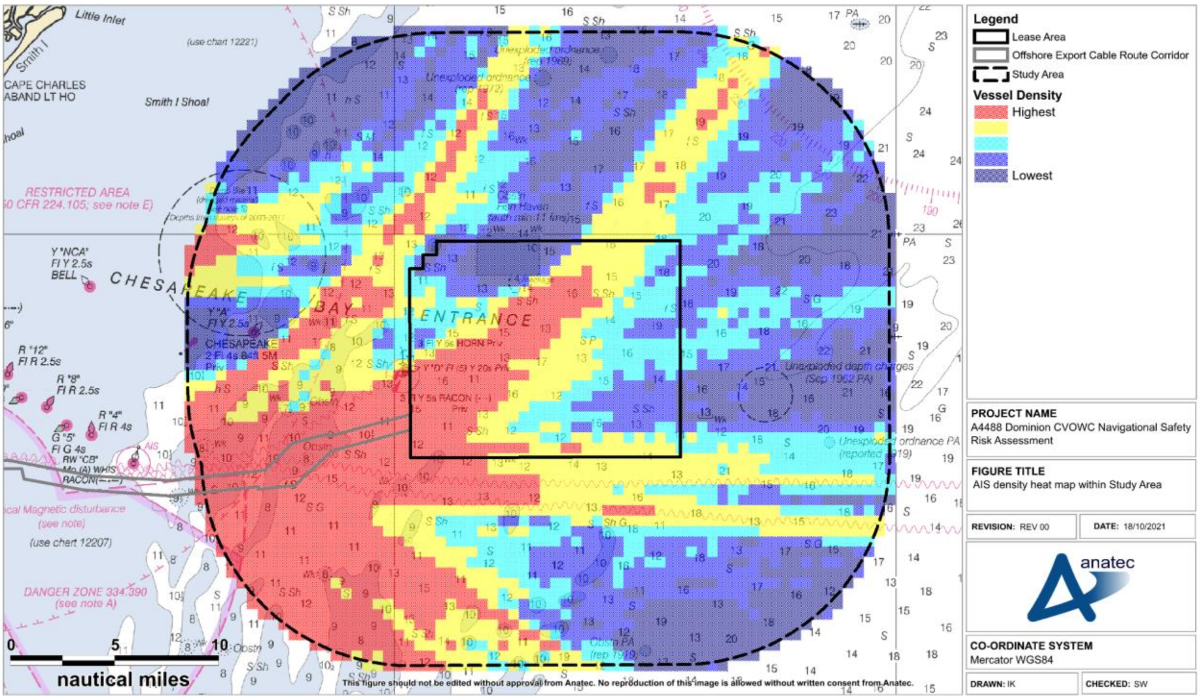

Figure 6.2 AIS density heat map within Study Area (12 months January to December 2019) – 0.5 x 0.5 nm Cell Resolution

The highest density area was in the approach to Chesapeake Bay, where large volumes of commercial traffic converged in the Southern Approach of the Chesapeake Bay TSS from the northeast, east, and southeast. Higher levels of density were also observed within the Lease Area (in comparison with much of the surrounding area), which was again primarily due to commercial traffic converging on the approach to Chesapeake Bay.

6.3.1 Vessel Count

Figure 6.3 presents the average number of unique vessels recorded per day for each month of 2019 within both the Study Area and the Lease Area itself.

It is noted that a unique vessel is defined as an individual vessel identified on any given calendar day, irrespective of the number of AIS tracks recorded for a given vessel on that day. This ensures that vessels are not over-counted. Individual vessels were identified using their Maritime Mobile Service Identity (MMSI) number.

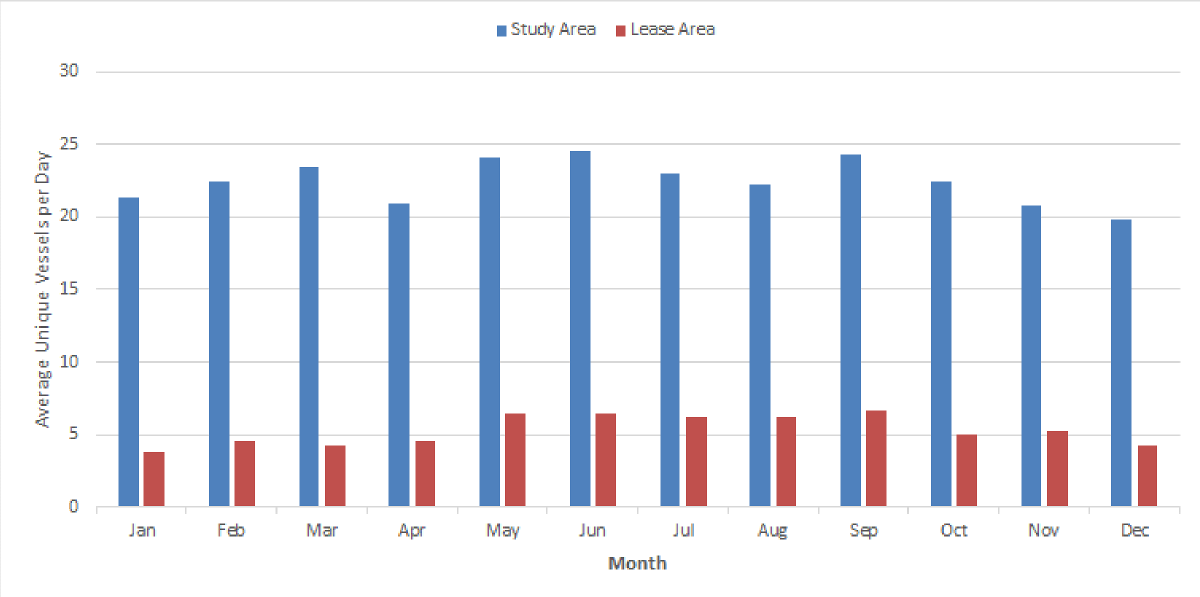

Figure 6.3 Average Unique Vessels per Day

Throughout the survey period an average of approximately 22 to 23 unique vessels per day was recorded within the Study Area. The busiest months of 2019 were May and September, with an average of approximately 24 unique vessels per day, while the busiest individual day was May 8th, on which 40 unique vessels were recorded. There was not considered to be significant fluctuation over the year in terms of vessel numbers, noting that the quietest month was December, when an average of 20 unique vessels per day were recorded. This is reflective of the majority of traffic in the area comprising larger commercial vessels (see Section 6.3.4), which are less likely to be influenced by seasonal weather changes than smaller vessel types.

When considering only those vessel tracks intersecting the Lease Area, there was an average of six unique vessels per day recorded during 2019. The busiest month was September, with an average of seven unique vessels per day, while the busiest individual days were August 29th and September 21st, each with 15 unique vessels recorded. Overall, approximately 25 percent of vessel tracks recorded within the Study Area intersected the Lease Area itself.

The AIS tracks recorded on the busiest day (May 8th 2019) and the busiest month (May 2019) within the Study Area are presented in Figure 6.4 and Figure 6.5 respectively.

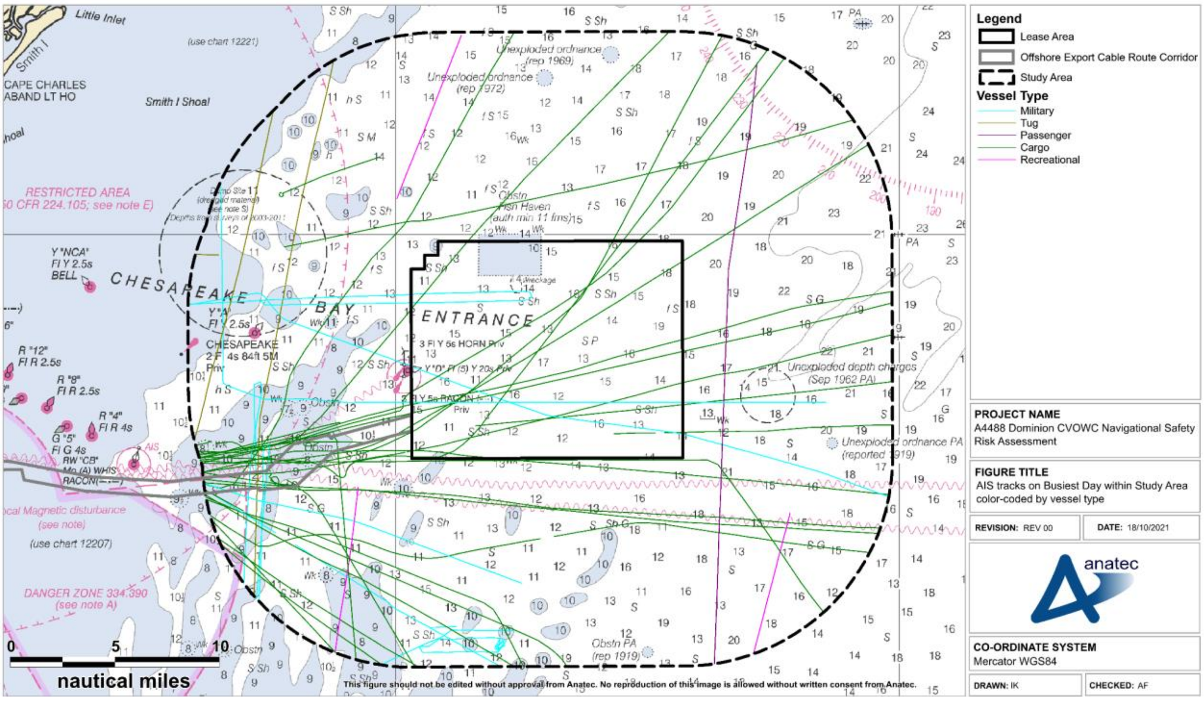

Figure 6.4 AIS tracks on Busiest Day within Study Area color-coded by vessel type

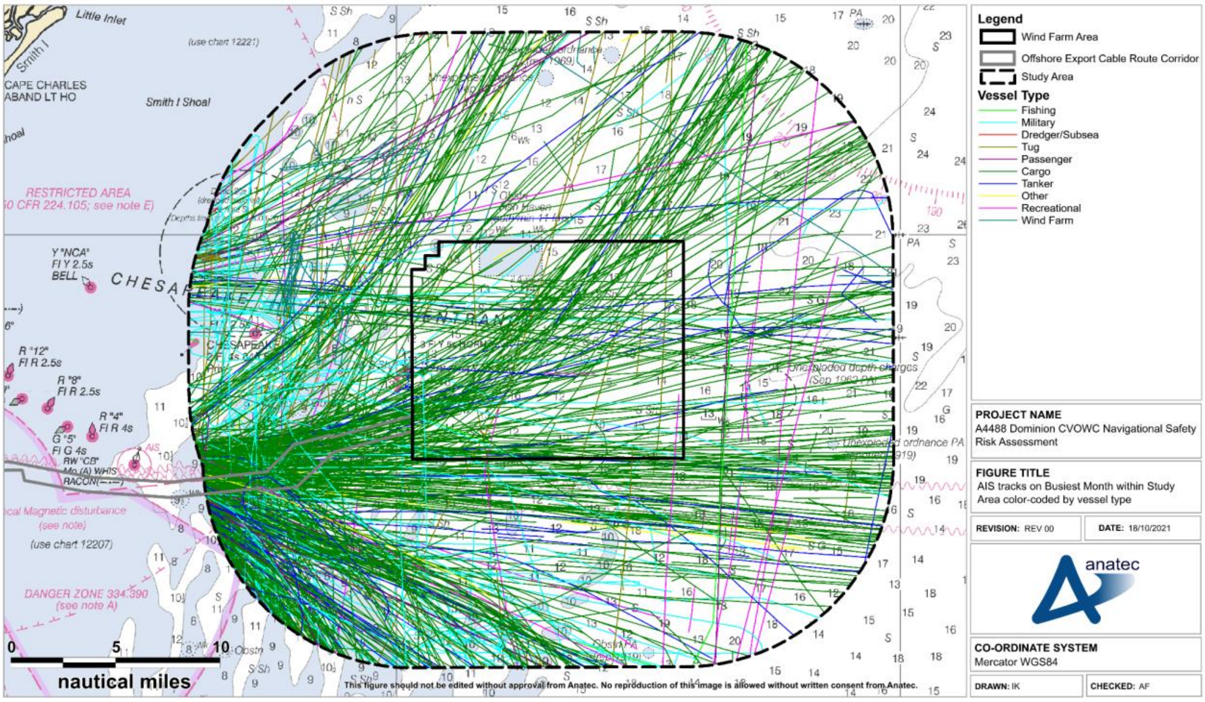

Figure 6.5 AIS tracks on Busiest Month within Study Area color-coded by vessel type

6.3.2 Vessel Size

6.3.2.1 Vessel Length

Figure 6.6 presents a plot of the vessel tracks recorded within the Study Area throughout the survey period, color-coded by vessel length. Following this, Figure 6.7 presents the corresponding distribution of vessel lengths. It is noted that a limited proportion of vessel tracks (approximately 0.1 percent) could not be associated with a valid length and have therefore been excluded from the analysis.

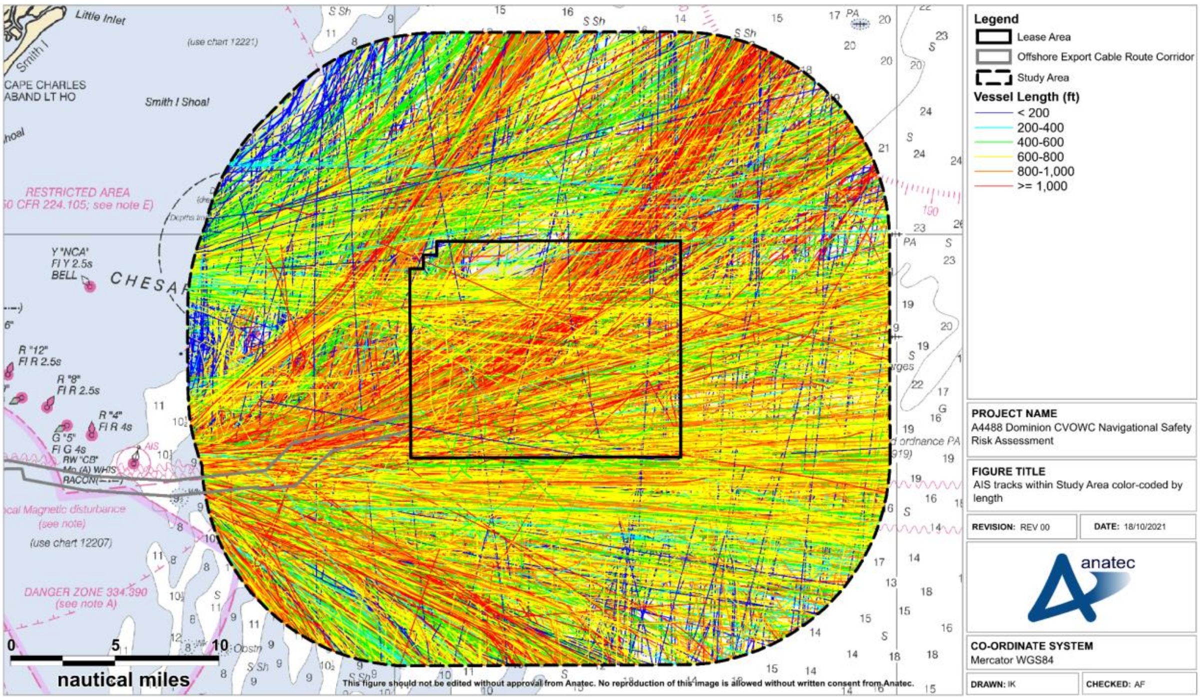

Figure 6.6 AIS tracks within Study Area color-coded by length (12 months January to December 2019)

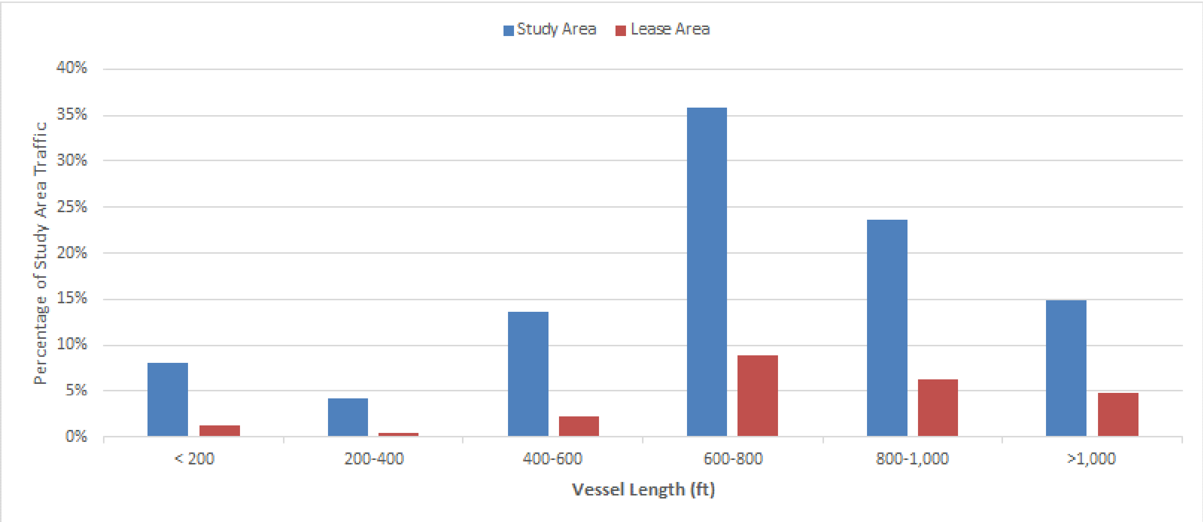

Figure 6.7 Vessel length distribution

Excluding those vessel tracks without a valid length, the average length of vessels recorded within the Study Area throughout the survey period was 728 ft (222 m). The majority of vessels were greater than 600 ft (183 m) length, with the majority of these being transiting cargo vessels. Excluding those vessel tracks without a valid length, the most frequent length of vessel recorded within the study area throughout the survey period was 600-800 ft (182-244 m), with approximately 36 percent of vessels falling within this range.

When considering only those vessel tracks intersecting the Lease Area, the average length of vessels was 798 ft (243 m), with the majority of vessels again greater than 500 ft (152 m) in length. The increase in the average length may be attributed to the heavy presence of larger commercial traffic passing through the Lease Area, whereas smaller craft (commercial fishing vessels and recreational vessels) were less frequently recorded intersecting the Lease Area (noting the distance offshore).

The longest vessels recorded within the Study Area were two 1,211 ft (369 m) Neopanamax[9] container vessels, travelling between the Port of Virginia, VA and Port of New York and New Jersey, NY (north out of Chesapeake Bay) or Colón, Panama (south out of Chesapeake Bay). Both vessels also intersected the Lease Area itself.

6.3.2.2 Vessel Draft

Figure 6.8 presents a plot of the vessel tracks recorded within the Study Area throughout the survey period, color-coded by vessel draft. It is noted that approximately 5 percent of vessel tracks did not broadcast a valid draft. Figure 6.9 presents the corresponding distribution of vessel drafts, excluding the tracks from vessels which could not be associated with a valid draft.

[9] Or New Panamax – refers to the size restrictions associated with using the Panama Canal

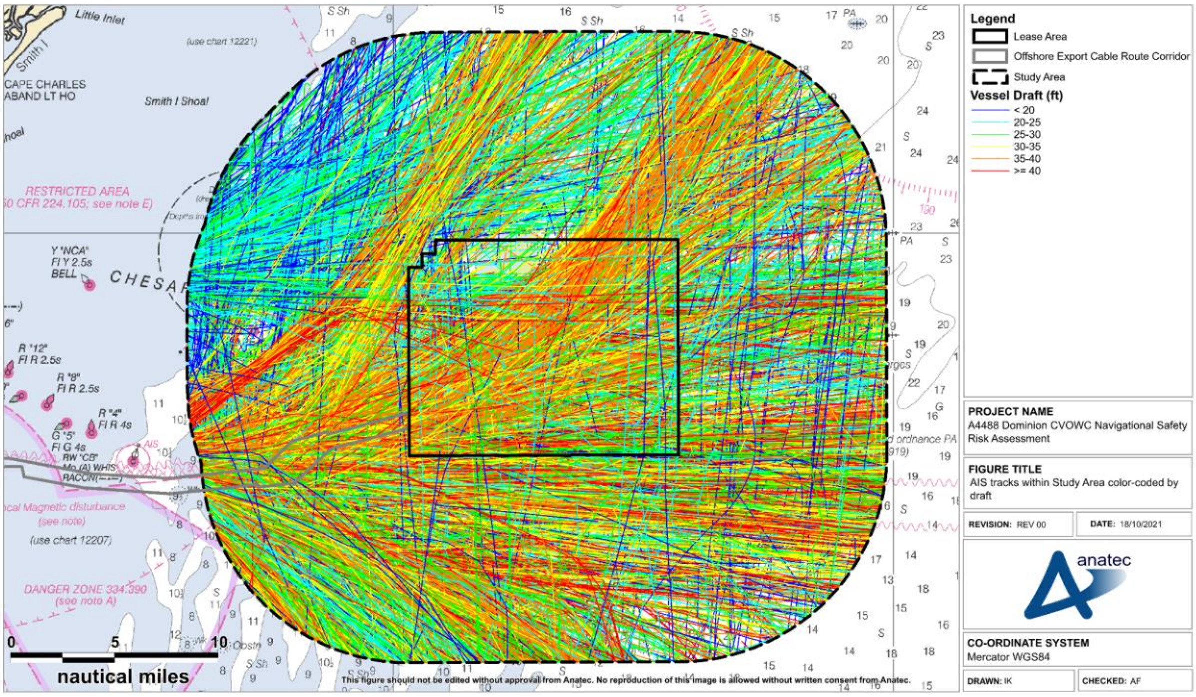

Figure 6.8 AIS tracks within Study Area color-coded by draft (12 months January to December 2019)

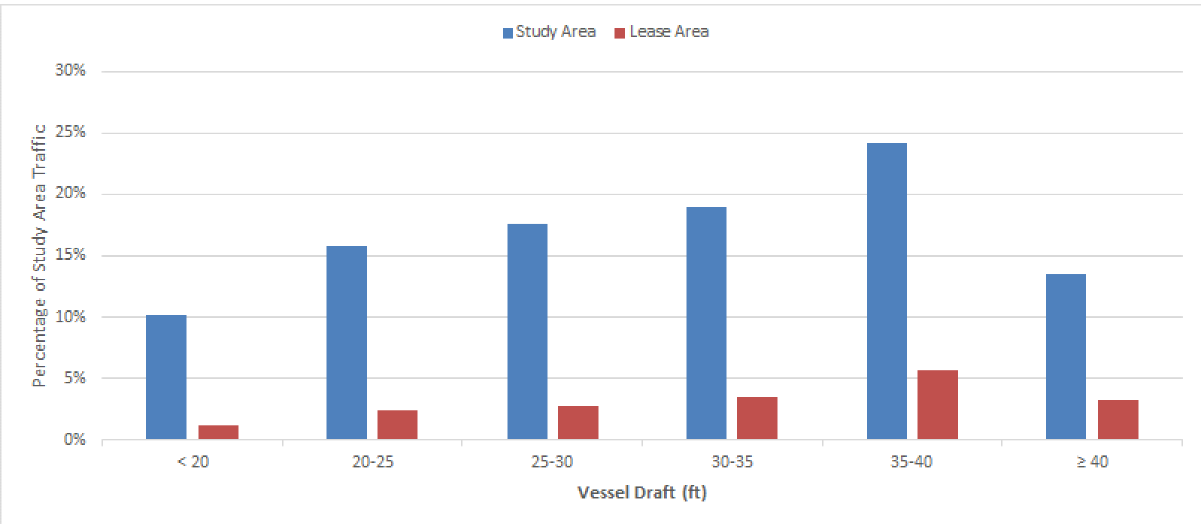

Figure 6.9 Vessel draft distribution (12 months January to December 2019)

Excluding those vessels not broadcasting a valid draft (the majority of which were observed to be military vessels), the average draft recorded within the Study Area was 31 ft (8.8 m). The deepest draft recorded in the Study Area was 50.9 ft (15.5 m), recorded by a bulk carrier.

When considering only those vessel tracks intersecting the Lease Area, the average draft of vessels was 33.1 ft (10.1 m). The deepest draft recorded within the Lease Area was 50.2 ft (15.3 m), recorded by a bulk carrier.

6.3.3 Vessel Speed

Figure 6.10 presents a plot of the vessel tracks recorded within the Study Area throughout the survey period, color-coded by vessel speed. Figure 6.11 then presents the corresponding distribution of vessel speeds.

It should be considered that the SMA described in Section 5.1.7 intersects the Study Area and as such, between the months of November and April, all vessels of 65 ft (19.8 m) in length or greater are restricted to speeds of 10 knots or less when entering the SMA. The SMA boundary is included in Figure 6.10 for reference.

Within this section, the speed of a track refers to the average of all speeds transmitted by the corresponding vessel associated with that track.

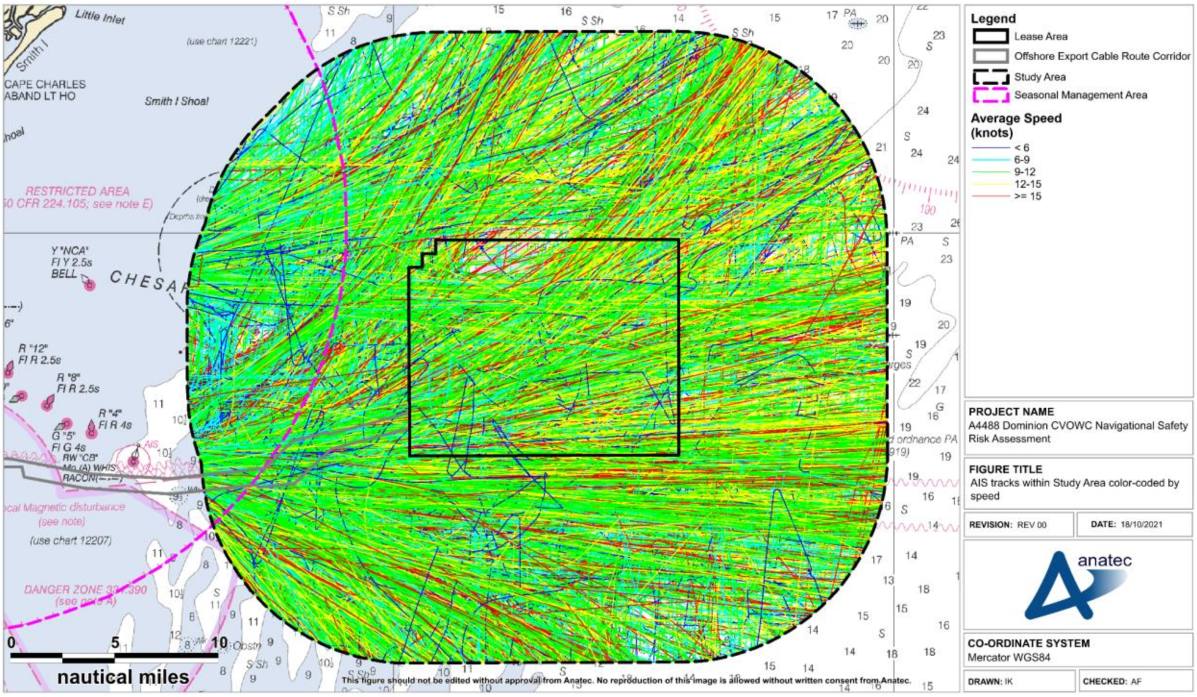

Figure 6.10 AIS tracks within Study Area color-coded by speed (12 months January to December 2019)

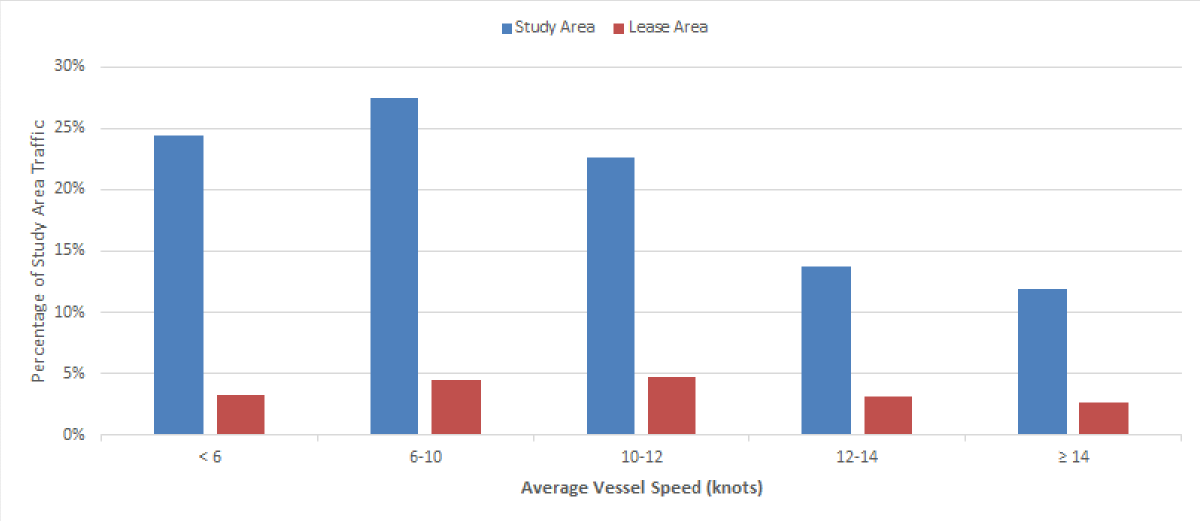

Figure 6.11 Vessel speed distribution

The average speed recorded within the Study Area was 8.9 kn; it is noted that this includes anchored vessels, which will typically have very low speeds (less than 1 kn). With anchored vessels excluded, the average speed recorded within the Study Area rose to 10.2 kn.

When considering only those vessel tracks intersecting the Lease Area, the average speed recorded was 9.8 kn, rising to 10.2 kn with anchored vessels excluded (noting that as per Section 6.3.5, anchoring activity within the Lease Area was limited when compared to the study area as a whole).

6.3.4 Vessel Type

6.3.4.1 Overview

Figure 6.1 presents a plot of the vessel tracks recorded within the Study Area throughout the survey period, color-coded by vessel type. The 'other' vessels category includes offshore supply vessels and research/survey vessels.

Figure 6.12 presents the distribution of the main vessel types within both the Study Area and the Lease Area itself.

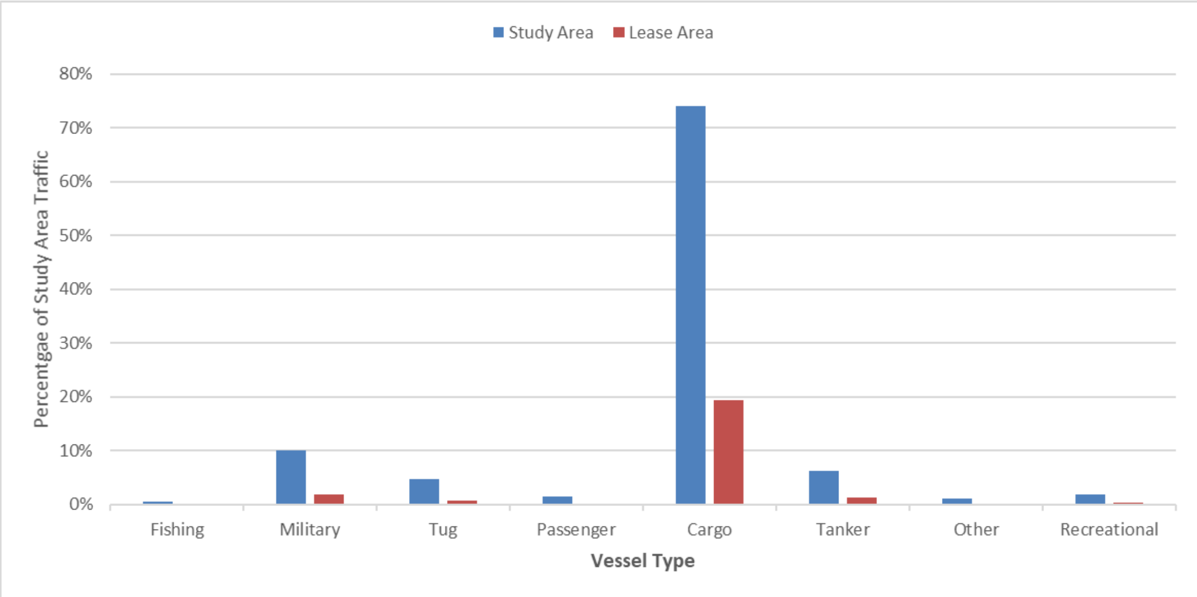

Figure 6.12 Main vessel type distribution

Throughout the survey period the most frequently recorded vessel types within the Study Area were cargo vessels (representing approximately 73 percent of all recorded traffic) followed by military vessels (10 percent) and tankers (6 percent).

When considering only those vessel tracks intersecting the Lease Area, cargo vessels remain the most frequently recorded vessel type (approximately 19 percent of all vessel traffic within the Study Area) followed by military vessels (2 percent) and tankers (1 percent).

The following subsections consider each of the main vessel types individually.

6.3.4.2 Commercial Vessels

Figure 6.13 presents a plot of the cargo vessel tracks recorded within the Study Area throughout the survey period, color-coded by cargo vessel type. Cargo vessels accounted for 73 percent of traffic within the Study Area. Cargo vessels intersecting the Lease Area itself accounted for 19 percent of traffic within the Study Area.

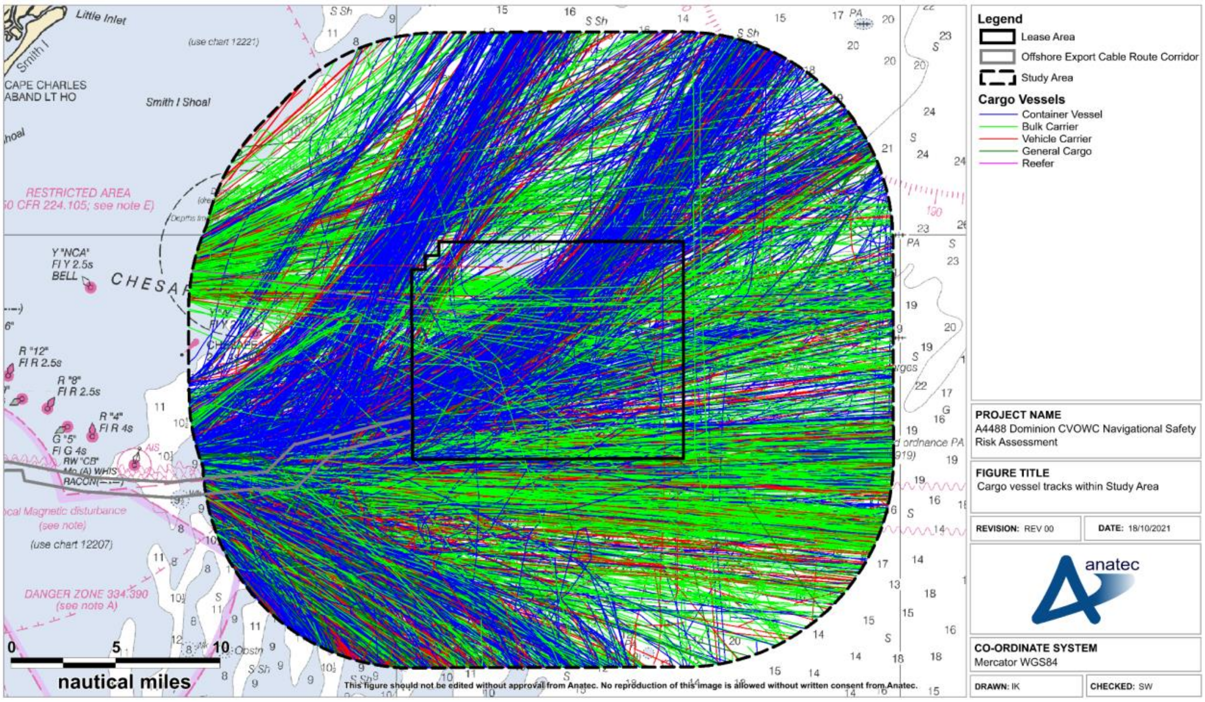

Figure 6.13 Cargo vessel tracks within Study Area (12 months January to December 2019)

Throughout the survey period, an average of 17 unique cargo vessels per day was recorded within the Study Area and four per day within the Lease Area itself. Container vessels were the most frequently recorded cargo vessel type within the Study Area (43 percent) followed by bulk carriers (33 percent) and vehicle carriers (14 percent).

Cargo vessels were most prominently recorded routing in and out of ports located within Chesapeake Bay to the west of the Study Area and either following the US east coast or headed for major ports in Europe and Africa.

Figure 6.14 presents a plot of the tanker tracks recorded within the Study Area throughout the survey period. Tankers accounted for approximately 6 percent of traffic within the Study Area.

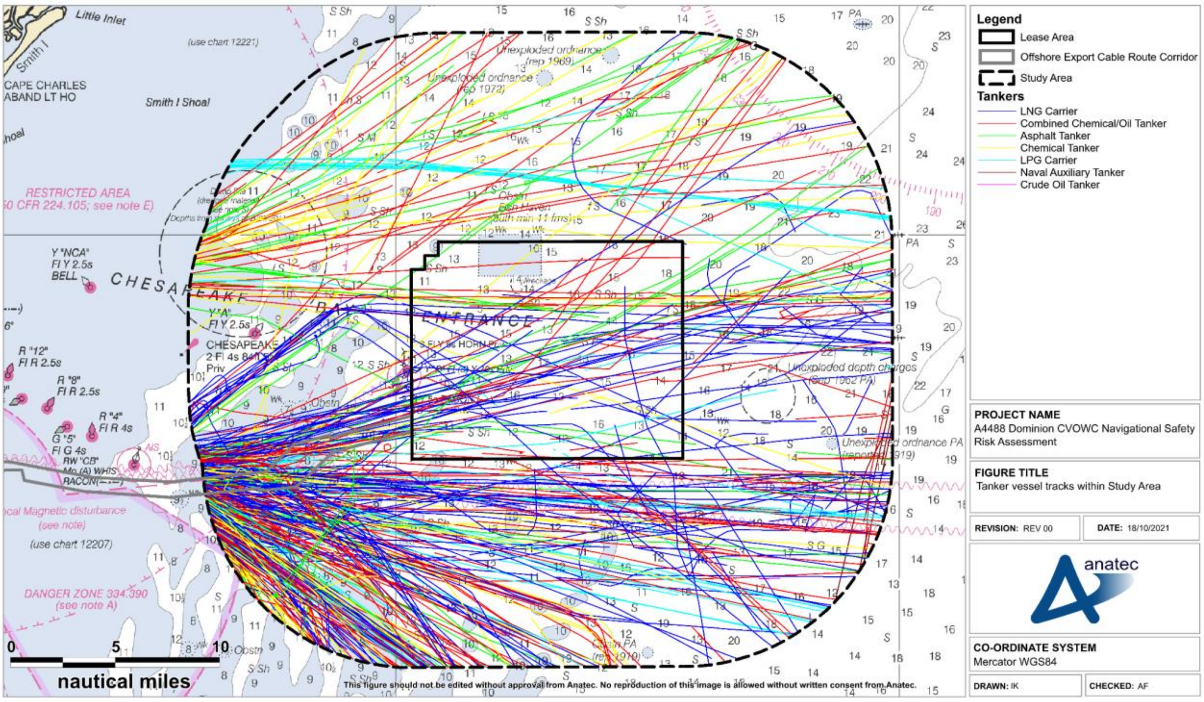

Figure 6.14 Tanker tracks within Study Area (12 months January to December 2019)

Throughout the survey period an average of one unique tanker per day was recorded within the Study Area and one in three days within the Lease Area itself. Liquid natural gas carriers were the most frequently recorded tanker type within the Study Area (33 percent) followed by combined chemical/oil tankers (25 percent) and chemical tankers (15 percent).

As with cargo vessels, tankers were most prominently recorded routing in and out of ports located within Chesapeake Bay to the west of the Study Area, predominantly following the US east coast and infrequently transiting European ports.

Figure 6.15 presents a plot of the passenger vessel tracks recorded within the Study Area throughout the survey period. Passenger vessels accounted for approximately 2 percent of traffic within the Study Area.

Throughout the survey period an average of one unique passenger vessel every three days was recorded within the Study Area although the presence of passenger vessel within the Lease Area itself was limited.

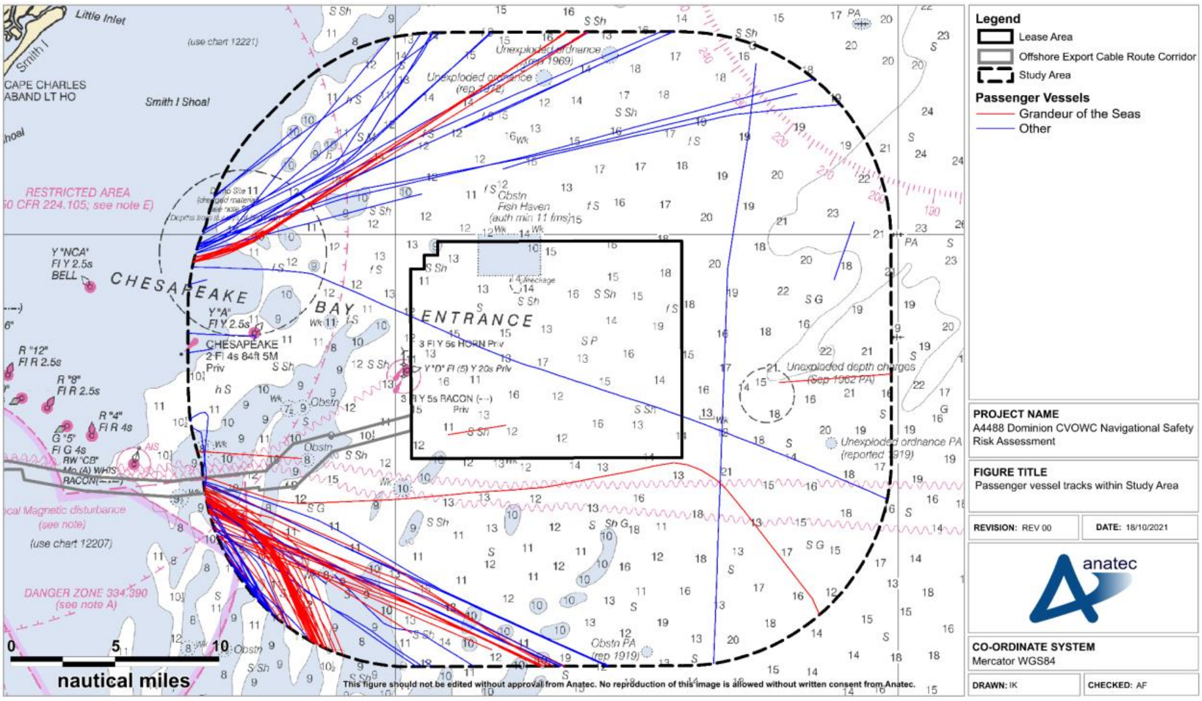

Figure 6.15 Passenger vessel tracks within Study Area (12 months January to December 2019)

The majority of these tracks belonged to the cruise liner *Grandeur of the Seas*, which runs round-trip Caribbean cruises throughout the year. In the south of the Study Area, vessels were observed transiting NW-SE between Baltimore, Maryland (MD) and Bermuda, while tracks turning southward are between Baltimore, MD and the Bahamas.

In the northern part of the Study Area, vessels were transiting between Baltimore, MD and ports on the US east coast such as Bar Harbor, Maine (ME) and Boston, Massachusetts (MA).

6.3.4.3 Military Vessels

Figure 6.16 presents a plot of the military vessel tracks recorded within the Study Area throughout the survey period. Military vessels, such as combat vessels and replenishment oilers and inclusive of USCG vessels, accounted for approximately 10 percent of traffic within the Study Area.

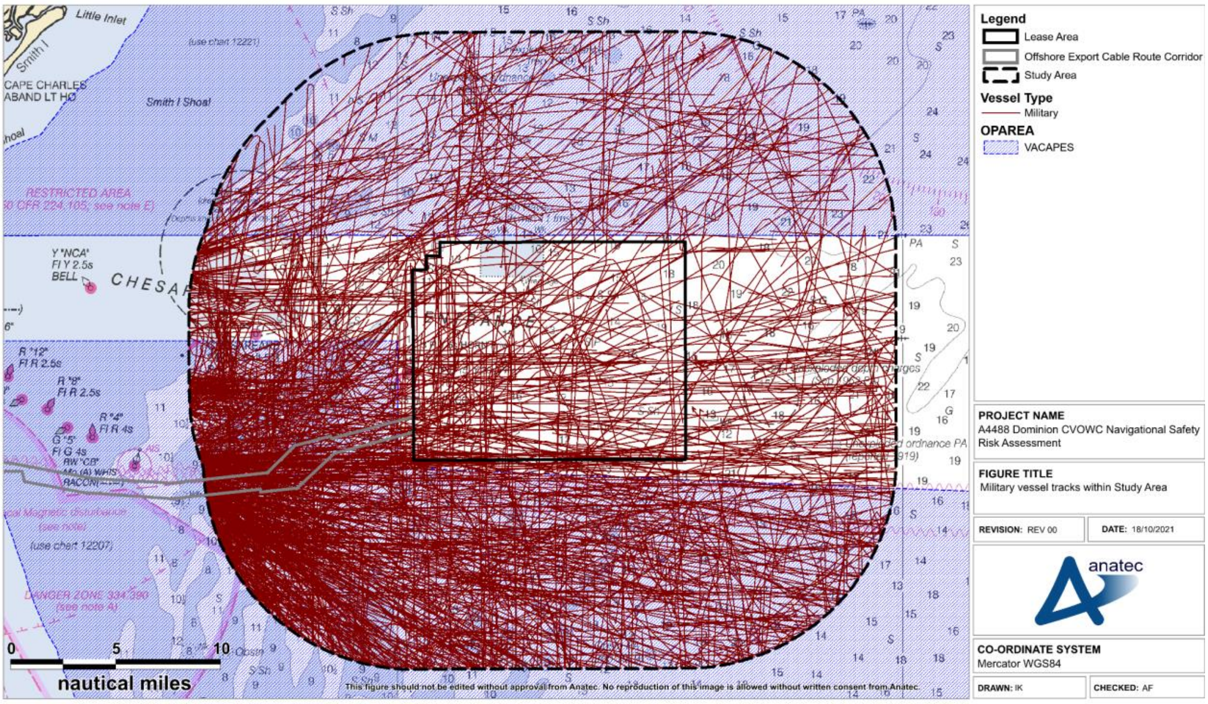

Figure 6.16 Military vessel tracks within Study Area (12 months January to December 2019)

Throughout the survey period an average of two unique military vessels per day were recorded within the Study Area and one every two to three days within the Lease Area itself. The majority of military vessels were inbound or outbound from Chesapeake Bay (including the Joint Expeditionary Base–Little Creek). A significant proportion of military traffic is undertaking military operations, noting that this is within the OPAREA described in Section 5.1.9.

6.3.4.4 Push/Tow Vessels

Figure 6.17 presents a plot of the push/tow vessel (tug) tracks recorded within the Study Area throughout the survey period.

Throughout the survey period an average of one unique push/tow vessel per day was recorded within the Study Area and one in six to seven days within the Lease Area itself.

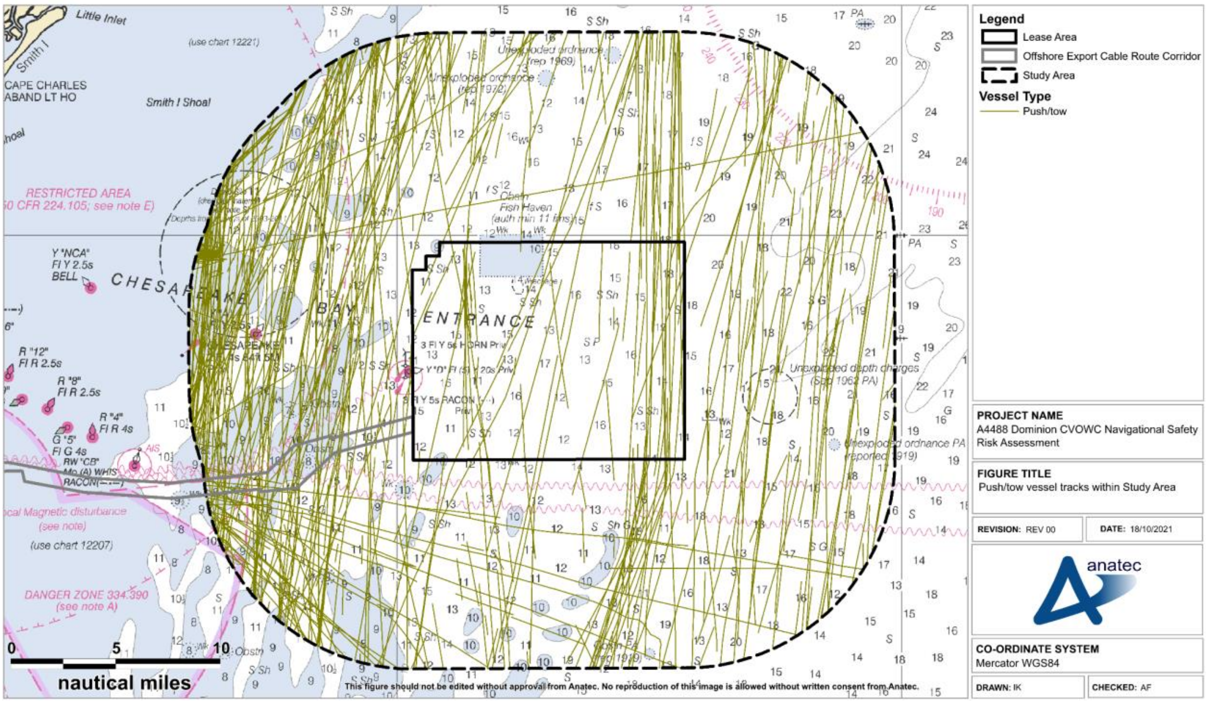

Figure 6.17 Push/tow vessel tracks within Study Area (12 months January to December 2019)

The majority of tugs (push/pull) vessels were observed transiting inshore of the Lease Area north-south between the Port of New York and New Jersey, NY and other ports along the eastern US coastline such as Charleston, South Carolina (SC), noting that a minority were also observed further from the coast intersecting or offshore of the Lease Area.

6.3.4.5 Fishing Vessels

Figure 6.18 presents a plot of the fishing vessel tracks recorded within the Study Area throughout the survey period. Fishing vessels accounted for approximately 1 percent of traffic within the Study Area.

As inferred in Section 6.2, the AIS carriage requirements do not extend to smaller craft including some fishing vessels. Together with the range of coastal receivers and the observed failure of fishing vessels to universally comply with AIS carriage requirements, the AIS data alone is not considered to provide a comprehensive characterization of fishing vessel movements within and in proximity to the Lease Area. Therefore, this section provides analysis of additional VMS fishing vessel data in order to validate the findings of the AIS data.

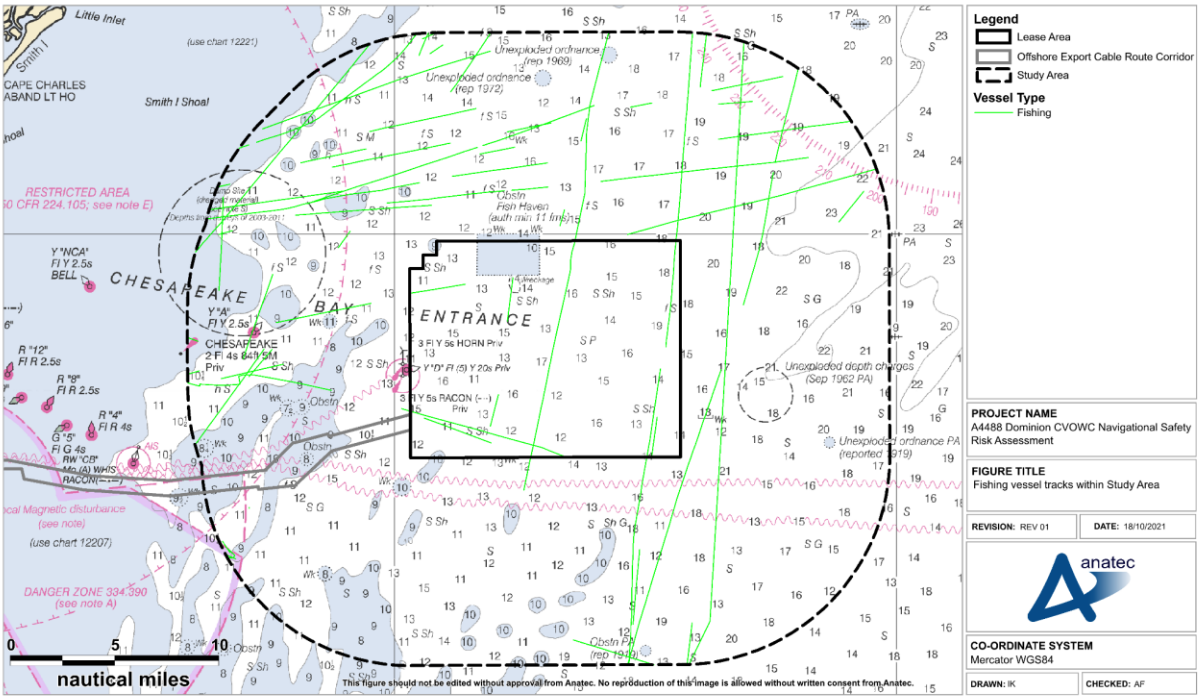

Figure 6.18 Fishing vessel tracks within Study Area (12 months January to December 2019)

Throughout the survey period an average of one unique fishing vessel every eight days was recorded within the Study Area, with a total of seven fishing vessel tracks intersecting the Lease Area itself. The low levels recorded are considered indicative of the offshore location of the Lease Area.

Based upon the nature of the vessel tracks (straight line transits through the Study Area) and the average speeds (all of which are greater than 5 kn), fishing vessels were considered likely to be in transit through the Study Area rather than engaged in fishing activity (i.e., gear deployed).

To enhance the fishing vessel baseline established by the AIS data, additional VMS collected by the NEODP during 2015-16 (NEODP, 2018) has been assessed. This was the most recently available VMS data provided by the portal. Data for multispecies of groundfish, monkfish, scallop, surfclam / ocean quahog, pelagic species, herring and squid were available, however only the groundfish and scallop data sets showed notable activity levels in proximity to the Lease Area (and as such other species have not been shown).

Figure 6.19 presents a cumulative plot of fishing density based on VMS data for the following species of groundfish, noting that these are not necessarily targeted within the Study Area:

- Atlantic cod;
- Haddock;
- Yellowtail flounder;
- Pollock;
- American plaice;
- Witch flounder;
- White hake;
- Windowpane flounder;
- Winter flounder;
- Acadian redfish;
- Atlantic halibut;
- Atlantic wolffish; and
- Ocean pout.

Following this, Figure 6.20 presents a similar plot for scallop fishing only, noting that scallop fishing activity was much higher than activity for the other groundfish species listed above.

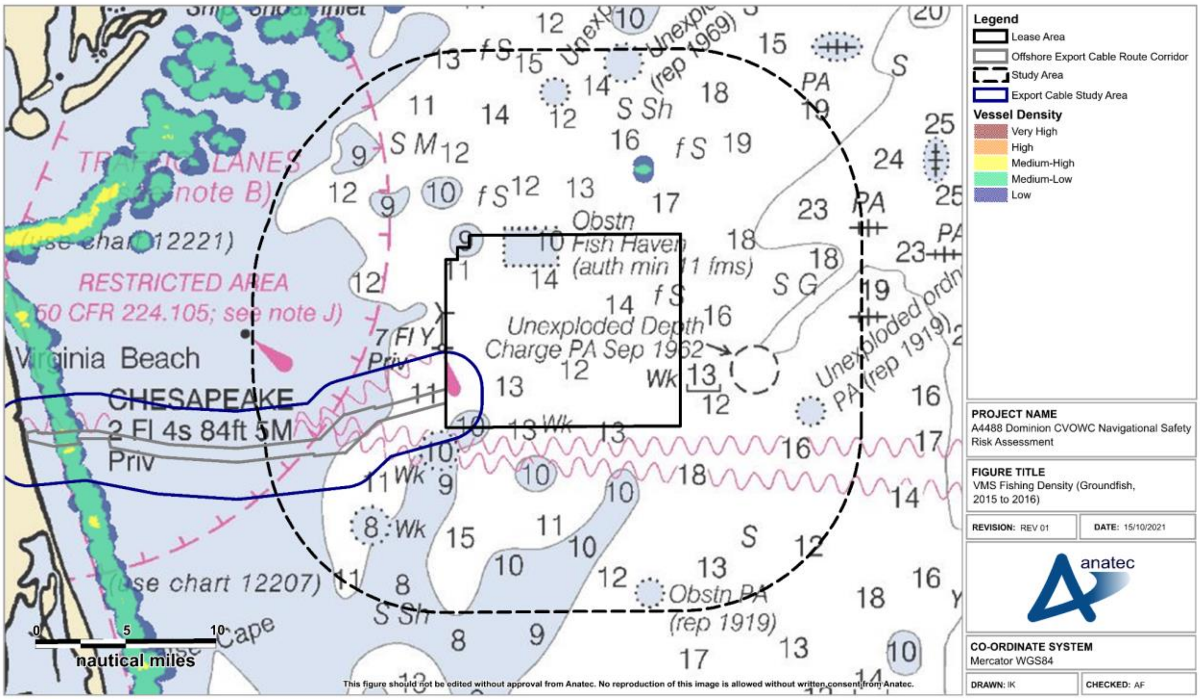

Figure 6.19 VMS Fishing Density (Groundfish, 2015 to 2016) (NEODP, 2018)

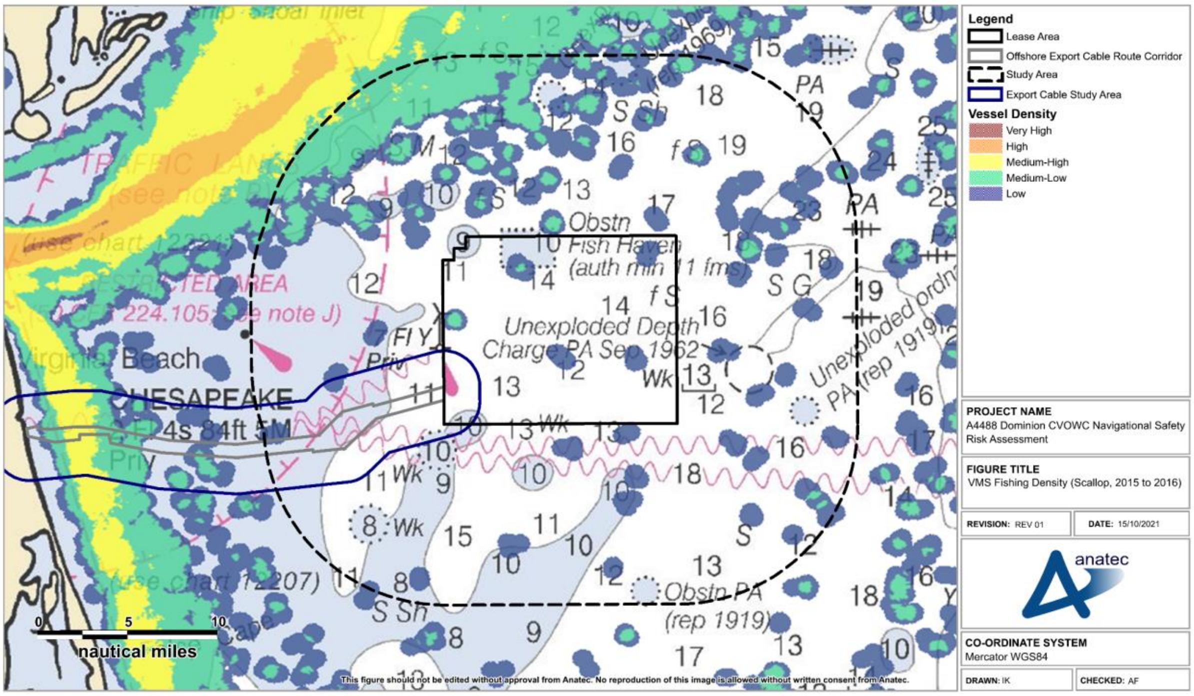

Figure 6.20 VMS Fishing Density (Scallop, 2015 to 2016) (NEODP, 2018)

It can be seen that groundfish fishing activity is minimal within the Study Area, while scallop fishing occurred at medium-low density at the northern extremity of the Study Area, and at a low level within the Lease Area itself. However, it is noted that when only vessels at speeds indicating potential fishing are considered, the NEODP shows no activity within the Lease Area, as shown in Figure 6.21.

This is in agreement with the analysis of AIS data presented in Figure 6.18, in that fishing vessel activity is low within the Lease Area itself, with the majority of traffic passing to the north of the Lease Area.

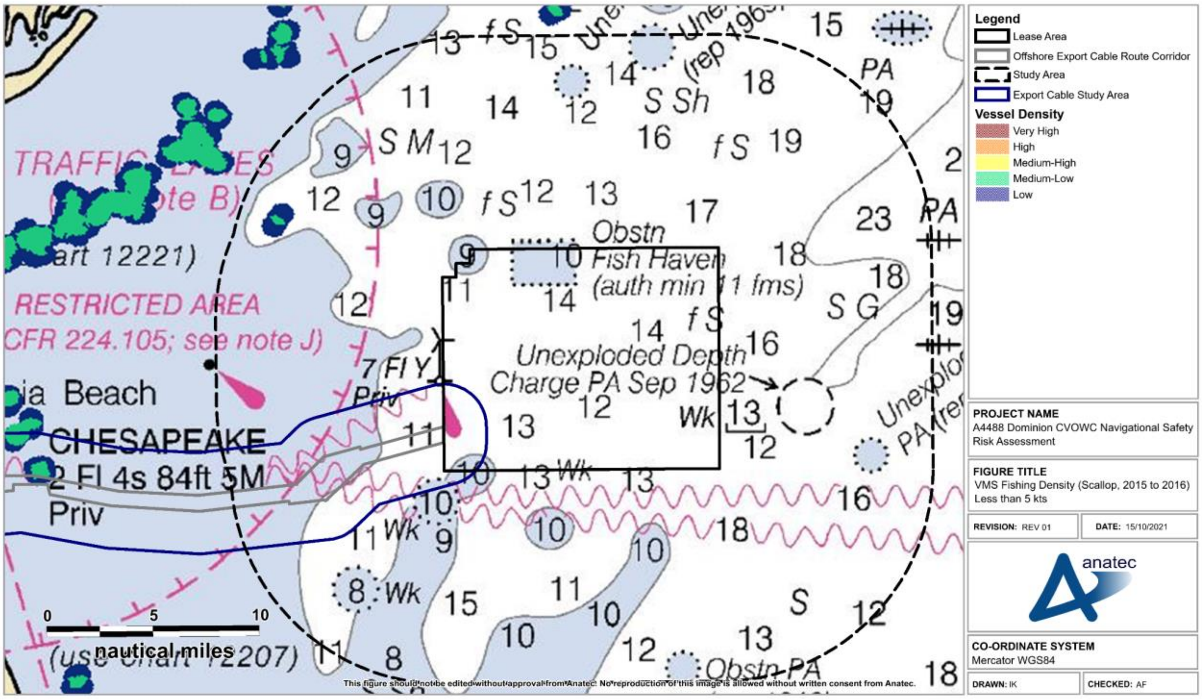

Figure 6.21 VMS Fishing Density (Scallop, 2015 to 2016) (NEODP, 2018) – less than 5 kts

6.3.4.6 Recreational Vessels

Figure 6.22 presents a plot of the recreational vessel tracks (including recreational fishing) recorded within the Study Area throughout the survey period. Recreational vessels accounted for approximately 4 percent of traffic within the Study Area.

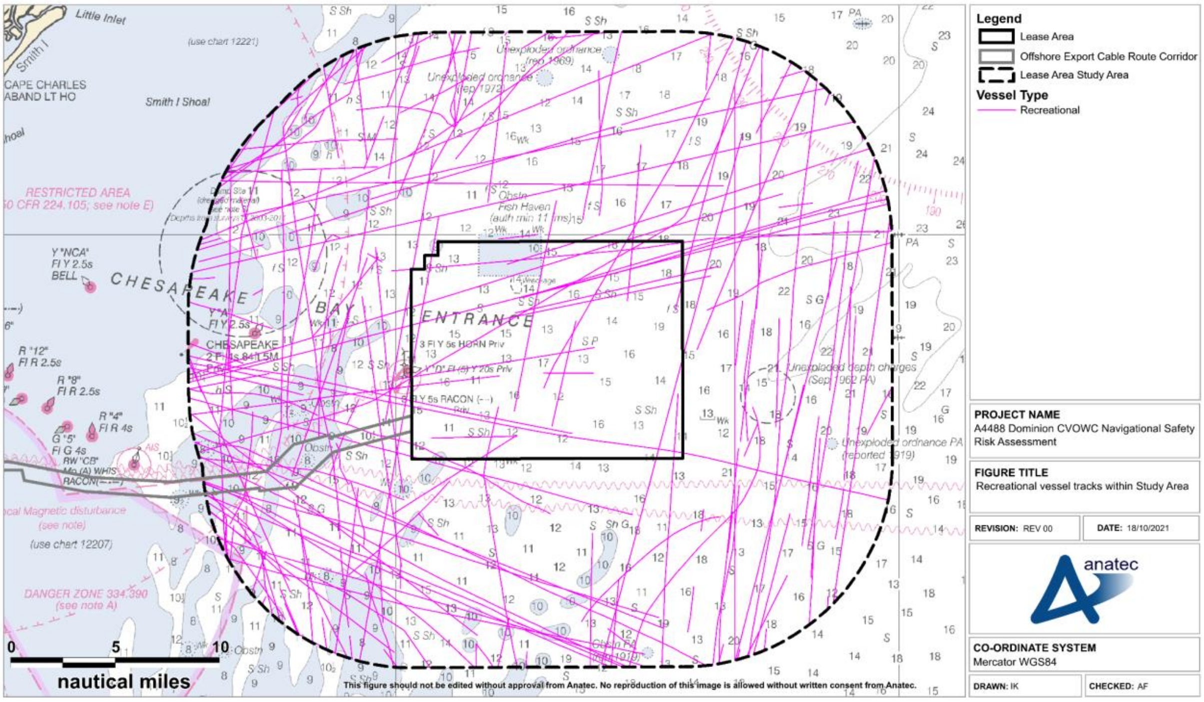

Figure 6.22 Recreational vessel tracks within Study Area (12 months January to December 2019)

An average of one unique recreational vessel every two to three days was recorded within the Study Area and twice a month within the Lease Area itself.

A total of 27 recreational vessels were recorded via AIS within the Lease Area during the year of data analyzed. The majority of these were small privately owned sailing vessels or motor yachts averaging 86 ft in length (noting this excludes any vessel that did not transmit length information via AIS).

It is likely that only a minority of recreational vessels operating in the region broadcast on AIS, therefore, the tracks are considered to provide only an indication of the recreational activity in the area. However, the low level recorded via AIS is considered indicative of the offshore location of the Lease Area.

It is noted that no clear activity associated with recreational fishing within the fish haven area was observed (see Section 5.1.7.1).

6.3.5 Anchored Vessels

Vessels at anchor have primarily been identified based on navigational status transmitted via AIS. However, given that this requires manual input into the vessel's AIS unit, an incorrectly transmitted navigational status is observed to be common. Therefore, the vessels transmitting a status other than "At Anchor" were filtered using a set of behavioural criteria[10] to identify further potential anchored

[10] Vessels recorded travelling at less than 1 knot for at least 30 minutes.

vessels. The vessels identified via both methods were then manually checked to ensure any vessels clearly not at anchor were removed.

The vessels within the Study Area identified as being at anchor on this basis are shown in Figure 6.23, color-coded by type.

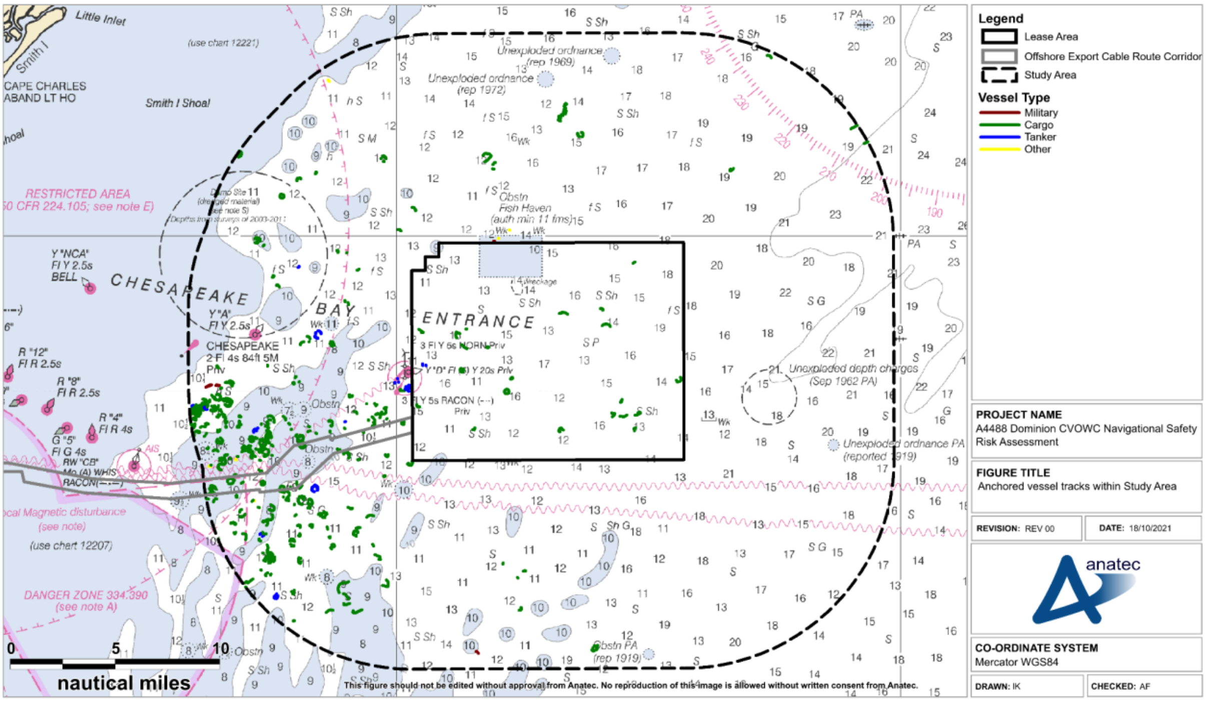

Figure 6.23 Anchored vessel tracks within Study Area (12 months January to December 2019)

On average, one unique vessel per day was deemed to be at anchor within the Study Area. During the year-long study period, 27 instances of vessels at anchor within the Lease Area itself were observed. It can be seen that the majority of these vessels were anchored to the west of the Lease Area at the entrance to Chesapeake Bay. The majority of anchored vessels observed were cargo vessels both within the Study Area and within the Lease Area itself.

6.3.6 Vessel Routing

6.3.6.1 Methodology for Main Route Identification

The vessel traffic data collected was used to identify the main vessel routes intersecting the Study Area. The routes were identified statistically with cases of commercial vessels and military vessels transiting at similar headings and locations classed as a main route. AIS data may also be analyzed to show vessels (by name and/or operator) that frequently transit those routes, thus identifying 'regular runner/operator routes.

The shipping route width is then calculated using the 90th percentile rule (as described in MGN 543 [MCA, 2016]) from the median line of the route as shown in Figure 6.24. The 90th percentile method assumes that the route width covers the 90 percent of vessels that are nearest the median line.

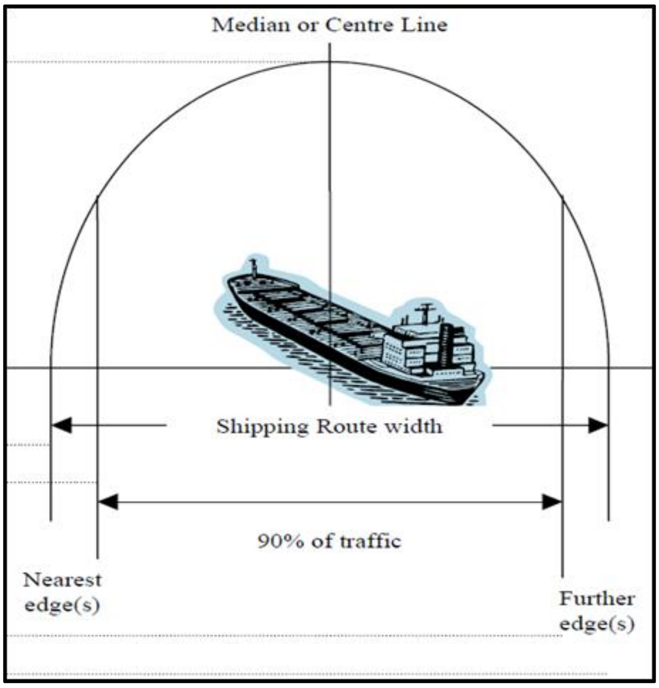

Figure 6.24 Illustration of main route calculation (MCA, 2016)

It is noted that the identification of main routes assists the assessment of key vessel movements within the Study Area; however, all individual vessel tracks have been incorporated into the risk assessment (see Section 6.3).

6.3.6.2 Pre Wind Farm Main Routes

Applying the methodology outlined in Section 6.3.6.1, a total of 19 main routes were identified and are presented in Figure 6.25 alongside the corresponding 90th percentiles.

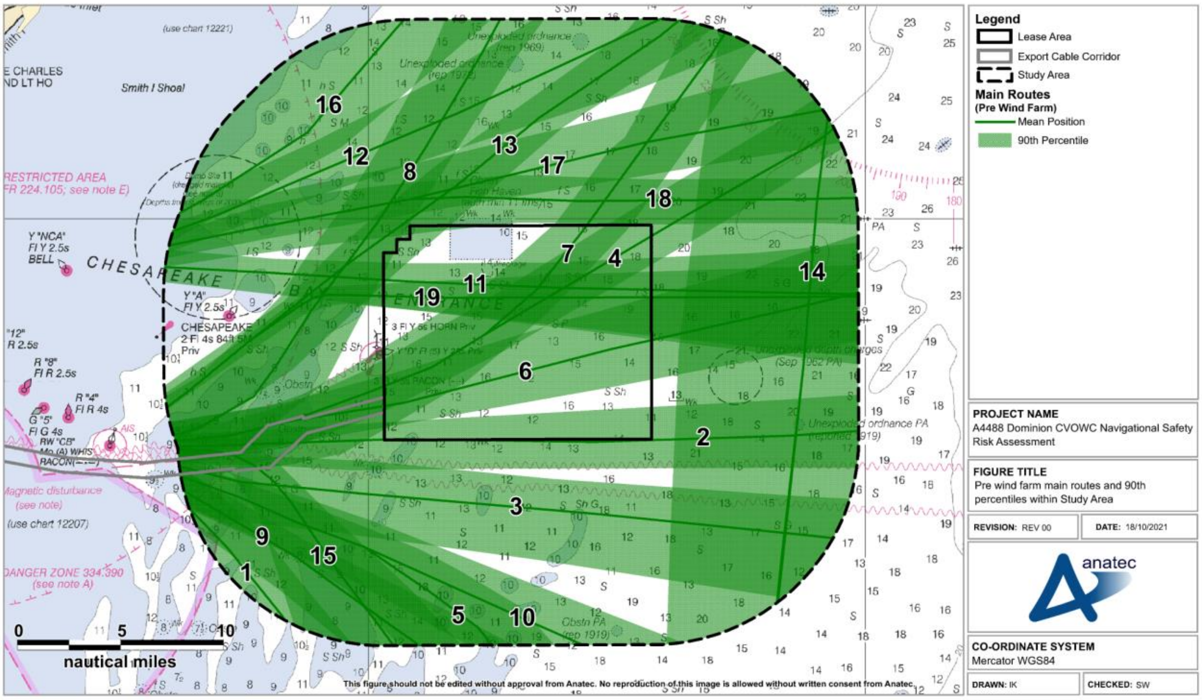

Figure 6.25 Pre wind farm main routes and 90th percentiles within Study Area

An overview of the volume, type, size, and most frequent destinations (based upon the AIS data and/or heading of the majority of vessels) of the vessel traffic on each main route is provided in Table 6.1. It is noted that as per the AIS broadcasts, international ports are a combination of specific terminals and countries.

Table 6.1 Overview of Main Routes

Route Number	Volume of Traffic	Most Frequent Destinations		Description
1	5 per day	▪ Port of Virginia, VA ▪ Baltimore, MD	▪ Savannah, GA ▪ Charleston, SC ▪ Mananzillo, Panama ▪ Jacksonville, FL	Primarily a cargo vessel (90%) route out of the Southern Approach of the Chesapeake Bay TSS and following the US east coast clear of shallow coastal waters.
2	3 per day	▪ Port of Virginia, VA ▪ Baltimore, MD	▪ Antwerp, Belgium ▪ Valencia, Spain ▪ Gibraltar ▪ Netherlands	Primarily a cargo vessel (95%) route out of the Southern Approach of the Chesapeake Bay TSS and headed to/from ports in Europe.
3	2 to 3 per day	▪ Baltimore, MD ▪ Port of Virginia, VA	▪ Gibraltar ▪ Antwerp, Belgium ▪ Valencia, Spain ▪ Europe (Various)	Primarily a cargo vessel (88%) and tanker (10%) route out of the Southern Approach of the Chesapeake Bay TSS and headed to/from ports in Europe.
4	1 to 2 per day	▪ Port of Virginia, VA ▪ Baltimore, MD	▪ Halifax, Canada ▪ Newark, NJ ▪ New York, NY	Primarily a cargo vessel (98%) route out of the Southern Approach of the Chesapeake Bay TSS and either following the US east coast clear of shallow coastal waters or headed to/from Canada; 67% of traffic is southbound.
5	2 per day	▪ Port of Virginia, VA ▪ Baltimore, MD	▪ Savannah, GA ▪ Charleston, SC	Primarily a cargo vessel (92%) route out of the Southern Approach of the Chesapeake Bay TSS and following the US east coast clear of shallow coastal waters.
6	1 per day	▪ Baltimore, MD ▪ Port of Virginia, VA	▪ Antwerp, Belgium ▪ Europe/North Africa (Various)	Primarily a cargo vessel (88%) and tanker (12%) route out of the Southern Approach of the Chesapeake Bay TSS and either headed to/from ports in Europe or North Africa or following the US east coast clear of shallow coastal waters; 64% of traffic is westbound.

Route Number	Volume of Traffic	Most Frequent Destinations		Description
7	1 per day	▪ Port of Virginia, VA ▪ Baltimore, MD	▪ Newark, NJ ▪ New York, NY	Primarily a cargo vessel (98%) route out of the Southern Approach of the Chesapeake Bay TSS following the US east coast clear of shallow coastal waters into the Port of New York and New Jersey; 77% of traffic is southbound.
8	1 per day	▪ Baltimore, MD ▪ Port of Virginia, VA	▪ Philadelphia, PA ▪ New York City, NY	Primarily a cargo vessel (99%) route out of the Southern Approach of the Chesapeake Bay TSS following the US east coast clear of shallow coastal waters; 68% of traffic is southbound.
9	1 every 1 to 2 days	▪ Baltimore, MD ▪ Port of Virginia, VA	▪ Savannah, GA ▪ Houston, TX ▪ Charleston, SC ▪ Kingston, Jamaica ▪ South America (Various)	Primarily a cargo vessel (69%) and tanker (26%) route out of the Southern Approach of the Chesapeake Bay TSS either following the US east coast clear of shallow coastal waters or headed to/from ports in South America and Jamaica.
10	1 every 2 days	▪ Port of Virginia, VA ▪ Baltimore, MD	▪ Bermuda ▪ Gibraltar ▪ Savannah, GA ▪ Charleston, SC ▪ Brazil ▪ Europe (Various) ▪ Panama	Primarily a cargo vessel (71%), passenger (14%) and tanker (12%) route out of the Southern Approach of the Chesapeake Bay TSS with cargo vessels and tankers primarily headed to/from Gibraltar and other European ports, while passenger vessels travel between Baltimore and Bermuda.
11	1 every 2 days	▪ Port of Virginia, VA ▪ Baltimore, MD	▪ Gibraltar ▪ Europe (Various)	Primarily a cargo vessel (86%) route out of the Eastern Approach of the Chesapeake Bay TSS headed to/from Gibraltar and various other European ports; 69% of traffic is westbound.
12	1 every 2 days	▪ Port of Virginia, VA ▪ Baltimore, MD	▪ Philadelphia, PA ▪ Boston, MA ▪ New York, NY ▪ Newark, NJ	Primarily a cargo vessel (86%) route out of the Eastern Approach of the Chesapeake Bay TSS following the US east coast clear of shallow coastal waters.

Route Number	Volume of Traffic	Most Frequent Destinations		Description
13	1 every 2 days	▪ Baltimore, MD ▪ Port of Virginia, VA	▪ Philadelphia, PA ▪ Halifax, Canada ▪ New York, NY	Primarily a cargo vessel (96%) route out of the Eastern Approach of the Chesapeake Bay TSS following the US east coast clear of shallow coastal waters.
14	1 every 2 days	▪ Chester, PA ▪ New York City, NY	▪ Charleston, SC ▪ Savannah, GA ▪ Wilmington, NC ▪ Miami, FL ▪ San Juan, Panama	Primarily a push/pull vessel (48%) and cargo vessel (25%) route out of Delaware Bay and New York Bay and either following the US east coast clear of shallow waters or headed to/from ports in Central America; 66% of traffic is southbound.
15	1 every 2 to 3 days	▪ Port of Virginia, VA ▪ Baltimore, MD	▪ Savannah, GA ▪ Kingston, Jamaica ▪ Brunswick, GA ▪ Charleston, SC ▪ Central/South America (Various)	Primarily a cargo vessel (88%) and tanker (10%) route out of the Southern Approach to the Chesapeake Bay TSS and either following the US east coast clear of shallow waters or headed to/from ports in Central and South America.
16	1 every 3 days	▪ Port of Virginia, VA	▪ Philadelphia, PA ▪ New York, NY ▪ Newark, NJ	Primarily a cargo vessel (73%) and push/pull vessel (11%) route out of the Eastern Approach to the Chesapeake Bay TSS following the US east coast clear of shallow coastal waters and headed to/from Delaware Bay and New York Bay.
17	1 every 4 days	▪ Port of Virginia, VA ▪ Baltimore, MD	▪ Philadelphia, PA ▪ Saint John NB, Canada	Primarily a cargo vessel (80%) and tanker (13%) route out of the Eastern Approach to the Chesapeake Bay TSS and either following the US east coast clear of shallow coastal waters into Delaware Bay or headed to/from New Brunswick, Canada; 79% of traffic is westbound.
18	1 every 4 days	▪ Baltimore, MD ▪ Port of Virginia, VA	▪ Europe (Various) ▪ Philadelphia, PA	Primarily a cargo vessel (93%) route out of the Eastern Approach to the Chesapeake Bay TSS and either headed to/from ports in Europe or following the US east coast clear of shallow coastal waters and into Delaware Bay; 78% of traffic is westbound.

Route Number	Volume of Traffic	Most Frequent Destinations	Description
19	1 every 4 days	▪ Port of Virginia, VA ▪ Baltimore, MD ▪ Europe (Various)	Primarily a cargo vessel (94%) route out of the Southern Approach to the Chesapeake Bay TSS headed to/from various European ports.

6.4 Export Cables Maritime Traffic

6.4.1 Overview

This section provides assessment of maritime traffic of relevance to the Offshore Export Cables. Details of the Offshore Export Cables including burial depths and external protection are available in Section 4.3.

Figure 6.26 presents a plot of the vessel tracks recorded within the Export Cable Corridor Study Area throughout the survey period, color-coded by vessel type. Following this, Figure 6.27 presents the corresponding vessel density heat map for the same dataset.

It should be noted that the traffic density within the Export Cable Corridor Study Area was higher on average than within the Study Area, and as such the density intervals in Figure 6.2 are relative only to the Export Cable Corridor Study Area (i.e., independent of the Study Area density shown in Figure 6.2).

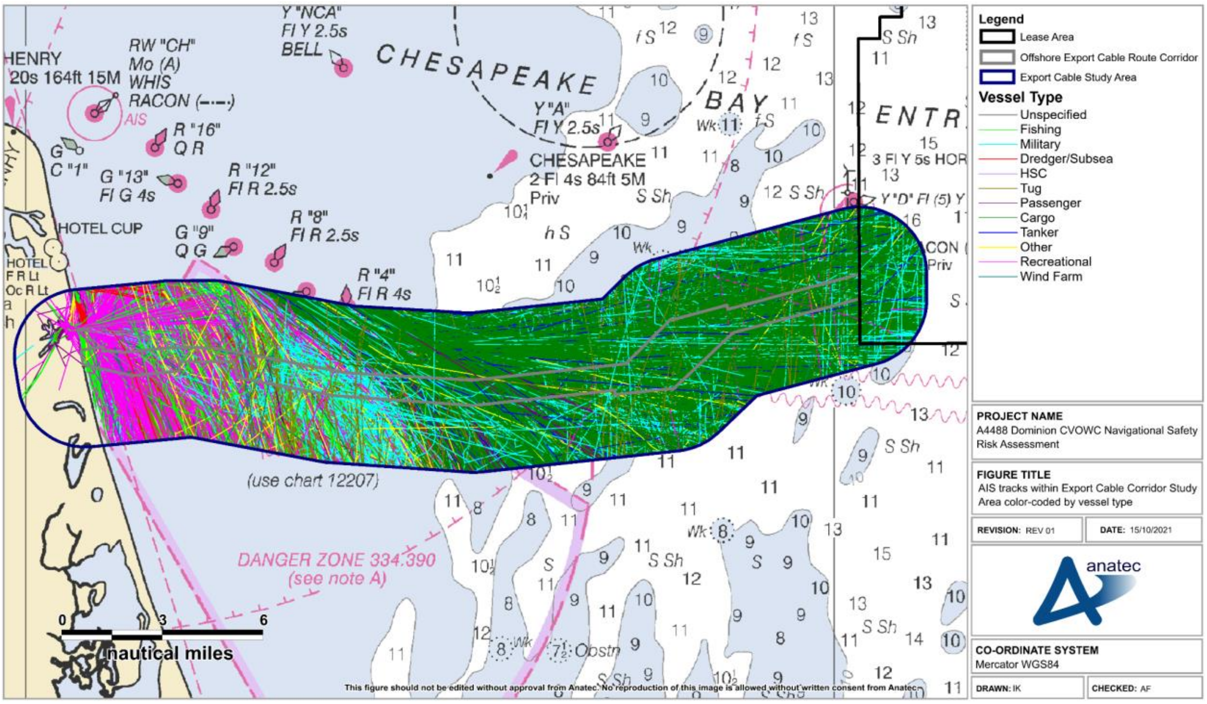

Figure 6.26 AIS tracks within Export Cable Corridor Study Area color-coded by vessel type (12 months January to December 2019)

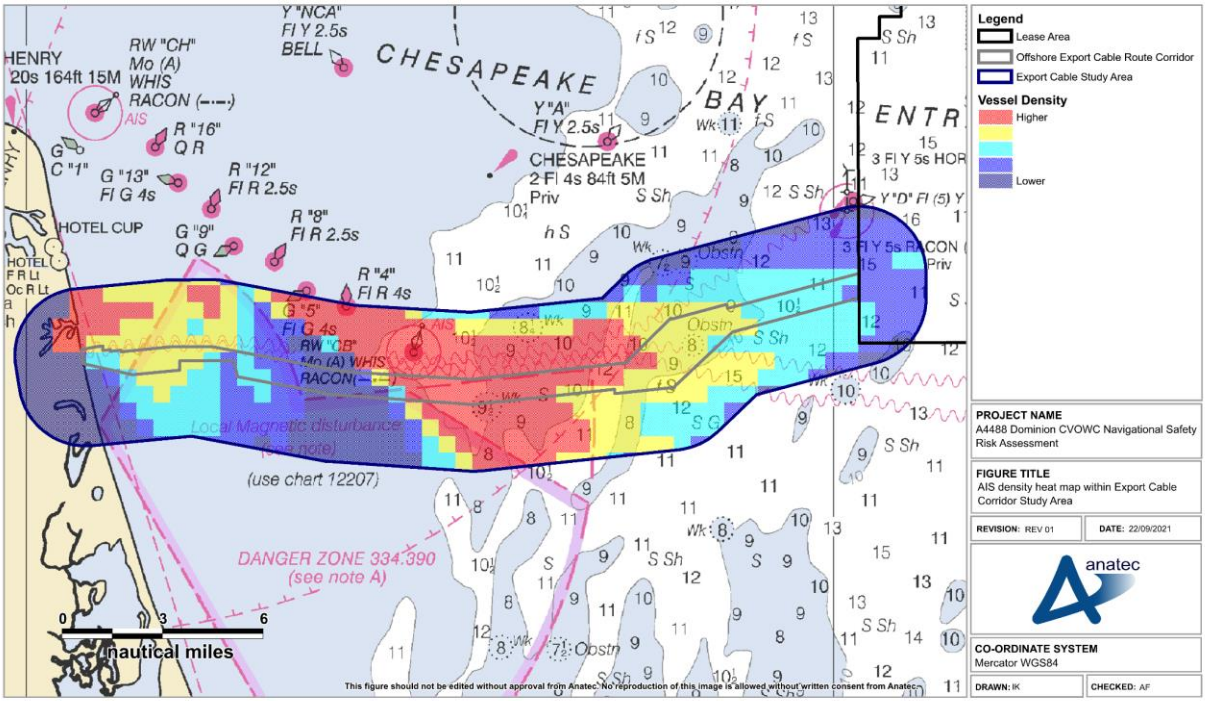

Figure 6.27 AIS density heat map within Export Cable Corridor Study Area (12 months January to December 2019)

On average, 36 unique vessels per day were recorded within the Export Cable Corridor Study Area.

There is moderate to high vessel density midway between the US east coast and the Lease Area where primarily cargo vessels are transiting in a northwest-southeast direction, converging on the southern approach to Chesapeake Bay. The coastal area north of the Offshore Export Cable Route Corridor is also of moderate to high density primarily due to recreational vessels and, to a lesser extent, fishing vessels.

6.4.2 Vessel Draft

In the year of AIS data analyzed within the Export Cable Corridor Study Area, approximately 45 percent of vessel tracks recorded broadcast a valid draft via AIS (of the 55 percent not broadcasting a draft, 53 percent were carrying Class B AIS, for which draft data is not available). The broadcast draft information within the Export Cable Corridor Study Area is presented in Figure 6.28.

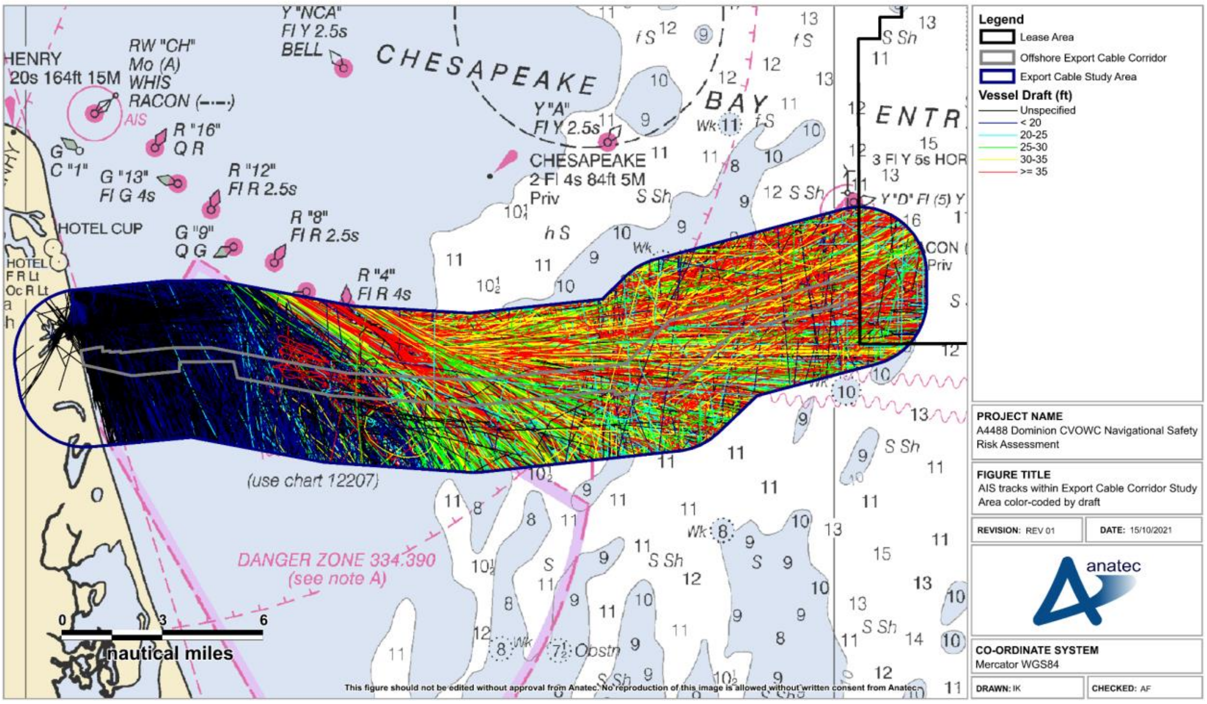

Figure 6.28 AIS tracks within Export Cable Corridor Study Area color-coded by draft (excluding unspecified)

Excluding those vessels not broadcasting a valid draft (in the majority recreational vessels), the average draft recorded within the Export Cable Corridor Study Area was 28 ft (8.5 m). The deepest draft recorded in the Export Cable Corridor Study Area was 55 ft (16.8 m), transmitted by a bulk carrier.

It can be seen that the shallower waters in the nearshore area were transited exclusively by shallow-drafted vessels (less than 20 ft [6.1 m]) with deeper-drafted vessels only observed further offshore to utilize the DWR in the Southern Approach to Chesapeake Bay.

6.4.3 Anchored Vessels

Vessels at anchor within the Export Cable Corridor Study Area have been identified using the methodology described in Section 6.3.5.

After applying these criteria, on average approximately one unique vessel per day was deemed to be at anchor within the Export Cable Corridor Study Area, as shown in Figure 6.29. A total of 35 anchored vessels were located within the Offshore Export Cable Route Corridor itself over the year. Cargo vessels accounted for approximately 70 percent of vessels deemed to be at anchor overall.

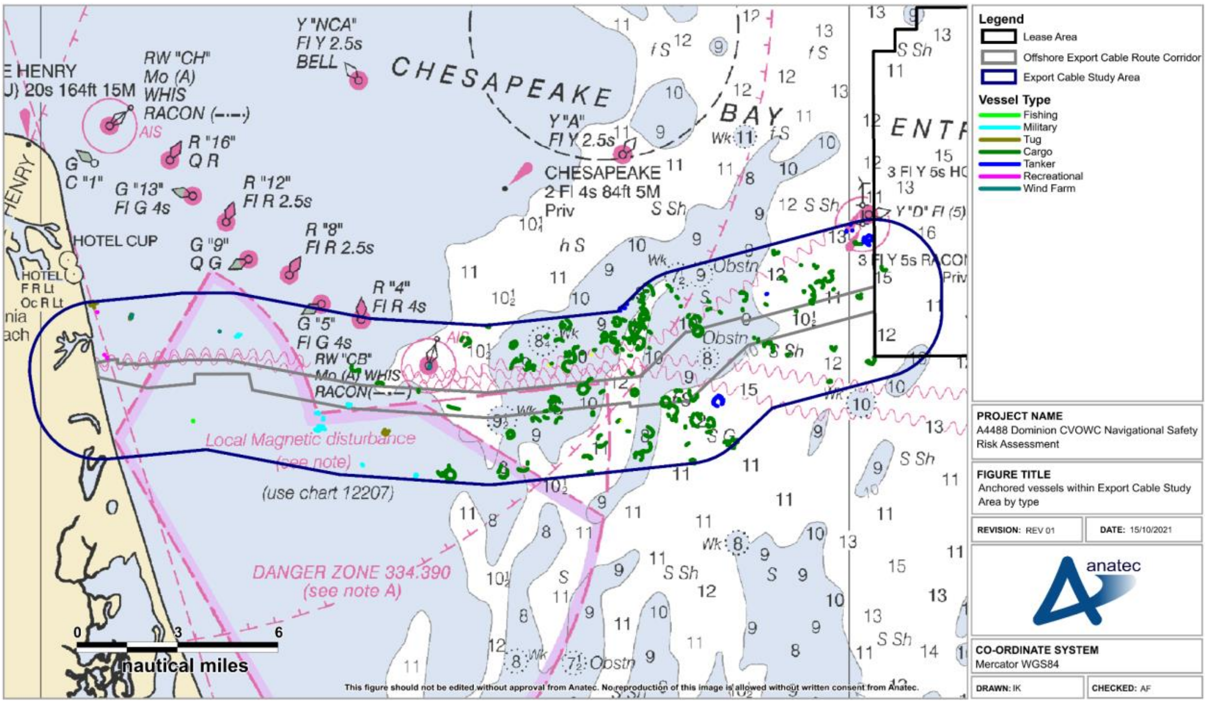

Figure 6.29 Anchored vessels within Export Cable Corridor Study Area

6.5 Future Case Vessel Traffic

The current level and nature of vessel traffic as outlined in previous sections is considered to be the base case scenario within the context of the collision, allision and grounding risk modelling (see Section 11). The modelling also considers a future case scenario, whereby the potential growth in shipping movements and traffic types as well as any foreseeable changes in the marine environment relevant to the Project are accounted for.

6.5.1 Increases in Commercial Vessel Activity

Based on consultation feedback, there is a trend of vessels growing larger and a subsequent decrease in the number of vessels, a trend which is supported by a study undertaken by the International Transport Forum at the Organization for Economic Cooperation and Development on the impact on "Mega Ships" (Organization for Economic Cooperation and Development and International Transport Forum, 2015). It was suggested during a combined meeting with the AWO, WSC, VMA, VPA, and Virginia Pilot's Association that 5-10 percent increase would be appropriate for container vessels.

Given the uncertainty associated with long-term forecasting of vessel traffic growth, including the potential for any major new developments in US ports, two conservative and independent scenarios of potential growth scenarios terms of commercial shipping movements of 10 percent and 20 percent have been applied directly to the base case as set increases of traffic volume. These increases are in line with the assessment of other renewables developments and align with the values recommended by stakeholders (noting that the 10 percent and 20 percent growth is applied to all commercial vessels and not just container vessels). Noting the trends outlined above, these assumptions are considered highly conservative and in reality, future case traffic growth fluctuates up and down depending on seasonality, and cargo / industry trends.

It is noted that the increase in wind farm traffic associated with the Project has not been specifically accounted for within the quantitative assessment given uncertainty over the specific transit routes that will be utilized. However, associated risks in terms of potential increases in collision risk with third party traffic is considered on a qualitative basis in Section 11.

6.5.2 Increases in Commercial Fishing Transits

Due to fishing traffic growth being dependent on a large number of direct and indirect factors and noting the level of AIS coverage for fishing vessels, there is uncertainty associated with the long-term forecasting of the future case. Therefore, to ensure a conservative approach, a 10 percent and 20 percent growth in transiting fishing vessel movements has been considered in line with those assessed for commercial vessels (see Section 6.5.1). It is noted that fishing vessels engaged in fishing activities have not been considered within this approach, but rather are assessed as part of the commercial fisheries assessment (see Section 4.4.6 of the COP).

6.5.3 Increases in Recreational Vessel Transits

There are no major developments currently known of which may impact the activity of recreational vessels in the region. Therefore, to ensure a conservative approach, a 10 percent and 20 percent growth in transiting fishing vessel movements has been considered in line with those assessed for commercial vessels (see Section 6.5.1), and potential future case scenarios have been considered on a qualitative basis in the impact assessment in Section 14. It is noted that there could also be an increase in future case recreational fishing given the benefit of aggregation around the foundations; this is qualified in Section 15, noting the distance offshore at which the Lease Area is sited makes it unfavorable to most day cruisers dependent on weather (i.e., seasonal peaks during fair weather periods).

6.5.4 Post Wind Farm Routing Methodology

Following construction of the Project, commercial vessels are considered likely to deviate around the Lease Area (as opposed to transiting internal to the array). Given that it is not possible to consider all potential deviation options, the shortest and therefore most likely alternatives have been considered within this NSRA, with a worst case re-routing passage plan applied to ensure a conservative approach (noting this maximizes WTG exposure to allision risk). It is not anticipated that any changes to vessel emission requirements will result in variations to routing patterns in proximity to the Lease Area.

As illustrated in Figure 6.30, the Lease Area is located adjacent to a deep draft route forming part of the proposed ACPARS safety fairways (see Section 2.2.2). The potential for vessels to utilize this lane has been considered within the post wind farm routing assessment. It is noted that additional fairways are proposed to the south of the Lease Area, however these have not been incorporated given this would remove traffic from the study area, and hence reduce collision risk estimated within the quantitative assessment (i.e., assuming vessels will not use the fairways to the south is considered a conservative approach).

As per Section 1.2.2, the Port Access Route Study: Approaches to the Chesapeake Bay, VA is of relevance to the Project, however is at too early a stage to assess. However, it is noted that stakeholder engagements have indicated desire for a northern fairway that runs parallel to the Lease Area and this was stated as such in the PARS comment period.

For the purposes of the assessment, the full width of the deep draft route (approximately 4 nm (7.4 km) at the point it passes the Lease Area) has been utilized, irrespective of the width of the route in the pre wind farm scenario. This methodology ensures that a worst case is under consideration for the assessment of allision risk due to the Project.

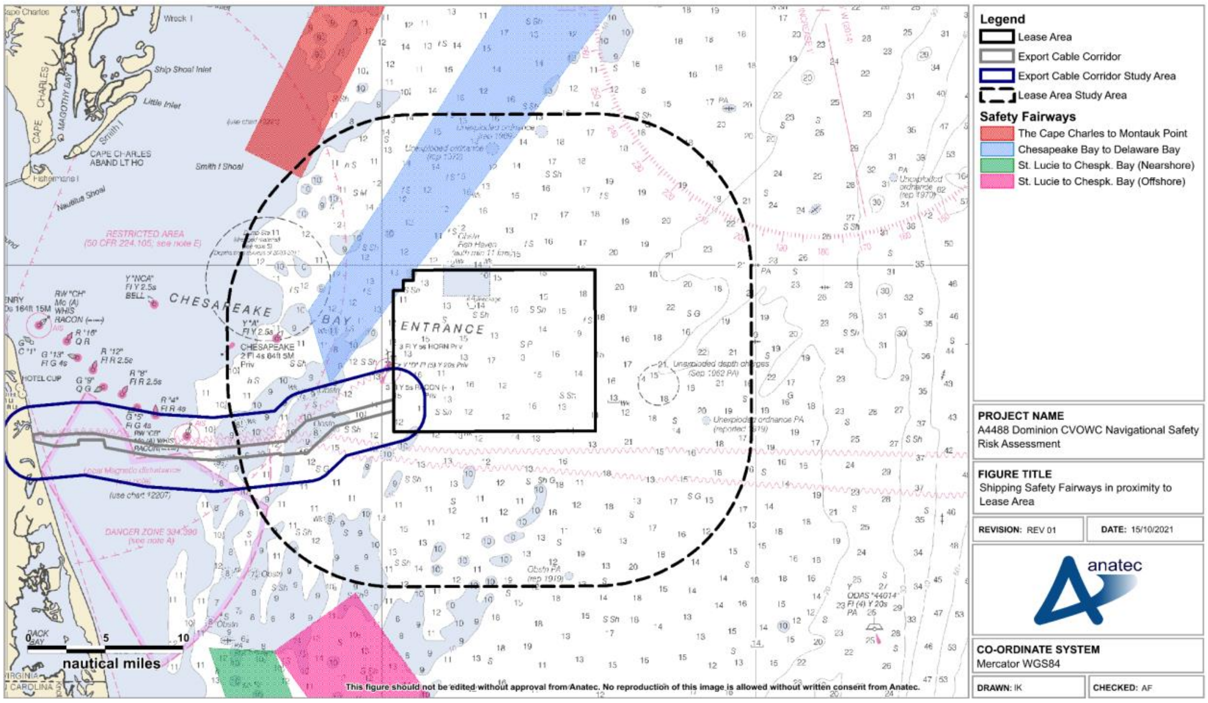

Figure 6.30 Shipping Safety Fairways in proximity to the Lease Area

Internal and external studies undertaken by Anatec at a number of offshore wind farms in UK waters including large developments in high traffic density areas such as the London Array and Walney Extension Offshore Wind Farms, have to date indicated that commercial vessels generally avoid transiting internally within arrays but do pass consistently and safely within 1 nm (1.9 km) of wind farm structures, with the case-by-case passing distance dependent on the sea room available and prevailing conditions. The evidence suggests that the mariner defines their own safe passing distance (outside of defined routing measures) based on the conditions and nature of the vessel traffic at the time, but that they are shown to frequently pass 1 nm (1.9 km) off established developments. Therefore, a mean distance of 1 nm (1.9 km) from the Lease Area has been assumed when re-routing commercial traffic around the array (with the exception of routing within the ACPARS as outlined above).

6.5.5 Post Atlantic Coast Port Access Route Study Scenario

As noted in Section 6.5.4, the proposed ACPARS fairways have been incorporated into the post wind farm commercial traffic routing (where appropriate, i.e., where considered as a conservative assumption). However, it is acknowledged that an additional potential scenario exists in which the proposed ACPARS fairways are present but the Project is not. Such a scenario may be considered an 'enhanced baseline' given that the proposed ACPARS fairways have not yet been implemented.

Given that there is limited supplementary information available for this 'enhanced baseline' (e.g., there is no existing vessel traffic data pertaining to this scenario), no quantitative modelling of collision and allision risk has been undertaken for this scenario, but it is noted that certain re-routing considered in Section 10.2.1 is a consequence of this scenario (i.e., the presence of the proposed ACPARS fairways) rather than the presence of the Project.

7 Lighting and Marking Characteristics

The surface Offshore Project Components associated with the Project will be lit and marked in line with the guidance provided in COMDTINST M16500.7A (*Aids to Navigation Manual*) (USCG, 2015) and will also comply with International Association of Marine aids to navigation and Lighthouse Authorities Recommendation O-139 on *The Marking of Man-Made Offshore Wind Structures* (IALA, 2013) and *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020). The *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM, 2021) have also been considered.

The WTG and general array characteristics applied in order to satisfy the USCG guidance and requirements are summarized within this section. It is noted the surface Offshore Project Components will also comply with Federal Aviation Administration (FAA) requirements, namely the appropriate lighting of structures exceeding 200 ft (61 m) height.

Given that the final layout will be agreed following approval of the COP, the specific locations of lighting and marking features (where not applied across all WTGs) have not been determined at this stage.

7.1 Marine Lighting

Key characteristics of relevance to marine lighting include:

- Each WTG will be lit as an offshore wind structure in accordance with 33 CFR § 67.
- Significant Peripheral Structures (SPS) will be marked by sufficient lights (quick flashing yellow) visible to the mariner from all relevant directions in the horizontal plane.
- SPS lights will display the character of a special mark with an operational range of no less than 5 nm (9.3 km) with 360˚ visibility from the sea surface and lights on individual SPSs will be synchronized. The distance between SPSs will not exceed 3 nm (5.6 km).
- Selected Intermediate Peripheral Structures (IPS) will be marked with flashing yellow lights visible to the mariner from all relevant directions in the horizontal plane.
- IPS lights will display a different flash character from those displayed on SPSs with an operational range of no less than 3 nm (5.6 km) and lights on individual IPSs will be synchronized.
- The distance between two IPSs or an IPS and the nearest SPS will not exceed 2 nm (3.7 km).
- WTGs not designated as an SPS or IPS may still require lighting; this will be a decision made by the USCG District Commander but will likely include yellow lights with an operational range of no less than 2 nm (3.7 km).
- The Offshore Substations will also be lit as appropriate.
- During construction any temporary / incomplete surface Offshore Project Component will be marked with quick yellow obstruction lights with an operational range of no less than 5 nm (9.3 km) with 360˚ visibility from the sea surface.

7.2 Aids to Navigation

The following aids to navigation for WTGs may be considered, each with an availability of no less than 99.0 percent (IALA Availability Category 2):

- Marking with Racons and / or AIS;
- Additional use of Radar reflectors and Radar target enhancers; and
- Sound signals.

The aids to navigation on each WTG will be mounted below the lowest point of the arc of the rotor blades and will exhibit at a height above Highest Astronomical Tide of no less than 20 ft (6 m) and no more than 50 ft (15 m). Should any aid to navigation experience a discrepancy, the USCG will be informed and the discrepancy rectified as soon as is practicable.

Any sound signals installed will sound every 30 seconds with a projected range of 2 nm (3.7 km).

An aid to navigation may also be installed on the Offshore Substations where appropriate.

7.3 Aviation Lighting

Key characteristics of relevance to aviation lighting include:

- Aeronautical obstruction lights which when fitted to the tops of WTGs are not visible below their horizontal plane.
- Aeronautical obstruction lights will be night vision imaging system compliant.
- The Offshore Substations will also be lit as appropriate.

7.4 General Marking

Key characteristics on a general marking basis include:

- During the construction and/or operation and maintenance phases navigational buoyage may be required to mark the array.
- All foundation structures will be painted yellow from the level of Highest Astronomical Tide up to 50 ft (15 m) and utilize retro reflective material to ensure visibility at night.
- WTG towers will have alphanumeric marking in black, approximately 9.8 ft (3 m) high and will be visible in all directions in both day and night conditions.
- A unique alphanumeric marking scheme will be determined in coordination with the USCG and will follow the rows of the array where possible.
- Letters will be easily visible by using either illumination or retro reflective material and have 360˚ visibility from the sea surface.
- The Offshore Substations will also be marked as appropriate.

8 Navigation, Communication and Position Fixing Equipment

This section discusses potential impacts that may arise from the structures and cables associated with the Project upon communication and position fixing equipment of vessels navigating in the area.

8.1 Very High Frequency Communications (Including Digital Selective Calling)

In 2004, trials were undertaken at the North Hoyle Offshore Wind Farm, located off the coast of North Wales, UK. As part of the trials, tests were undertaken to evaluate the operational use of typical small vessel Very High Frequency (VHF) transceivers (including Digital Selective Calling [DSC]) when operated close to wind farm structures.

The wind farm structures had no noticeable effect on voice communications within the wind farm or ashore. It was noted that if small craft vessel to vessel and vessel to shore communications were not affected significantly by the presence of WTGs, then it is reasonable to assume that larger vessels with higher powered and more efficient systems would also be unaffected.

Furthermore, as part of the SAR trials carried out at the North Hoyle Wind Farm in 2005, radio checks were undertaken between the Sea King helicopter and both Holyhead and Liverpool coastguards. The aircraft was positioned to the seaward side of the wind farm and communications were reported as very clear, with no apparent degradation of performance. Communications with the service vessel located within the wind farm were also fully satisfactory throughout the trial (MCA, 2005).

In addition to the North Hoyle Wind Farm trials, a desk based study was undertaken for the Horns Rev 3 offshore wind farm in Denmark in 2014 and it was concluded that there was not expected to be any conflicts between point to point radio communications networks and no interference upon VHF communications (Energinet.dk, 2014).

Following consideration of these reports, the Project is anticipated to have no significant impact upon VHF communications as demonstrated at other operational sites.

Since the trials detailed above, no significant issues with regards to VHF have been observed or reported in relation to UK wind farm projects.

8.2 Very High Frequency Direction Finding

During the North Hoyle Offshore Wind Farm trials in 2004, the VHF Direction Finding (DF) equipment carried in the trial boats did not function correctly when very close to WTGs (within approximately 164ft (50 m)). This is deemed to be a relatively small-scale impact due to the limited use of VHF direction finding equipment and will not impact operational or SAR activities (MCA and QinetiQ, 2004).

Throughout the 2005 SAR trials carried out at North Hoyle, the Sea King radio homer system was tested. The Sea King[11] radio homer system utilizes the lateral displacement of a vertical bar on an instrument to indicate the sense of a target relative to the aircraft heading. With the aircraft and the

[11] Sea King helicopters are no longer used for SAR within UK waters.

target vessel within the wind farm, at a range of approximately 1 nm (1.9 km), the homer system operated as expected with no apparent degradation.

Since the trials detailed above, no significant issues with regards to VHF DF have been observed or reported in relation to UK wind farm projects.

8.3 Rescue 21

Rescue 21 is the USCG command, control and direction-finding communications system. The system includes:

- Direction-finding capability that provides SAR responders with lines of bearing to vessels in distress;
- DSC support, which allows mariners with DSC-equipped and registered radios to transmit, at the push of a button, their exact Global Positioning System (GPS) position and vital vessel information to the USCG and other DSC equipped vessels; and
- Automated transmission of urgent marine information broadcasts.

Figure 8.1 presents the line of sight coverage for the Rescue 21 system.

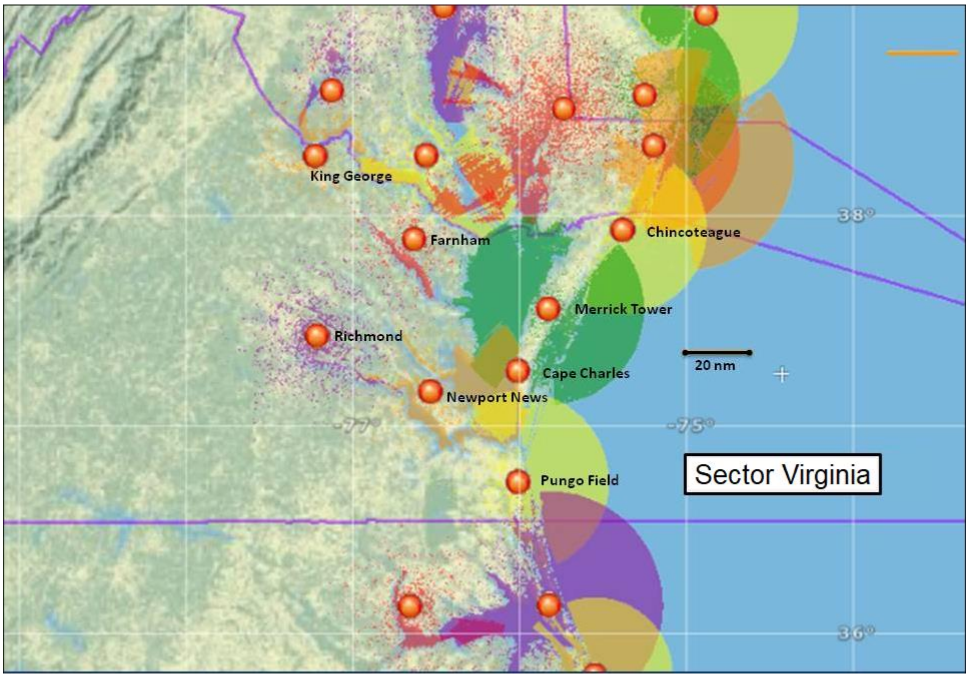

Figure 8.1 Rescue 21 regional coverage of VHF antennas based on geographical line of sight (USCG)

The Pungo Field Remote Fixed Facility (RFF) is of most relevance to the Project, and is located approximately 25 nm (46 km) southwest of the Lease Area. It is noted that this distance means there may not be comprehensive coverage of the Lease Area.

Given that the system is based on VHF and that no adverse effects have been found with VHF use (including DSC), it is not anticipated that the Rescue 21 systems will be impacted during or following the construction of the Project.

8.4 Automatic Identification System

In theory there could be interference when there is a structure located between the transmitting and receiving antennas (i.e. blocking line of sight) of the AIS. This was not evident in the trials carried out at the North Hoyle Offshore Wind Farm (MCA and QinetiQ, 2004) and no significant impact is anticipated for any AIS signals being transmitted or received within the array.

8.5 Navigational Telex System

The Navigational Telex (NAVTEX) system is used for the automatic broadcast of localized Maritime Safety Information (MSI) and either prints it out in hard copy or displays it on a screen, depending on the model.

There are two NAVTEX frequencies. All transmissions on NAVTEX 518 Kilohertz (kHz), the international channel, are in English. NAVTEX 518kHz provides the mariner (both recreational and commercial) with weather forecasts, severe weather warnings and navigation warnings such as obstructions or buoys off station. Depending on the user's location other information options may be available such as ice warnings for high latitude sailing. In the US, NAVTEX is broadcast from various USCG facilities.

Although no specific trials have been undertaken, no significant effect on NAVTEX has been noted at operational sites and therefore no effects are expected to arise from the Project.

8.6 Global Positioning System

GPS is a satellite based navigational system. GPS trials were also undertaken throughout the 2004 trials at North Hoyle Offshore Wind Farm and it was stated that '*no problems with basic GPS reception or positional accuracy were reported during the trials*'.

The additional tests showed that '*even with a very close proximity of a wind turbine to the GPS antenna, there were always enough satellites elsewhere in the sky to cover for any that might be shadowed by the wind turbine tower*' (MCA and QinetiQ, 2004).

Therefore, there are not expected to be any significant impacts associated with the use of GPS systems within or in proximity to the array; noting that GPS works the same way across the globe

8.7 Long Range Navigation Systems

Long Range Navigation (Loran)-C is a radio navigation system which uses multilateration principles to compare the difference in reception time of low frequency radio signals transmitted by radio beacons located onshore, thus allowing the receiver's position to be computed. This system was used extensively by the USCG but is no longer commonplace due to developments in GPS, financial reasons and the USCG discontinuing use of the system in 2010. An upgraded version of Loran-C called Enhanced Long Range Navigation (eLoran) is currently in use outside of the US.

Based on technology used for Loran, it is assumed that since similar systems are not expected to be impacted by the Project, that Loran will not be significantly affected, noting that dedicated surveys have not been undertaken.

8.8 Electromagnetic Interference

A compass, magnetic compass or mariner's compass is a navigational instrument for determining direction relative to the earth's magnetic poles. It consists of a magnetized pointer (usually marked on the north end) free to align itself with the earth's magnetic field. A compass can be used to calculate heading, used with a sextant to calculate latitude, and with a marine chronometer to calculate longitude.

Like any magnetic device, compasses are affected by nearby ferrous materials as well as by strong local electromagnetic forces, such as magnetic fields emitted from power cables. As the compass still serves as an essential means of navigation in the event of power loss or a secondary source, it should not be allowed to be affected to the extent that safe navigation is prohibited. The important factors with respect to cables that affect the resultant deviation are:

- Water depth;
- Burial depth;
- Current (alternating or direct) running through the cables;
- Spacing or separation of the two cables in a pair (balanced monopole and bipolar designs); and/or
- Cable route alignment relative to the earth’s magnetic field.

The Offshore Export Cables and Inter-Array cables will be alternating current (AC), with studies indicating that AC (unlike direct current) does not emit an electromagnetic field (EMF) significant enough to impact marine magnetic compasses (Convention for the Protection of the Marine Environment of the North-East Atlantic, 2008).

No problems with respect to magnetic compasses have been reported to date in any of the trials carried out (inclusive of SAR helicopters). However, small vessels with simple magnetic steering and hand bearing compasses should be wary of using these close to WTGs as with any structure in which there is a large amount of ferrous material (MCA and QinetiQ, 2004).

8.9 Marine Radar

Summaries of trials and studies undertaken in relation to Radar effects from offshore wind farms in the UK and US are provided in this section. It is important to note that since the time of the trials and studies summarized, wind turbine technology has advanced significantly, most notably in terms of the size of WTGs available to be installed and utilized. The use of these larger WTGs allows for minimum spacing greater than what was achievable at the time of the UK studies being undertaken, which is beneficial in terms of Radar interference effects (and surface navigation in general) as detailed below, noting that other impacts associated with the WTGs (e.g., allision) are assessed in the Impact Assessment (see Section 11), which include consideration of spacing and WTG size.

It is noted that potential effects on USCG radar used within their SAROPS software is assessed within Appendix T, Obstruction Evaluation and Additional Analysis.

8.9.1 UK Trials

During the early years in offshore renewables within the UK, maritime regulators undertook a number of trials into the effects of WTGs on the use and effectiveness of marine radar – both shore based and vessel based.

In 2004 trials undertaken at the North Hoyle Offshore Wind Farm (MCA, 2004) identified areas of concern regarding the potential impact on marine and shore-based Radar systems due to the large vertical extents of the WTGs (based on the technology at that time). This extent resulted in radar responses strong enough to produce interfering side lobes and reflected echoes (often referred to as false targets or ghosts).

Side lobe patterns are produced by small amounts of energy from the transmitted pulses that are radiated outside of the narrow main beam (see Figure 8.2). The effects of side lobes are most noticeable within targets at short range (below 1.5 nm [2.8 km]) and with large objects. Side lobe echoes form either an arc on the radar screen similar to range rings, or a series of echoes forming a broken arc.

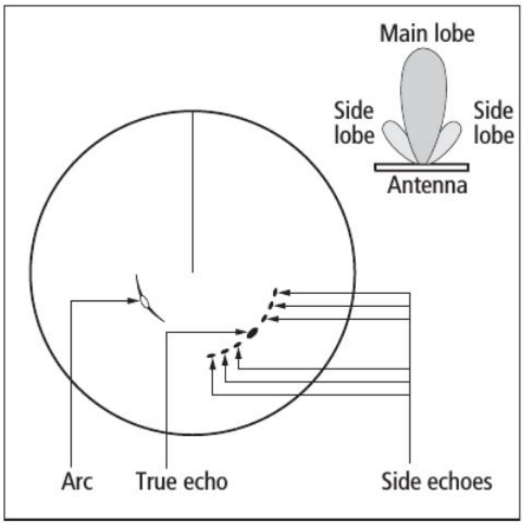

Figure 8.2 Side Lobes

Multiple reflected echoes are returned from a real target by reflection from some object in the Radar beam (see Figure 8.3). Indirect Echoes or ‘ghost’ images have the appearance of true echoes but are usually intermittent or poorly defined; such echoes appear at a false bearing and false range.

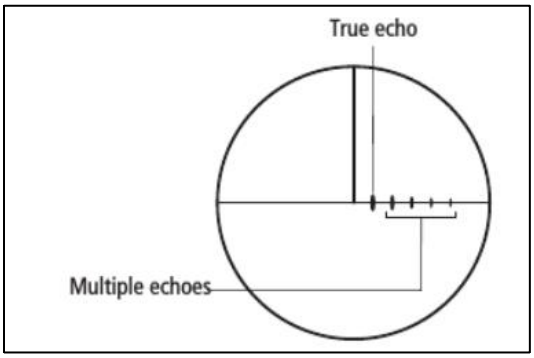

Figure 8.3 Multiple Reflected Echoes

Based upon the results of the North Hoyle trials, the MCA produced a *'Shipping Route Template'* designed to give guidance to mariners on the distances which should be considered when assessing safe spacing between shipping routes and offshore wind farms – noting it is not intended to be prescriptive, but applied intelligently on a case by case basis. However, as experience of effects associated with use of marine radar in proximity to wind farm arrays grew, the MCA have refined their guidance, offering more flexibility within the most recent *'Shipping Route Template'* contained within MGN 543 (MCA, 2016). MGN 543 has been used within this NRSA to assist consideration of radar impacts given that the US guidance does not yet have specific detail.

A second set of trials conducted at Kentish Flats Offshore Wind Farm in 2006 on behalf of the British Wind Energy Association (BWEA) now called Renewables UK (BWEA, 2007) also found that Radar antennas which are sited unfavorably with respect to material items of / on the vessel structure can enhance effects such as side lobes and reflected echoes. Careful adjustment of Radar controls suppressed these spurious Radar returns but mariners were warned that there is a consequent risk of losing targets with a small Radar cross section, which may include buoys or small craft, particularly yachts or Glass Reinforced Plastic constructed craft, therefore due care should be taken in making such adjustments.

Theoretical modelling of the effects of the development of the proposed Atlantic Array Offshore Wind Farm, which was to be located off the south coast of Wales in the UK, on marine radar systems was undertaken by the Atlantic Array project (2012) and considered a wider spacing of WTGs than that considered within the early trials. The main outcomes of the modelling were the following:

- Multiple and indirect echoes were detected under all modelled parameters.
- The main effects noticed were stretching of targets in azimuth (horizontal) and appearance of ghost targets.
- There was a significant amount of clear space amongst the returns to ensure recognition of vessels moving amongst the wind farm structures and safe navigation.
- Even in the maximum design scenario with radar operator settings artificially set to be poor, there is significant clear space around each WTG that does not contain any multipath or side lobe ambiguities to ensure safe navigation and allow differentiation between false and real (both static and moving) targets.

- Overall, it was concluded that the amount of shadowing observed was very little (noting that the model considered lattice-type foundations which are sufficiently sparse to allow Radar energy to pass through).
- The lower the density of structures, the easier it is to interpret the Radar returns and fewer multipath ambiguities are present.
- In dense, target rich environments S-Band Radar scanners suffer more severely from multipath effects in comparison to X-Band scanners.
- It is important for passing vessels to keep a reasonable separation distance (see Table 9.1) between the wind farm structures in order to minimize the effect of multipath and other ambiguities.
- The potential Radar interference is mainly a problem during periods of reduced visibility when mariners may not be able to visually confirm the presence of other vessels in the vicinity (i.e., those without AIS installed which are typically fishing and recreational craft).
- The performance of a vessel's Automatic Radar Plotting Aid (ARPA) could also be affected when tracking targets in or near the array. However, although greater vigilance is required, during the Kentish Flats trials false targets were quickly identified as such by the mariners and then by the equipment itself.

In summary, experience in UK waters has shown that mariners have become increasingly aware of any Radar effects as more offshore wind farms become operational. Based on this experience, the mariner can interpret the effects correctly, noting that effects are the same as those experienced by mariners in other environments (e.g., being in close proximity to other vessels or structures). Effects can be mitigated by 'careful adjustment of Radar controls'.

The MCA has also produced guidance to mariners operating in the vicinity of OREIs in the UK which highlights Radar issues amongst others to be taken into account when planning and undertaking voyages in the vicinity of OREIs (MCA, 2008). The interference 'areas' presented in Table 8.1 are based on MGN 371 (MCA, 2008), MGN 543 (MCA, 2018) and MGN 372 (MCA, 2008). This information had been used given that US guidance does not contain specific information of Radar interference, noting that this information is intended to be used on a case by case basis given these trials were undertaken spacing within wind farms has increased.

Table 8.1 Distances at which impacts on marine radar occur

Distance at which effect occurs	Identified Effect
0.5 nm	▪ Intolerable impacts can be experienced. ▪ X Band radar interference is intolerable under 0.25 nm (1,519 ft) ▪ Vessels may generate multiple echoes on shore-based radars under 0.45 nm (2,734 ft)

Distance at which effect occurs	Identified Effect
1.5 nm	▪ Under MGN 543 impacts on radar are considered to be tolerable with mitigation between 0.5 nm and 3.5 nm (0.9 and 6.5 km). ▪ S band radar interference starts at 1.5 nm (2.8 km). ▪ Echoes develop at about 1.5 nm (2.8 km), with progressive deterioration in the radar display as the range closes. Where a main vessel routes passes within this range considerable interference may be expected along a line of WTGs. ▪ The WTGs produced strong radar echoes giving early warning of their presence. ▪ Target size of the WTG echo increases close to the WTG with a consequent degradation of target definition and bearing discrimination. ▪ Effects were encountered on both X and S band radars.

As noted in Table 8.1, the onset range from the WTGs of false returns is approximately 1.5 nm (2.8 km), with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) Rule 6 Safe speed are particularly applicable and must be observed with due regard to the prevailing circumstances. In restricted visibility, Rule 19 Conduct of vessels in restricted visibility applies and compliance with Rule 6 becomes especially relevant. In such conditions, mariners are required, under Rule 5 Lookout to take into account information from other sources which may include sound signals and VHF information, for example from a VTS or AIS (MCA, 2016). For the purposes of SAR within the windfarm it is noted that the intolerable effects do not block targets from being seen but instead could create multiple echoes however this would need the vessel (Radar scanner) and target to be within close proximity to the WTGs at which point visual observations are likely to also be undertaken. This situation is considered similar to SAR within an enclosed waterway whereby shore based features could interfere with Radar returns.

8.9.2 US Trial

The simulation study into effects of OREI on marine radar commissioned by the USCG (USCG, 2008) for the purpose of assessing navigational safety impacts associated with the Cape Wind Project concluded that while all targets within a wind farm would remain visible on the Radar screen, other than during transient periods of short duration, additional mitigation was necessary to ensure the targets were noticeable to the radar operator given the false targets produced by the WTGs.

The key mitigation proposed by the study was to ensure measures were in place to minimize the Radar cross section of the WTGs. The Radar cross section is the size and ability of a target to reflect radar energy. It is noted that although the Radar cross section of WTGs using non-lattice foundations is increasing so is the spacing between WTGs meaning that a transiting vessel will observe multipath or side lobe effects less frequently than in a dense array with smaller WTGs.

The study found no concerns around targets outside the wind farm.

8.9.3 Experience from operational projects

The evidence from mariners operating in the vicinity of existing offshore wind farms is that they quickly learn to adapt to any effects (with no recorded incidents). An example is given in Figure 8.4, which shows the WTGs installed within the Galloper and Greater Gabbard wind farms in the UK, relative to the nearby TSS lanes and yet there have been no reported incidents or issues raised by mariners who operate within the vicinity. The interference 'areas' presented in Figure 8.4 are as per Table 8.1.

As indicated by Figure 8.4, vessels utilizing these TSS lanes will experience some Radar interference based on the available guidance. Both projects are operational, and each of the lanes is used by a minimum five vessels per day on average. However, to date, there have been no incidents recorded (including any related to radar use) or concerns raised by the users.

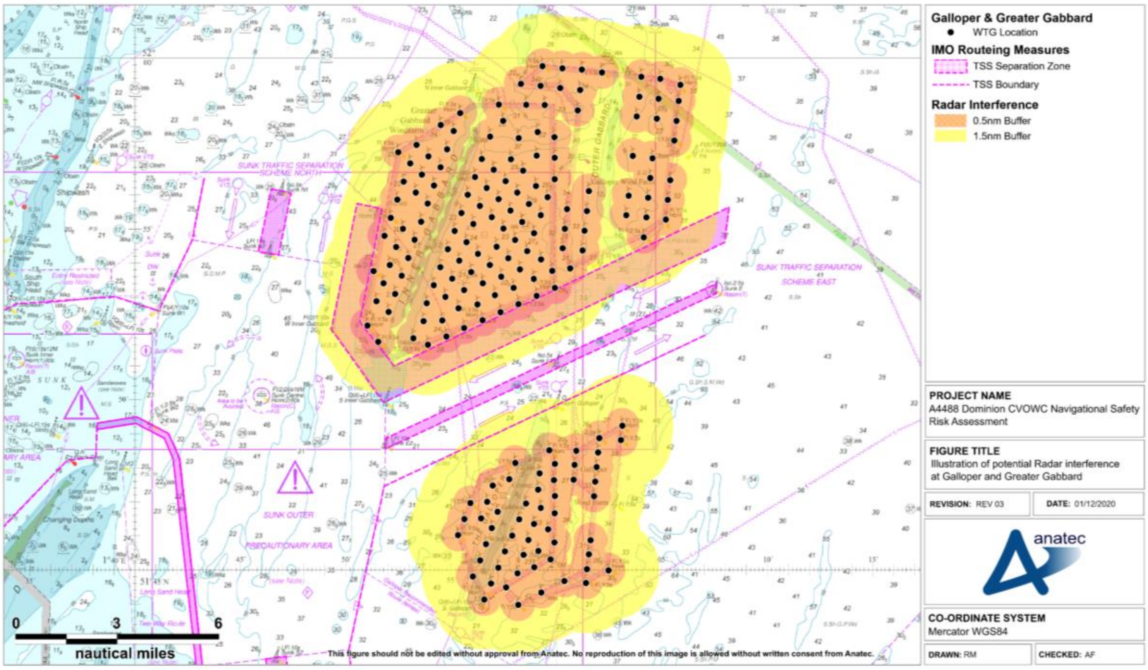

Figure 8.4 Potential Radar Interference Illustration – Greater Gabbard and Galloper

AIS information can also be used to verify the targets of larger vessels (generally vessels above 65 ft in length – the threshold at which commercial vessels must carry an AIS Class A device according to 33 CFR § 164.46). It is noted that approximately 1 percent of the vessel traffic recorded within the Study Area was below 65 ft in length, and approximately 1 percent within the Lease Area itself. There are increasing number of smaller vessels, particularly fishing vessels and recreational vessels, which are voluntarily utilizing an AIS Class B device, which therefore allows the verification of these small craft when in proximity to a wind farm.

8.9.4 Increased Target Returns

Beam width is the angular width, horizontal or vertical, of the path taken by the radar pulse. Horizontal beam width ranges from 0.75 to 5°, and vertical beam width from 20 to 25°. How well an object reflects energy back towards the radar depends on its size, shape and aspect angle.

Larger WTGs (either in height or width) will return greater target sizes and/or stronger false targets. However, there is a limit to which the vertical beam width would be affected (20 to 25°) dependent on the distance from the target. Therefore, increased WTG height in the wind farm will not create any effects in addition to those already identified from existing operational wind farms (i.e., interfering side lobes, multiple and reflected echoes).

Again, when taking into consideration the potential options available to marine users (e.g., reducing gain to remove false returns) and feedback from operational experience, this shows that the effects of increased returns can be managed effectively.

8.9.5 Fixed Radar Antenna use in Proximity to an Operational Windfarm

It is noted that there are multiple windfarms including Galloper in the UK that successfully operate fixed Radar antenna from locations on the periphery of the constructed wind farms. These antennas are able to provide accurate and useful information to marine coordination centers.

8.10 Sonar Systems

No evidence has been found to date with regard to existing offshore wind farms to suggest that they produce any kind of sonar interference which is detrimental to the fishing industry, or to military systems. No impact is therefore anticipated in relation to the Project.

8.11 Noise

8.11.1 Surface Noise

The sound level from a wind farm at a distance of 1,148 ft (350 m) has been predicted to be between 51 decibels (dB) and 54 dB (A). Furthermore, modelling undertaken during the consenting process for the Atlantic Array Offshore Wind Farm showed that the highest predicted level due to operational WTG noise (for a 410 ft (125 m) tall 8 MW WTG) is around 60 dB (Atlantic Array, 2012).

A vessel’s whistle for a vessel of 23 ft (7 m) should generate in the order of 138 dB and be audible at a range of 1.5 nm (2.8 km) (IMO, 1972/77); hence this should be heard above the background noise of the WTGs. Similarly, foghorns will also be audible over the background noise of the project.

There are therefore no indications that the sound level of the Project will have a significant influence on marine safety.

8.11.2 Underwater Noise

In 2005, the underwater noise produced by WTGs of 361 ft (110 m) height and with 2 MW capacity was measured at the Horns Rev Offshore Wind Farm in Denmark. The maximum noise levels recorded underwater at a distance of 328 ft (100 m) from the WTGs was 122 dB or 1 micropascal (µPa) (Institut für technische und angewandte Physik [ITAP], 2006).

During the operational phase of the Project, the subsea noise levels generated by WTGs will likely be greater than that produced at Horns Rev given the larger WTG size, but nevertheless is not anticipated to have any significant impact upon sonar systems as they are designed to work in pre-existing noisy environments. See the Underwater Acoustic Assessment (COP Appendix Z) for project specific modelling of underwater acoustic impacts.

Therefore, no impacts are anticipated.

8.12 Existing Aids to Navigation

The only AtoN within 10 nm (18.9 km) of the Lease Area are a lit navigational buoy approximately 6.7 nm (12.4 km) to the west and two AtoN on the existing Pilot Project turbines (see Section 5.1.5) adjacent to the western side of the Lease Area, as shown in Figure 8.5.

The presence of the surface Offshore Project Components will impact the visibility of the AtoN on the existing Pilot Project turbines to vessels on certain transits offshore of the Lease Area. However, the AtoN to be installed on the surface Offshore Project Components (see Section 7) are considered as compensating for any such effect. The buoy to the west is considered as being sufficiently distanced from the Lease Area to avoid any impact from the surface Offshore Project Components.

On this basis, no impact on existing Aids to Navigation is anticipated from the Project.

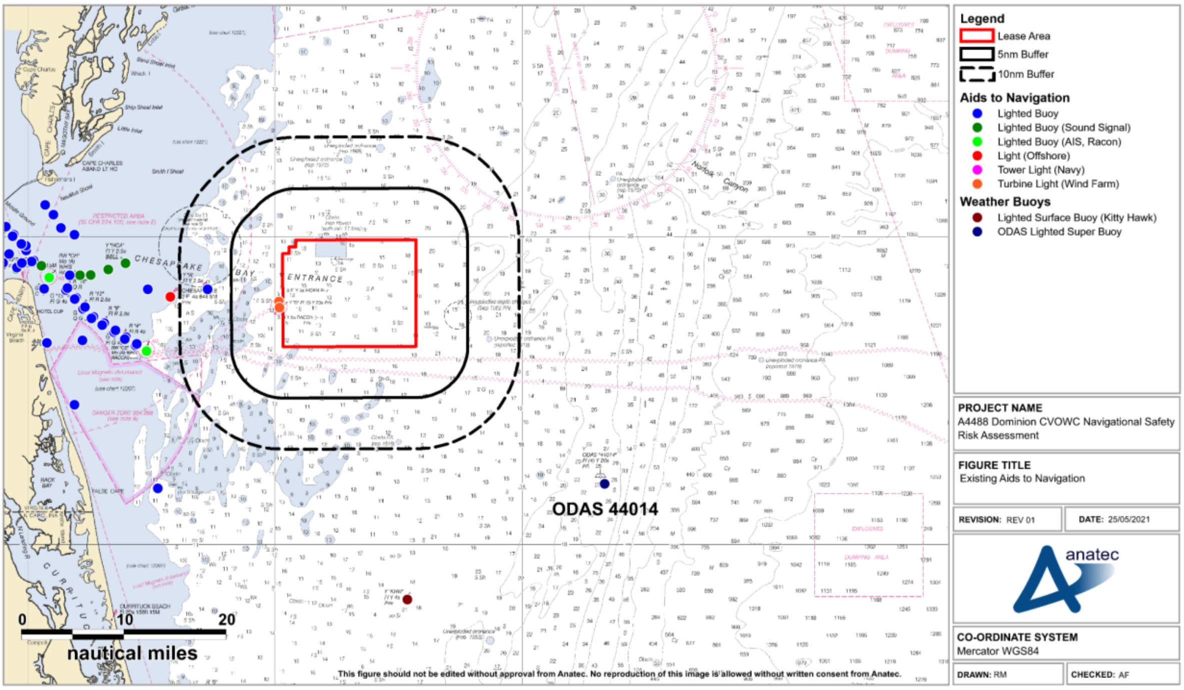

Figure 8.5 Existing Aids to Navigation

8.13 Summary of Effects on Communication and Position Fixing Equipment

Table 8.2 summarizes the impacts of the Project on communication and position fixing equipment.

Table 8.2 Summary of Effects on Communication and Position Fixing Equipment

Topic		Sensitivity	Screen In/Out (Isolation)	Screen In/Out (Cumulative)
Type	**Specific**			
Communication	VHF (Section 8.1)	No anticipated impacts. Not impacted by layout design.	Screened out	Screened out
	VHF direction finding (Section 8.2)	No notable degradation and therefore no anticipated impacts. Not impacted by layout design.	Screened out	Screened out
	Rescue 21 (Section 8.3)	No anticipated impacts. Not impacted by layout design.	Screened out	Screened out
	AIS (Section 8.4)	No anticipated impacts. Not impacted by layout design.	Screened out	Screened out
	NAVTEX (Section 8.5)	No anticipated impacts. Not impacted by layout design.	Screened out	Screened out
	GPS (Section 8.6)	No anticipated impacts. Not impacted by layout design.	Screened out	Screened out
EMF (Section 8.8)	Cables	No anticipated impacts.	Screened out	Screened out
	WTGs	No anticipated impacts. Not impacted by layout design.	Screened out	Screened out
Marine Radar	Use of marine Radar (Section 8.9)	Vessels have sufficient sea room to distance themselves from the array in line with the "Shipping Route Template" to mitigate any effects. Relevant rules of COLREGS (e.g., 5,6,19) would apply to vessels near or within the Lease Area.	Screened out	Screened out
Noise	WTG generated noise (Section 8.11)	No anticipated impacts. Not impacted by layout design.	Screened out	Screened out
	Sonar (Section 8.10)	No anticipated impacts. Not impacted by layout design.	Screened out	Screened out

9 Search, Rescue, Environmental Protection and Salvage

9.1 United States Coast Guard

9.1.1 Stations and Assets

The mission of the USCG is to ensure maritime safety, security and stewardship in the US. There are two area commands (Atlantic Area and Pacific Area) which are each split into a number of district commands. The Project lies within the Fifth District in the Atlantic Area (specifically, Sector Virginia) for the purposes of the USCG.

The Fifth District office is based in Portsmouth, VA and is responsible for all USCG missions from New Jersey to the North Carolina–South Carolina border. The locations of the active USCG stations within the Fifth District in proximity to the Lease Area (and therefore deemed relevant to the Project) are shown in Figure 9.1.

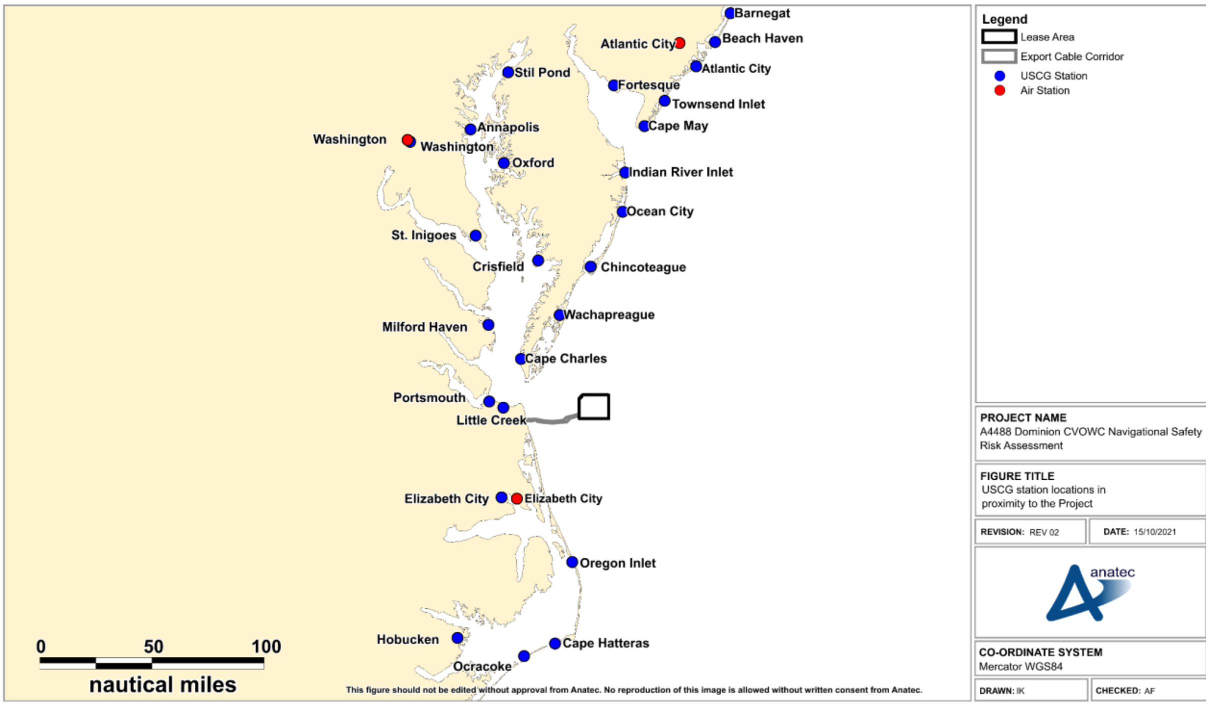

Figure 9.1 USCG station locations in proximity to the Project

The closest USCG station to the Lease Area is located on Naval Amphibious Base Little Creek. This station is a tenant at the largest base of its kind in the world, and the major operating base of the Amphibious Forces in the United States Navy's Atlantic Fleet.

The closest air station to the Lease Area is Air Station Elizabeth City located approximately 44 nm (81.5 km) to the southwest. This station is one the busiest USCG air stations, with airborne operations extending as far as the Caribbean, the Azores and Greenland (ElizCity.com, 2020). The station operates five C-130 Hercules aircraft and four MH-60T Jayhawk helicopters, with an example of the latter, located at Air Station Elizabeth City, shown in Figure 9.2. The Jayhawk operates at maximum speeds of between 125 and 150 knots and has an operational range of 300 nm (446 km).

Figure 9.2 Photo of MH-60T Jayhawk helicopter (USCG, 2016)

9.1.2 SAR Incident Response

The locations of SAR incidents (where a location was identifiable) to which the USCG have responded over the 10-year period between 2010 and 2019 are shown in Figure 9.3, according to the MISLE database. It should also be noted that multiple responses may be associated with the same incident.

Although the MISLE database contains point data, it is acknowledged that SAR incidents may involve a search of a wider area, and therefore the application of the study areas ensure that incidents defined outside the Lease Area and Offshore Export Cable Route Corridor, but which may have involved some degree of search within these areas, are accounted for.

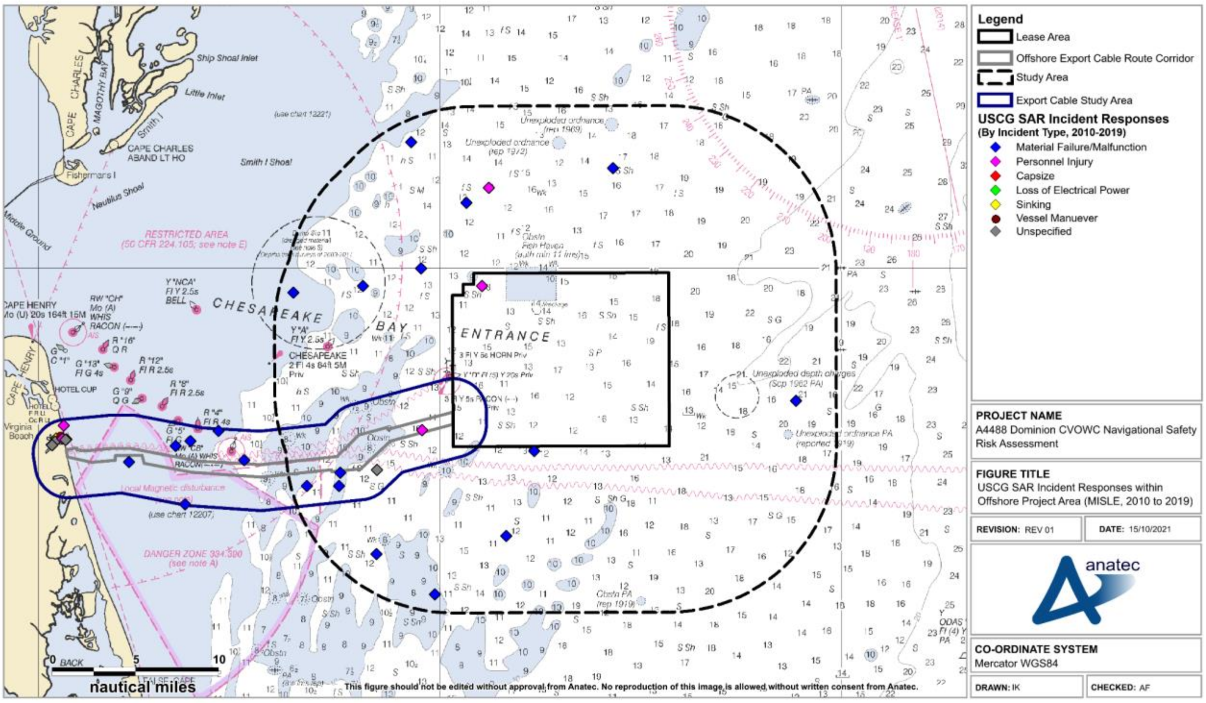

Figure 9.3 USCG SAR Incident Responses within Offshore Project Area (MISLE, 2010 to 2019)

Between 2010 and 2019, a total of 18 SAR incidents were recorded within the Study Area. Of these incidents, 14 involved material failure or malfunction, while three incidents involved injury to personnel. One incident occurred within the Lease Area, which was considered a serious incident, in which an injured person was medivacked to a Norfolk hospital from a vessel located 23 nm (43 km) off Cape Henry.

A total of 26 SAR incidents were recorded within the Export Cable Study Area between 2010 and 2019, of which 10 involved material failure or malfunction. Five incidences of personnel injury occurred, four of which were considered serious incidents.

9.1.3 Pollution Incident Response

The locations of pollution incidents within Offshore Project Area to which the USCG have responded over the 10-year period between 2010 and 2019 are shown in Figure 9.4, according to the MISLE database.

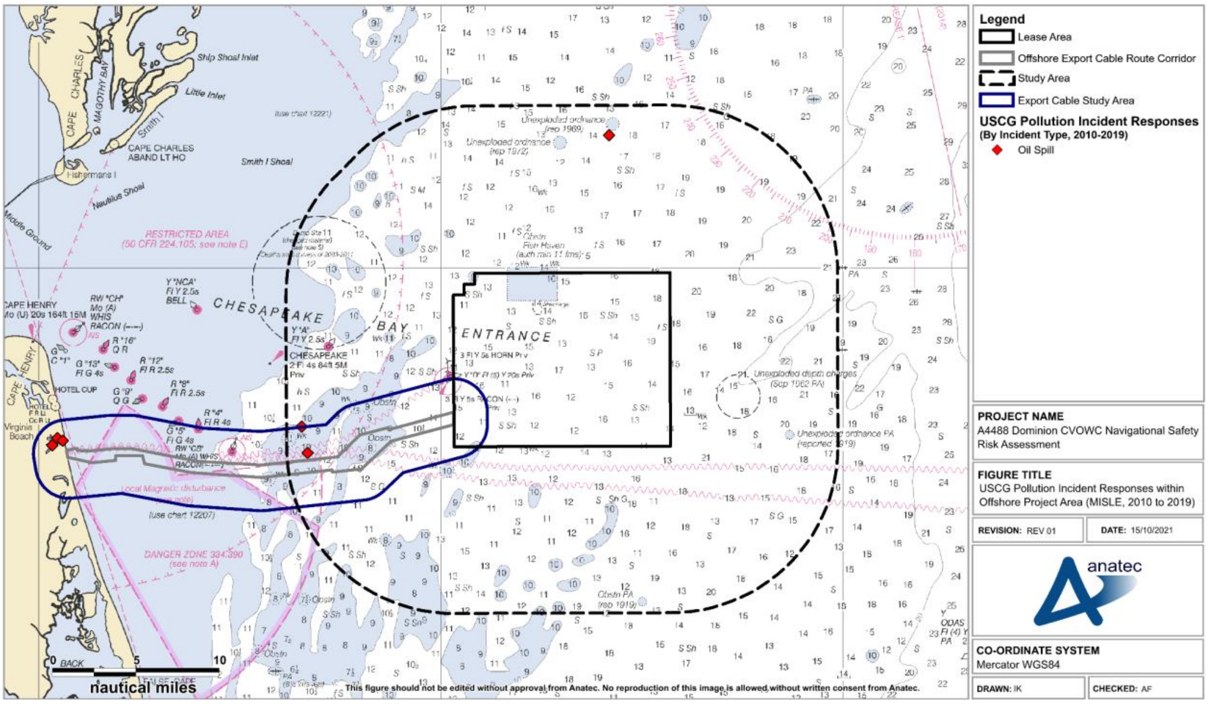

Figure 9.4 USCG Pollution Incident Responses within Offshore Project Area (MISLE, 2010 to 2019)

In the period between 2010 and 2019, three pollution incidents were recorded within the Study Area and eight within the Export Cable Study Area, all of which were oil spills. None of the incidents were considered a serious incident, and none occurred within the Lease Area or Offshore Export Cable Route Corridor.

9.1.4 Allision, Collision and Grounding Incidents

Allision, collision and grounding incidents were observed to be limited over the period studied, with no such incidents recorded within the Study Area. One collision and one allision were recorded within the Export Cable Study Area, however these were both within inshore waters.

9.1.5 Not Under Command Vessels

Based on the incident type definitions provided within the USCG MISLE data, a total of 14 incidents were identified where the vessel may have been NUC within the Study Area between 2010 and 2019 (noting that such an incident could lead to a drifting allision risk with the surface Offshore Project Components).

A vessel is considered NUC (i.e., Not Under Command) when it is unable to maneuver as required under COLREGs (IMO, 1972/77) due to some exceptional circumstance (e.g., engine failure).

The 14 incidents identified are shown in Figure 9.5.

Following this, Figure 9.6 shows the distances at which these incidents occurred from the Lease Area. As shown, of the 14 incidents recorded, just five were within 5 nm (9.3 km) of the Lease Area. The closest occurred approximately 0.2 nm (0.4 km) south of the Lease Area and involved a naval logistics vessel.

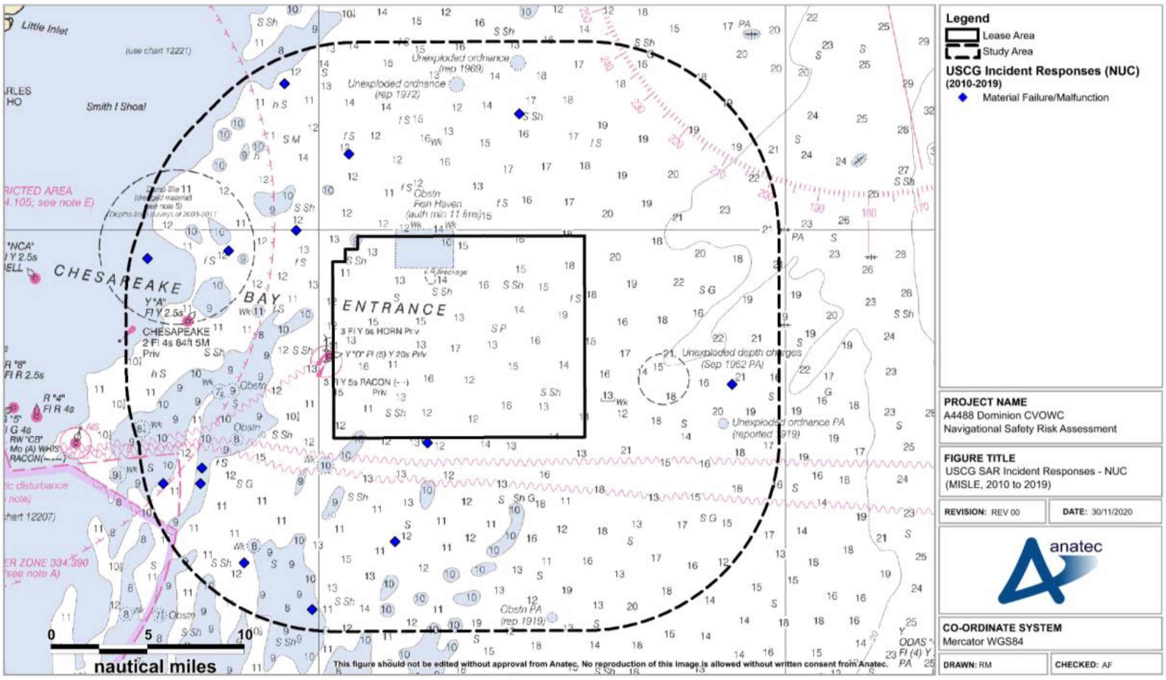

Figure 9.5 USCG Incident Responses – Potential NUC (MISLE, 2010 to 2019)

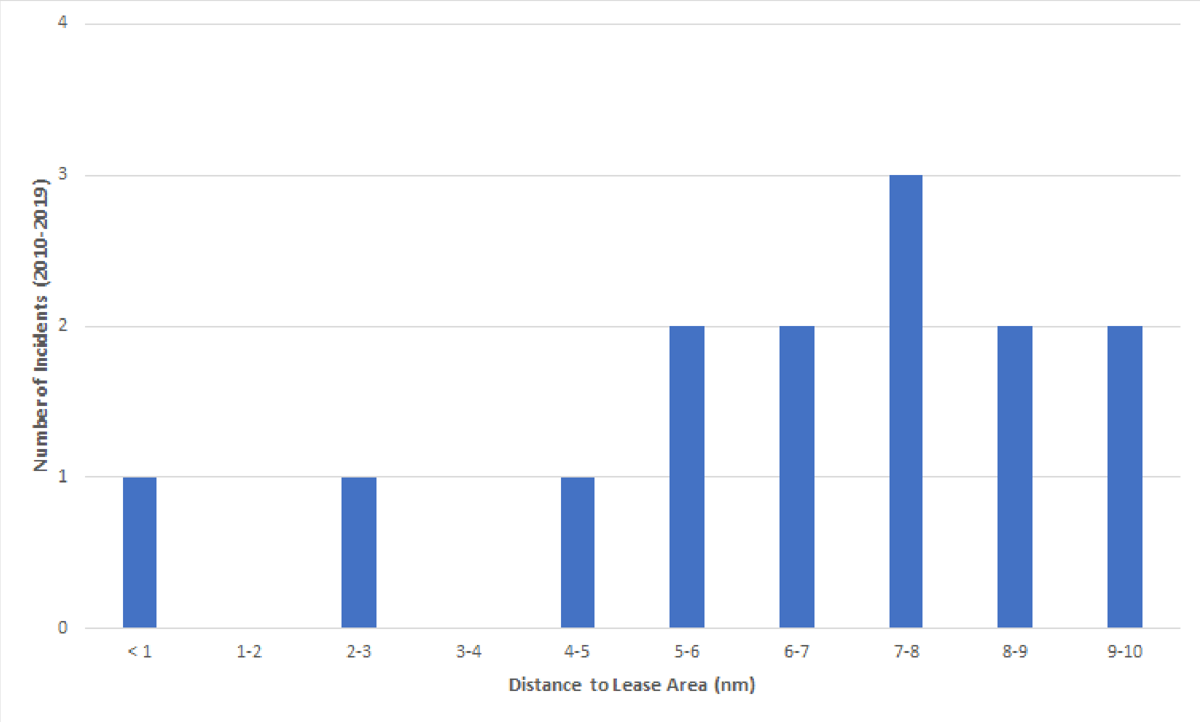

Figure 9.6 Potential NUC Incidents – proximity to Lease Area

9.2 Historical Offshore Wind Farm Incidents

9.2.1 UK

As of November 2020[12], there are 39 fully commissioned and operational offshore wind facilities in the UK, ranging from the North Hoyle Offshore Wind Farm (fully commissioned in 2003) to East Anglia ONE (fully commissioned in July 2020). These developments consist of approximately 14,700 fully operational WTG years (including years for now decommissioned developments).

To date there have been no collisions (vessel to vessel) as a result of the presence of an offshore wind farm in the UK. The only reported collision incident in relation to a UK offshore wind farm involved a project vessel hitting a third-party vessel while in harbor.

To date there have been nine reported cases of an allision incident between a vessel and a WTG (under construction, operational or disused) in the UK, with eight involving a support vessel for the development and the errant vessel in each case under power rather than drifting. Therefore, taking into account the number of operational WTGs and time since installed, there has been an average of 1,636 years per WTG allision incident in the UK, noting that this is a conservative value given that only

[12] Information in this section correct as of 11/11/2020.

operational WTG hours have been included whereas allision incidents counted include non-operational WTGs.

The worst consequences reported for vessels involved in an allision incident involving a UK offshore wind farm has been minor flooding, with no life-threatening injuries to persons reported. No material damage to WTGs has been reported in any of the allision incidents.

9.2.2 United States

Given the early stage of offshore wind development in the US, there is limited historical data for consideration in relation to collision and allision incidents involving offshore wind facilities.

However, there is one incident has occurred near the Block Island Offshore Wind Farm, the only currently operational offshore wind farm in the US. This involved a fishing vessel in January 2019 which issued a mayday call stating that the vessel was taking on water near the site (The Martha's Vineyard Times, 2019). The first responder reported the rescue of one fisherman and that the vessel had capsized, leaving two fishermen missing. A USCG helicopter and response boat were dispatched to conduct a search but were forced to return to their respective bases due to low visibility and unsafe weather conditions. Although the search was later resumed, the two missing fishermen were not found, with the sunken vessel discovered a month later.

Although the incident itself was considered unrelated to the offshore wind farm, it is understood from a review of publicly available information that a case study was/is undertaken by the USCG to determine if the presence of the wind farm had any impact on the USCG's SAR operation. At the time of writing this case study (investigation) has not been released to the public.

10 Collision, Allision, and Grounding – In Isolation

This section provides a quantitative assessment of potential interactions associated with the development of the Project. A base case and future case in terms of traffic volume is included, with hazards assessed including:

- Increased vessel to vessel collision risk;
- Powered vessel to structure allision risk;
- Drifting vessel to structure allision risk;
- Internal fishing vessel to structure allision risk; and
- Grounding vessel risk.

The quantitative assessment forms only one part of the NSRA, and feeds into the qualitative assessment introduced in Section 11. It should be considered that given historical maritime incident data is used to calibrate the models and minor collision and allision incidents are not frequently reported, it is only possible to make a comprehensive quantitative assessment of major interactions (i.e., major collision and allision incidents).

The base case assessment uses vessel traffic survey data in combination with consultation responses and other baseline data sources. The future case assessment then makes potential vessel traffic growth assumption as detailed within Section 6.5.

Quantitative assessment results are generally reported as a return period (i.e., expected number of years between occurrences[13]), noting that annual frequency (i.e., number of expected occurrences per year, the inverse of the return period) is referenced where appropriate. This represents the standard method of presenting the results of NSRA modelling in relation to offshore installations.

10.1 Pre-Wind Farm

10.1.1 Encounters

This section presents a quantitative assessment of encounter levels within the study area, based on modelling of one year of AIS data (see Section 1.5).

The input data was run through Anatec's Encounters program which identified any instance of two (or more) vessels located within 1 nm (1.9 km) of each other within a one-minute interval, based upon the vessel tracks. Where any such instance is identified, the program will log the lengths of AIS track that form part of that encounter, noting that the encounter ends when the vessel positions are no longer within 1 nm (1.9 km) of each other within a one-minute interval.

[13] For example, a return period of 1 in 100 years indicates that over a 100-year period the expected number of occurrences is one. This is different from the notion that it will take 100 years for one instance to occur.

It should be noted that no account has been given as to whether the encounters are head on or stern to head; just close proximity.

The output of this process was then manually filtered to identify any cases where an encounter situation was the result of a planned multiple vessel operation (e.g., dual towing operations). Any such case was removed from the assessment to ensure the focus remained on genuine encounter situations (i.e., multiple vessels engaged in independent activities including transit).

Where there was doubt as to whether an encounter was genuine or not, it has been retained.

The output of the Encounter software is shown in Figure 10.1, color coded by vessel type. A total of 561 encounters were identified, which corresponds to between one and two encounters per day on average. The significant majority of vessels involved in these encounter situations were observed to be cargo vessels, which accounted for approximately 80 percent of the total.

Encounter density is then shown in Figure 10.2. The highest area in terms of encounter density was observed to be in the area around the southern buoyed approach to Chesapeake Bay. This as would be expected noting multiple busy routes converge upon this area as per Section 6.3.6. Encounter density further offshore was low, and this is reflective of the available sea room for vessel transit pre wind farm.

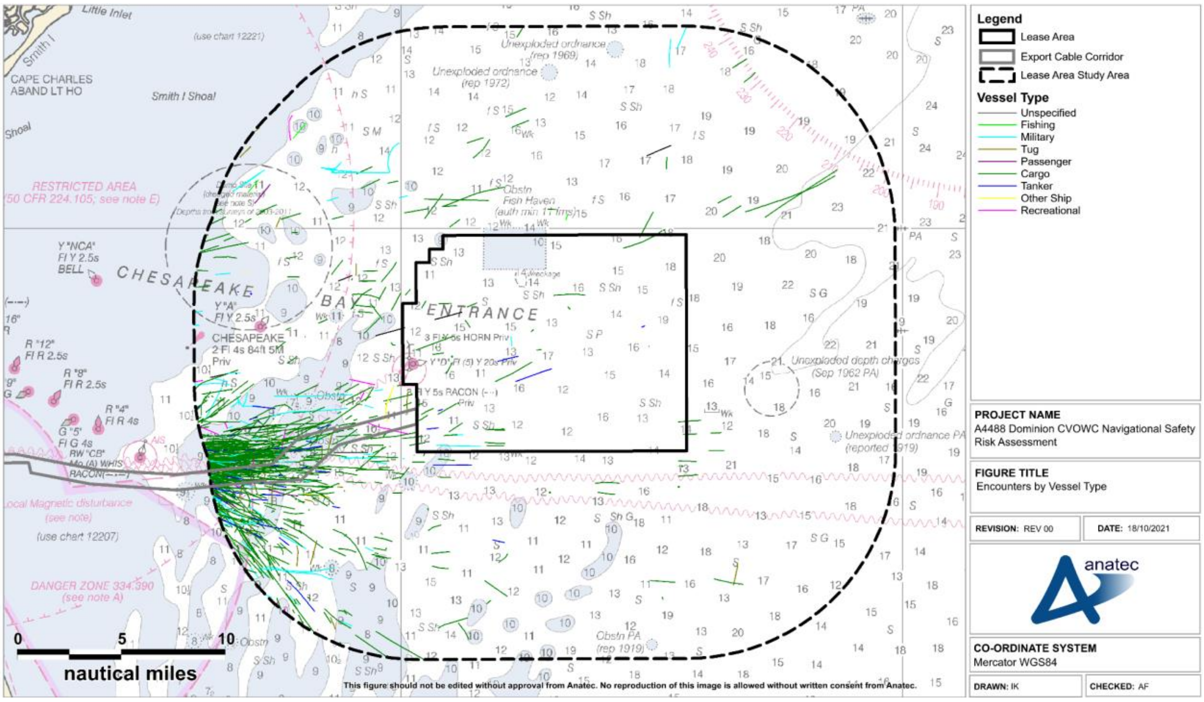

Figure 10.1 Encounters by Vessel Type

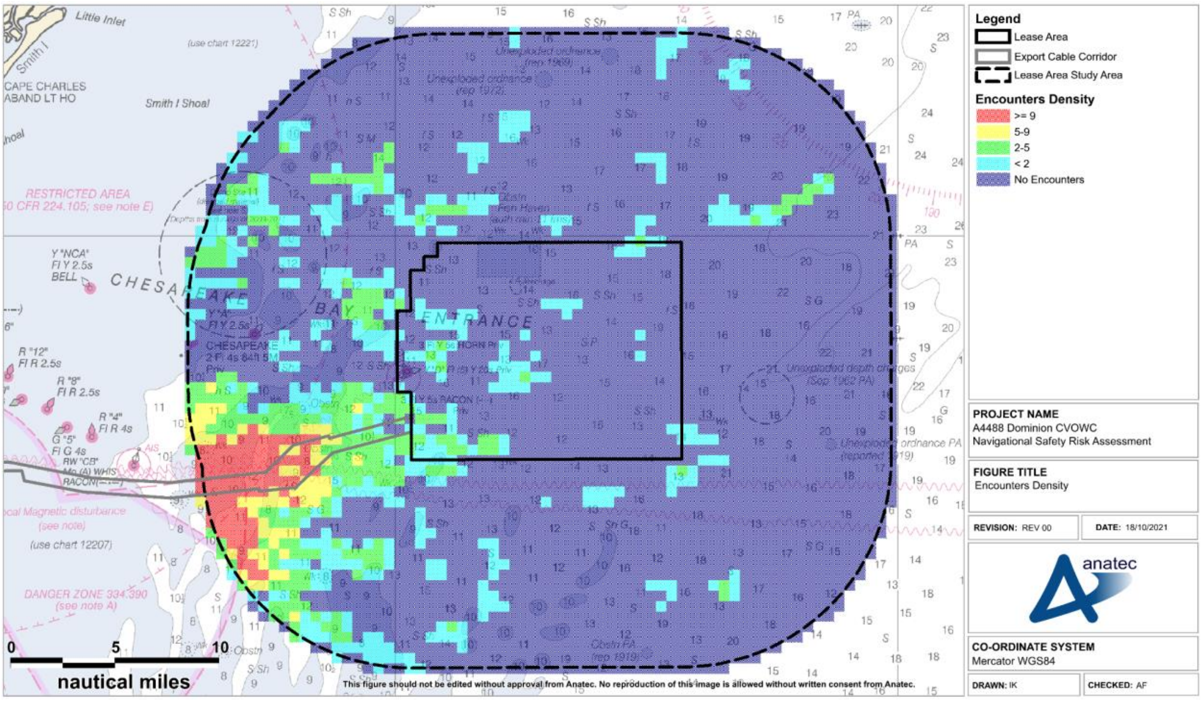

Figure 10.2 Encounter Density (Cell Resolution 0.5x0.5nm)

10.1.2 Vessel to Vessel Collisions

To assess vessel to vessel collision risk pre wind farm, the main routes identified (based on the pre wind farm scenario as per Section 6.3.6) were used as input to the collision function of Anatec's COLLRISK modelling software suite. The COLLRISK collision model uses vessel numbers, types, sizes (length and beam), mean route positions and standard deviation from the mean position to assess potential collision frequency. The likelihood of a major incident takes account of the probability of poor visibility (noting that collisions are more likely to occur when visibility is poor) and has been calibrated against historical maritime incident data.

On this basis, Figure 10.3 presents the pre wind farm vessel to vessel collision risk heat map within the study area.

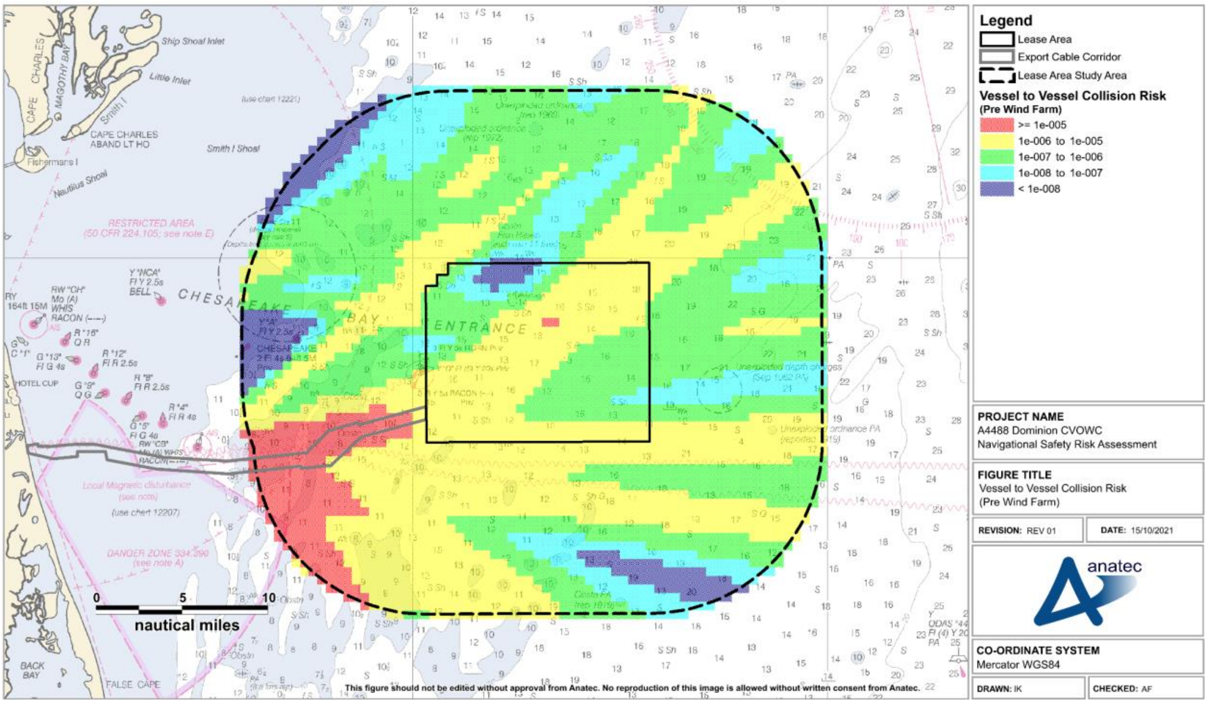

Figure 10.3 Vessel to Vessel Collision Risk – Pre Wind Farm (Cell Resolution 0.5x0.5nm)

Based on the pre wind farm scenario collision modelling output, it was estimated that a vessel would be involved in a collision once per 93 years, assuming base case traffic volumes. The highest area of risk was observed to be in the approach to the Chesapeake Bay TSS lanes, where numerous main routes converge. The Lease Area itself is currently intersected by busy main routes, and as such represents a moderate area in terms of collision risk.

In terms of future case risk, the return period rose to once per 77 years assuming a 10 percent increase in traffic, and once per 65 years assuming a 20 percent increase in traffic.

It is noted that the vessel to vessel collision risk model is calibrated using major incident data at sea which allows for benchmarking but does not cover all incidents, such as minor impacts. Other incident data from the USCG, which includes minor incidents, is presented in Section 9.

10.2 Post Wind Farm

10.2.1 Deviations

Figure 10.4 presents the anticipated mean positions of the main routes identified in Section 6 (see Figure 6.25) following installation of the surface Offshore Project Components. These deviations follow the methodology outlined in Section 6.5.4, including the mean position of routes being set to a minimum of 1 nm (1.9 km) from the Lease Area and utilization of the ACPARS fairways where appropriate (based on the pre wind farm routing and consideration of relevant consultation).

A deviation may be required for nine of the 19 main routes identified, as shown in Table 10.1, which shows the change in transit distance within a 150nm buffer of the Lease Area (this is in line with the radius considered on a cumulative level, and ensures changes outside of the 10nm study area are still captured).

It should be considered when viewing Table 10.1 that changes associated with routes deviated into ACPARS were observed to be primarily influenced by the ACPARS as opposed to the Project.

The largest deviation not associated with ACPARS was to Route 4, which is anticipated to pass south of the Lease Area once the surface Offshore Project Components are in place. Note that Routes 2, 6, 11, and 19 (see Table 6.1) are also anticipated to pass south of the Lease Area, but the magnitude of these deviations was less than for Route 4.

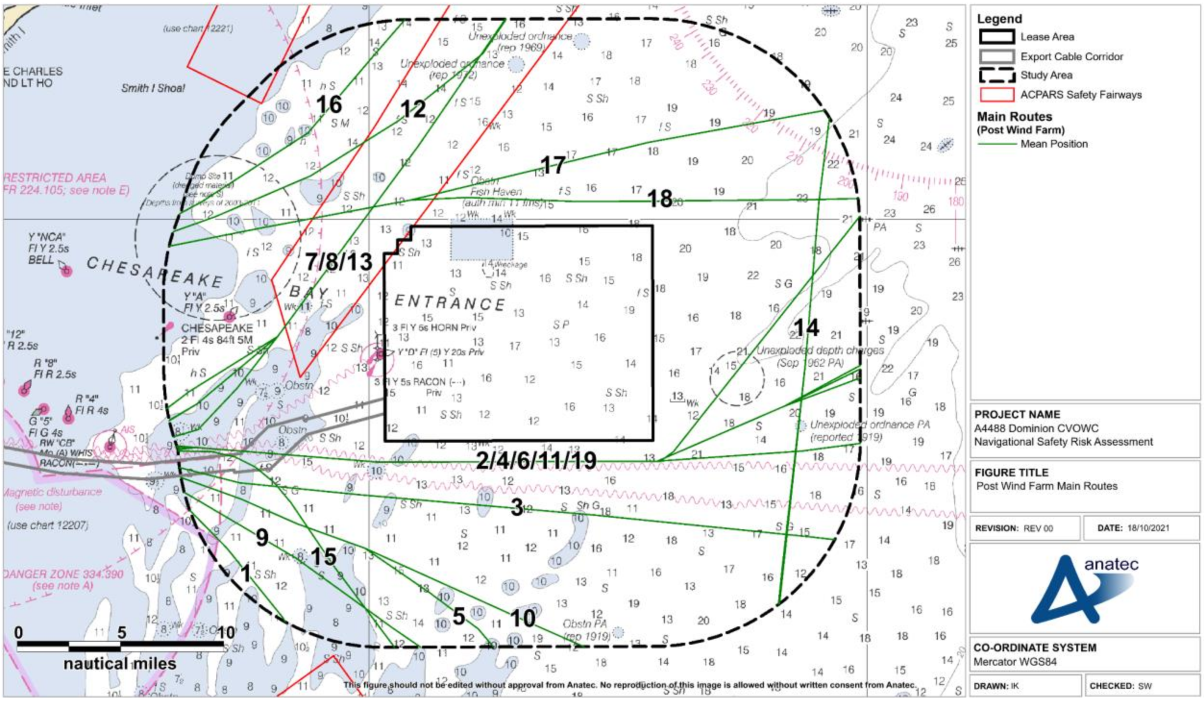

Figure 10.4 Post wind farm main routes and 90th percentiles within Study Area

Table 10.1 Post wind farm main route deviations

Main Route	Vessels per Day	Distance of Route within 150nm of Lease Area		Change within 150nm of Lease Area (nm)	Deviated into ACPARS
		Pre Wind Farm (nm)	Post Wind Farm (nm)		
1	5	173.8	173.8	No Change	No
2	3	190.5	190.6	0.1	No
3	2	190.7	190.7	No Change	No
4	2	192.0	197.2	5.2	No

Main Route	Vessels per Day	Distance of Route within 150nm of Lease Area		Change within 150nm of Lease Area (nm)	Deviated into ACPARS
		Pre Wind Farm (nm)	Post Wind Farm (nm)		
5	1	177.9	177.9	No Change	No
6	1	192.0	193.5	1.5	No
7	1	191.6	187.9	-3.7	Yes
8	1	204.3	211.8	7.7	Yes
9	1	185.3	185.3	No Change	No
10	1	188.3	188.3	No Change	No
11	1	187.7	191.9	4.3	No
12	1	182.6	179.3	-3.3	Yes
13	< 1	189.4	187.5	-1.9	Yes
14	< 1	326.5	326.5	No Change	No
15	< 1	180.5	180.5	No Change	No
16	< 1	176.8	176.8	No Change	No[14]
17	< 1	187.3	187.3	No Change	No
18	< 1	187.7	187.7	No Change	No
19	< 1	192.1	192.2	0.1	No

10.2.2 Simulated AIS

Using the post wind farm main routes (see Section 10.2.1), the associated standard deviations from the mean position and the average number of vessels on each route, the Anatec AIS Track Simulator has been used to gain insight into the potential post wind farm re-routed vessel traffic following the installation of the Project. On this basis, Figure 10.5 presents a plot of 12 months of simulated AIS tracks (to match the length of the survey period for the primary vessel traffic data used in the baseline assessment).

[14] May join ACPARS north of study area.

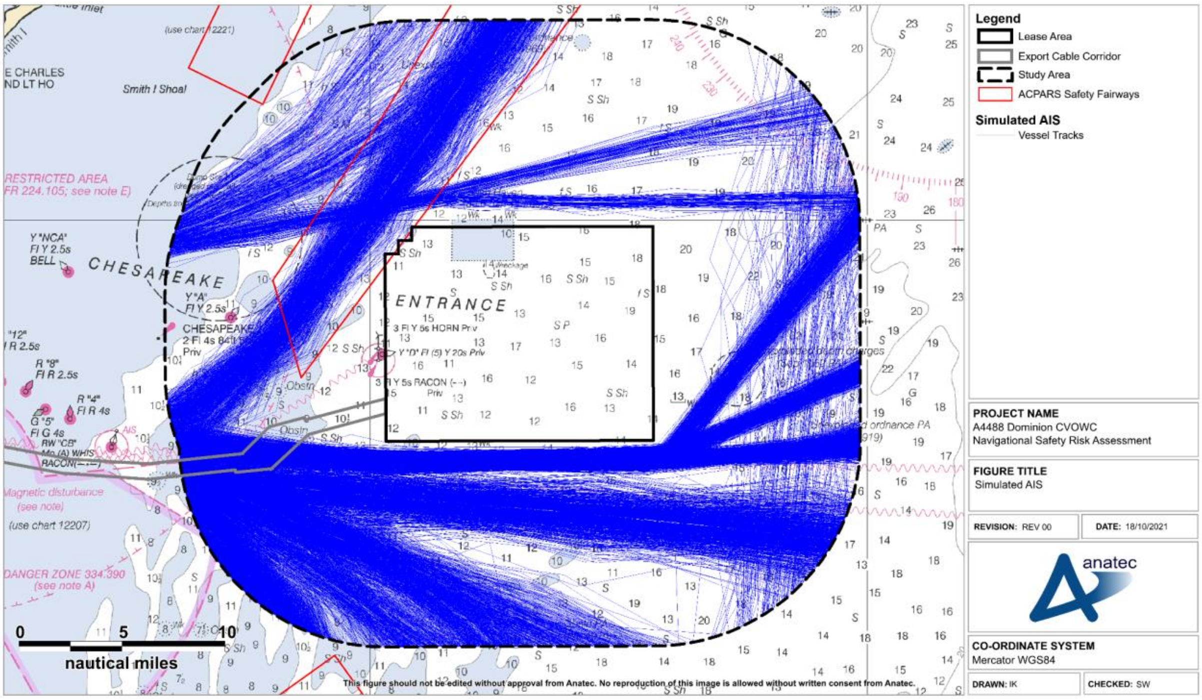

Figure 10.5 Simulated AIS

10.2.3 Vessel to Vessel Collisions

Using the anticipated post wind farm routing (see Section 10.2.1) as input to the collision function of Anatec's COLLRISK modelling software suite, the potential increase in vessel to vessel collision risk in proximity to the Lease Area following the installation of the Project has been assessed.

On this basis, Figure 10.6 presents the post wind farm vessel to vessel collision risk heat map within the study area.

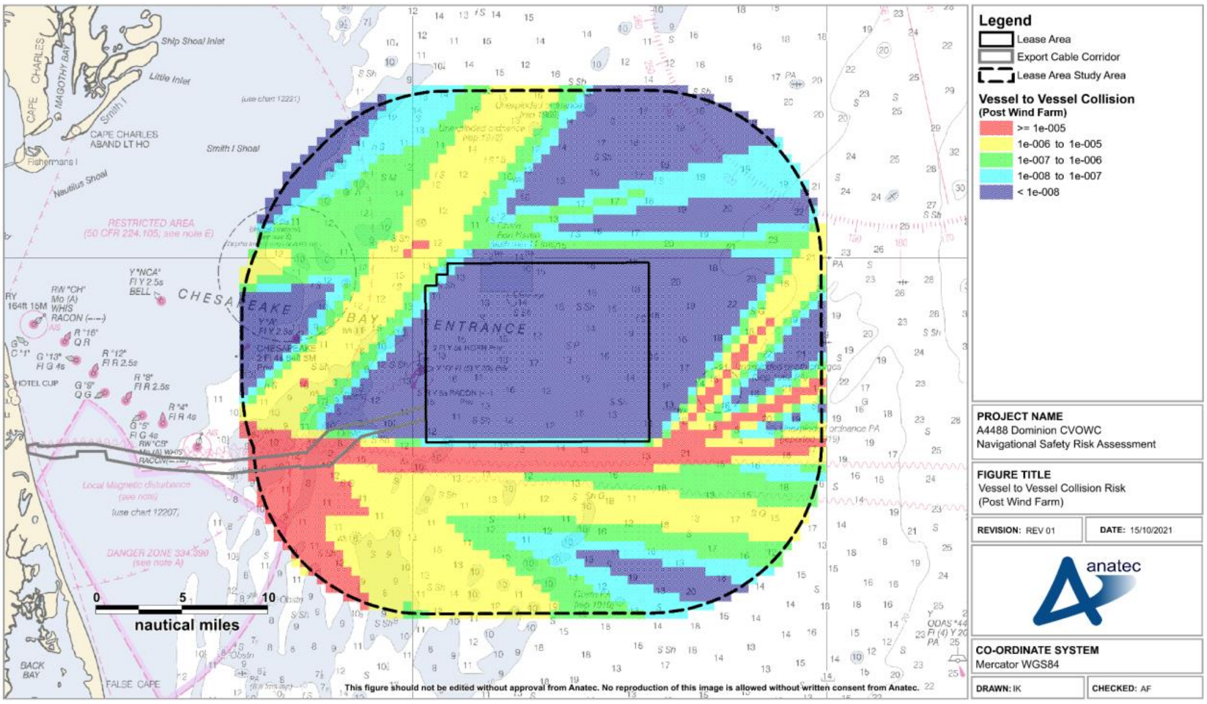

Figure 10.6 Vessel to Vessel Collision Risk – Post Wind Farm (Cell Resolution 0.5x0.5nm)

Based on the post wind farm scenario collision modelling output, it was estimated that a vessel would be involved in a collision once per 52 years, assuming base case traffic volumes. This represents an increase in collision risk (as high as 80 percent) over the pre wind farm scenario. Dominion Energy will continue discussions with the USCG (including with the USCG NAVCEN) regarding potential mitigation strategies for reducing this risk.

In terms of future case risk, the return period rose to once per 43 years assuming a 10 percent increase in traffic, and once per 36 years assuming a 20 percent increase in traffic.

Noting that commercial vessels on main routes are expected to deviate to avoid the surface Offshore Project Components, collision risk within the Lease Area itself associated with such vessels will decrease. However, risk within the study is increasing overall, particularly to the south of the Lease Area, where busy routes are anticipated to deviate post wind farm.

This is illustrated in Figure 10.7, which plots the change in risk between the pre and post wind farm scenarios assuming base case traffic levels. As shown, the biggest change in risk is occurring to the south of the Lease Area, noting that risk is also increasing, albeit to a lesser extent within the ACPARS lane to the west.

It is noted that as per Section 10.1.2, the vessel to vessel collision risk model is calibrated using major incident data at sea which allows for benchmarking but does not cover all incidents, such as minor impacts. Other incident data from the USCG, which includes minor incidents, is presented in Section 9.1.

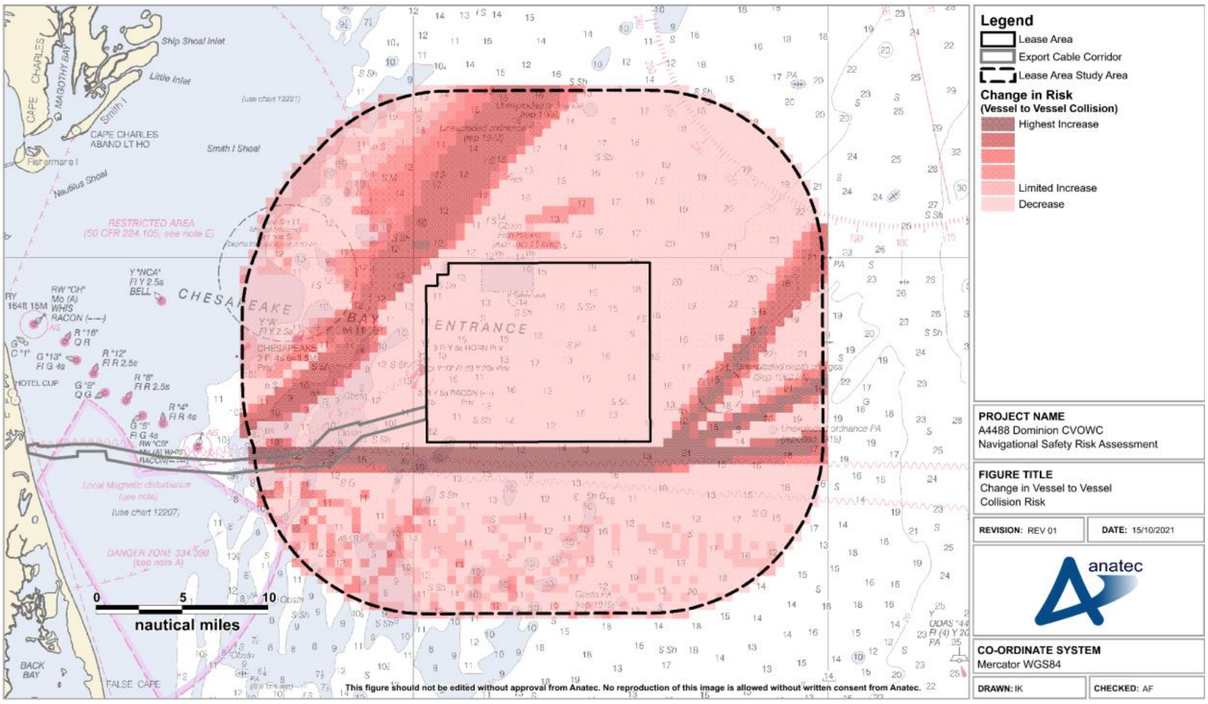

Figure 10.7 Change in Vessel to Vessel Collision Risk

10.2.4 Vessel to Structure Allisions

10.2.4.1 Powered

Using the post wind farm routing (see Section 10.2.1) as input to the powered allision function of Anatec's COLLRISK modelling software suite, the potential powered vessel to structure allision risk following the installation of the Project has been assessed.

A powered allision represents the scenario of an errant vessel under power deviating from its route to the extent that it comes into proximity with a surface Offshore Project Component, leading to an allision. The COLLRISK powered allision model uses vessel numbers, types, sizes (length and beam), mean route positions and standard deviation from the mean position, array layout and structure dimensions. The likelihood of a major allision incident takes account of the probability of poor visibility and has been calibrated against historical maritime incident data.

It is noted that the existing Pilot WTGs (see Section 5.1.5) have been included within the allision modelling given their proximity to the Lease Area and the baseline allision risk they create.

On this basis, Figure 10.8 presents the powered vessel to structure allision risk for each individual surface Offshore Project Component. It should be considered when viewing this plot that for the purposes of comparison, the same range brackets have been used to present the allision risk for the powered and drifting allision scenarios.

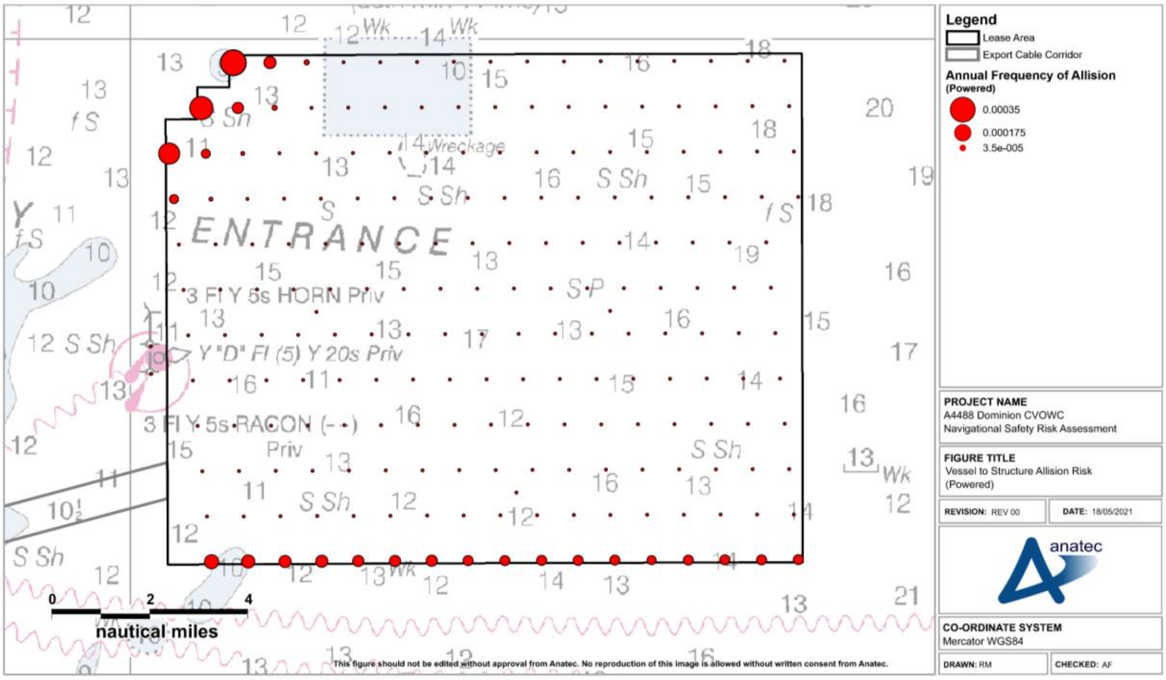

Figure 10.8 Vessel to Structure Allision – Powered

For the base case scenario, it was estimated that the annual powered allision return period across all surface Offshore Project Components was one in 394 years. As indicated in Figure 10.8, the majority of the post wind farm powered allision risk is associated with the WTGs adjacent to the proposed ACPARS Safety Fairway. This is due to the proximity of these structures to the traffic anticipated to utilize the ACPARS lane post wind farm. It should be considered that as per Section 4.2.1, the three structures directly adjacent to the ACPARS are spare locations, and therefore may not be used.

Based on the modelling, the surface Offshore Project Component most at risk of a powered allision was the northernmost of the three WTGs adjacent to the ACPARS. One powered allision per 2,900 years was estimated for this WTG.

The other notable area of risk was the southern periphery, noting that as per Section 10.2.1, certain busy vessel routes are anticipated to pass south of the Lease Area.

In terms of future case risk, the return period rose to once per 357 years assuming a 10 percent increase in traffic, and once per 328 years assuming a 20 percent increase in traffic.

Allision risk to the existing pilot WTGs is low when considered in isolation, noting no direct routing in proximity is predicted based on the anticipated effects of the Project on traffic patterns.

10.2.4.2 Drifting

Using the post wind farm routing (see Section 10.2.1) as input to the drifting allision function of Anatec's COLLRISK modelling software suite, the potential drifting vessel to structure allision risk following the installation of the Project has been assessed.

A drifting allision represents the scenario of a vessel NUC drifting from its original route to the extent that it comes into proximity with a surface Offshore Project Component, leading to an allision. The likelihood of a major allision incident takes account of drift speed and direction (from wind, sea state and tidal data) and has been calibrated against historical maritime incident data.

The model is based on the premise that propulsion on a vessel must fail before a vessel would drift, with the type and size of the vessel, number of engines, average time to repair and differing sea state conditions taken into account. The exposure times for a drifting scenario are based on the vessel hours spent in proximity to the surface Offshore Project Components (up to 10 nm (18.5 km) from the perimeter of the Lease Area). These have been estimated based on the vessel traffic levels, speeds and routing patterns.

Using this information, the overall rate of mechanical failure within the area surrounding the Lease Area was estimated. The probability of a vessel drifting towards a surface Offshore Project Component and the drift speed are dependent on the prevailing wind, wave and tidal conditions at the time of the incident.

The following three drift scenarios have been modelled:

- Wind;
- Peak spring flood tide; and
- Peak spring ebb tide.

The probability of vessel recovery from drift is estimated based on the speed of drift and hence the time available before reaching a surface Offshore Project Component. Vessels which do not recover within this time are assumed to allide.

After modelling each of the drift scenarios it was established that the ebb dominant drift produced the worst case results and therefore has been used within this NSRA for the purposes of assessing drifting vessel to structure allision risk.

It is noted that the existing Pilot WTGs (see Section 5.1.5) have been included within the allision modelling given their proximity to the Lease Area and the baseline allision risk they create.

On this basis, Figure 10.9 presents the drifting vessel to structure allision risk for each individual surface Offshore Project Component. It should be considered when viewing this plot that for the purposes of comparison, the same range brackets have been used to present the allision risk for the powered and drifting allision scenarios.

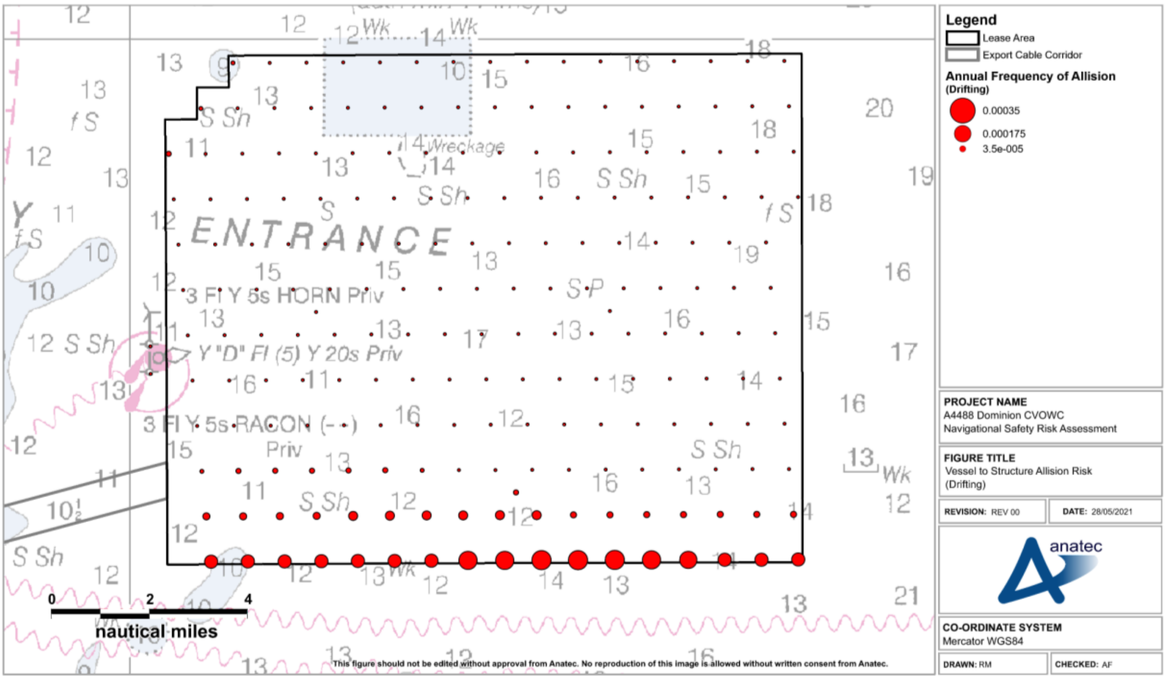

Figure 10.9 Vessel to Structure Allision – Drifting

For the base case scenario, it was estimated that the annual powered allision return period across all surface Offshore Project Components was one in 306 years. As indicated in Figure 10.9, the majority of the post wind farm drifting allision risk is associated with the WTGs on the southern periphery. This is resultant notable numbers of vessels anticipated to deviate to the south of the Lease Area, and the peak ebb tidal direction.

Based on the modelling, the surface Offshore Project Component most at risk of a drifting allision was a WTG on the southern periphery. One drifting allision per 4,900 years was estimated for this WTG.

In terms of future case risk, the return period rose to once per 279 years assuming a 10 percent increase in traffic, and once per 255 years assuming a 20 percent increase in traffic.

Allision risk to the existing pilot WTGs was low, noting no direct routing in proximity is predicted based on the effects of the Project on traffic patterns.

10.2.5 Fishing Allision Risk

The 12 months of AIS data (see Section 6.3.4.5) was used as input to the fishing allision function of Anatec's COLLRISK modelling software suite to assess the potential fishing vessel to structure allision risk following the installation of the Project.

A fishing vessel allision is classified separately from other allisions since, unlike in the case of the commercial traffic characterized via the main routes (see Section 10.2.1), fishing vessels may be either in transit or actively fishing within the area. Further, fishing vessels could be observed internally within the array in addition to externally (noting that experience shows that commercial vessels will generally avoid wind farm structures). The COLLRISK fishing allision model uses fishing vessel numbers, sizes (length and beam), array layout, and structure dimensions as input. The likelihood of a major allision incident has been calibrated against historical maritime incident data and historical AIS vessel traffic data within operational offshore arrays. Given that not all fishing vessels broadcast on AIS, the vessel density observed is scaled up to account for non-AIS fishing vessels, with the scaling factor dependent on the distance of the array offshore.

It is noted that the existing Pilot WTGs (see Section 5.1.5) have been included within the allision modelling given their proximity to the Lease Area and the baseline allision risk they create.

The results of the fishing allision assessment are shown geographically in Figure 10.10. It should be considered when viewing the figure that specific risk ranges have been utilized to ensure clarity, and as such the plot is not directly comparable to the allision results shown in Section 10.2.4.

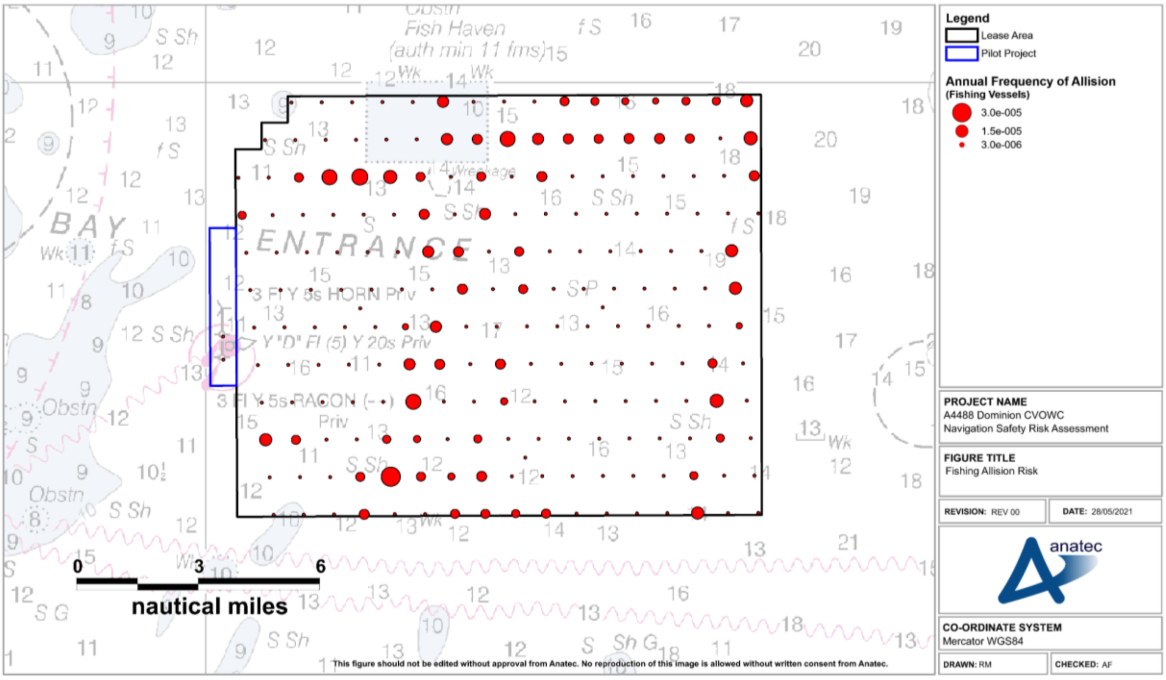

Figure 10.10 Fishing Allision Risk

For the base case scenario, it was estimated that the annual fishing vessel allision return period across all surface Offshore Project Components was one in 1,690 years. The greatest annual fishing vessel allision return period associated with any individual structure was one in 34,000 years.

Assuming a 10 percent traffic increase to represent potential future vessel traffic trends (see Section 6.5.2), it was estimated that the annual fishing vessel allision return period would be one in 1,560 years. This rose to one in 1,450 years assuming a 20 percent traffic increase.

10.2.6 Vessel Grounding Risk

The only underwater devices forming part of the Project are the Inter-Array, interconnector, and Offshore Export Cables. As noted in Section 4.3, there is potential for the cables to require protection where burial depths are not feasible, and residual risk remains. Should the Cable Protection reduce navigable water depths, there may be an increased risk of vessel grounding in shallower waters. However, the extent and locations of any required external Cable Protection are not known at the time of writing, and therefore a detailed quantitative assessment of the grounding risk has not been undertaken. However, a high-level assessment based on the information available at the time of writing has been undertaken.

With regards to the Lease Area:

- Water depths range from between 66 and 114 ft over MLLW (see Section 5.2.1);
- Commercial vessels are anticipated to deviate to avoid the surface Offshore Project Components and as such are unlikely to transit through the Lease Area (see Section 10.2.1); and
- Volumes of smaller vessels are likely to be low given distance offshore, and regardless are unlikely to have drafts that would risk subsea interaction given the water depths.

Taking these factors into account, there is not considered to be any additional risk to vessels of grounding within the Lease Area due to the presence of the Project.

With regards to the Offshore Export Cable Route Corridor:

- In terms of areas that are navigated based on the vessel traffic data, water depths range from between 6 and 85 ft over MLLW (see Section 5.2.2);
- Within the Offshore Export Cable Route Corridor, the shallowest area observed to be utilized for navigation based on the vessel traffic data (between the 6 and 18 ft contours) was navigated exclusively by smaller vessels (max draft transmitted of 3.3 ft, max length 21 ft) – regardless this area is anticipated to be within the HDD Nearshore Area; and
- Between the 18 and 30 ft contours, the maximum draft recorded was 21 ft, however all vessels of draft 10 ft or larger were observed to transit in depths in excess of 25 ft.

Taking these factors into account, there may be additional risk to vessels of grounding within the Offshore Export Cable Route Corridor due to the presence of the Project, dependent on the Cable Protection implemented (such as concrete mattresses). This will be required to be studied in more detail as part of the Cable Burial Risk Assessment, noting that this NSRA assessment is high level, and based on charted depths (as opposed to comprehensive bathymetry data), and does not account for non-AIS data vessels.

It is noted that based on assessment of the SAR incident data assessed from the MISLE database (see Section 9.1.4), there have been no grounding incidents responded to by the USCG SAR services within the Study Area and Export Cable Corridor Study Area over the 10-year period studied (2010 to 2019), indicating that the likelihood of a grounding incident occurring in proximity to the Project is very low.

Should a grounding incident occur, the most likely consequences would be low, with the vessel able to refloat and make port without support and only minor damage incurred. The worst case consequences are the foundering of the vessel, with pollution caused, but this is considered an unlikely outcome.

10.2.7 Risk Results Summary

A summary of the collision and allision risk modelling results is provided in Table 10.2. The annual frequency of each risk is presented alongside the corresponding return period for all three scenarios assessed (base case, future case with 10 percent traffic growth and future case with 20 percent traffic growth). The total annual collision and allision frequency and return period is also provided (consisting of the sum of the annual vessel to vessel collision, powered vessel to structure allision, drifting vessel to structure allision and fishing vessel to structure allision frequencies).

As previously stated and discussed, it should be considered that the post wind farm scenario accounts for the introduction of the ACPARS fairways, and as such this has factored into the change in risk.

Table 10.2 Allision and Collision Risk Summary

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	1.08E-02 (1 in 93 years)	1.93E-02 (1 in 52 years)	8.50E-03 (1 in 118 years)
	Future case (10%)	1.30E-02 (1 in 77 years)	2.33E-02 (1 in 43 years)	1.03E-02 (1 in 97 years)
	Future case (20%)	1.55E-02 (1 in 65 years)	2.78E-02 (1 in 36 years)	1.23E-02 (1 in 81 years)
Powered vessel to structure allision	Base case	N/A	2.54E-03 (1 in 394 years	2.54E-03 (1 in 394 years)
	Future case (10%)	N/A	2.80E-03 (1 in 357 years)	2.80E-03 (1 in 357 years)
	Future case (20%)	N/A	3.05E-03 (1 in 328 years)	3.05E-03 (1 in 328 years)
Drifting vessel to structure allision	Base case	N/A	3.27E-03 (1 in 306 years)	3.27E-03 (1 in 306 years)
	Future case (10%)	N/A	3.59E-03 (1 in 279 years)	3.59E-03 (1 in 279 years)
	Future case (20%)	N/A	3.92E-03 (1 in 255 years)	3.92E-03 (1 in 255 years)
Fishing vessel to structure allision	Base case	N/A	5.91E-04 (1 in 1,692 years)	5.91E-04 (1 in 1,692 years)
	Future case (10%)	N/A	6.41E-04 (1 in 1,560 years)	6.41E-04 (1 in 1,560 years)
	Future case (20%)	N/A	6.91E-04	6.91E-04

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
			(1 in 1,447 years)	(1 in 1,447 years)
Total	Base case	**1.08E-02 (1 in 93 years)**	**2.57E-02 (1 in 39 years)**	**1.49E-02 (1 in 67 years)**
	Future case (10%)	**1.30E-02 (1 in 77 years)**	**3.03E-02 (1 in 33 years)**	**1.73E-02 (1 in 58 years)**
	Future case (20%)	**1.55E-02 (1 in 65 years)**	**3.55E-02 (1 in 28 years)**	**2.00E-02 (1 in 50 years)**

10.3 Consequences Assessment

10.3.1 Third Party

The most likely consequences for the majority of hazards associated with shipping and navigation are anticipated to be minor (such as collision/allision resulting in no hull breaches, foundering or injury to personnel). While the COLREGs Rule 5 requires that "every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision"; in the worst case scenario, the consequences of a collision may be severe, including events resulting in PLL (Potential Loss of Life as per Section 2.1.3). For larger commercial vessels an allision incident would likely result in the collapse of the surface Offshore Project Component before it is able to significantly damage the hull of the vessel (see Section 10.3.2). The breach of a vessel's fuel (bunker) tank is considered unlikely and in the case of vessels carrying cargoes which could be deemed to be hazardous (e.g., liquid tankers or gas carriers) the additional safety features associated with these vessels would further mitigate the risk of pollution (for example mandatory double hulls). Similarly, in a drifting allision incident the surface Offshore Project Component would likely absorb the majority of the impact energy, particularly given the likely low speed of the errant vessel, with some energy being retained by the vessel in the form of rotational movement.

For smaller vessels such as fishing vessels and recreational vessels, the worst case consequences would be the risk of vessel damage leading to foundering of the vessel and PLL.

A quantitative assessment of the potential consequences of a collision or allision incident is provided in full in Appendix B. This assessment applies the risk results presented in this section to historical data regarding collision and allision incidents, and oil pollution. Full details are provided in Appendix B, but in summary, the overall annual increase in PLL estimated due to the impact of the Project on passing vessels is approximately one fatality per 24,000 years, assuming no increase in traffic (i.e., base case). In terms of individual risk to people, the incremental increase estimated due to the impact of the Project for the base case (and future cases) is negligible. Given these very low results the fatality risk resulting from the Project is not considered to be significant.

It was estimated that should the Project be built, the overall increase in oil spilled from passing vessels would be approximately 100 gallons per year, assuming no increase in traffic. Based upon data available from the Bureau of Transportation Statistics (BTS) (BTS, 2019), the annual average volume of petroleum oil spilled from all vessels affecting navigable US waterways between 1995 and 2016 was approximately 600,000 gallons. Therefore, the overall change in pollution estimated due to the Project represents a negligible increase in the total volume of oil spilled (< 0.02 percent).

10.3.2 Structure Integrity

As discussed in Section 9.2.1, there have been nine reported allision incidents with WTGs in UK wind farms to date, and none have resulted in reported material WTG damage or catastrophic damage to vessels. It should be considered that eight of these involved vessels involved with the wind farm itself, and the remaining incident involved a fishing vessel. Given that there have been no reported allisions to date from a large commercial vessel with a WTG (reflective of the effectiveness of the relevant mitigations utilized), there is no data available as to the damage that could arise to the structure from such an allision.

Should a large commercial vessel at transit speed allide with a WTG, it is likely that the majority of the impact would be absorbed by the WTG rather than the vessel, noting that the collapse of the WTG is a possibility in this instance (Grand Valley State University (GVSU), 2014). However, the likelihood of such an allision is low based on both historical incident data for operational wind farms and the allision assessment undertaken within this NSRA (see Section 10.2.4).

A study into potential oil spills associated with the Cape Wind Energy Project (Schmidt Etkin, 2006) found that should vessels of 1,200 GRT or larger at transit speeds allide with a WTG, there is the potential that the WTG could collapse after impact. However, the study also noted that vessels in the area would be unlikely to cause WTG collapse should a drifting allision occur. It should be considered that vessels considerably larger than this are present within proximity to the Lease Area, however as discussed above, the potential for such an allision is low.

In the event of an allision with a surface Offshore Project Component, an assessment of the residual structural integrity would be undertaken, with the results submitted to USCG. This will include details of the incident cause and structural integrity of the WTG structure.

10.4 Cumulative Routing Assessment

As outlined in Section 2.2, a tiered approach has been taken towards the inclusion of other developments into the cumulative assessment undertaken in this NSRA. This section assesses anticipated rerouting on a cumulative basis for each tier assessed.

10.4.1 Tier 1

As per Section 2.2, developments considered as Tier 1 are those for which data confidence is high or medium, are within 100 nm (185 km) of the Lease Area, may impact a main route which transits through or within 1 nm (1.9 km) of the Lease Area and/or interact with traffic that may be directly displaced by the Lease Area. On this basis, Tier 1 projects are as follows:

- Lease Area OCS-A 0508;

- US Wind;
- Skipjack; and
- Garden State Offshore Energy.

Given the proximity of Lease Area OCS-A-508 (i.e., Kittyhawk) to the Lease Area (20 nm [37 km]), there could be some cumulative displacement of vessel traffic. However, no main route was observed to interact with both OCS-A-508 and the Project in terms of potential displacement (i.e., certain main routes may be displaced by one or the other, but no routes were deviated by both). This is reflective of the majority of traffic in the area being associated with Chesapeake Bay, noting that the approach to the TSS lanes is between the Project and OCS-A-508, and therefore the relevant routes did not interact with both sites.

The other Tier 1 developments are within lease areas that take into account the local IMO adopted routing measures and the ACPARS deep draft routes, which some of the main routes identified are anticipated to utilize. For relevant vessel traffic not using the ACPARS fairways, the distance from the Lease Area to these developments (in excess of 70 nm [130 km]) is considered to be sufficient to allow the magnitude of additional deviations to be minimized.

No cumulative rerouting has therefore been undertaken, however cumulative effects associated with collision and allision in particular are still considered and assessed in Section 19.

10.4.2 Tier 2

As per Section 2.2, developments considered as Tier 2 are those for which data confidence is high or medium, are within 150 nm (278 km) of the Lease Area, may impact a main route which transits through or within 1 nm (1.9 km) of the Lease Area and/or interact with traffic that may be directly displaced by the Lease Area. On this basis, Tier 2 projects are as follows:

- Ocean Wind; and
- Atlantic Shore.

The Tier 2 developments are within lease areas that take into account the proposed ACPARS routes, which some of the main routes identified are anticipated to utilize. For relevant vessel traffic not using the ACPARS fairways, the distance from the Lease Area to these developments (in excess of 100 nm [185 km]) is considered to be sufficient to allow the magnitude of additional deviations to be minimized.

10.4.3 Tier 3

Following the methodology outlined in Section 2.2, no cumulative developments were screened in as Tier 3 developments, noting that there are no further developments beyond those screened in as Tier 1 or Tier 2 developments within 150 nm (278 km) of the Lease Area.

10.4.4 Tier 4 (Screened Out)

As per Section 2.2, developments considered as Tier 4 developments have been screened out of the cumulative assessment and therefore are not considered in this section.

11 Introduction to Impact Assessment

Quantitative assessment of characteristics (waterway, maritime traffic and facility), and the outputs of consultation have been considered to assess the impact of the major hazards associated with the development of the Project throughout the construction, operation and maintenance and decommissioning phases.

Each potential user identified is considered separately to ensure that a specific assessment is undertaken for each specific user. The potential users are as follows:

- Commercial vessels in Section 12;
- Military vessels in Section 13;
- Recreational vessels in Section 14;
- Commercial fishing vessels in Section 15;
- Anchored vessels in Section 16;
- Emergency responders in Section 17; and
- Port access and services in Section 18.

For the purposes of the FSA, it has been assumed that the embedded mitigation summarized in Section 20 and referenced within this impact assessment will be in place. On this basis, the significance of each impact (for each user) has been determined as either Broadly Acceptable, Tolerable or Unacceptable based on the definitions provided in Section 2.1.1. Where necessary, additional mitigation is then introduced to bring impacts to within ALARP parameters (see Section 2.1.2).

Each impact (for each user) includes a summary of the impact in *italic text*, prior to the main discussion of the impact. This is then followed (where appropriate) by a list of the relevant embedded mitigation before a final statement on the significance of the impact is given in **bold text**, with the significance ranking itself **highlighted**.

12 Commercial Vessels

For the purposes of this impact assessment, commercial vessels are considered to be dry bulk, wet bulk, vehicle carriers and containerized cargo vessels, passenger vessels, marine aggregate dredgers and push/pull (tug) vessels. They do not include commercial fishing vessels which are assessed separately in Section 15.

12.1 Vessel Deviations

The presence of the Project may lead to commercial vessels deviating around the surface Offshore Project Components resulting in increased journey times and distances.

12.1.1 Qualification of Risk

Of the 19 main routes identified, a total of nine are anticipated to deviate as a result of the surface Offshore Project Components, assuming a minimum mean passing distance of 1 nm (1.9 km). It is noted that certain routes unaffected by the presence of the surface Offshore Project Components are still anticipated to deviate from their pre wind farm course in order to follow the ACPARS deep draft route adjacent to the Lease Area.

The largest anticipated deviation to a route unaffected by ACPARS is 5.2 nm (9.6 km). This is resultant of Route 4 (see Section 10.2.1) being anticipated to pass south of the Lease Area before heading northeast to re-join the pre-wind farm route outside of the study area.

Concern was raised during consultation around the shallow waters located inshore of the Lease Area, noting that available navigable sea room for deep draft vessels will decrease once the structures are in place. These shallow waters mean deep draft vessels may choose to pass south of the Lease Area, regardless of the presence of the ACPARS deep draft lane, resulting in a larger deviation.

Commercial vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project including the display of infrastructure on relevant nautical and electronic charts.

12.1.2 Level of Stakeholder Concern

The deviations in relation to the shallow depths in the vicinity of the Chesapeake Bay to Delaware Bay ACPARs were raised as a concern during consultation, specifically during a meeting held with the AWO, WSC, VMA, VPA, and the Virginia Pilot's Association. Consensus from stakeholder was that the container vessels which frequent the area would not utilize this ACPARS fairway if implemented, however that concern is not directly linked to the construction of the windfarm.

Concerns were primarily associated with effects on collision and allision risk (as opposed to deviations in of themselves). These have been assessed in Sections 12.2 (collision), 12.3 (powered allision), and 12.4 (drifting allision).

With regards to the consultation outreach to regular operators (see Section 3.2), this correspondence included a request for input into concern over potential deviations (see Appendix C). No responses were received[15].

12.1.3 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Ongoing engagement with stakeholders; and
- Promulgation of Information.

12.1.4 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Tolerable. Further discussions with stakeholders including USCG and regular operators will be undertaken to identify necessary additional mitigation to ensure the risk is within ALARP parameters.

12.2 Increased Vessel to Vessel Collision Risk

The presence of the Project may lead to commercial vessels deviating or altering routing due to the surface Offshore Project Components, potentially resulting in an increased number of vessel to vessel encounters and consequently an increased vessel to vessel collision risk.

12.2.1 Qualification and Quantification of Risk

Taking into account the anticipated post wind farm routing, it is considered likely that encounter rates between two vessels in proximity to the Lease Area will increase, given that vessels are being displaced into similar areas.

Should an encounter occur between two vessels, the most likely consequences would be low, with collision avoidance action implemented and the vessels complying with international and flag state regulations (including the COLREGs and SOLAS).

Based on the pre wind farm routing, a vessel will be involved in a collision within the study area once every 97 years. This rose to once per 52 years assuming the post wind farm routing, which represents an increase of approximately 75 percent. This increase is reflective of the number of vessels being displaced from a large area of previously available searoom for transit. It should be considered that while the proposed ACPARS Safety Fairway adjacent to the Lease Area has been considered within the post wind farm routing, no account has been made of the proposed ACPARS lanes to the south (see Sections 6.5.4 and 6.5.5), given that doing so would remove traffic from the study area and hence reduce collision risk (i.e., the conservative assumption is to assume vessels will remain in study area).

[15] Note that the Project did consult with the VMA which represents regular operators in the area.

It is noted that the quantitative assessment does not account for certain embedded mitigation, including promulgation of information relating to the Project, and the presence of infrastructure on relevant nautical and electronic charts. These mitigations will facilitate advanced passage planning, taking all relevant factors into account. It is noted in this regard that the post wind farm routing assessment is undertaken on a worst case basis. In reality, vessels may choose to pass at a greater distance from the Lease Area, utilizing the available sea room, particularly during the construction and decommissioning phases. This will reduce the likelihood of a collision incident. Further consultation will be undertaken with operators following submission to define stakeholder concern.

It should also be considered that given the minimum spacing between WTGs within the Lease Area (approximately 0.75 nm (1.39 km) center-to-center), there are not expected to be any issues with the structures blocking or hindering the view of other vessels underway, particularly given that the foundations are only 36 ft (11 m) in width at surface level. Further, the impacts of the Project on communication and position fixing equipment are anticipated to be limited (see Section 8).

In cases where vessels do pass in proximity to the Lease Area, lighting and marking will be in compliance with COMDTINST M16500.7A (USCG, 2015), IALA Recommendation O-139 (IALA, 2013), NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance (USCG, 2020), and the BOEM guidelines (BOEM, 2021), with PATON also potentially deployed to mark any working areas (where deemed appropriate by risk assessment). This will maximize mariner awareness of the surface Offshore Project Components when in proximity, in both day and night conditions.

In the event that an encounter developed into a collision incident, the most likely consequences would likely be low based on historical collision consequences, with low impact contact between the vessels resulting in minor damage, and both vessels being able to continue on their respective passages. The worst case consequences are the foundering of one or both of the vessels, with pollution caused, but this is considered highly unlikely (worst case). If pollution were to occur, then the response procedures in place would be implemented by the Project to minimize the environmental effects.

12.2.1.1 Collision Risk Associated with Project Vessels

There is also a collision risk associated with vessels associated with the Project, particularly during the construction and decommissioning phases where vessel numbers will likely be higher than during the operational phase. It is noted in this regard that construction, maintenance and decommissioning will likely involve vessels which are restricted in their ability to maneuver. However, marine coordination will be implemented for all Project vessels, consisting of a central coordination hub from which all Project vessel movements will be managed, and third party traffic monitored. All Project vessels will also carry and broadcast via AIS.

Project vessels will also be compliant with international and flag state regulations (including the COLREGs and SOLAS), follow operational procedures such as entry/exit points to/from the array and designated routes to/from port. Furthermore, safety zones of up to 1,640 ft (500 m) may be applied for, and, where feasible, a minimum advisory safe passing distance for cable laying vessels will be implemented. These measures minimize the collision risk associated with Project vessels.

12.2.1.2 Reduced Visibility

In conditions of reduced visibility, the collision risk is likely to be greater, particularly with regard to Project vessels entering or exiting the array. However, the COLREGs regulates vessel movements in adverse weather conditions, and requires all vessels operating in reduced visibility to reduce speed to allow more time for reacting to encounters, thus minimizing the collision risk. It is also noted that the quantitative assessment of collision risk between third party vessels (see Section 10.2.3) accounts for the potential of poor visibility.

12.2.1.3 Level of Stakeholder Concern

Potential for changes in traffic patterns were discussed with the AWO, WSC, VMA, VPA, Virginia Pilot's Association, and concern over reduced searoom was raised, with the water depths inshore of the Lease Area being raised as particular concern. The input received was used to inform the post wind farm routing assessment, which inputs into the collision modelling.

12.2.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning;
- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Marine Coordination;
- Minimum advisory safe passing distance around cable installation vessels;
- Ongoing engagement with stakeholders;
- Project Vessel AIS Carriage;
- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures;
- Promulgation of Information; and
- Safety vessel where appropriate.

12.2.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Tolerable. Further discussions with stakeholders including USCG and regular operators will be undertaken to identify necessary additional mitigation to ensure the risk is within ALARP parameters.

12.3 Powered Vessel to Structure Allision Risk

The presence of the Project may create a risk of a commercial vessel under power experiencing an allision with a surface Offshore Project Component.

12.3.1 Qualification and Quantification of Risk

Internal and external research undertaken by Anatec indicate that commercial vessels generally avoid transiting internally within arrays. However, taking into account the anticipated post wind farm vessel routing (see Section 10.2.1), the surface Offshore Project Components create additional allision risk to commercial vessels under power utilizing one of the main routes in proximity to the Lease Area, noting that the anticipated re-routing includes multiple main routes passing at the minimum 1 nm (1.9 km) mean distance from the array.

These findings align with the output of the assessment of powered allision risk, which estimated a powered allision return period for all routing vessels of approximately one in 400 years for base case traffic levels. The highest risk positions were observed to be those located on the northwest periphery, which is reflective of their proximity to the proposed ACPARS fairway. It is noted that these WTGs are spare locations, and therefore the significance ranking assessed is based on the potential use of these positions.

It is noted that the quantitative assessment does not take account of the promulgation of information relating to the Project, and the display of structures on relevant nautical and electronic charts. Additionally, the Project will be lit and marked in compliance with COMDTINST M16500.7A (USCG, 2015), IALA Recommendation O-139 (IALA, 2013), NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance (USCG, 2020), and the BOEM guidelines (BOEM, 2021), with PATON also potentially deployed to mark any working areas (where deemed appropriate by risk assessment). This will maximize mariner awareness of the surface Offshore Project Components when in proximity, both in day and night conditions.

Should a powered allision incident occur, it is anticipated that the impact energy would largely be absorbed by the surface Offshore Project Components rather than the vessel (see Section 10.3.2), noting the high level of construction standards for commercial vessels operating at sea. On this basis, the most likely consequences would be low, with minor damage sustained by the vessel, (i.e., hull damage). In the highly unlikely case of a powered allision incident resulting in pollution, then the Project will have emergency response procedures in place, which would be implemented to minimize the environmental effects.

12.3.1.1 Lessons Learned

To date there have been nine reported powered allision incidents with an offshore wind structure in the UK, corresponding to 1,636 years per WTG allision incident, but none have involved a third party commercial vessel. Further details are provided in Section 9.2.1.

12.3.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning;
- Charting of infrastructure;
- Lighting and Marking;
- Marine pollution contingency plans;
- Ongoing engagement with stakeholders;
- Operational SAR procedures;

- Promulgation of Information;
- Provision of self-help capability;
- Emergency Response Plan;
- Safety vessel where appropriate; and
- Use of PATON.

12.3.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Tolerable. Further discussions with stakeholders including USCG and regular operators will be undertaken to identify necessary additional mitigation to ensure the risk is within ALARP parameters.

12.4 Drifting Vessel to Structure Allision Risk

The presence of the Project may create a risk of a commercial vessel NUC alliding with a surface Offshore Project Component in an emergency situation.

12.4.1 Qualification and Quantification of Risk

An assessment of historical NUC incidents (see Section 9.1.5) showed that over the 10-year period studied, a total of 14 potential incidents of a vessel NUC were responded to by the USCG within the study area. None occurred within the Lease Area itself, however three occurred within 5 nm (9.3 km) of the Lease Area boundaries.

It should be considered that these comprise incidents defined as “Material Failure/Malfunction” by the USCG, and as such will not all necessarily result in the vessel being NUC. Further, these incidents occurred prior to the presence of the surface Offshore Project Components (i.e., the relevant vessels may have utilized different passage should there have been structures present).

Quantitative assessment of drifting allision risk estimated a drifting allision return period for all routing vessels of approximately one in 306 years assuming base case traffic levels, with the majority of risk associated with the WTGs on the southern periphery.

This aligns with studies undertaken by Anatec, which indicate that commercial vessels generally avoid transiting internally within arrays given that there are no time or distance savings associated with transiting through, and as such highest risk will be to the periphery WTGs.

Should a drifting allision incident occur, it is anticipated that the impact energy would largely be absorbed by the surface Offshore Project Component as opposed to the vessel, noting the high level of construction standards for modern commercial vessels operating at sea. The most likely consequences would be low with minor damage sustained by the vessel (i.e., hull damage). In the highly unlikely case of an allision incident resulting in pollution, then the Project will have emergency response procedures in place, which would be implemented to minimize the environmental effects.

12.4.1.1 Lessons Learned

It is noted that there is precedent for operational wind farms to be sited in proximity to busy areas of shipping and hence potential drifting risk. For example, Greater Gabbard and Galloper in the UK are located immediately adjacent to the Sunk TSS, as shown in Figure 12.1.

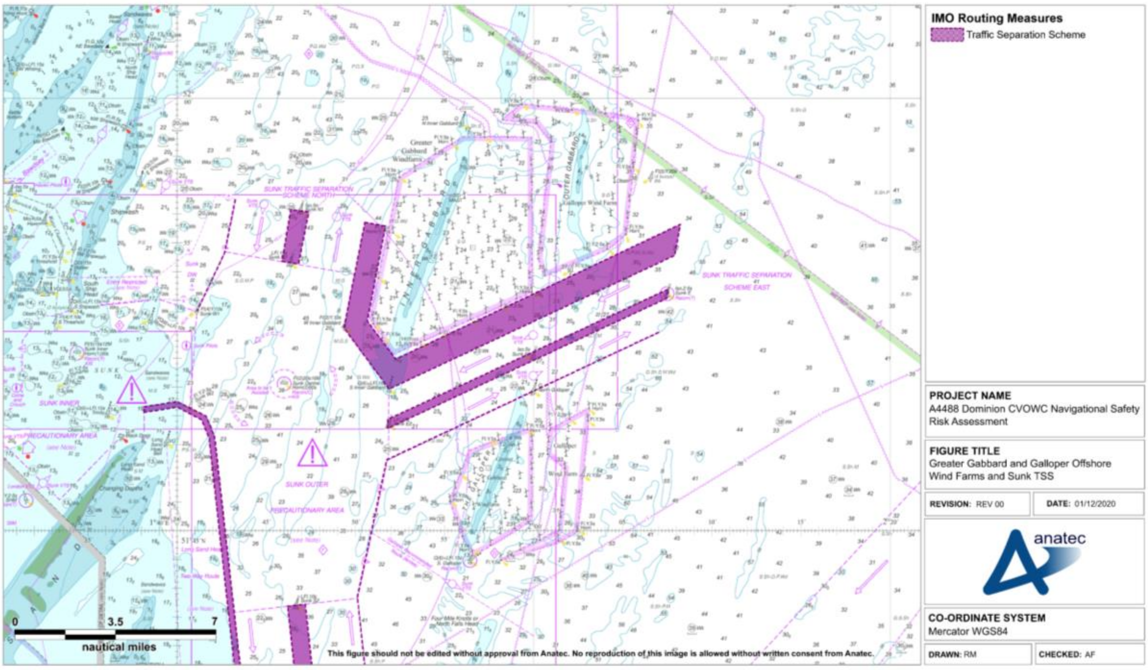

Figure 12.1 Greater Gabbard and Galloper Offshore Wind Farms and Sunk TSS

The Sunk TSS is a busy IMO routing measure (approximately four to five transits per day in each direction in the Sunk East TSS) and therefore is exposed to potential drifting allision risk. However, both developments were awarded consent and no drifting incidents have been reported in the eight years since Greater Gabbard was fully commissioned (noting that Galloper was fully commissioned later, in 2018).

Furthermore, it is also noted that there have been no drifting allision incidents with an offshore wind structure reported in the UK to date, despite the operational projects in place including those in proximity to areas of busy traffic. Of the nine allision incidents reported in the UK to date (noting that these involved vessels under power), the worst consequences reported have been minor flooding of the vessel, with no life-threatening injuries to persons onboard reported - no material damage to WTGs was reported in any of the incidents. Further details are provided in Section 9.2.1.

12.4.1.2 Weather or Tidal Effects

Should a vessel be adrift in proximity to the Lease Area, there is a possibility that the tidal and/or wind conditions may push the vessel towards the surface Offshore Project Components. However, in such a scenario, it is likely that the vessel will first initiate its own emergency plans that may include the use of thrusters (depending on availability and power supply) and anchors to prevent an allision occurring. Vessels associated with the Project would seek to assist, and operational SAR procedures would be implemented. The operational procedures will be discussed and agreed with the USCG in advance of construction and will be reviewed and updated as necessary in liaison with USCG as the Project progresses.

Taking these mitigation measures into account, the likelihood of an allision incident occurring is considered very low, particularly given that a drifting vessel is likely to be drifting at low speeds and therefore preventative action is more likely to be successful.

12.4.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Marine pollution contingency plans;
- Ongoing engagement with stakeholders;
- Operational SAR procedures;
- Promulgation of Information;
- Provision of self-help capability;
- Emergency Response Plan; and
- Safety vessel where appropriate.

12.4.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Tolerable. Further discussions with stakeholders including USCG and regular operators will be undertaken to identify necessary additional mitigation to ensure the risk is within ALARP parameters.

13 Military Vessels

For the purposes of this assessment, military vessels are considered to be any vessel associated with a branch of the US military, namely either the USCG, US Navy or other visiting military vessels.

13.1 Vessel Deviations

The presence of the Project may lead to military vessels both in transit and engaged in military exercise deviating around the Lease Area resulting in increased journey times and distances.

13.1.1 Qualification of Risk

Surface based military vessels in transit have been incorporated into the identification of main routes as per the methodology for main route identification (see Section 6.5.4). Therefore, surface military vessels in transit are incorporated into the assessment undertaken in Section 12.1.

In terms of military operations, the Lease Area is positioned outside the boundaries of the VACAPES OPAREA (see Section 5.1.9) and as such is not anticipated to affect planned military operations. It should be considered that the Offshore Export Cable Route Corridor does intersect the VACAPES OPAREA, however any cable laying or maintenance activities will be temporary and spatially limited.

It is noted that submarine transit lanes are located 22 nm (41 km) to the east. No effects on submarine transits are expected given this distance.

13.1.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Ongoing engagement with stakeholders; and
- Promulgation of Information.

13.1.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

13.2 Increased Vessel to Vessel Collision Risk

The presence of the Project may lead to military vessels deviating or altering routing due to the array, potentially resulting in an increased number of vessel to vessel encounters and consequently an increased vessel to vessel collision risk.

13.2.1 Qualification and Quantification of Risk

As noted in Section 13.1, routing military vessels have been incorporated into the identification of main routes as per the methodology for main route identification (see Section 6.3.6.1) and therefore with the same embedded mitigation measures considered, the assessment of the equivalent impact for commercial vessels is considered applicable to routing military vessels.

For military vessels engaged in exercises, it is anticipated that such vessels will comply with international and flag state regulations (including the COLREGs and SOLAS). It is also assumed that such vessels local to the area will have a high level of awareness of the Project and therefore be well equipped to adjust their practices to minimize the collision risk.

13.2.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning;
- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Marine Coordination;
- Minimum advisory safe passing distance around cable installation vessels;
- Ongoing engagement with stakeholders;
- Project Vessel AIS Carriage;
- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures;
- Promulgation of Information; and
- Safety vessel where appropriate.

13.2.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

13.3 Powered Vessel to Structure Allision Risk

The presence of the Project may create a risk of a military vessel under power experiencing an allision with a surface Offshore Project Component.

13.3.1 Qualification of Risk

As noted in Section 13.1, routing military vessels have been incorporated into the identification of main routes as per the methodology for main route identification (see Section 6.3.6.1) and therefore with the same embedded mitigation measures considered the assessment of the equivalent impact for commercial vessels is considered applicable to routing military vessels.

For military vessels engaged in exercises, it should be considered that the Lease Area (and hence the structures within) is located between the boundaries of the VACAPES OPAREA (see Section 5.1.9). However, it is assumed that military vessels local to the area will have a high level of awareness of the Project and therefore be well equipped to adjust their practices to minimize the allision risk. This will be heightened by continued engagement with the USCG throughout the life of the Project, particularly with regard to specific operations which may be undertaken in proximity to the array.

13.3.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning;
- Charting of infrastructure;
- Lighting and Marking;
- Marine pollution contingency plans;
- Ongoing engagement with stakeholders;
- Operational SAR procedures;
- Promulgation of Information;
- Provision of self-help capability;
- Emergency Response Plan;
- USCG SAR trials;
- Safety vessel where appropriate; and
- Use of PATON.

13.3.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

13.4 Drifting Vessel to Structure Allision Risk

The presence of the Project may create a risk of a military vessel NUC alliding with an offshore structure in an emergency situation.

13.4.1 Qualification of Risk

As noted previously, routing military vessels have been incorporated into the identification of main routes as per the methodology for main route identification (see Section 6.3.6.1) and therefore with the same embedded mitigation measures considered the assessment of the equivalent impact for commercial vessels is considered applicable to routing military vessels.

For military vessels engaged in exercises, the embedded mitigation measures considered for the equivalent impact for commercial vessels are again applicable. Namely, vessels associated with the Project would seek to assist, and operational SAR procedures would be implemented. The operational procedures will be discussed and agreed with the USCG in advance of construction and will be reviewed and updated as necessary in liaison with USCG as the Project progresses. As with commercial vessels, a military vessel adrift, particularly when engaged in exercises, is likely to be drifting at low speeds and therefore preventative action is more likely to be successful.

Should a drifting allision incident occur, it is anticipated that the impact energy would be primarily absorbed by the surface Offshore Project Component rather than the vessel. The most likely consequences would be low, with minor damage sustained by the vessel, particularly when accounting for the likely low speed of the allision.

In the unlikely case of a drifting allision incident resulting in pollution (such as a replenishment oiler), then the Project will have emergency response procedures in place, which would be implemented to minimize the environmental effects.

13.4.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Marine pollution contingency plans;
- Ongoing engagement with stakeholders;
- Operational SAR procedures;
- Promulgation of Information;
- Provision of self-help capability;
- Emergency Response Plan; and
- Safety vessel where appropriate.

13.4.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

14 Recreational Vessels

14.1 Vessel Deviations

The presence of the Project may lead to recreational vessels deviating around the array resulting in increased journey times and distances.

14.1.1 Qualification of Risk

The volume of recreational vessel traffic within and in proximity to the Lease Area is considered low when compared to nearshore areas of the US Atlantic coast, with the AIS data showing less than one vessel a day on average over the year studied. It is noted that the AIS data is a long-term data source, and therefore incapsulates any seasonal variation (for recreational vessels broadcasting on AIS). It should be considered that this will underrepresent actual activity as it does not include non-AIS traffic. Given the distance offshore, it is likely that levels of non-AIS recreational vessels will be less than areas nearer shore.

Regardless, there will be no restrictions on transit through the array (except for the potential for safety zones / advisory safe passing distances). Minimum spacing of 0.75 nm (1.39 km) and alignment of WTGs is considered as sufficient to facilitate such recreational transit, should the vessels choose to do so.

Safety zones may be utilized around structures where active construction or maintenance works are ongoing, and advisory safe passing distances may be utilized around vessels associated with cable installation or maintenance. However, any such areas would be temporary and spatially limited. Other than these areas, no restrictions on transit will be implemented.

It is noted that no regular transits were recorded to the fish haven area intersecting the site based on the data studied. In the event that WTGs were installed within the fish haven area, as above there would be no restrictions on transit in the area for recreational fishermen.

Should a recreational vessel choose to deviate around the Lease Area (i.e., avoid the structures), then there is considered to be available sea room to do so, however it is noted that recreational vessels may choose to avoid the ACPARS deep draft lane to the west given the likely volumes of larger traffic.

Recreational vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project and the presence of infrastructure on relevant nautical and electronic charts.

14.1.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Charting of infrastructure;
- Construction vessel and schedule notification system;

- Ongoing engagement with stakeholders; and
- Promulgation of Information.

14.1.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

14.2 Adverse Weather Deviations

The presence of the Project may lead to recreational vessels deviating around the array resulting in increased journey times and distances during periods of adverse weather.

14.2.1 Qualification of Risk

During adverse weather conditions, or when such conditions are forecast, it may be necessary for recreational vessels to seek safe refuge, either by returning to port or travelling to sheltered waters. The presence of the array may result in increased time required to perform this action, and therefore may result in the vessel being more exposed to the adverse weather conditions.

Based on NOAA data (see Section 5.3.5), a total of seven tropical cyclones tracks have intersected the Lease Area since 1900, with the most recent occurrence being in 2000. Adverse conditions to the extent of a tropical cyclone may therefore occur over the lifetime of the Project. However, as per the analysis in Section 5.3.5, at a local level the exposure is relatively lower owing to the sheltered location of the Lease Area when compared to areas further offshore.

The volume of recreational vessel traffic within and in proximity to the Lease Area is considered low when compared to nearshore areas of the US Atlantic coast, with the AIS data showing less than one vessel a day on average over the year studied. While this does not account for non AIS traffic, given the distance offshore it is not considered likely that non-AIS recreational vessels will be present in large numbers.

For such transits, if it is deemed unsafe to transit internally through the array then any deviation is expected to be of low magnitude. Recreational vessel masters would assess the forecast in terms of severity and timeframe, and the distance to the nearest ports or areas of shelter before choosing a transit plan, which may involve the selection of an alternative port or sheltered location, or choosing to not make passage at all if the conditions were deemed too dangerous. However, it is considered likely that in most cases, vessels would simply deviate around the array to access their preferred port without significantly increased journey times.

As with recreational vessel deviations in normal weather conditions, recreational vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project and the presence of infrastructure on relevant nautical and electronic charts.

14.2.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Lighting and Marking;
- Ongoing engagement with stakeholders;
- Operational SAR procedures;
- Promulgation of Information;
- Provision of self-help capability;
- Emergency Response Plan;
- Safety vessel where appropriate; and
- Use of PATON.

14.2.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

14.3 Increased Vessel to Vessel Collision Risk

The presence of the Project may lead to recreational vessels deviating or altering routing due to the array, potentially resulting in an increased number of vessel to vessel encounters and consequently an increased vessel to vessel collision risk.

14.3.1 Qualification of Risk

As assessed within Section 12.2, collision risk is considered high in the area, and this will increase once the Project is in place, with commercial vessel density increasing around the southern and western peripheries of the Lease Area in particular. It should therefore be considered that there may be a rise in encounters between recreational vessels and larger commercial vessels in these areas, and therefore a potential rise in collision rates.

However, recreational traffic volumes are considered low in the area, and as such a notable rise in collision risk is unlikely, particularly as skippers of recreational vessels operating as far offshore as the Lease Area can be expected to have a high level of awareness and expertise. It should be considered that there is the potential for an increase in recreational fishing vessels associated with fish aggregation at the structures, particularly during any peak seasonal recreational periods (i.e., fair weather periods). Regardless, these vessels are not anticipated to be a significant contributor to collision risk in the area.

Given the minimum spacing between WTGs (approximately 0.75 nm [1.39 km]) there are not expected to be any issues with surface Offshore Project Components blocking or hindering the view of other vessels underway, particularly given that the foundations are only 36 ft (11 m) in width at surface level. Further, it is noted that Project is anticipated to have limited effects on communication and position fixing equipment (see Section 8).

Recreational vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project and the presence of infrastructure on relevant nautical and electronic charts.

14.3.1.1 Internal Array Navigation

For recreational vessels choosing to navigate internally within the array, there is an additional collision risk arising from vessels associated with the Project, particularly during the construction and decommissioning phases, or during periods of major maintenance which are all likely to require vessels which are restricted in their ability to maneuver. Similar risk will also apply to any recreational vessel navigating in proximity to a cable laying vessel. However, mitigation measures outlined for Project vessels in relation to the equivalent impact for commercial vessels will be implemented including marine coordination, compliance with international and flag state regulations and health and safety requirements, and operational procedures.

Further, safety zones of up to 1,640 ft (500 m) may be utilized around construction works, and advisory safe passing distances around cable installation vessels. This will ensure recreational vessels pass at a safe distance to sensitive operations.

14.3.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning;
- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Marine Coordination;
- Minimum advisory safe passing distance around cable installation vessels;
- Ongoing engagement with stakeholders;
- Project Vessel AIS Carriage;
- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures;
- Promulgation of Information; and
- Safety vessel where appropriate.

14.3.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

14.4 Powered Vessel to Structure Allision Risk

The presence of the Project may create a risk of a recreational vessel under power experiencing an allision with a surface Offshore Project Component.

14.4.1 Qualification of Risk

Given the very low volume of recreational vessel traffic within and in proximity to the Lease Area, there is anticipated to be limited allision risk for powered (including under sail) recreational vessels. In particular, recreational vessels navigating externally to the array should have a high level of awareness of the Project given the promulgation of information and presence of infrastructure on relevant nautical and electronic charts. Such vessels should therefore be able to passage plan accordingly to navigate in such a way that an allision incident is unlikely (i.e., keeping a safe distance from the array).

The most likely consequences would be minor, with minor damage sustained by the vessel (noting the blade clearance). Given the smaller size of recreational vessels they are more susceptible to material damage than commercial vessels in an allision incident, however the pollution effects from a recreational vessel involved in an allision would likely be less substantial than for commercial vessels. If pollution were to occur, then the Project will have emergency response procedures in place, which would be implemented to minimize the environmental effects.

14.4.1.1 Internal Array Navigation

There is also potential for recreational vessels to navigate internally within the array, including recreational fishing given the potential aggregation around the foundations. However, this is not expected to reach a level at which additional assessment is required given that overall it is likely to be a negligible increase against total vessel numbers, particularly given that the distance offshore of the Lease Area makes it unfavorable to most day cruisers.

For any recreational vessels navigating internally within the array, the powered allision risk is significantly greater given the greater exposure to surrounding surface Offshore Project Components. The array layout includes two main lines of orientation consistent across all internal WTGs which will assist with ensuring recreational vessels are able to safely navigate from one side of the array to the other. The minimum spacing center-to-center between WTGs is 0.75 nm (1.39 km), which is considered sufficient for safe navigation based on Anatec's experience of existing offshore wind developments in the UK, where recreational vessels have been observed to safely adapt to the presence of offshore wind farm structures with much lower spacing.

Should a recreational vessel with a mast enter the proximity of a WTG, there is not only an allision risk associated with the WTG tower but also the WTG blades. NVIC No. 01-19 (USCG, 2019) does not suggest a minimum safe clearance, and so the 72 ft (22 m) above MHWS requirement defined in MGN 543 (MCA, 2016) has been considered. The minimum WTG blade clearance above HAT for the Project is 82 ft (25 m), and therefore there is considered to be sufficient air clearance for the majority of recreational vessels with a mast navigating in proximity to a WTG to avoid mast contact.

Should a recreational vessel under sail enter the proximity of a WTG, there is also potential for effects such as wind shear, masking and turbulence to occur. From previous studies of offshore wind developments it has been concluded that WTGs do reduce wind velocity downwind of a WTG but that no negative effects on recreational craft have been reported given the limited spatial extent of the effect is not considered to be significant, and similar to that experienced when passing a large vessel or close to other large structures (e.g., bridges) or the coastline. In addition, no practical issues have been raised by recreational users to date when operating in proximity to existing offshore wind developments.

The array will be lit and marked in compliance with COMDTINST M16500.7A (USCG, 2015), IALA Recommendation O-139 (IALA, 2013), NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance (USCG, 2020), and the BOEM guidelines (BOEM, 2021), with PATON also potentially deployed to mark any working areas (where deemed appropriate by risk assessment), thus maximizing mariner awareness of the array both when within and in proximity, both in day and night conditions. The marking will also include unique identification marking of individual structures which will minimize the risk of a recreational vessel navigating internally becoming disoriented.

14.4.2 Lessons Learned

As discussed in Section 9.2.1, it should be considered that there have been nine powered allision incidents with an offshore wind structure reported in the UK to date, corresponding to 1,636 years per WTG allision incident, but none have involved a recreational vessel.

14.4.3 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning;
- Charting of infrastructure;
- Lighting and Marking;
- Marine pollution contingency plans;
- Minimum blade clearance;
- Ongoing engagement with stakeholders;
- Operational SAR procedures;
- Promulgation of Information;
- Provision of self-help capability;
- Emergency Response Plan;
- USCG SAR trials;
- Safety vessel where appropriate; and
- Use of PATON.

14.4.4 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

14.5 Drifting Vessel to Structure Allision Risk

The presence of the Project may create a risk of a recreational vessel NUC alliding with an offshore structure in an emergency situation.

14.5.1 Qualification of Risk

Given the very low volume of recreational vessel traffic based on the data studied, within and in proximity to the Lease Area there is anticipated to be a limited allision risk for drifting recreational vessels. This is supported by the fact that there have been no drifting allision incidents with an offshore wind structure reported in the UK to date (noting that the UK has a major yachting and sailing industry).

14.5.1.1 Weather and Tidal Effects

Should a recreational vessel be adrift in proximity to the array, there is a possibility that the tidal and/or wind conditions may push the vessel away from the structures therein. However, in cases where the vessel does drift towards the array, or is already situated within the array, it is likely that the vessel will first initiate its own emergency plans that may include the use of anchors to prevent allision occurring (noting this will depend on water depths and size of vessel). Vessels associated with the Project would seek to assist and operational SAR procedures would be implemented. The operational procedures will be discussed and agreed with the USCG in advance of construction and will be reviewed and updated as necessary in liaison with USCG as the Project progresses.

Taking these mitigation measures into account, the likelihood of an allision incident occurring is considered low, particularly given that a drifting vessel is likely to be drifting at low speeds and therefore preventative action is more likely to be successful.

As with risk of a powered allision for a recreational vessel with a mast, there is not only an allision risk associated with the WTG tower but also the WTG blades. As stated previously (see Section 14.4), the minimum WTG blade clearance above HAT for the Project is 82 ft (25 m), and this is considered to be a sufficient air clearance for the majority of drifting recreational vessels with a mast to avoid a contact involving its mast.

The most likely consequences would be minor, with minor damage sustained by the vessel (noting the blade clearance). Given the smaller size of recreational vessels they are more susceptible to material damage than commercial vessels in an allision incident, however the pollution effects from a recreational vessel involved in an allision would likely be less substantial than for commercial vessels. If pollution were to occur, then the Project will have emergency response procedures in place, which would be implemented to minimize the environmental effects.

14.5.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Marine pollution contingency plans;
- Minimum blade clearance;
- Ongoing engagement with stakeholders;
- Operational SAR procedures;
- Promulgation of Information;
- Provision of self-help capability;
- Emergency Response Plan; and

- Safety vessel where appropriate.

14.5.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

15 Commercial Fishing Vessels

It is noted that as per Section 1.3, commercial impacts and impacts associated with gear (e.g., snagging) are considered in Section 4.4.6 of the COP.

15.1 Deviations

The presence of the Project may lead to commercial fishing vessels in transit deviating around the array resulting in increased journey times and distances.

15.1.1 Qualification of Risk

The volume of commercial fishing vessel traffic within and in proximity to the Lease Area is considered low based on assessment of AIS and VMS data, noting that these are long term data sources, and therefore incapsulate any seasonal variation.

Regardless, there will be no restrictions on transit through the array (except for the potential for safety zones / advisory safe passing distances). Minimum spacing of 0.75 nm (1.39 km) is considered as sufficient to facilitate fishing vessel transit, should the vessels choose to do so.

Safety zones may be utilized around structures where active construction or maintenance works are ongoing, and advisory safe passing distances may be utilized around vessels associated with cable installation or maintenance. However, any such areas would be temporary and spatially limited.

Should a fishing vessel choose to deviate around the Lease Area (i.e., avoid the surface Offshore Project Components), then there is considered to be available sea room to do so, however it is noted that fishing vessels may choose to avoid the ACPARS deep draft lane to the west given the likely volumes of larger traffic.

Fishing vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project and the presence of infrastructure on relevant nautical and electronic charts.

15.1.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Ongoing engagement with stakeholders; and
- Promulgation of Information.

15.1.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

15.2 Adverse Weather Deviations

The presence of the Project may lead to commercial fishing vessels in transit deviating around the array resulting in increased journey times and distances during periods of adverse weather.

15.2.1 Qualification of Risk

During adverse weather conditions, or when such conditions are forecast, it may be necessary for commercial fishing vessels to seek safe refuge, either by returning to port or travelling to sheltered waters. The presence of the array may result in increased time required to perform this action, and therefore may result in the vessel being more exposed to the adverse weather conditions.

Based on NOAA data (see Section 5.3.5), a total of seven tropical cyclones tracks have intersected the Lease Area since 1900, with the most recent occurrence being in 2000. Adverse conditions to the extent of a tropical cyclone may therefore occur over the lifetime of the Project. However, as per the analysis in Section 5.3.5, at a local level the exposure is relatively lower owing to the sheltered location of the Lease Area when compared to areas further offshore

Further, the volume of commercial fishing vessel traffic within and in proximity to the Lease Area is considered low based on assessment of AIS and VMS data, noting that these are long term data sources, and therefore incapsulate any seasonal variation.

If it is deemed unsafe to transit internally through the array, then any deviation is expected to be of low magnitude. Fishing vessel masters would assess the forecast in terms of severity and timeframe, and the distance to the nearest ports or areas of shelter before choosing a transit plan, which may involve the selection of an alternative port or sheltered location, or choosing to not make passage at all if the conditions were deemed too dangerous. However, it is considered likely that in most cases, vessels would simply deviate around the array to access their preferred port without significantly increased journey times.

As with commercial fishing vessel deviations in normal weather conditions, vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project and the presence of infrastructure on relevant nautical and electronic charts.

15.2.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Lighting and Marking;
- Ongoing engagement with stakeholders;
- Operational SAR procedures;
- Promulgation of Information;
- Provision of self-help capability;
- Emergency Response Plan;

- Safety vessel where appropriate; and
- Use of PATON.

15.2.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

15.3 Increased Vessel to Vessel Collision Risk

The presence of the Project may lead to commercial fishing vessels in transit deviating or altering routing due to the array, potentially resulting in an increased number of vessel to vessel encounters and consequently an increased vessel to vessel collision risk.

15.3.1 Qualification of Risk

As assessed within Section 12.2, collision risk is considered high in the area, and this will increase once the Project is in place, with commercial vessel density increasing around the southern and western peripheries of the Lease Area in particular. It should therefore be considered that there may be a rise in encounters between commercial fishing vessels and larger commercial vessels in these areas, and therefore a potential rise in collision rates.

However, fishing vessel volumes are considered low in the area (based on the data studied), and as such a notable rise in associated collision risk is unlikely.

Given the minimum spacing between WTGs (approximately 0.75 nm [1.39 km]) there are not expected to be any issues with surface Offshore Project Components blocking or hindering the view of other vessels underway, particularly given the limited impacts of the Project on communication and position fixing equipment (see Section 8).

Fishing vessels are expected to comply with international and flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan in advance given the promulgation of information relating to the Project and the presence of infrastructure on relevant nautical and electronic charts. Should an encounter occur involving a commercial fishing vessel, the most likely consequences would be low, with collision avoidance action implemented and the vessels complying with international and flag state regulations (including the COLREGs and SOLAS).

Should an encounter develop into a collision incident, the most likely consequences would also be low based on historical collision consequences, with minor contact between the vessels resulting in minor damage and both vessels able to continue their respective passages. The worst case consequences are the foundering of one of the vessels, with pollution caused, but this is considered highly unlikely. Given the smaller size of commercial fishing vessels (in comparison to commercial vessels) they are more susceptible to material damage than commercial vessels in a collision incident, but the pollution effects from a commercial fishing vessel involved in a collision would likely be less substantial than for commercial vessels. If pollution were to occur, then the response procedures in place would be implemented by the Project to minimize the environmental effects.

15.3.1.1 Internal Array Navigation

For commercial fishing vessels choosing to navigate internally within the array, there is an additional collision risk associated with vessels associated with the Project, particularly during the construction and decommissioning phases involving vessels which are restricted in their ability to maneuver. The same risk also applies to any commercial fishing vessel navigating in proximity to a cable laying vessel. However, mitigation measures outlined for Project vessels in relation to the equivalent impact for commercial vessels will be implemented including marine coordination, compliance with international and flag state regulations and health and safety requirements, and operational procedures. Furthermore, safety zones around construction and decommissioning activities may be utilized (see Section 21) and, where feasible, a minimum advisory safe passing distance for cable laying vessels will be implemented. These measures minimize the collision risk associated with Project vessels.

15.3.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning;
- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Marine Coordination;
- Minimum advisory safe passing distance around cable installation vessels;
- Ongoing engagement with stakeholders;
- Project Vessel AIS Carriage;
- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures;
- Promulgation of Information; and
- Safety vessel where appropriate.

15.3.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

15.4 Powered Vessel to Structure Allision Risk

The presence of the Project may create a risk of a commercial fishing vessel under power experiencing an allision with a surface Offshore Project Component.

15.4.1 Qualification of Risk

Given the very low volume of commercial fishing vessel traffic within and in proximity to the Lease Area, there is anticipated to be a limited allision risk for powered commercial fishing vessels. In particular, commercial fishing vessels navigating externally to the array should have a high level of awareness of the Project given the promulgation of information and presence of infrastructure on relevant nautical and electronic charts. Such vessels should therefore be able to passage plan accordingly to navigate in such a way that an allision incident is unlikely (i.e., keeping a safe distance from the array).

15.4.1.1 Internal Array Navigation

Minimum spacing of 0.75 nm (1.39 km) is considered sufficient to facilitate internal transit of fishing vessels based on Anatec's experience of existing offshore wind developments in the UK, where fishing vessels have been observed to safely adapt to the presence of offshore wind farm structures with much lower spacing. However, it should be considered that the powered allision risk is significantly greater to such vessels given the greater exposure to surrounding surface Offshore Project Components.

The array layout includes two main lines of orientation consistent across all internal WTGs which will assist with ensuring fishing vessels are able to safely navigate from one side of the array to the other.

Regardless, the volume of commercial fishing vessel traffic within and in proximity to the Lease Area is considered low based on assessment of AIS and VMS data, noting that these are long term data sources, and therefore incapsulate any seasonal variation.

This is reflected by the quantitative assessment of fishing vessel allision risk which estimates an allision return period for commercial fishing vessels of approximately one in 1,690 years for base case traffic levels.

Should a powered allision occur, it is anticipated that the impact energy would primarily be absorbed by the surface Offshore Project Component rather than the vessel. The most likely consequences would be low, with minor damage sustained by the vessel. Given the smaller size of commercial fishing vessels they are more susceptible to material damage than commercial vessels in an allision incident, however pollution effects from a commercial fishing vessel involved in an allision would likely be less substantial than for commercial vessels. If pollution were to occur, then the response procedures in place would be implemented by the Project to minimize the environmental effects.

The array will be lit and marked in compliance with COMDTINST M16500.7A (USCG, 2015), IALA Recommendation O-139 (IALA, 2013), NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance (USCG, 2020), and the BOEM guidelines (BOEM, 2021), with PATON also potentially deployed to mark any working areas (where deemed appropriate by risk assessment), thus maximizing mariner awareness of the array both when within and in proximity, in both day and night conditions. The marking will also include unique identification marking of individual structures which will minimize the risk of a commercial fishing vessel navigating internally becoming disoriented.

15.4.1.2 Lessons Learned

To date there have been nine reported powered allision incidents with an offshore wind structure in the UK, corresponding to 1.636 years per WTG allision incident, noting that one has involved a fishing vessel. Further details are provided in Section 9.2.1.

15.4.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning;
- Charting of infrastructure;
- Lighting and Marking;
- Marine pollution contingency plans;
- Ongoing engagement with stakeholders;
- Operational SAR procedures;
- Promulgation of Information;
- Provision of self-help capability;
- Emergency Response Plan;
- USCG SAR trials;
- Safety vessel where appropriate; and
- Use of PATON.

15.4.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

15.5 Drifting Vessel to Structure Allision Risk

The presence of the Project may create a risk of a commercial fishing vessel NUC alliding with a surface Offshore Project Component in an emergency situation.

15.5.1 Qualification of Risk

Given the very low volume of commercial fishing vessel traffic within and in proximity to the Lease Area, there is anticipated to be a limited allision risk for drifting commercial fishing vessels. This is supported by the fact that there have been no drifting allision incidents with an offshore wind structure reported in the UK to date (noting that the UK has a major commercial fishing industry).

15.5.1.1 Weather and Tidal Effects

Should a commercial fishing vessel be adrift in proximity to the array, there is a possibility that the tidal and/or wind conditions may push the vessel away from the structures therein. However, in cases where the vessel does drift towards the array, or is already situated within the array, it is likely that the vessel will first initiate its own emergency plans that may include the use of anchors to prevent allision occurring (noting this will depend on water depths and size of vessel). Vessels associated with the Project would seek to assist and operational SAR procedures would be implemented. The operational procedures will be discussed and agreed with the USCG in advance of construction and will be reviewed and updated as necessary in liaison with USCG as the Project progresses.

Taking these mitigation measures into account, the likelihood of an allision incident occurring is considered low, particularly given that a drifting vessel is likely to be drifting at low speeds and therefore preventative action is more likely to be successful.

Should a drifting allision incident occur, it is anticipated that the impact energy would primarily be absorbed by the surface Offshore Project Component rather than the vessel. The most likely consequences would be minor, with minor damage sustained by the vessel. Given the smaller size of commercial fishing vessels, they are more susceptible to material damage than commercial vessels in an allision incident, however the pollution effects from a fishing vessel involved in an allision would likely be less substantial than for commercial vessels. If pollution were to occur, then the Project will have emergency response procedures in place, which would be implemented to minimize the environmental effects.

15.5.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Marine pollution contingency plans;
- Ongoing engagement with stakeholders;
- Operational SAR procedures;
- Promulgation of Information;
- Provision of self-help capability;
- Emergency Response Plan; and
- Safety vessel where appropriate.

15.5.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

16 Anchored Vessels

16.1 Displacement of Anchoring

The presence of the Offshore Project Components may displace existing anchoring activity.

16.1.1 Qualification of Risk

Based on the vessel traffic data assessment (see Section 6.3.5), an average of one unique vessel per day anchored within the study area. This included 27 instances of vessels anchoring within the Lease Area, corresponding to an average of approximately three per month. While there would be no restrictions on anchoring within the Lease Area, it is considered unlikely that commercial vessels would seek to do so once the Offshore Project Components were installed, and as such the existing activity is likely to be displaced (noting that average length of the vessels at anchor within the Lease Area was 797 ft [242.9 m]).

However, the level of activity which may be displaced is low, and there is established anchoring space inshore of the Lease Area where the majority of commercial anchoring was observed within the 2019 data studied.

In terms of the Offshore Export Cable Route Corridor, the presence of the Offshore Export Cables may dissuade vessels from anchoring in proximity to the charted locations, and as such existing activity may be displaced. Based on the 2019 data studied, a total of 35 instances of anchoring within the Offshore Export Cable Route Corridor were recorded, and as such the level of displaced activity is low, and as discussed above, there is existing established anchoring space to the west of the Lease Area. It is noted that a Cable Burial Risk Assessment will be undertaken which will assess required levels of burial / Cable Protection based on the existing anchoring activity.

16.1.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Cable Burial Risk Assessment;
- Cable Installation Plan;
- Charting of infrastructure (including prior to installation);
- Minimum advisory safe passing distance around cable installation vessels;
- Monitoring of cables and associated protection;
- Ongoing engagement with stakeholders; and
- Promulgation of Information.

16.1.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

16.2 Anchor Snagging and Contact Risk

The presence of the Offshore Project Components may create an underwater snagging or contact risk to vessels anchoring in close proximity.

16.2.1 Qualification of Risk

There is potential that a vessel anchor may interact with subsea infrastructure associated with the Project. The WTGs will be installed on monopile foundations, and the three offshore substations on jackets. As these do not require mooring or anchor lines, this impact is considered to be limited to the subsea cables. Examples of potential anchor snagging or contact scenarios involving the cables include:

- A vessel deliberately drops anchor over a subsea cable in an emergency including within construction or decommissioning areas during sensitive operations;
- The deployed anchor of a vessel fails to embed, and the vessel subsequently drags anchor over a subsea cable;
- A vessel departs an anchorage but neglects to raise anchor and subsequently drags anchor over a subsea cable;
- The anchor is deployed over a subsea cable negligently, with the vessel unaware of the subsea cable presence, or the vessel incorrectly judges the position/location of the subsea cable; or
- The anchor is deployed over a subsea cable accidentally via human error or mechanical failure.

In terms of planned anchoring, approximately one vessel per day was recorded at anchor within the Export Cable Corridor Study Area within the 2019 vessel traffic data studied, and as such it is likely that there will be anchoring activity in proximity to the laid Offshore Export Cables. The Cable Burial Risk Assessment will consider this activity to determine appropriate target burial depths (and any necessity for external Cable Protection) based on the potential penetration depths of anchors likely to be utilized. Cable protection methods will also be monitored to ensure they remain effective, with a focus on any known areas of anchoring.

Given the presence of the Project and other associated risks (such as collision and allision risk) emergency anchoring may occur over the life of the Project. However, it is anticipated that even in an emergency situation vessels will exhibit good seamanship in line with Regulation 34 of SOLAS Chapter V (IMO, 2002), including checking charts to ensure anchor interaction with subsurface features is minimized, noting that all infrastructure relating to the Project will be included on relevant nautical and electronic charts prior to installation.

16.2.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Cable Burial Risk Assessment;
- Cable Installation Plan;
- Charting of infrastructure (prior to installation);
- Monitoring of cables and associated protection;

- Ongoing engagement with stakeholders;
- Promulgation of Information; and
- Safety vessel where appropriate.

16.2.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

17 Emergency Responders

17.1 Impacts on Emergency Response Capability

The increased number of vessels and personnel undertaking activities associated with the Project will increase the likelihood of an incident requiring emergency response, and consequently diminish emergency response capability for the region, including SAR services.

17.1.1 Qualification of Risk

Based on the USCG incident data studied (see Section 9.1), a total of 39 SAR incidents were recorded within the study areas, corresponding to an average of four per year. Of these, one occurred within the Lease Area and one occurred within the Offshore Export Cable Route Corridor, both of which involved injury to personnel.

These rates indicate the likelihood of an incident requiring an emergency response (SAR and/or pollution) in proximity to the Lease Area is low. These rates are not considered likely to increase markedly due to the presence of the Project, noting the range of preventative embedded mitigation measures (see Section 20) designed to minimize the risk of an incident associated with the Project occurring.

COMDTINST M16130.2F (USCG, 2013) states that USCG units "*with SAR readiness responsibility shall maintain a B-0 (have a suitable SAR resource ready to proceed within 30 minutes of notification of a distress) readiness*". Furthermore, USCG units "*should provide for no greater than a two-hour total response time*" within their area of responsibility (inclusive of the 30 minutes preparation time).

As per Section 9.1.1, there are various active USCG stations in proximity from which assets could be mobilized in the event of an incident. This includes Air Station Elizabeth City, located 44 nm (81.5 km) to the south west of the Lease Area. In the event of an incident associated with the Project occurring which required airborne assets, it is likely that Air Station Elizabeth City would be used for mobilization based on its location relative to the Offshore Project Area.

In the event of an incident occurring in proximity to the Offshore Project Area, there is considered to be sufficient available sea room to facilitate emergency response operations. Given that Elizabeth City is the closest air station, located approximately 44 nm (81.5 km) from the Lease Area, and operates assets such as the MH-60T Jayhawk helicopter (operates at maximum speeds of between 125 and 150 knots and has an operational range of 300 nm [556 km]), it is anticipated that there will be no effect on the USCG target of two-hour response time including preparation.

In the unlikely event of multiple incidents occurring in proximity to the Lease Area simultaneously, based on the number and locations of USCG stations (and units), there is anticipated to be no increased difficulty in satisfying the USCG target two-hour response time including preparation.

In the event of an incident occurring within the Lease Area itself, the minimum spacing between WTGs (0.75 nm [1.39 km]), and the two primary lines of orientation consistent across all WTGs will ensure that access to the sea area occupied by the array for SAR purposes is not compromised significantly.

It is noted that the Project will have an Emergency Response Plan in place, and that this will include shut down procedures for the WTGs to reduce visual distraction, physical collision and turbulence risk to SAR helicopters and/or rescue boats during SAR operations. Further, any vessels on-site associated with the Project may be able to assist if required (in liaison with the USCG), noting such vessels will likely have an increased level of response equipment onboard over that of a typical third party vessel.

It is also noted that the marine coordination and monitoring associated with the Project is anticipated to have a positive and beneficial effect on emergency response in the area. This will include facilitation of the USCG to undertake SAR trials within and in proximity to the Lease Area. The surface Offshore Project Components themselves will provide a place of refuge if needed, and would be marked in compliance with COMDTINST M16500.7A (USCG, 2015), IALA Recommendation O-139 (IALA, 2013), NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance (USCG, 2020), and the BOEM guidelines (BOEM, 2021), thus enhancing SAR operation capability.

17.1.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Marine Coordination;
- Marine pollution contingency plans;
- Ongoing engagement with USCG via specialist helicopter consultancy;
- Operational SAR procedures;
- Project vessel compliance with international and flag state regulations;
- Provision of self-help capability;
- Emergency Response Plan;
- USCG SAR trials, field exercises and familiarity training; and
- WTG shut down procedures.

17.1.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

18 Ports and Services

18.1 Port Access – Project Vessels

The construction, maintenance and decommissioning activities associated with the Project may result in restricted access at local ports, including those used as base ports by the Project.

18.1.1 Qualification of Risk

Given that the Lease Area is located in excess of 20nm from shore, and in excess of 10nm from the nearby Routing Measures associated with local port access, the surface Offshore Project Components are not expected to have any notable effect on access to ports in the area. However, the presence of vessel traffic associated with the Project has a low potential to impact on port access.

It is currently anticipated that the base construction port will be the Portsmouth Marine Terminal, VA, and as such Project vessels will be transiting between this port and the Lease Area. Smaller Project vessels (e.g., Crew Transfer Vessels) are not anticipated to cause access issues in these areas, however there is potential that larger vessels such as jack-up barges may restrict port access when in transit to / from the Lease Area. This includes the potential for effect on pilotage operations, noting in particular the pilotage boarding area located within the precautionary area where the Southern and Eastern Approaches of the Chesapeake Bay IMO routing measure converge (see Section 5.1.2).

To ensure third party vessels and relevant ports are aware of likely Project Vessel movements, operational procedures such as designated routes to/from port will be established for Project vessels. These procedures will be determined in consultation with key stakeholders, including relevant ports and the USCG. Details of the agreed procedures would then be promulgated to relevant parties. Noting the location of the anticipated base port, designated routes may involve use of the Chesapeake Bay IMO routing measure, however given the significant volume of vessel traffic already utilizing these lanes (including notable volumes of large commercial vessels), it is not anticipated that the presence of construction traffic associated with the Project will have a significant effect on access or pilotage operations.

The O&M facility locations under consideration are Newport News, Portsmouth and Norfolk, Virginia, with Lambert's Point, which is located on a brownfield site, as the preferred location, and as such any Project vessel activity will be taking similar transit to / from the Lease Area as during the construction phase, including potential use of the Chesapeake Bay IMO routing measure. However, given Project traffic volumes will likely be notably less during the operational phase, no significant impact is anticipated.

Throughout all phases, Project vessel movements will be managed through marine coordination to minimize disruption (as far as is feasible) to third party traffic, and Project vessels will comply with international and flag state regulations (including the COLREGs and SOLAS).

18.1.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Construction vessel and schedule notification system;
- Marine Coordination;
- Ongoing engagement with stakeholders;
- Project Vessel AIS Carriage;
- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures; and
- Promulgation of Information

18.1.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

18.2 Port Access – Cable Installation

Cable installation / maintenance activities associated with the Project may result in restricted access at local ports.

18.2.1 Qualification of Risk

Surface works (i.e., Project vessels) associated with cable installation or maintenance may cause temporary displacement to third party traffic, noting that advisory safe passing distances around such activities may be utilized to ensure the safety of both the Project vessels and third party passing traffic. However, any such displacement would be temporary and spatially limited to the area where work was ongoing. Measures and procedures associated with the installation of the Offshore Export Cables will be detailed in a Cable Installation Plan, which will be produced in consultation with the United States Army Corps of Engineers (USACE) and USCG.

It is noted that the Offshore Export Cable Route Corridor is located approximately 0.4 nm (0.7 km) from the outbound lane of the southern TSS associated with the Chesapeake Bay Routing Measure. Consideration to this will be given in the Cable Installation Plan to ensure any disruption to the TSS is minimized, noting that there is still considered to be available room for vessels utilizing the TSS to navigate given any impacted area would be spatially limited (and temporary).

18.2.2 Relevant Mitigation Measures

Relevant embedded mitigation measures which have been identified are as follows (further detail on mitigation is included in Section 20):

- Cable Burial Risk Assessment;
- Cable Installation Plan;
- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Marine Coordination;
- Minimum advisory safe passing distance;
- Monitoring of cables and associated protection;
- Ongoing engagement with stakeholders;
- Project Vessel AIS Carriage;

- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures; and
- Promulgation of Information.

18.2.3 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Broadly Acceptable and within ALARP parameters.

19 Cumulative Impact Assessment

19.1 Deviations

The presence of cumulative developments may lead to vessels deviating around the multiple arrays resulting in increased journey times and distances.

19.1.1 Qualification of Risk

Based on the cumulative routing assessment (see Section 10.4), there are no main routes impacted by the Project (in terms of displacement), that are also notably impacted by a cumulative development. This is primarily due the majority of traffic in the area being associated with Chesapeake Bay, noting that the approach to the TSS lanes is between the Lease Area and Kittyhawk (the only cumulative development in proximity), and therefore the relevant routes did not interact with both sites.

There may be minor levels of cumulative displacement associated with the cumulative developments in proximity to Delaware Bay, however given the distance of these from the Lease Area, the magnitude of any additional deviations will be minimized, particularly given the majority of the affected routes would likely utilize the proposed ACPARS safety fairways.

19.1.2 Relevant Mitigation Measures

Mitigation measures associated with the equivalent impacts for the assessment of the Project in isolation are also applicable for this cumulative impact; in particular all developments will have infrastructure charted and information promulgated.

19.1.3 Impact Significance

With these embedded mitigation measures considered, the cumulative impact is assessed to be Broadly Acceptable and within ALARP parameters.

19.2 Increased Vessel to Vessel Collision Risk

The presence of cumulative developments may lead to vessels deviating or altering routing around the multiple arrays, potentially resulting in an increased number of vessel to vessel encounters and consequently an increased vessel to vessel collision risk.

19.2.1 Qualification of Risk

As per Section 19.1.1, on a cumulative basis there is not considered likely to be a notable change in deviations to routes identified as potentially being impacted by the Project. As such, there is not anticipated to be a notable increase in encounters on a cumulative level associated with these routes (noting that there is anticipated to be a large increase based on the assessment of the Project in isolation as per Section 12.2.1).

It is noted that the presence of Kittyhawk to the south may result in higher densities of northbound / southbound traffic from vessels on routes parallel to the East Coast that are deviating to avoid the Kittyhawk array. One such northbound / southbound route was identified as a main route passing within 10 nm (18.5 km) of the Lease Area (Route 14 as per Section 6.3.6.2). It should therefore be considered that any increases in traffic associated with this passage may lead to increased encounters in certain areas with the eastbound / westbound traffic deviating south of the Lease Area, noting that this was identified as an area where collision risk would be increasing. However, based on the traffic volumes utilizing this route, a significant increase is not anticipated.

19.2.2 Relevant Mitigation Measures

Mitigation measures associated with the equivalent impacts for the assessment of the Project in isolation are also applicable for this cumulative impact; in particular all developments will have infrastructure charted and information promulgated, and marine coordination will be in place for Project vessels.

19.2.3 Impact Significance

With these embedded mitigation measures considered, the cumulative impact is assessed to be Broadly Acceptable and within ALARP parameters.

19.3 Vessel to Structure Allision Risk (Powered and Drifting)

The presence of cumulative developments may create a risk of a vessel under power or NUC experiencing an allision with a structure within one of the arrays.

19.3.1 Qualification of Risk

The only traffic likely to be affected in terms of cumulative allision risk are those that pass in proximity to both the Lease Area, and the Kittyhawk array to the south. Proximity of the other cumulative development to the Lease Area is such that any cumulative allision impact will be minimal.

As per Section 19.1, the majority of traffic in the area was associated with Chesapeake Bay, and as such is only influenced by either the Project or Kittyhawk, but not both (given the approach to Chesapeake is between the two projects). Any cumulative allision impact to this traffic will therefore be minimal.

However, traffic on northbound / southbound transits was also observed. This included one main route (Route 14 as per Section 6.3.6.2), which passes offshore of the Lease Area. Such traffic may therefore be exposed to increased allision risk from the two projects on a cumulative level. However, it is observed that the majority of risk arising from the Project in terms of allision risk (both powered and drifting), was associated with the southern and north western surface Offshore Project Components, and there is not anticipated to be a notable increase of traffic passing these particular structures on a cumulative level compared to the in-isolation case.

19.3.2 Relevant Mitigation Measures

Mitigation measures associated with the equivalent impacts for the assessment of the Project in isolation are also applicable for this cumulative impact; in particular, lighting and marking to ensure vessels are aware of the presence of the structures.

19.3.3 Impact Significance

With these embedded mitigation measures considered, the cumulative impact is assessed to be Broadly Acceptable and within ALARP parameters.

20 Mitigation Measures

As referenced throughout Sections 12 through 18, there are a range of embedded mitigation measures which have been assumed within the impact assessment undertaken within this NSRA to bring impacts to within ALARP parameters. These measures are summarized in Table 20.1 for ease of reference and completeness. This includes a summary of how each measure manages the relevant risk.

Table 20.1 Summary of Mitigation Measures

Measure	Description	Relevance to Risk Management
Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning	Where applicable, safety zones will be established surrounding the construction areas of the Offshore Project Components. Where feasible, a minimum advisory safe passing distance for cable laying vessels will be implemented, as per the COLREGs. Where safety zones are not applicable, on-site vessels will be utilized to promote awareness of the relevant activities, highlighting the ongoing sensitive operations and ensuring the safety of the construction equipment and personnel.	Protects Project vessels from passing third party vessels, minimizing collision risk. Protects third party vessels from surface Offshore Project Structures under construction (and prior to operational lighting / marking), minimizing powered allision risk.
Cable Burial Risk Assessment	A Cable Burial Risk Assessment will be undertaken prior to the commencement of construction, taking into account locations of existing anchoring and fishing activity. This will also include further consultation with stakeholders most notably the USCG and USACE.	Will ensure target burial depths and external protection are sufficient to minimize cable interaction risk from anchors and fishing gear.
Cable Installation Plan	A Cable Installation Plan will be produced in consultation with the USACE and USCG detailing how cable installation will be managed to ensure disruption is minimized, in particular in approaches to routing measures / ports.	Will ensure any disruption associated with cable installation works / vessels is minimized, including consideration of ports with which Project vessels are associated.
Charting of infrastructure	All Offshore Project Components (i.e., infrastructure associated with the Project) will be charted on the relevant nautical and electronic charts in conjunction with NOAA. Dominion Energy will seek to have infrastructure charted prior to the start of the construction phase. This includes precise planned export cable location information provided in spreadsheet and information graphic formats.	Facilitates passage planning in advance, thus minimizing deviations, collision risk and powered allision risk. Facilitates third party vessels in determining suitable anchoring locations, which minimizes anchor snagging and contact risk.

Measure	Description	Relevance to Risk Management
Construction vessel and schedule notification system	A construction vessel and schedule notification system will be created and implemented.	Assists third party vessels to passage plan in advance, thus minimizing deviations, collision risk and powered allision risk.
Lighting and Marking	The array will be lit and marked in compliance with COMDTINST M16500.7A (USCG, 2015), IALA Recommendations O-139 (IALA, 2013), *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020), and the BOEM guidelines (BOEM, 2021). Additionally, Federal Aviation Administration requirements for the lighting of structures over 200 ft will be adhered to.	Facilitates third party vessel awareness of the Project, to minimize collision risk and powered allision risk. Facilitates emergency response, ensuring SAR operations can be undertaken as efficiently as possible.
Marine Coordination	Marine coordination will be implemented for all vessels associated with the Project, i.e., a central coordination hub from which all Project vessel movements will be managed and third-party vessel traffic monitored.	Minimizes collision risk and assists emergency responders to undertake SAR operations as efficiently as possible. Ensures disruption is minimized, including access to ports used for operations relating to the Project.
Minimum advisory safe passing distance	Where feasible, a minimum advisory safe passing distance for cable laying vessels will be implemented.	Protects Project vessels undertaking sensitive works associated with cables from passing third party vessels, minimizing collision risk.
Minimum blade clearance	The minimum blade clearance for WTG blades will be 82 ft (25 m) above HAT.	Minimizes powered and drifting allision risk for recreational vessels with a mast.
Monitoring of cables and associated protection	Cable burial and protection measures will be periodically monitored to ensure they remain effective, with regular monitoring of protection in the vicinity of any areas of existing anchoring as identified within the Cable Burial Risk Assessment.	Minimizes anchor snagging and contact risk.
Marine pollution contingency plans	Appropriate marine pollution contingency planning will be undertaken.	Minimizes environmental effects should an incident occur, including a collision or allision incident.
Ongoing engagement with stakeholders	Consultation and stakeholder engagement will be ongoing beyond this NSRA, and continue through the construction of the Project, including use of a Fisheries Liaison Officer for discussions with commercial fishing stakeholders.	Assists dynamic risk assessment to minimize collision and allision risk to vessels operating in the area. Ensures disruption is minimized, including access to ports used for operations relating to the Project.

Measure	Description	Relevance to Risk Management
Ongoing engagement with USCG via specialist helicopter consultancy	Consultation and stakeholder engagement will be ongoing beyond this NSRA with the USCG with regards to facilitation of SAR operations.	Facilitates emergency response, ensuring SAR operations can be undertaken as efficiently as possible.
Operational SAR procedures	Operational SAR procedures will be put in place to detail how Dominion Energy will cooperate with the USCG in the event of an emergency situation. These will be discussed and agreed with USCG in advance of construction and will be reviewed and updated in liaison with USCG as necessary as the Project progresses.	Facilitates emergency response, ensuring SAR operations can be undertaken as efficiently as possible.
Project Vessel AIS Carriage	All vessels associated with the Project will carry operational AIS, pursuant to USCG and AIS carriage requirements, to monitor the number of vessels and traffic patterns.	Assists third party vessel awareness of Project vessel movements to minimize collision risk.
Project vessel compliance with international and flag state regulations	All vessels associated with the Project will be compliant with international and flag state regulations including the COLREGs and SOLAS and other health and safety requirements.	Minimizes collision risk for Project vessels. Ensures disruption is minimized, including access to ports used for operations relating to the Project.
Project vessel operational procedures	All vessels associated with the Project will follow operational procedures such as entry/exit points to/from the array and designated routes to/from port.	Minimizes collision risk for Project vessels. Ensures disruption is minimized, including access to ports used for operations relating to the Project.
Promulgation of Information	Information relating to the Project and associated activities will be promulgated via Notices to Mariners and other appropriate means.	Assists third party vessels to passage plan in advance, thus minimizing deviations, collision risk and powered allision risk. Ensures disruption is minimized, including access to ports used for operations relating to the Project.
Provision of self-help capability	In the event of an emergency any onshore or vessel / structure-based resources or facilities relating to the Project may be able to assist.	Minimizes drifting allision risk and assists in limiting the effects of the Project on emergency response capability.
SMS	An SMS will be created and implemented and will include an Emergency Response Plan outlining procedures in an emergency situation.	Details approach to be followed by the Project to manage safety risks, assisting in limiting the effects of the Project on emergency response capability.

Measure	Description	Relevance to Risk Management
USCG SAR trials	Facilitation of USCG SAR trials within and in proximity to the Lease Area.	Assists emergency responders to undertake SAR operations as efficiently as possible.
Safety vessel where appropriate	Use of safety vessel during the construction and decommissioning phases, where deemed appropriate via risk assessment. It is noted that safety vessels will have no law enforcement authority and will contact USCG on VHF-CH 16 if necessary.	Minimizes powered and drifting allision risk.
Use of PATON	PATON may be deployed during the construction, operation and maintenance, and decommissioning phases to mark the working area or Lease Area (where deemed appropriate by risk assessment).	Assists third party vessel awareness of the Project to minimize collision risk and powered allision risk.
WTG shut down procedures	It will be possible for the WTGs to be remotely shut down, either individually, in a row or across the complete array.	Assists emergency responders to undertake SAR operations as efficiently as possible.

21 Conclusion

This NSRA has assessed the impact of the major hazards associated with the development of the Coastal Virginia Offshore Wind Commercial Project based on waterway, maritime traffic, and vessel characteristics as well as key responses received during consultation with stakeholders, lessons learned from trials and existing offshore wind farms, and collision, allision, and grounding risk modelling.

Table 21.1 summarizes the potential impacts identified for shipping and navigation which were assessed in the NSRA. It is noted that impacts, such as those relating to navigation and communication position fixing equipment, tropical cyclones, and ice, which were not deemed significant enough to be considered fully in the impact assessment have not been included in Table 21.1.

As per the FSA process, further consultation is considered necessary to ascertain the required additional mitigation to ensure all risks associated with impacts to commercial vessels are within ALARP parameters. Impacts to other receptors are all considered Broadly Acceptable and ALARP.

Table 21.1 FSA Summary

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
Commercial vessels	Deviations	Tolerable	▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Ongoing engagement with stakeholders; and ▪ Promulgation of Information.	**Further mitigation required to ascertain necessary mitigation to bring impact to within ALARP parameters.**
	Increased vessel to vessel collision risk	Tolerable	▪ Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Marine Coordination; ▪ Minimum advisory safe passing distance around cable installation vessels; ▪ Ongoing engagement with stakeholders; ▪ Project Vessel AIS Carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of Information; and ▪ Safety vessel where appropriate.	**Further mitigation required to ascertain necessary mitigation to bring impact to within ALARP parameters.**
	Powered vessel to structure allision risk	Tolerable	▪ Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Lighting and Marking; ▪ Marine pollution contingency plans; ▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information;	**Further mitigation required to ascertain necessary mitigation to bring impact to within ALARP parameters.**

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			▪ Provision of self-help capability; ▪ Emergency Response Plan; ▪ Safety vessel where appropriate; and ▪ Use of PATON.	
	Drifting vessel to structure allision risk	Tolerable	▪ Marine pollution contingency plans; ▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information; ▪ Provision of self-help capability; ▪ Emergency Response Plan; and ▪ Safety vessel where appropriate.	**Further mitigation required to ascertain necessary mitigation to bring impact to within ALARP parameters.**
Military vessels	Deviations	Broadly Acceptable	▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Ongoing engagement with stakeholders; and ▪ Promulgation of Information.	Risk level has been reduced to ALARP and no further mitigation is required.
	Increased vessel to vessel collision risk	Broadly Acceptable	▪ Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Marine Coordination; ▪ Minimum advisory safe passing distance around cable installation vessels; ▪ Ongoing engagement with stakeholders; ▪ Project Vessel AIS Carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of Information; and	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			▪ Safety vessel where appropriate.	
	Powered vessel to structure allision risk	Broadly Acceptable	▪ Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Lighting and Marking; ▪ Marine pollution contingency plans; ▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information; ▪ Provision of self-help capability; ▪ Emergency Response Plan; ▪ USCG SAR trials; ▪ Safety vessel where appropriate; and ▪ Use of PATON	Risk level has been reduced to ALARP and no further mitigation is required.
	Drifting vessel to structure allision risk	Broadly Acceptable	▪ Marine pollution contingency plans; ▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information; ▪ Provision of self-help capability; ▪ Emergency Response Plan; and ▪ Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
Recreational vessels	Deviations	Broadly Acceptable	▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Ongoing engagement with stakeholders; and ▪ Promulgation of Information.	Risk level has been reduced to ALARP and no further mitigation is required.
	Adverse weather deviations	Broadly Acceptable	▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system;	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			▪ Lighting and Marking; ▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information; ▪ Provision of self-help capability; ▪ Emergency Response Plan; ▪ Safety vessel where appropriate; and ▪ Use of PATON.	
	Increased vessel to vessel collision risk	Broadly Acceptable	▪ Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Marine Coordination; ▪ Minimum advisory safe passing distance around cable installation vessels; ▪ Ongoing engagement with stakeholders; ▪ Project Vessel AIS Carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of Information; and ▪ Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
	Powered vessel to structure allision risk	Broadly Acceptable	▪ Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Lighting and Marking; ▪ Marine pollution contingency plans; ▪ Minimum blade clearance;	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information; ▪ Provision of self-help capability; ▪ Emergency Response Plan; ▪ USCG SAR trials; ▪ Safety vessel where appropriate; and ▪ Use of PATON.	
	Drifting vessel to structure allision risk	Broadly Acceptable	▪ Marine pollution contingency plans; ▪ Minimum blade clearance; ▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information; ▪ Provision of self-help capability; ▪ Emergency Response Plan; and ▪ Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
Commercial fishing vessels	Deviations	Broadly Acceptable	▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Ongoing engagement with stakeholders; and ▪ Promulgation of Information.	Risk level has been reduced to ALARP and no further mitigation is required.
	Adverse weather deviations	Broadly Acceptable	▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Lighting and Marking; ▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information; ▪ Provision of self-help capability; ▪ Emergency Response Plan;	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			▪ Safety vessel where appropriate; and ▪ Use of PATON.	
	Increased vessel to vessel collision risk	Broadly Acceptable	▪ Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Marine Coordination; ▪ Minimum advisory safe passing distance around cable installation vessels; ▪ Ongoing engagement with stakeholders; ▪ Project Vessel AIS Carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of Information; and ▪ Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
	Powered vessel to structure allision risk	Broadly Acceptable	▪ Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Lighting and Marking; ▪ Marine pollution contingency plans; ▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information; ▪ Provision of self-help capability; ▪ Emergency Response Plan; ▪ USCG SAR trials; ▪ Safety vessel where appropriate; and	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			▪ Use of PATON.	
	Drifting vessel to structure allision risk	Broadly Acceptable	▪ Marine pollution contingency plans; ▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information; ▪ Provision of self-help capability; ▪ Emergency Response Plan; and ▪ Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
Anchored vessels	Displacement of Anchoring	Broadly Acceptable	▪ Cable Burial Risk Assessment; ▪ Cable Installation Plan; ▪ Charting of infrastructure (including prior to installation); ▪ Minimum advisory safe passing distance around cable installation vessels; ▪ Monitoring of cables and associated protection; ▪ Ongoing engagement with stakeholders; and ▪ Promulgation of Information.	Risk level has been reduced to ALARP and no further mitigation is required.
	Underwater snagging or contact risk	Broadly Acceptable	▪ Cable Burial Risk Assessment; ▪ Cable Installation Plan; ▪ Charting of infrastructure (prior to installation); ▪ Monitoring of cables and associated protection; ▪ Ongoing engagement with stakeholders; ▪ Promulgation of Information; and ▪ Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
Emergency responders	Emergency response capability	Broadly Acceptable	▪ Marine Coordination; ▪ Marine pollution contingency plans; ▪ Ongoing engagement with USCG via specialist helicopter consultancy;	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			▪ Operational SAR procedures; ▪ Project vessel compliance with international and flag state regulations; ▪ Provision of self-help capability; ▪ Emergency Response Plan; ▪ USCG SAR trials; and ▪ WTG shut down procedures.	
Ports and services	Restricted access at ports – Project Vessels	Broadly Acceptable	▪ Construction vessel and schedule notification system; ▪ Marine Coordination; ▪ Ongoing engagement with stakeholders; ▪ Project Vessel AIS Carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; and ▪ Promulgation of Information	Risk level has been reduced to ALARP and no further mitigation is required.
	Restricted access at ports – Cable Installation	Broadly Acceptable	▪ Cable Burial Risk Assessment; ▪ Cable Installation Plan; ▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Marine Coordination; ▪ Minimum advisory safe passing distance; ▪ Monitoring of cables and associated protection; ▪ Ongoing engagement with stakeholders; ▪ Project Vessel AIS Carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; and ▪ Promulgation of Information.	

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
All users (cumulative)	Deviations	Broadly Acceptable	▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Ongoing engagement with stakeholders; and ▪ Promulgation of Information.	Risk level has been reduced to ALARP and no further mitigation is required.
	Increased vessel to vessel collision risk	Broadly Acceptable	▪ Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Marine Coordination; ▪ Minimum advisory safe passing distance around cable installation vessels; ▪ Ongoing engagement with stakeholders; ▪ Project Vessel AIS Carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of Information; and ▪ Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
	Powered and drifting vessel to structure allision risk	Broadly Acceptable	▪ Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Lighting and Marking; ▪ Marine pollution contingency plans; ▪ Ongoing engagement with stakeholders; ▪ Operational SAR procedures; ▪ Promulgation of Information; ▪ Provision of self-help capability; ▪ Emergency Response Plan;	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			▪ Safety vessel where appropriate; and ▪ Use of PATON.	

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Appendix A NVIC No.01-19 Checklist

Table A.1 provides the NVIC No. 01-19 checklist with comments included for each entry. Where appropriate, comments include references to where each respective issue has been addressed within this NSRA.

Table A.1 NVIC 01-19 Checklist

Issue	Yes/ No	Comments
1. Site and installation coordinate		
Has the developer ensured that coordinates and subsequent variations of site parameters and individual structures are made available, upon request, to interested parties at all, relevant project stages?	Yes	Coordinates for the Lease Area are provided in Section 4.1. The location of individual structures will not be finalized until acceptance of the COP but will be provided once available.
Has the coordinate data been supplied as authoritative Geographical Information System data, preferably in Environmental Systems Research Institute format? Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in World Geodetic System 1984 datum.	Yes	Coordinates for the Lease Area are provided in Section 4.1. Geographical Information System data will be provided to the USCG.
2. Traffic survey		
Was the traffic survey conducted within 12 months of the NSRA?	Yes	As agreed with USCG in the meeting of Sept 17th, 2020 (see Section 3.1), pre Covid data has been used. This covers the most recent unaffected year of data (2019) as per Section 6.1.
Does the survey include all vessel types?	Yes	Vessels determined to be engaged in works considered as temporary have been excluded but all other vessel types have been included as noted in Section 6.1. Detailed analysis of the main vessel types is provided in Section 6.3.4.
Is the time period of the survey at least 28 days duration?	Yes	A year of data (2019) has been assessed as per Section 6.1.
Does the survey include consultation with recreational vessel organizations?	Yes	Consultation with recreational representatives has been undertaken and is summarized in Section 4.4.6 of the COP and Appendix L, Summary of Agency and Stakeholder Engagement.

Issue	Yes/ No	Comments
Does the survey include consultation with fishing vessel organizations?	Yes	Consultation with fishing representatives is ongoing and is summarized in Section 4.4.6 of the COP and Appendix L, Summary of Agency and Stakeholder Engagement. The plan for ongoing communications is included in Appendix V, Fisheries Communication Plan.
Does the survey include consultation with pilot organizations?	Yes	Consultation has been undertaken with the Virginia Pilots Association with key points summarized in Section 3.1.
Does the survey include consultation with commercial vessel organizations?	Yes	Consultation has been undertaken with the AWO, VMA, and WSC with key points summarized in Section 3.1. Regular operators of the area were also given opportunity to comment as per Section 3.2.
Does the survey include consultation with port authorities?	Yes	Consultation has been undertaken with the Port of Virginia with key points summarized in Section 3.1.
Does the survey include proposed structure location relative to areas used by any type of vessel?	Yes	The marine traffic data has been shown relative to the Lease Area and / or Offshore Export Cable Route Corridor throughout Section 6.
Does the survey include numbers, types, sizes and other characteristics of vessels presently using such areas?	Yes	Vessel numbers are assessed within Section 6.3.1, sizes in Section 6.3.2, and types in Section 6.3.4.
Does the survey include types of cargo carried by vessels presently using such areas?	Yes	Commercial cargo vessels have been subcategorized in Section 6.3.4.2. Tankers have been assessed within the same section.
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)?	Yes	Recreational vessels are assessed within Section 6.3.4.6, and fishing vessels within Section 6.3.4.5. It is noted that fishing vessels engaged in fishing activities have not been considered within the assessment, but rather have been assessed as part of the commercial fisheries assessment (Section 4.4.6 of the COP).
Does the survey include whether these areas contain transit routes used by coastal or deep-draft vessels, ferry routes, and fishing vessel routes?	Yes	Vessel draft is assessed within Section 6.3.2.2, and commercial vessel routing is assessed within Section 6.3.6. Fishing vessel activity is assessed within Section 6.3.4.5.
Does the survey include alignment and proximity of the site relative to adjacent shipping routes?	Yes	Commercial vessel routing is assessed within Section 6.3.6.

Issue	Yes/ No	Comments
Does the survey include whether the nearby area contains prescribed or recommended routing measures or precautionary areas?	Yes	Relevant routing measures are presented in Section 5.1.1.
Does the survey include whether the site lies on or near a prescribed or conventionally accepted separation zone between two opposing routes or TSS?	Yes	Relevant routing measures are presented in Section 5.1.1.
Does the survey include the proximity of the site to anchorage grounds or areas, safe haven, port approaches, and pilot boarding or landing areas?	Yes	Relevant navigational features are presented within Section 5.1.
Does the survey include the feasibility of allowing vessels to anchor within the vicinity of the structure field?	Yes	Existing anchoring activity is assessed within Section 6.3.5.Feasibility of anchoring within the Lease Area is assessed within Section 16.1.
Does the survey include the proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds?	Yes	Fishing vessel activity is assessed within Section 6.3.4.5, noting that additional assessment is available within Section 4.4.6 of the COP.
Does the survey include whether the site lies within the limits of jurisdiction of a port and/or navigation authority?	Yes	Local ports are presented in Section 5.1.12.
Does the survey include the proximity of the site to offshore firing/bombing ranges and areas used for any marine or airborne military purposes?	Yes	Military areas of relevance are presented in Section 5.1.9.
Does the survey include the proximity of the site to existing or proposed offshore OREI/gas platform or marine aggregate mining?	Yes	Proposed offshore wind facilities developments have been considered in Section 2.2.4. No relevant marine aggregate dredging areas or gas platforms have been identified.
Does the survey include the proximity of the site to existing or proposed structure developments?	Yes	Existing structures are considered in Section 5.1.5. Proposed offshore wind facilities developments have been considered in Section 2.2.4.
Does the survey include the proximity of the site relative to any designated areas for the disposal of dredging material or ocean disposal site?	Yes	See Section 5.1.7.
Does the survey include the proximity of the site to aids to navigation and/or VTS in or adjacent to the area and any impact thereon?	Yes	Aids to Navigation are presented in Section 5.1.6. The Lease Area does not fall under the jurisdiction of any port.

Issue	Yes/ No	Comments
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?	Yes	Post wind farm routing based on the main vessel traffic dataset (and therefore considering multiple vessel types) is provided in Section 10.2.1. Changes in traffic density and vessel to vessel collision risk including choke points have been assessed on a quantitative basis in Section 10.2.2.
Does the survey include whether the site is in or near areas that will be affected by variations in traffic patterns as a result of changes to vessel emission requirements?	Yes	No changes are expected in relation to changes to vessel emission requirements as per Section 6.5.4.
Does the survey include seasonal variations in traffic?	Yes	A year of data (2019) has been assessed as per Section 6.1, and as such is considered to capture seasonal variations.
3. Offshore above water structure		
Does the NSRA denote whether any features of the offshore above water structure, including auxiliary platforms outside of the main generator site and cabling to the shore, could pose any type of difficulty or danger to vessels underway, performing normal operations, or anchoring? Such dangers would include clearances of wind turbine blades above the sea surface, the burial depth of cabling and lateral movement of floating wind turbines.	Yes	Impacts relating to the interaction of vessels with surface Offshore Project Components (allision risk) (Section 12) and cables (underwater snagging or contact risk) (Section 16) have been assessed. The WTG blade clearance has been considered in the assessment of allision risk to recreational vessels in Section 14. The burial depth of cables has been considered in the assessment of underwater snagging or contact risk in Section 16. The Project is utilizing monopile foundations as per Section 4.2.2 (i.e., floating foundations are not under consideration).
Does the NSRA denote whether minimum safe (air) clearances between sea level conditions at Mean Higher High Water (MHHW) and wind turbine rotors are suitable for the vessel types identified in the traffic survey? Depths, clearances and similar features of other structure types which might affect navigation safety and other Coast Guard missions should be determined on a case by case basis.	Yes	The WTG blade clearance has been considered in the assessment of allision risk to recreational vessels in Section 14. No characteristics of individual structures have been identified as potentially affecting navigational safety in relation to USCG missions. However, the location of the offshore substations between rows of turbines may require modifications to helicopter search procedures when searching in the lanes with offshore substations present.

Issue	Yes/ No	Comments
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?	Yes	The impact on emergency response capability has been assessed in Section 17.
Does the NSRA denote how the rotor blade rotation and power transmission, etc. will be controlled by the designated services when this is required in an emergency?	Yes	WTG shut down procedures have been outlined in Section 4.2.4. Further details will be outlined within the SMS.
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?	Yes	Impacts due to surface and underwater noise have been assessed in Section 8.11.
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?	Yes	Structure integrity post allision is considered in Section 10.3.2.
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?	Yes	There are no underwater devices planned (other than subsea cables) but a partially quantitative assessment has been applied with respect to vessel grounding risk in Section 10.2.6.
Has the developer demonstrated an evidence-based, case-by-case approach which will include dynamic draft modelling in relation to charted water depth to ascertain the safe clearance over a device?	Yes	There are no underwater devices planned (other than subsea cables) but a partially quantitative assessment has been applied with respect to vessel grounding risk in Section 10.2.6.
To establish a minimum clearance depth over devices, has the developer identified from the traffic survey the deepest draft of observed traffic? This will then require modelling to assess impacts of all external dynamic influences giving a calculated figure for dynamic draft. A 30% factor of safety for under keel clearance should then be applied to the dynamic draft, giving an overall calculated safe clearance depth to be used in calculations.	Yes	There are no underwater devices planned (other than subsea cables) but a partially quantitative assessment has been applied with respect to vessel grounding risk in Section 10.2.6, which includes consideration of the maximum vessel drafts recorded.
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:		

Issue	Yes/ No	Comments
Navigation within the site would be safe? ▪ By all vessels or ▪ By specified vessel types, operations and/or sizes? ▪ In all directions or areas; or ▪ In specified directions or areas? ▪ In specified tidal, weather or other conditions; and ▪ At any time, day or night?	Yes	Navigation relative to the site (including internal navigation where appropriate) is assessed for key vessel types in Sections 12 through 15. Adverse weather transits have also been considered where appropriate within these sections. Weather and tidal conditions have been accounted for in drifting allision risk modelling in Section 10.2.4.2. The above assessments have been qualified with Project characteristics applied which include suitable lighting and marking in both day and night conditions as considered in Section 7.
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?	Yes	Post wind farm routing is assessed within Section 10.2.1, and assumes in line with experience of other operational wind farms that commercial vessels will avoid the Lease Area. The effects of this post wind farm routing on collision risk are assessed in 10.2.2.
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?	Yes	Based on the available data and distance offshore no impacts relating to tidal streams are anticipated as noted in Section 5.3.4.
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?	Yes	Based on the available data and distance offshore no impacts relating to tidal streams are anticipated as per Section 5.3.4. Routing in the area is observed to be primarily dictated by the IMO routing measure at the entrance to Chesapeake Bay (Section 5.1.1).
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?	Yes	Based on the available data and distance offshore no impacts relating to tidal streams are anticipated as noted in Section 5.3.4.
Current directions/velocities might aggravate or mitigate the likelihood of allision with the structure?	Yes	The drifting vessel to structure allision risk modelling has taken into consideration the speed and direction of the tide as noted in Section 10.2.4.2.
The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect?	Yes	Based on the available data and distance offshore no impacts relating to tidal streams are anticipated as noted in Section 5.3.4.

Issue	Yes/ No	Comments
The set is across the major axis of the layout at any time, and, if so, at what rate?	Yes	Based on the available data and distance offshore no impacts relating to tidal streams are anticipated as noted in Section 5.3.4.
In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream or currents?	Yes	The drifting vessel to structure allision risk modelling accounts for likely engine breakdown rates, including consideration for the potential for vessels to have multiple engines as noted in Section 10.2.4.2.
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?	Yes	Based on the available data and distance offshore no impacts relating to tidal streams are anticipated as noted in Section 5.3.4. Grounding risk is assessed within Section 10.2.6, noting that any change in risk is only considered likely to be associated with subsea cables.
Structures would cause danger and/or severely affect the air column, water column, seabed and sub-seabed in the general vicinity of the structure?	Yes	Impacts to the air column have been addressed in Section 4.4.10 of the COP, Aviation and Radar and Appendix T, Obstruction Evaluation and Additional Analysis to the COP. Impacts to the seabed and water column have been addressed in Section 4.2.4 of the COP, Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat, and Section 4.1.2 of the COP, Water Quality.
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 the Coast Guard can properly assess the applicant's determination of whether:		
The site, in all weather conditions, could present difficulties or dangers to vessels, which might pass in close proximity to the structure?	Yes	Visibility, tidal streams, wind direction, and sea state are considered within the allision and collision modelling undertaken as per Section 10. Adverse weather transits have been considered for recreational vessels (Section 14.2) and fishing vessels (Section 15.2).
The structures could create problems in the area for vessels under sail, such as wind masking, turbulence, or sheer?	Yes	The potential for effects such as wind shear, masking and turbulence to occur has been assessed for recreational vessels under sail in Section 14.4.
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?	Yes	The drifting vessel to structure allision risk modelling accounts for local wind direction probabilities and likely engine breakdown rates, including consideration for the potential for vessels to have multiple engines, as noted in Section 10.2.4.2.

Issue	Yes/ No	Comments
Depending on the location of the structure and the presence of cold weather, sea ice and/or icing of the structure may cause problems? A thorough analysis of how the presence of the structure would mitigate or exacerbate icing?	Yes	The presence of sea ice and icing of the WTG blades has been considered in Section 5.3.6.
An analysis of the ability for structures to withstand anticipated ice floes should be conducted by the applicant?	Yes	The presence of sea ice and icing of the WTG blades has been considered in Section 5.3.6.
An analysis of the likelihood that ice may form on the structure, especially those types that have rotating blades such as a 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?	Yes	The presence of sea ice and icing of the WTG blades has been considered in Section 5.3.6.
8. Configuration and collision avoidance		
The Coast Guard will provide SAR services in and around OREIs in US waters. Layout designs should allow for safe transit by SAR helicopters operating at low altitude in bad weather, and those vessels (including rescue craft) that decide to transit through them. Has the developer conducted additional site specific assessments, if necessary, to build on any previous assessments to assess the proposed locations of individual turbine devices, substations, platforms and any other structure within OREI such as a wind farm or tidal/wave array? Any assessment should include the potential impacts the site may have on navigation and SAR activities. Liaison with the USCG is encouraged as early as possible following this assessment which should aim to show that risks to vessels and/or SAR helicopters are minimized and include proposed mitigation measures.	Yes	The impact on emergency response capability including SAR services has been assessed in Section 17. It is noted that Dominion Energy is in discussions with the USCG regarding possible mitigations to reduce SAR mission risks. This is an ongoing discussion that will continue through the construction and operations phases.
Each OREI layout design will be assessed on a case-by-case basis.	Yes	The array layout assessed is considered the maximum design scenario for shipping and navigation as noted in Section 4.2.1. The final layout will be agreed following acceptance of the COP.

Issue	Yes/ No	Comments
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 the 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 ALARP.	Yes	A maximum design scenario approach has been taken within the NSRA (see Section 4.7), which ensures any refinement to the PDE will not increase the significance of the impacts identified The risk assessment uses an RBDM approach (Section 2.1) with the ALARP principle applied (Section 2.1.2) and is presented with a consistent structure applied to each user and impact in turn (summary of the impact, main discussion of the impact, list of relevant embedded mitigation and final significance ranking) (see Section 11).
In order to minimize risks to surface vessels and/or SAR helicopters transiting through an OREI, structures (turbines, substations) should be aligned and in straight rows or columns. Multiple lines of orientation may provide alternative options for passage planning and for vessels and aircraft to counter the environmental effects on handling, i.e., sea state, tides, current, weather, visibility. Developers should plan for at least two lines of orientation unless they can demonstrate that fewer are acceptable.	Yes	As per Section 4.2.1, the WTGs are arranged in strict rows and columns providing two lines of orientation. Indicative Offshore Substation locations are not in alignment with the WTGs. This topic will be included in the ongoing SAR Mitigation discussions with the USCG.
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.	Yes	The preferred base case layout does not include a packed boundary as per Section 4.2.1.
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?	Yes	The potential blocking or hindering of the view of other vessels in relation to increased collision risk has been assessed in Section 12.2.
Structures could block or hinder the view of the coastline or of any other navigational feature such as aids to navigation, landmarks, promontories?	Yes	The impact on existing aids to navigation has been assessed in Section 8.12.

Issue	Yes/ No	Comments
Structures and locations could limit the ability of vessels to maneuver in order to avoid collisions?	Yes	Collision risk including the available sea room for safe re-routing has been assessed in Section 12.2.
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 AIS, whether shipborne ashore, or fitted to any of the proposed structures?	Yes	Impacts relating to VHF (Section 8.1 and Section 8.2), AIS (Section 8.4), NAVTEX (Section 8.5), GPS (Section 8.6) and Loran-C (Section 8.7) have been assessed.
Structures could produce Radar reflections, blind spots, shadow areas or other adverse effects in the following interrelationships: ▪ Vessel to vessel; ▪ Vessel to shore; ▪ VTS Radar to vessel; ▪ Racon to /from vessel; and ▪ Aircraft and Air Traffic Control.	Yes	Impacts on marine Radar are assessed in Section 8.9.
Structures, in general, would comply with current recommendations concerning electromagnetic interference?	Yes	Impacts relating to electromagnetic interference have been assessed in Section 8.8.
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?	Yes	Impacts that may arise from the offshore wind infrastructure relating to noise have been assessed in Section 8.11.
Structures, generators, and the seabed cabling within the site and onshore might produce electromagnetic fields affecting compasses and other navigation systems?	Yes	Impacts relating to electromagnetic interference have been assessed in Section 8.8.
The power and noise generated by structures above or below the water would create physical risks that would affect the health of vessel crews?	Yes	Impacts that may arise from the offshore wind infrastructure relating to noise have been assessed in Section 8.11.

Issue	Yes/ No	Comments
11. Risk of collision, allision, or grounding. Does the NSRA, based on the data collected per Paragraph 2 above, provide an evaluation that was conducted to determine the risk of collision between vessels, risk of allisions with structures, or grounding because of the establishment of a structure, including, but not limited to:		
▪ Likely frequency of collision (vessel to vessel); ▪ Likely consequences of collision (“What if” analysis); ▪ Likely location of collision; ▪ Likely type of collision; ▪ Likely vessel type involved in collision; ▪ Likely frequency of allision (vessel to structure); ▪ Likely consequences of allision (“What if” analysis); ▪ Likely location of allision; ▪ Likely vessel type involved in allision; ▪ Likely frequency of grounding; ▪ Likely consequences of grounding (“What if” analysis); ▪ Likely location of grounding; and ▪ Likely vessel type involved in grounding?	Yes	Collision risk has been assessed on a quantitative basis within Section 10.2.2, with associated impact assessment then undertaken for key vessel types in Sections 12 through 15. Collision risk has been assessed on a quantitative basis within Section 10.2.4, with associated impact assessment then undertaken for key vessel types in Sections 12 through 15. Grounding risk is considered in Section 10.2.6. Consequences of potential incidents are assessed in Appendix B.
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 SAR and the Marine Environmental Protection emergency response missions?		

Issue	Yes/ No	Comments
For SAR, the Coast Guard will assist in gathering and providing the following information: ▪ The number of SAR cases the USCG has conducted in the proposed structure region over the last 10 years. ▪ The number of cases involving helicopter hoists. ▪ The number of cases performed at night or in poor visibility/low ceiling. ▪ The number of cases involving aircraft (helicopter, fixed-wing) searches. ▪ The number of cases performed by commercial salvors (for example, BOAT US, SEATOW, commercial tugs) responding to assist vessels in the proposed structure region over the last 10 years. ▪ Has the developer provided an estimate of the number of additional SAR cases projected due to allisions with the structures? ▪ Will the structure enhance SAR such as by providing a place of refuge or easily identifiable markings to direct SAR units?	Yes	SAR data provided by the USCG has been assessed in Section 9.1. Effects of the Project on emergency response are assessed in Section 18. This includes likely effects on incident rates, and the potential for the surface Offshore Project Components to provide places of refuge. As per Section 7, all surface Offshore Project Components will be marked with clearly visible alphanumeric identifiers.
For marine environmental protection/response: ▪ How many marine environmental/pollution response cases has the USCG conducted in the proposed structure region over the last 10 years? ▪ What type of pollution cases were they? ▪ What type and how many assets responded? ▪ How many additional pollution cases are projected due to allisions with the structures?	Yes	SAR data provided by the USCG has been assessed in Section 9.1, including cases of pollution. Potential additional pollution resultant of the Project is assessed on a quantitative basis in Appendix B.
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 navigation marking?	Yes	Proposed lighting and marking for the purposes of marine navigation has been outlined in Section 7.

Issue	Yes/ No	Comments
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?	Yes	Proposed lighting and marking for the purposes of marine navigation has been outlined in Section 7. This includes consideration for both day and night conditions.
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?	Yes	Proposed lighting and marking for the purposes of marine navigation has been outlined in Section 7. This includes consideration for both day and night conditions.
If the site would be marked by one or more Racons or, an AIS transceiver, or both and if so, the AIS data it would transmit?	Yes	AIS will be used to mark structures within the Lease Area, pending additional guidance from USCG (see Section 7.2). The structures from which AIS will be transmitted (and the information transmitted) will be confirmed following finalization of the layout post acceptance of the COP.
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?	Yes	Sound signals will be utilized as appropriate as per Section 7.2, noting that the structures on which sound signals will be deployed will be confirmed following finalization of the layout post acceptance of the COP.
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?	Yes	Proposed aviation lighting including screening from mariners has been outlined in Section 7.3.
Whether the proposed site and/or its individual generators would comply in general with markings for such structures, as required by the Coast Guard?	Yes	Proposed lighting and marking is in line with the relevant guidance provided by the USCG, IALA and BOEM as noted in Section 7.
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?	Yes	Proposed lighting and marking is in line with guidance provided by the USCG, IALA and BOEM (Section 7) and the availability of aids to navigation has been outlined (Section 7.2).
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?	Yes	Proposed action should any aid to navigation experience a discrepancy has been outlined in Section 7.2.
How the marking of the structure will impact existing Federal aids to navigation in the vicinity of the structure?	Yes	The impact on existing aids to navigation has been assessed in Section 8.12.
14. Design requirements. Is the structure designed and constructed to satisfy the following recommended design requirements for emergency shutdown in the event of a search and rescue, pollution response, or salvage operation in or around a structure?		

Issue	Yes/ No	Comments
All above surface structure individual structures should be marked with clearly visible unique identification characters (for example, alpha-numeric labels such as 'A1', '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).	Yes	Proposed marking in terms of unique alphanumeric marking has been outlined in Section 7.4.
All generators and transmission systems should be equipped with control mechanisms that can be operated from an operations center of the installation.	Yes	WTG shut down procedures have been outlined in Section 4.2.4. Further details will be outlined within the SMS.
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.	Yes	WTG shut down procedures have been outlined in Section 4.2.4. Further details will be outlined within the SMS.
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.	Yes	Remote positioning of the nacelle and the blades will be possible. Further WTG shut down procedures have been outlined in Section 4.2.4, and full details will be outlined within the SMS. The nacelle exterior hatch will be capable of being opened from the exterior roof.

Issue	Yes/ No	Comments
Access ladders, although designed for entry by trained personnel using specialized equipment and procedures for maintenance in calm weather, could conceivably be used in an emergency situation to provide refuge on the structure for distressed mariners. This scenario should therefore be considered when identifying the optimum position of such ladders and take into account the prevailing wind, wave and tidal conditions.	Yes	Access ladders will be available. Precise details relating to the location of access ladders will be determined later in the COP process but will take into account the meteorological conditions outlined in Section 5.3.
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?	Yes	O&M facility will be manned 24 hours a day as noted in Section 4.5.
The operations center personnel should have a chart indicating the GPS position and unique identification numbers of each of the structures?	Yes	Personnel at O&M facility will have access to chart indicating the position and unique identification number of each surface Offshore Project Component as per Section 4.5.
All applicable Coast Guard command centers (District and Sector) will be advised of the contact telephone number of the operations center?	Yes	This will be provided to the USCG as noted in Section 4.5.
All applicable Coast Guard command centers will have a chart indicating the position and unique identification number of each of the structures?	Yes	Charts indicating the position and unique identification number of each surface Offshore Project Component will be provided to the USCG as noted in Section 4.5.
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 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.	N/A	Noted.
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.	Yes	This will be in built into procedures to be followed as part of emergency operation plans. Additional details of WTG shut down procedures have been outlined in Section 4.2.4. Further details will be outlined within the SMS.

Issue	Yes/ No	Comments
Communication and shutdown procedures should be tested satisfactorily at least twice each year.	Yes	WTG shut down procedures have been outlined in Section 4.2.4, and include minimum twice yearly testing. Further details will be outlined within the SMS.
After an allision, the applicant should submit documentation that verifies the structural integrity of the structure.	Yes	Post incident, a report will be available that will describe the incident cause and structural integrity of the WTG structure as per Section 10.3.2.

Appendix B Consequences

This appendix presents an assessment of the consequences of collision and allision incidents, in terms of risk to people and the environment, due to the impact of the surface Offshore Project Components.

B.1 Risk Evaluation Criteria

B.1.1 Risk to People

With regard to the assessment of risk to people two measures are considered, namely:

- Individual risk; and
- Societal risk.

B.1.2 Individual Risk per Year

This measure considers whether the risk from an accident to a particular individual changes significantly due to the presence of the surface Offshore Project Components. Individual risk considers not only the frequency of the accident and the consequences (likelihood of death), but also the individual's fractional exposure to that risk, i.e., the probability of the individual being in the given location at the time of the accident.

The purpose of estimating the individual risk is to ensure that individuals who may be affected by the presence of the surface Offshore Project Components are not exposed to excessive risks. This is achieved by considering the significance of the change in individual risk resulting from the presence of the surface Offshore Project Components relative to the background individual risks.

Annual individual risk levels to crew (the annual risk to an average crew member) for different vessel types are presented in Figure B.1, which also includes the upper and lower bounds for risk acceptance criteria as suggested in IMO Maritime Safety Committee 72/16 (IMO, 2000). The annual individual risk to crew falls within the ALARP region for each of the vessel types presented.

Following this, typical bounds defining the ALARP regions for RBDM within shipping are presented in Table B.1.

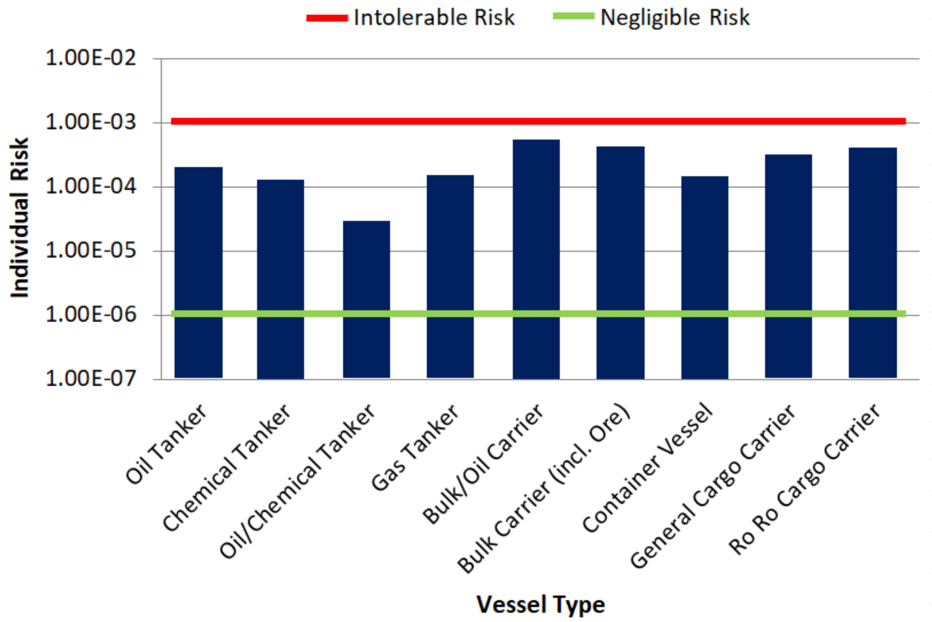

Figure B.1 Individual risk levels and acceptance criteria per vessel type (IMO, 2000)

Table B.1 Individual risk ALARP criteria

Individual	Lower Bound for ALARP	Upper Bound for ALARP
Crew members	10^{-6}	10^{-3}
Passenger	10^{-6}	10^{-4}
Third party	10^{-6}	10^{-4}
New vessel target	10^{-6}	Above values reduced by one order of magnitude

B.1.3 Societal Risk

Societal risk is used to estimate the risk of an accident affecting many persons, e.g., catastrophes, and acknowledging risk averse or neutral attitudes. Societal risk includes the risk to every person, even if a person is only exposed on one brief occasion to that risk. For assessing the risk to a large number of affected people, societal risk is desirable because individual risk is insufficient in evaluating risks imposed on large numbers of people.

Within this assessment societal risk (navigational based) can be assessed for the Project, giving account to the change in risk associated with each accident scenario caused by the introduction of the surface Offshore Project Components. Societal risk may be expressed as:

- Annual fatality rate where frequency and fatality are combined into a convenient one-dimensional measure of societal risk (also known as PLL); and
- FN-diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

When assessing societal risk this study focuses on PLL, which takes into account the number of people likely to be involved in an incident.

B.1.4 Risk to Environment

For risk to the environment the key criteria considered in terms of the effect of the Project is the potential amount of oil spilled from the vessel involved in an accident.

It is recognized that there will be other potential pollutions, e.g., hazardous containerized cargoes; however, oil is considered the most likely pollutant and the extent of predicted oil spills will provide an indication of the significance of pollution risk due to the Project.

B.2 Fatality Risk

This section uses incident data along with information on average manning levels per vessel type to estimate the probability of fatality in a marine incident associated with the Project.

The Project is assessed to have the potential to affect the following incidents:

- Vessel to vessel collision;
- Powered vessel to structure allision;
- Drifting vessel to structure allision; and
- Fishing vessel to structure allision.

B.2.1 Incident Data

UK flagged commercial vessels are required to report accidents to the MAIB. Non-UK flagged vessels do not have to report unless they are at a UK port or within 12 nm (22.2 km) territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report accidents to MAIB; however, a significant proportion of these incidents are reported to and investigated by the MAIB.

The MCA, harbor authorities and inland waterway authorities also have a duty to report accidents to the MAIB. Therefore, while there may be a degree of underreporting of accidents with minor consequences, those resulting in more serious consequences, such as fatalities, are likely to be reported.

Only incidents occurring in UK waters have been considered within this assessment for which the MAIB data is most comprehensive. It is also noted that incidents occurring in ports/harbors and rivers/canals have been excluded since the causes and consequences may differ from an accident occurring offshore, which is the location of most relevance to the Project.

Taking into account these criteria, approximately 13,400 accidents, injuries and hazardous incidents were reported to the MAIB between 1994 and 2014 involving approximately 15,200 vessels (some incidents such as collisions involved more than one vessel).

A plot of the locations of incidents reported in proximity to the UK is presented in Figure B.2, color-coded by incident type. This appendix uses this data, and in particular the data for collision and allision incidents to determine the fatality probability for different vessel categories.

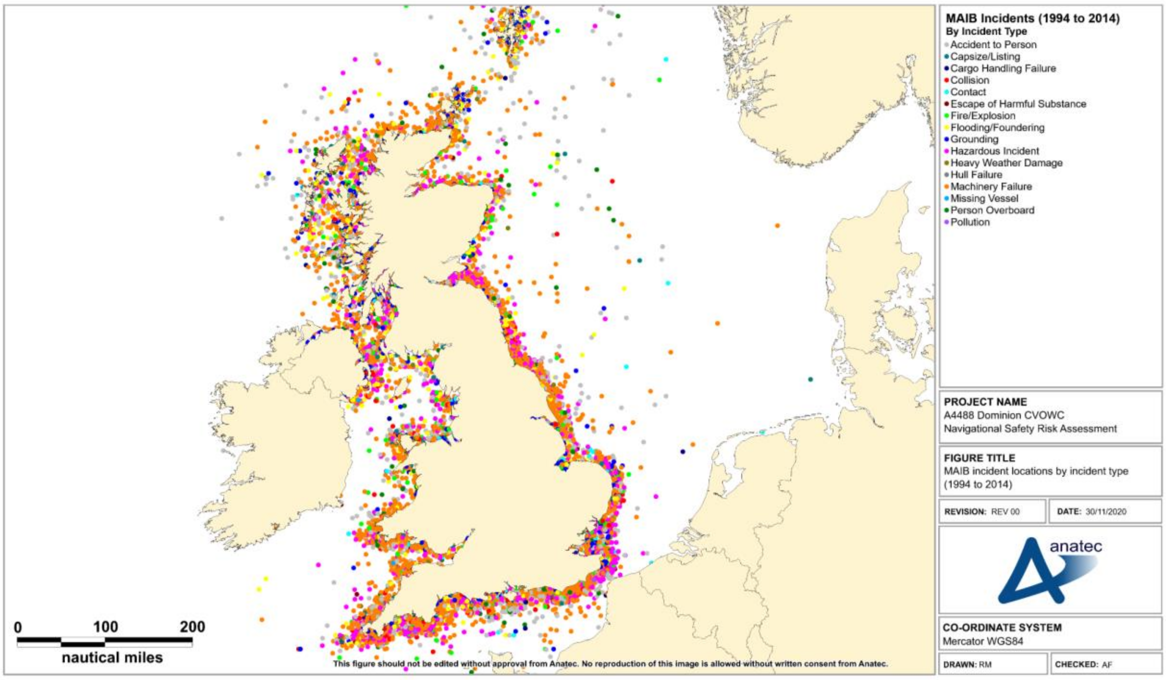

Figure B.2 MAIB Incident Data by Type (1994 to 2014)

B.2.2 Fatality Probability

Using collision and allision incident data from the MAIB spanning a 20-year period, the number of fatalities, number of people involved in incidents and thus the fatality probability have been estimated. Given that the fatality probability associated with smaller craft is higher, this analysis has been divided into three categories of vessel, as shown in Table B.2.

Table B.2 MAIB fatality probability per collision per vessel category[16]

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability
Commercial	Dry cargo, passenger, tanker, etc.	1	9,718	1.0×10^{-4}
Fishing	Trawler, potter, dredger, etc.	1	708	1.4×10^{-3}
Pleasure craft	Yacht, small commercial motor vessel, etc.	2	2,540	7.9×10^{-4}

[16] Note this data has been used for the purpose of calibrating Anatec's collision and allision risk models. The data is UK based, however is considered as being representative of worldwide incident rates, and therefore fit for the purposes of model calibrations within this NSRA.

It can be seen that the risk is up to one order of magnitude higher for people onboard small craft compared to larger commercial vessels.

B.2.3 Fatality Risk due to the Project

The base and future-case annual collision and allision frequency levels without and with the development are summarized in Table B.3. Background into the methodology by which these values were calculated is provided in Section 10.

Table B.3 Summary of annual collision and allision frequency results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	1.08E-02 (1 in 93 years)	1.93E-02 (1 in 52 years)	8.50E-03 (1 in 118 years)
	Future case (10%)	1.30E-02 (1 in 77 years)	2.33E-02 (1 in 43 years)	1.03E-02 (1 in 97 years)
	Future case (20%)	1.55E-02 (1 in 65 years)	2.78E-02 (1 in 36 years)	1.23E-02 (1 in 81 years)
Powered vessel to structure allision	Base case	N/A	2.54E-03 (1 in 394 years	2.54E-03 (1 in 394 years)
	Future case (10%)	N/A	2.80E-03 (1 in 357 years)	2.80E-03 (1 in 357 years)
	Future case (20%)	N/A	3.05E-03 (1 in 328 years)	3.05E-03 (1 in 328 years)
Drifting vessel to structure allision	Base case	N/A	3.27E-03 (1 in 306 years)	3.27E-03 (1 in 306 years)
	Future case (10%)	N/A	3.59E-03 (1 in 279 years)	3.59E-03 (1 in 279 years)
	Future case (20%)	N/A	3.92E-03 (1 in 255 years)	3.92E-03 (1 in 255 years)
Fishing vessel to structure allision	Base case	N/A	5.91E-04 (1 in 1,692 years)	5.91E-04 (1 in 1,692 years)
	Future case (10%)	N/A	6.41E-04 (1 in 1,560 years)	6.41E-04 (1 in 1,560 years)
	Future case (20%)	N/A	6.91E-04 (1 in 1,447 years)	6.91E-04 (1 in 1,447 years)
Total	**Base case**	**1.08E-02 (1 in 93 years)**	**2.57E-02 (1 in 39 years)**	**1.49E-02 (1 in 67 years)**
	Future case (10%)	**1.30E-02 (1 in 77 years)**	**3.03E-02 (1 in 33 years)**	**1.73E-02 (1 in 58 years)**
	Future case (20%)	**1.55E-02 (1 in 65 years)**	**3.55E-02 (1 in 28 years)**	**2.00E-02 (1 in 50 years)**

Table B.4 presents the estimated average number of people on board (POB) for the local vessels operating in the region. The POB for passenger vessels is based on the combined crew and passenger capacities of passenger vessels identified within the vessel traffic data, given that this information is readily available for the majority of passenger vessels. POB information for specific cases of the other vessel types is not as readily available, and as such these have been estimated on a conservative basis.

Table B.4 Vessel types, incidents and average number of POB

Vessel Type	Collision/Allision Incidents	Average Number of POB
Cargo vessel	▪ Vessel to vessel collision; ▪ Powered vessel to structure allision; and ▪ Drifting vessel to structure allision.	15
Tanker		20
Passenger vessel		3,085
Fishing vessel		3
Recreational vessel	▪ Vessel to vessel collision	4

From the detailed results of the collision and allision frequency modelling, the distribution of the predicted change in annual collision and allision frequency by vessel type due to the Project for the base case (0 percent increase in traffic), future case (10 percent increase in traffic), and future case (20 percent increase in traffic) are presented in Figure B.3.

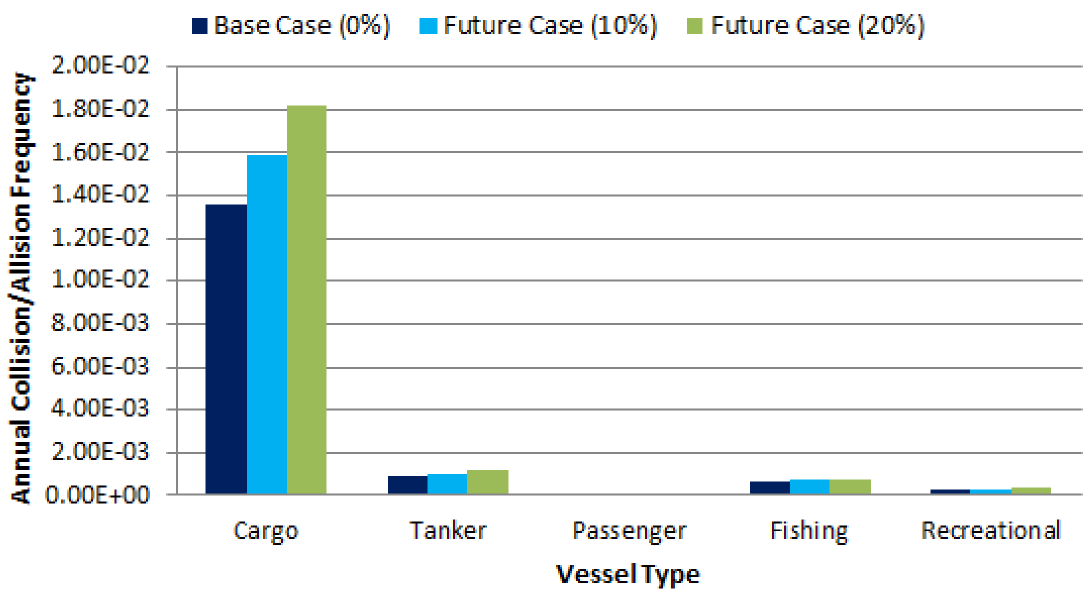

Figure B.3 Change in annual collision and allision frequency by vessel type

The majority of change in allision and collision risk was observed to be associated with cargo vessels. This is resultant of the volume of cargo traffic in the area relative to other vessel types.

Combining the annual collision and allision frequency (Table B.3), estimated POB of each vessel type (Table B.4) and the estimated fatality probability for each vessel category (Table B.2) the annual increase in PLL due to the impact of the Project for the base case is approximately 4.16 x 10^{-5}, which equates to one additional fatality in approximately 24,000 years.

In terms of future case, the annual increase in PLL due to the impact of the Project assuming a 20 percent increase in traffic is estimated to be approximately 4.90 x 10^{-5}, which equates to one additional fatality in approximately 20,000 years. Assuming a 20 percent increase in traffic this rises to an estimated frequency of 5.67 x 10^{-5}, which equates to one additional fatality in approximately 17,500 years.

The estimated incremental changes in PLL due to the Project, distributed by vessel type for the base and future cases, are presented in Figure B.4.

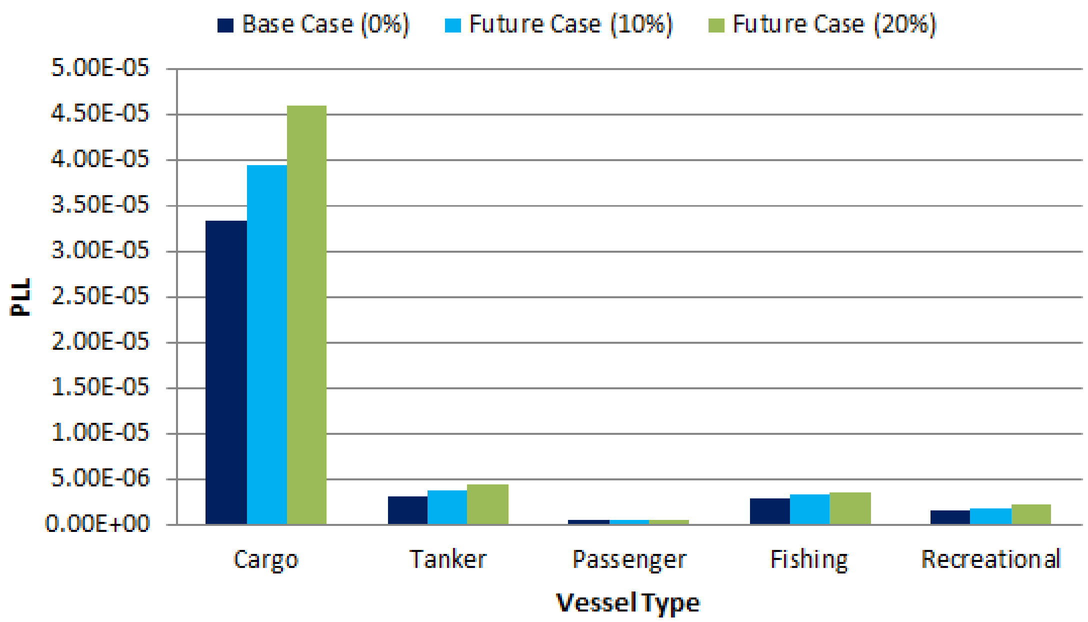

Figure B.4 Estimated change in annual PLL by vessel type

The majority of increase in PLL was observed to be associated with cargo vessels, which is due to the volume of this type of vessel in the area.

Individual risk per annum (IRPA) has been assessed based upon the average number of people exposed by vessel type per year, as shown in Figure B.5. This calculation assumes that the risk is shared between 10 vessels of each type, which is considered to be conservative based upon the number of different vessels operating in the vicinity of the Lease Area.

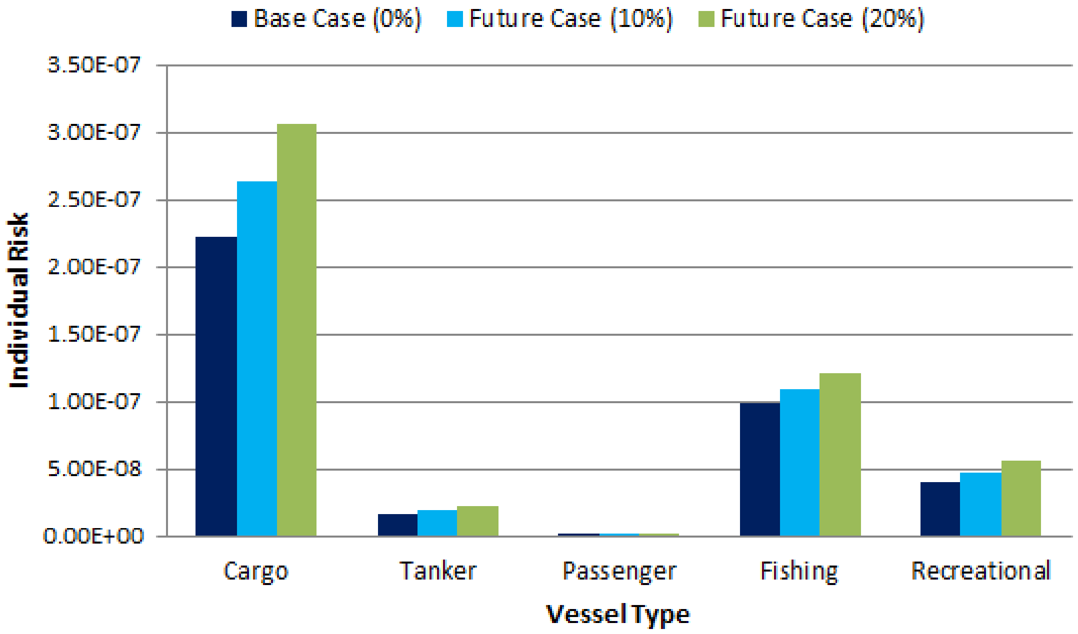

Figure B.5 Estimated change in individual risk by vessel type

IRPA was observed to be greatest to cargo vessels owing to the volume of this type of vessel in the area. IRPA for passenger vessels is lowest owing to the high average number of POB therefore distributing the risk among many more individuals. Inversely, the IRPA for recreational vessels and fishing vessels was relatively higher owing to the lower average number of POB, therefore distributing the risk among fewer individuals.

B.2.4 Significance in increase in Fatality Risk

The overall increase in PLL and individual risk for the future-case are summarized in Table B.5. PLL refers to the potential increase in lives lost per year as a result of the Project, and individual risk refers to the probability of fatality to an individual.

Table B.5 Summary of fatality risk for Future Cases

Fatality Risk	Change in Frequency	
	10% Increase	20% Increase
PLL	4.90×10^{-5}	5.67×10^{-5}
IRPA	4.39×10^{-7}	5.05×10^{-7}

Each of these changes in frequency is considered very low and indicates that the increase in fatality risk resulting from the Project is negligible.

B.3 Pollution

B.3.1 Historical Analysis

The pollution consequences of a collision in terms of oil spill depend upon the following:

- Spill probability (i.e., likelihood of outflow following an accident); and
- Spill size (amount of oil).

Two types of oil spill are considered in this assessment:

- Fuel oil spills from bunkers (all vessel types); and
- Cargo oil spills (laden tankers).

The research undertaken as part of the DfT's Marine Environmental High Risk Areas project (DfT, 2001) has been used as it was comprehensive and based upon worldwide marine spill data analysis.

From this research, the overall probability of a spill per accident was calculated based upon historical accident data for each accident type as presented in Figure B.6.

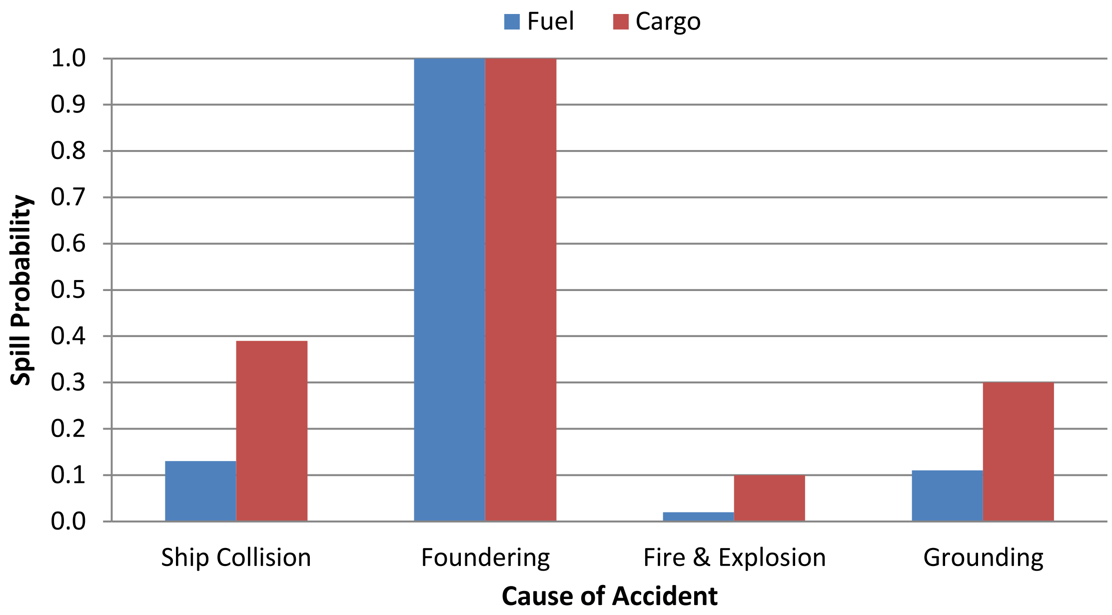

Figure B.6 Probability of an oil spill resulting from an accident

Based on this data, it was estimated that 13 percent of vessel collisions result in a fuel oil spill and 39 percent of collisions involving a laden tanker result in a cargo oil spill.

In the event of a bunker spill, the potential outflow of oil depends upon the bunker capacity of the vessel. Historical bunker spills from vessels have generally been limited to a size of below 50 percent of the bunker capacity, and in most incidents much lower. For the types and sizes of vessels exposed to the Project, an average spill size of 100 tons (30,467 gallons) of fuel oil is considered to be a conservative assumption.

For cargo spills from laden tankers, the spill size can vary significantly. The International Tanker Owners Pollution Federation (ITOPF) report the following spill size distribution for tanker collisions between 1974 and 2004:

- 31 percent of spills below seven tons (2,100 gallons);
- 52 percent of spills between seven and 700 tons (2,100 and 213,000 gallons); and
- 17 percent of spills greater than 700 tons (213,000 gallons).

For fishing vessel collisions, comprehensive statistical analysis is not available. Consequently, it is conservatively assumed that 50 percent of all collisions involving fishing vessels will lead to an oil spill with the quantity spilled being on average five tons (1,500 gallons). Similarly, for recreational vessels, due to a lack of data 50 percent of collisions are assumed to lead to a spill with an average size of one ton (300 gallons).

B.3.2 Pollution Risk due to the Project

Applying the probabilities from Section B.3.1 to the annual collision and allision frequency by vessel type presented in Table B.3 and the average spill size per vessel, the amount of oil spilled per year due to the impact of the Project is estimated to be approximately 100 gallons per year for the base case. In terms of future case, spills totalling approximately 118 gallons per year were estimated assuming a 10 percent increase in traffic, rising to approximately 136 gallons per year assuming a 20 percent increase in traffic.

The estimated increase in gallons of oil spilled distributed by vessel type for the base case, future case (10 percent increase in traffic), and future case (20 percent increase in traffic) are presented in Figure B.7.

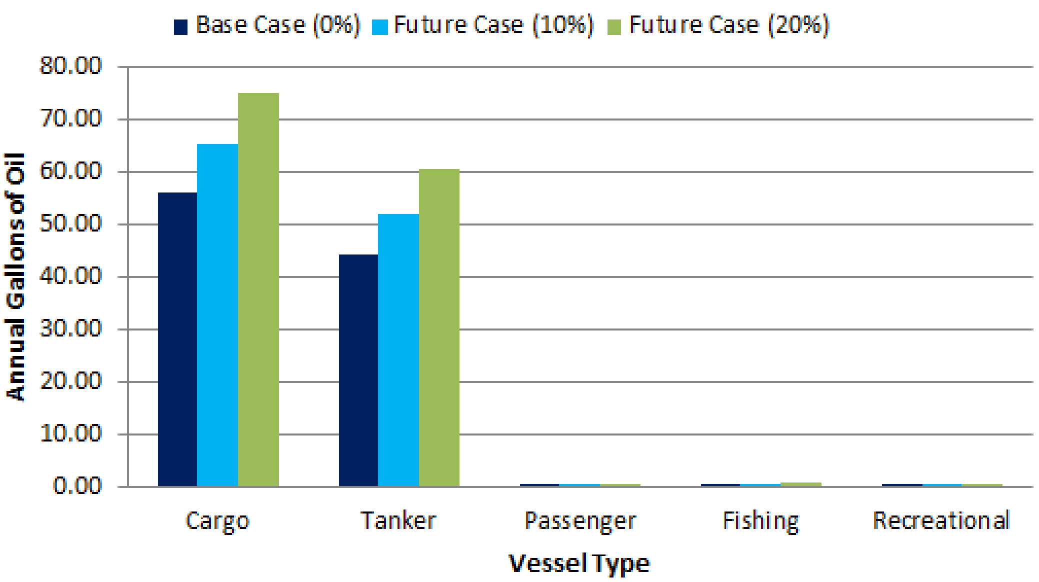

Figure B.7 Estimated change in pollution by vessel type

The majority of increase in oil spilled was observed to be associated with cargo vessels, noting their prominence in the area. Tankers also accounted for a relatively high proportion of the total, noting the potential for larger spills associated with tanker incidents.

B.3.3 Significance of Increase in Pollution Risk

Based upon data available from the BTS (BTS, 2019), the annual average volume of petroleum oil spilled from all vessels impacting navigable US waterways between 1995 and 2018 was approximately 600,000 gallons. During this period, the annual average number of oil spill incidents from all vessels impacting navigable US waterways was 2,790.

The overall change in pollution estimated due to the Project (approximately 100 gallons per year for the base case) represents a negligible increase (< 0.02 percent) in the total annual average gallons of oil spilled which impact navigable US waterways. This indicates that the increase in pollution risk resulting from the Project is negligible.

Appendix C Regular Operators Letter

anatec

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Date: Oct 26, 2020

Opportunity to Participate in Consultation for Coastal Virginia Offshore Wind (CVOW) Commercial Project

Dear Sir/Madam,

You may be aware that Virginia Electric Power Company, d/b/a Dominion Energy Virginia (Dominion Energy), formerly d/b/a Dominion Virginia Power are intending to construct and operate the Coastal Virginia Offshore Wind (CVOW) Commercial Project (the 'Project') located approximately 24 nautical miles (nm) east of the Virginia Beach coastline. The commercial lease for the Project went into effect on Nov 1st, 2013, with construction anticipated to begin in 2024. At present, Dominion Energy is in the pre-application stage of the Project and as required are preparing the formal application submission (Construction and Operations Plan, COP) to the Bureau of Ocean Energy Management (BOEM).

The location of the Wind Farm Area, within which all surface piercing offshore structures associated with the Project will be located, is shown in Figure 1 alongside the Export Cable Corridor. Based on the current Project Design Envelope (PDE), there will be up to 205 wind turbines installed within the Wind Farm Area, and up to three offshore substations. The Export Cable Corridor (within which export cables will be installed) is expected to make landfall in Virginia Beach, Virginia. It is noted that the CVOW Pilot project consisting of two demonstration turbines is located west and directly adjacent to the Wind Farm Area, and is included in Figure 1 for reference.

Anatec Ltd have been contracted by Dominion Energy to produce a Navigation Safety Risk Assessment (NSRA) for the Project and engaging in comprehensive stakeholder consultation forms a key part of this process. On this basis, we are seeking to provide you the opportunity to provide feedback on the Project at this stage, should you seek to do so. Your organization has been identified as a potential stakeholder, given that vessel traffic data we have collected and studied has indicated that vessels you operate transit within the vicinity of the Commercial Lease Area, and hence may be affected by the presence of the Project. Should you require any further information on these vessel traffic studies undertaken, then please feel free to get in touch.

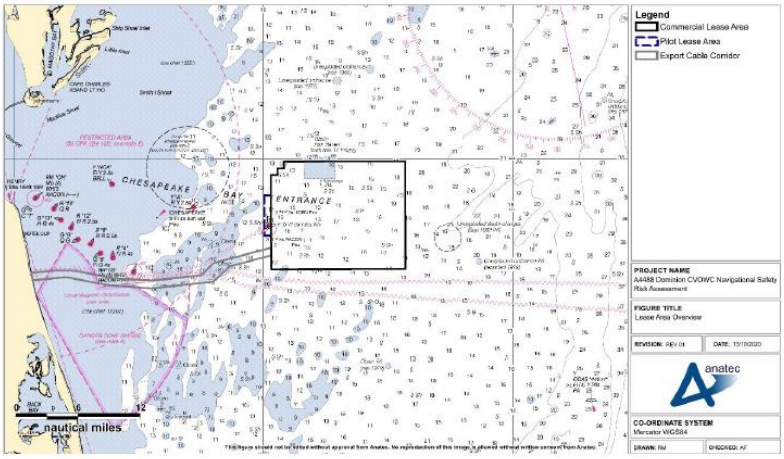

Figure 1 Overview of the CVOW Commercial Project

We are particularly interested in how the Project may impact vessel routing in the area, noting the location of the Commercial Lease Area relative to the International Maritime Organization (IMO) routing measure at the entrance to Chesapeake Bay, and to an adjacent proposed Safety Fairway from the Atlantic Coast Port Access Study (ACPARS), see Figure 2.

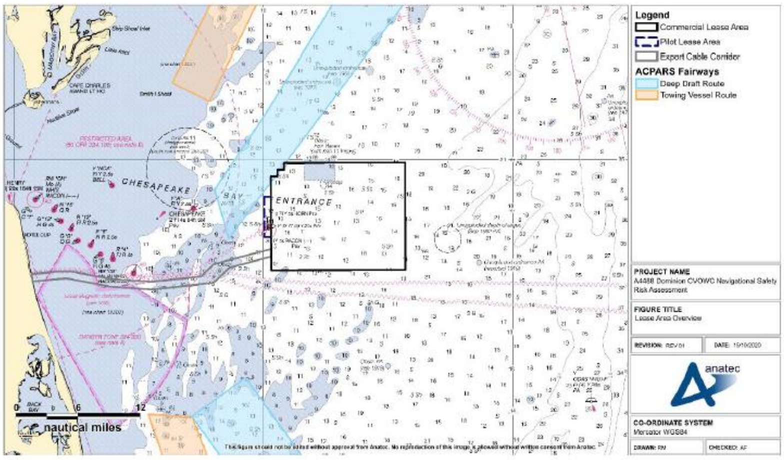

Figure 2 Overview of the CVOW Commercial Project including Proposed ACPARS

Therefore, answers to the following specific questions would be helpful, should you deem them relevant to your organization:

1. What impacts would you foresee the Project having on your vessels operating in the area, and would anything change about the way you operate as a result?

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2. Are you familiar with the ACPARS referenced above? If so, what impact might these proposed Safety Fairways have on your operations in the area including when considered in combination with the presence of the Project?
3. Are there any specific mitigation measures you would like to see in place for the Project?
4. Do vessels you operate regularly transit past operational or constructing offshore wind farm projects in other areas (e.g., within European Waters)? If so, do you have any comments arising from your experience that may be of interest to Dominion Energy?
5. Do you intend to publicly comment on the Project during the associated National Environmental Policy Act (NEPA) process?

Please note that any consultation input not specifically arising from the above questions would also be welcome. Consultation responses and any queries should be sent to [redacted]. It is noted that if you have no specific comments or concerns, a response to this effect would be appreciated. To aid the timeframe within which the NSRA must be completed, I would be grateful if all responses are received prior to Nov 20, 2020.

Should you require any further information about the Project, or have any queries on the NSRA process, then please do not hesitate to get in touch. In the meantime, I would be grateful if you could confirm receipt of this correspondence for our records.

Yours sincerely,

[redacted]
Risk Analyst
Anatec Ltd.
On behalf of Dominion Energy