Kitty Hawk Wind
AVANGRID

Construction and Operations Plan

Appendix BB - Navigation Saftey Risk Assessment

September 30, 2022

Submitted by
Kitty Hawk Wind, LLC
1125 NW Couch Street, Suite 600
Portland, Oregon 97209

Submitted to
Bureau of Ocean Energy Management
45600 Woodland Road
Sterling, Virginia 20166

Prepared by
Tetra Tech, Inc.
10 Post Office Square, 11th Floor
Boston, Massachusetts 02109

AVANGRID

Appendix BB – Navigation Safety Risk Assessment

Document Reference: KTH-GEN-CON-PLN-AGR-000067_035 Rev 03

Prepared by:	Checked by:	Approved by:
September 30, 2022	September 30, 2022	September 30, 2022

Revision Summary				
Rev	**Date**	**Prepared by**	**Checked by**	**Approved by**
01	09 Dec 2020	Anatec Limited	Tetra Tech, Inc.	Brian Benito Jr.
02	01 Oct 2021	Anatec Limited	Tetra Tech, Inc.	Marcus Cross
03	30 Sep 2022	Anatec Limited	Tetra Tech, Inc.	Megan Higgins

Description of Revisions			
Rev	**Page**	**Section**	**Description**
01	All	All	Submitted to BOEM
02	All	All	Updated based on BOEM comments and Project updates
03	Many	Various	Updated based on BOEM comments and Project name

Kitty Hawk North Wind Project
Navigation Safety Risk Assessment

Prepared by	Anatec Limited
Presented to	Tetra Tech, Inc. / Kitty Hawk Wind, LLC
Date	21 September 2022
Revision Number	10
Document Reference	A4551-TT-NRA-01

	Aberdeen Office	Cambridge Office
Address	10 Exchange Street, Aberdeen, AB11 6PH, UK	Braemoor, No. 4 The Warren, Witchford Ely, Cambs, CB6 2HN, UK
Tel	01224 253700	01353 661200
Email	aberdeen@anatec.com	cambs@anatec.com

Revision Number	Date	Summary of Change
00	24th September 2020	Initial version
01	2nd October 2020	Revised following Tetra Tech comments
02	14th October 2020	Revised following Kitty Hawk Wind, LLC comments
03	16th October 2020	Revised following Kitty Hawk Wind, LLC comments
04	23rd October 2020	Final for USCG review
05	2nd December 2020	Revised following USCG comments
06	9th June 2021	Revised following USCG and BOEM comments
07	24th September 2021	Revised following changes to PDE
08	1st October 2021	Final
09	4th February 2022	Revised following USCG and BOEM comments
10	21st September 2022	Revised for minor textual edit

Table of Contents

Table of Figures

Table of Tables

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 Transportation Statistics
CBRA	Cable Burial Risk Assessment
CFR	Code of Federal Regulations
COMDTINST	Commandant Instruction
COP	Construction and Operations Plan
CVOW	Coastal Virginia Offshore Wind
dB	Decibel
DF	Direction Finding
DoD	Department of Defense
DSC	Digital Selective Calling
DWR	Deep Water Route
ECMWF	European Centre for Medium Range Weather Forecast
ESP	Electrical Service Platform
FL	Florida
FSA	Formal Safety Assessment
ft	Foot
GA	Georgia
GPS	Global Positioning System
HAT	Highest Astronomical Tide
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IPS	Intermediate Peripheral Structure
IRPA	Individual Risk per Annum
km	Kilometer
LA	Louisiana
Loran	Long Range Navigation
m	Meter
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MD	Maryland

Abbreviation	Definition
MGN	Marine Guidance Note
MHHW	Mean Higher High Water
MHWS	Mean High Water Springs
MISLE	Marine Information for Safety and Law Enforcement
MLLW	Mean Lower Low Water
MSL	Mean Sea Level
MSN	Merchant Shipping Notice
MW	Megawatt
m/s	Meter per Second
N	North
NAVTEX	Navigational Telex
NC	North Carolina
NDBC	National Data Buoy Center
NJ	New Jersey
nm	Nautical Mile
nm^2	Square Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
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
RI	Rhode Island
SAR	Search and Rescue
SC	South Carolina
SMC	Search and Rescue Mission Coordinator
SMS	Safety Management System

Abbreviation	Definition
SOLAS	International Convention for the Safety of Life at Sea
SPS	Significant Peripheral Structure
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
U.S.	United States
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
VA	Virginia
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 of Terms

Term	Definition
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.
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.
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.
Deep Water Route	A route in a designated area within defined limits which has been accurately surveyed for clearance of the sea bottom and submerged articles. They are of particular use to vessels restricted in their ability to maneuver due to their draft size.
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.
Export cable corridor study area	A 2 nm (3.7 km) area applied around the export cable corridor in order to ensure that focus is placed upon the vessel traffic relevant to the offshore export cables.
Future case	Assessment of risk based upon the predicted growth of future vessel traffic levels and types.
Highest Astronomical Tide (HAT)	The highest level of water which can be predicted to occur under any combination of astronomical conditions.
In isolation	Assessment of a development on a standalone basis without (or before) considering other developments within the region.
International Maritime Organization (IMO) routing measure	An internationally recognized shipping route established by IMO.
Main route	Defined transit routes (mean position) of commercial vessels identified within the region.
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 structures.

Term	Definition
Marine Guidance Note (MGN)	A system of guidance notes issued by the 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 Higher High Water (MHHW)	The average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch (a 19-year period adopted by the National Ocean Service (NOS)).
Mean High Water Springs (MHWS)	The average of all high water observations at the time of spring tide over a period time (preferably 19 years).
Mean Lower Low Water (MLLW)	The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch.
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).
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 Renewable Energy Installation (OREI)	A facility placed in the navigable waters of the United States that creates electricity by using sources other than oil or gas.
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[1]	An area established under United States Coast Guard (USCG) authority around facilities 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.

[1] 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. Project construction is not anticipated to commence within two years of the passage of the Act; however, the authority may be extended or made permanent. The Company will continue to monitor the results of this pilot program

Term	Definition
Wind Development Area Study Area	A 10 nautical mile area applied around the Wind Development Area in order to ensure that focus is placed upon the vessel traffic relevant to the proposed area of development.
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.

and any implementing regulations to determine where safety zones may be applicable during Project construction. Where applicable, safety zones will extend up to 500 m around construction sites, per 33 CFR § 147.15. All areas will be marked and lit in accordance with USCG requirements and monitored by a safety vessel that will be available to assist local mariners.

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 Kitty Hawk North Wind Project (hereby referred to as 'the Project') being developed by Kitty Hawk Wind, LLC (hereby referred to as 'the Company'), a wholly owned subsidiary of Avangrid Renewables, LLC. The Project is located within Bureau of Ocean Energy Management (BOEM) offshore Lease Area OCS-A 0508 (Lease Area) and consists of approximately 40 percent of the Lease Area closest to shore (hereby referred to as the 'Wind Development 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. The main guidance considered throughout 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 is 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 facilities have been considered, 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 USCG incident response data has also been considered.

Vessel traffic data has been collected over a 12-month period via coastal and satellite Automatic Identification System (AIS) data and has been used to establish the existing maritime traffic behavior and patterns within and surrounding the Project. Approximately three unique vessels per day were recorded within the Wind Development Area, with cargo vessels observed most frequently. Military vessels, tankers, recreational vessels and fishing vessels were also observed, but much less frequently. A total of 11 main routes used by commercial vessels were identified in proximity to the Wind Development Area, with four of these passing through the Wind Development Area itself.

Using the information gathered, the assessment of shipping and navigation impacts (both for the Project in isolation and cumulatively with other offshore developments in the region) was undertaken using Risk Based Decision Making (RBDM), and it was determined that all impacts were considered to be within (at most) tolerable limits when assessed to be As Low as Reasonably Practicable (ALARP) using a range of embedded mitigation measures.

Cumulative impacts associated with deviations for all vessels were assessed to be **Tolerable with Mitigation** with all other impacts deemed to be **Broadly Acceptable**. Under the NSRA methodology (which has been agreed upon with stakeholders), it has been ensured that the risks associated with the tolerable impact are ALARP.

1 Introduction

1.1 Guidance

This Navigation Safety Risk Assessment (NSRA) has been undertaken primarily to comply with the requirements set out in the main guidance documents outlined in Section 1.1.1. However, where appropriate, the other supplementary references outlined in Section 1.1.2 have also been taken into consideration.

1.1.1 Main Guidance Documents

1.1.1.1 Navigation and Vessel Inspection Circular No. 01-19

The Navigation and Vessel Inspection Circular (NVIC) No. 01-19 (United States Coast Guard [USCG], 2019) is considered the primary guidance document and has been taken into account throughout this NSRA. The NVIC provides guidance on information and factors the USCG will consider when reviewing an application for a permit to build and operate an Offshore Renewable Energy Installation (OREI) in United States (US) navigable waters.

To ensure the requirements of the NVIC are considered fully and addressed where appropriate, 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.

1.1.1.2 Commandant Instruction 16003.2B

The Commandant Instruction (COMDTINST) 16003.2B (USCG, 2019) promulgates USCG policy, roles and responsibilities to carry out statutory requirements. 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.

1.1.2 Other Supplementary References

Although NVIC No. 01-19 is the primary guidance document considered in this NSRA, it does note that "*guidelines from other recognized sources such as governmental agencies or classification societies that may be applicable*" should be referenced. A number of other guidance documents considered in this NSRA are outlined in the following subsections.

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 information requirements for a COP. Specifically, the document provides guidance on survey requirements and project-specific information and advises of the possible need for an NSRA to be conducted which will be reviewed by the USCG in line with the contents of NVIC No. 02-07 (USCG, 2007) (now superseded by NVIC No. 01-19).

1.1.2.2 Atlantic Coast Port Access Route Study Final Report

The *Atlantic Coast Port Access Route Study (ACPARS) Final Report* (USCG, 2016) is considered relevant given the proximity of the Wind Development Area to routing measures recommended by 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.

The USCG has undertaken a set of new studies of routes used by vessels to access ports on the Atlantic coast of the U.S which is intended to supplement and build on the ACPARS. Of primary importance is the *Port Access Route Study: Approaches to the Chesapeake Bay, Virginia*. At this stage it is too early to identify any impacts associated with the outputs of these new studies.

1.1.2.3 Commandant M16500.7A and Private Aids to Navigation Marking Guidance

Proposed lighting and marking of structures associated with the Project 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*[2] (IALA, 2013);
- *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure Private Aids to Navigation (PATON) Marking Guidance* (USCG, 2020); and
- *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM, 2021).

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

The *Revised Guidelines for Formal Safety Assessment 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 Formal Safety Assessment (FSA) process is iterative in nature and closely follows the Risk Based Decision Making (RBDM) basis noted in NVIC No. 01-19. It is an internationally recognized standard and considered best practice for marine risk assessment.

[2] USCG is a member of IALA.

1.1.2.5 Marine Guidance Note 654

Marine Guidance Note (MGN) 654 (Merchant & Fishing) Safety of Navigation Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Responses (Maritime and Coastguard Agency [MCA], 2021)[3] is the key guidance used for United Kingdom (UK) offshore wind facilities. 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).

Given the relative infancy of the offshore wind industry in the US, MGN 654 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 (OREI)* are explicitly referenced in NVIC No. 01-19 and described as a "*well-regarded source*", noting that the methodology forms an annex to MGN 654.

1.2 Consultees and Stakeholders

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

- American Waterways Operators (AWO);
- BOEM;
- Chamber of Shipping of America;
- Department of Defense (DoD);
- Port of Virginia;
- USCG;
- Virginia Maritime Association (VMA);
- Virginia Pilot Association; and
- World Shipping Council (WSC).

Regular operators identified from vessel traffic data 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, noting 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 7.2 of the COP).

1.3 Data Sources

The main data sources used to assess the existing environment (Section 5) and baseline shipping activities (Section 6) relative to the Project are summarized in Table 1.1.

[3] This updated version of the document supersedes MGN 543.

Table 1.1 Summary of data sources

Data	Sources
Vessel traffic (most recent available periods have been used)	AIS data recorded via coastal receivers (2019).
	AIS data recorded via satellite receivers (2019).
	Visual observation and AIS data recorded from the survey vessel *Gerry Bordelon* during summer 2020.
	Vessel Monitoring System (VMS) data for various species including groundfish and scallops (Mid-Atlantic Ocean Data Portal, 2015 to 2016) with further detail provided in Section 6.4. *Note: for VMS data, data period availability lags behind AIS data source availability.*
	VMS Polar Histograms from January 2014 to August 2019 (BOEM, 2021).
Maritime incidents	Marine Information for Safety and Law Enforcement (MISLE) database (USCG, 2010 to 2019).
	Marine Accident Investigation Branch (MAIB) collision and allision incident database (2000 to 2019)[4].
	Historical UK offshore wind facility allision incidents from the UK Confidential Reporting Programme for Aviation and Maritime, International Marine Contractors Association and basic web searches.
Navigational features	National Oceanic and Atmospheric Administration (NOAA) nautical charts 12200 (NTM edition 53), 12207 (NTM edition 25), 12208 (NTM edition 17), 12221 (NTM edition 84) and 13003 (NTM edition 52) (NOAA, 2020).
	United Kingdom Hydrographic Office (UKHO) Admiralty Chart 2919 (issued 11th February 2021) (UKHO , 2021).
	United States Coast Pilot 3 (NOAA, 2021) and *United States Coast Pilot 4* (NOAA, 2021).
	Admiralty Sailing Directions NP69 (UKHO, 2017).
	Code of Federal Regulations Title 33 – Navigation and Navigable Waters and *Title 50 – Wildlife and Fisheries* (Office of the Federal Register, 2020).
	Light List Volume II: Atlantic Coast (Shrewsbury River, NJ to Little River, SC) (USCG, 2019).
	Military Operating Area Boundaries: Atlantic/Gulf of Mexico (NOAA, 2020).
	Military Submarine Transit Lanes: Atlantic/Gulf of Mexico (NOAA, 2018).
	Automated Wreck and Obstruction Information System (AWOIS) (NOAA, 2016)
Meteorological Ocean (Metocean)	National Center for Environmental Prediction Climate Forecast System Reanalysis (1979 to 2019).
	National Data Buoy Center (NDBC) (2010 to 2019 for wind/wave, 2010 to 2013 for tidal streams).

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

Data	Sources
	United States Coast Pilot 3 (54th Edition) (NOAA, 2021) and *United States Coast Pilot 4* (52nd Edition) (NOAA, 2020).
	European Centre for Medium Range Weather Forecasts (ECMWF) (1979 to 2019).
	Admiralty Sailing Directions NP69 (UKHO, 2017).
	Historical Hurricane Tracks database (NOAA, 2021) plotted by Multipurpose Marine Cadastre.
	Ocean Data Acquisition System (ODAS) Buoy 44014 (2000 to 2019).
	Oceanweather 14945 (1979 to 2018).

1.4 Lessons Learned

Due to the early stage of offshore wind development in the US, the domestic lessons learned to date are limited. 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 in addition to the available U.S. sources. These papers and data sources are clearly referenced where used in this NSRA.

- *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 facility technology has advanced significantly since many of the sources above were published. In particular, foundation and turbine technology has allowed for much larger WTGs, which in turn means the minimum spacing value will likely be in excess of that included at the permitting stage when defining final array layouts. This has had a beneficial effect in terms of reducing impacts on communications and position fixing equipment. This is considered further in Section 8.

2 Navigation Safety Risk Assessment Methodology

2.1 Methodology for Assessment of the Project in Isolation

2.1.1 Impact Identification

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.

The NSRA primarily addresses safety-based impacts to third party vessels and operators, 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 12) have been identified on this basis. Impacts associated with Project vessels will be mitigated by the processes put in place to control transits to/from the Wind Development Area and entry/exit to ensure that they do not pose an increased collision risk to third party vessels or allision risk.

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

Impact assessment has been undertaken with 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 particular, 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; the approach used within this NSRA is aligned with the FSA approach.

2.1.2 Impact Significance

Once identified, those effects for which the sensitivity level is low (i.e., there is no anticipated impact) are screened out of the impact assessment. Those impacts which carry some degree of sensitivity are considered further in the impact assessment (see Section 12) in terms of the following elements, where appropriate:

- 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 implemented for the Project (see Section 21) and qualitatively determines the significance of each individual impact reviewed as Broadly Acceptable, Tolerable, or Unacceptable.

The definitions of each significance ranking are given in Table 2.1. These definitions are based on the IMO's FSA process for the qualification of ALARP. This terminology is used throughout the NSRA to identify where impacts are considered ALARP or whether they require further mitigation.

Table 2.1 Significance rankings

Significance	Definition
Broadly Acceptable	A level of risk that is managed by standard mitigations in place for offshore wind facilities. 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 facilities. 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. 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 into ALARP parameters.

2.1.3 As Low As Reasonably Practicable Principle

The ALARP principle is considered in the IMO's FSA process which is illustrated in Figure 2.1.

Figure 2.1 indicates that there is a risk level above which the risk is intolerable 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 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.

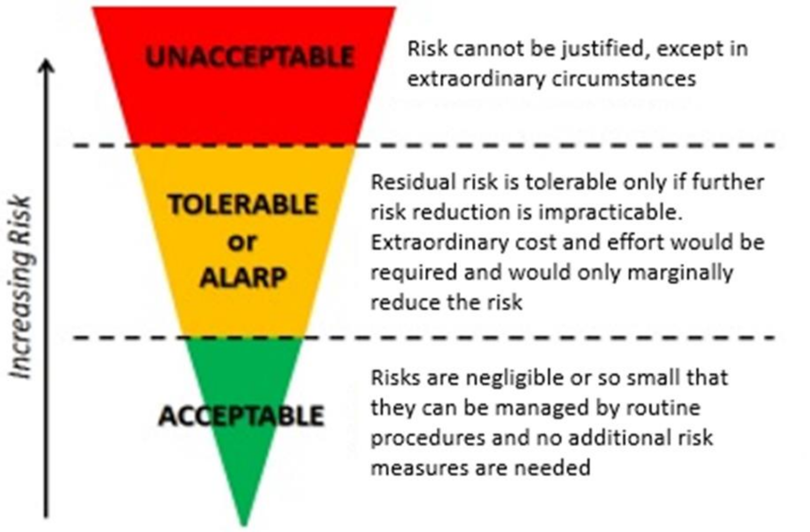

Figure 2.1 ALARP Principle (IMO, 2018)

2.1.4 Risk to People and the Environment

In addition to assessing the tolerability of impacts qualitatively, a risk evaluation with regard to people and the environment has 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 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 11.5, with further details provided in Appendix B.

2.1.5 Modelling Software

The risks associated with the Project have been assessed on a qualitative basis (see Section 12); however the 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 facility applications within the UK, and are refined and improved on a continuous basis. Key models include:

- **Encounters** – identifies instances of vessel encounters within an AIS dataset;
- **COLLRISK vessel to vessel collision** – estimates the frequency at which two vessels may collide within a pre-defined area;
- **COLLRISK vessel to structure allision (powered)** – estimates the frequency at which a passing vessel may allide with an offshore wind structure while under power;
- **COLLRISK vessel to structure allision (drifting)** – estimates the frequency at which a passing vessel may allide with an offshore wind structure 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 facility may allide with an offshore wind structure.

Further details pertaining to the methodology of the models used are provided in the relevant subsections of Section 1.

2.2 Methodology for Assessment for Cumulative Effects

2.2.1 Other Offshore Wind Facilities

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 facilities in the region. Given the varying development status of current U.S. renewables developments, a tiered approach to cumulative assessment has been undertaken, which splits developments into tiers depending on:

- Development status[5];
- 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 10.

Precedent is given to the distance from the Wind Development Area when determining the relevant tier of a development, e.g., a development greater than 150 nautical miles (nm) (278 kilometers [km]) from the Wind Development Area is screened out (Tier 4) irrespective of the development status, level to which they are anticipated to cumulatively impact 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	Proposed Assessment within NSRA
1	Active	Operational, approved, submitted or not submitted	▪ Within 100 nm (185 km) of the Wind Development Area; **and** ▪ May impact a main route which transits through or within 1 nm (1.9 km) of the Wind Development Area and/or interacts with traffic that may be directly displaced by the Wind Development Area.	High or medium	Quantitative cumulative re-routing of main routes.

[5] 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	Proposed Assessment within NSRA
2	Active	Submitted or not submitted	▪ Within 150 nm (278 km) of the Wind Development Area, **and** ▪ May impact a main route which transits through or within 1 nm (1.9 km) of the Wind Development Area and/or interacts with traffic that may be directly displaced by the Wind Development Area.	High or medium	Qualitative cumulative re-routing of main routes.
3	Identified but not yet auctioned	Not submitted	▪ Within 150 nm (278 km) of the Wind Development Area; **and** ▪ May impact a main route which transits through or within 1 nm (1.9 km) of the Wind Development Area and/or interacts with traffic that may be directly displaced by the Wind Development 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 Wind Development Area; or ▪ Within 150 nm (278 km) of the Wind Development Area but does not impact a main route which transits through or within 1 nm (1.9 km) of the Wind Development Area and does not interact with traffic that may be directly displaced by the Wind Development Area.	Any	Screened out.

2.3 Consultation on Methodology

As part of the consultation meetings undertaken between February and September 2020, stakeholders were asked to consider and comment on the proposed methodology to ensure that they were content with the process. Relevant feedback is summarized in Section 3.1.

2.3.1 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 facility main routes and therefore are also considered in the assessment of the Project in isolation. Although the ACPARS have been included within the future case assessment it is noted that the USCG's *Port Access Route Study: Approaches to the Chesapeake Bay, Virginia* (USCG, 2019), and the *Advanced Notice of Proposed Rulemaking (ANPRM) for Shipping Safety Fairways Along the US Atlantic Coast* (USCG, 2020) are not considered final at the time of writing (comment submission period ended in July 2021) and there is only limited information available.

2.3.2 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.

2.4 Study Areas

2.4.1 Wind Development Area

A minimum buffer of 10 nm (18.5 km) has been applied around the Wind Development Area (hereby referred to as the 'Wind Development Area study area'), as shown in **Error! Reference source not found.**. This study area has been defined so that focus is placed upon the vessel traffic relevant to the Wind Development Area in order to provide a comprehensive assessment of related commercial vessel routing.

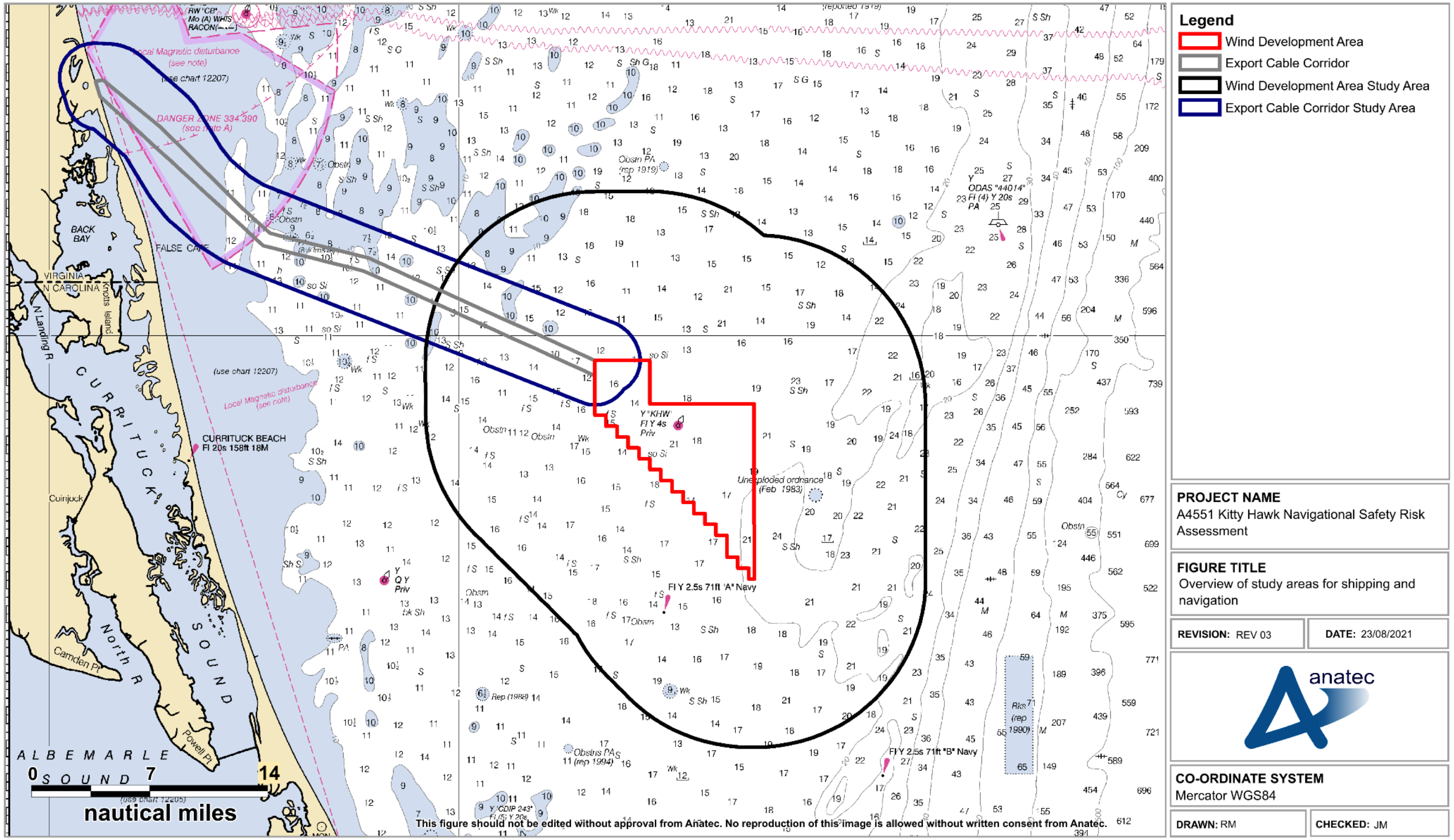

Figure 2.2 Overview of study areas for shipping and navigation

2.4.2 Export Cable Corridor

An approximately 2 nm (3.7 km) buffer has been applied around the export cable corridor (hereby referred to as the 'export cable corridor study area') as shown in **Error! Reference source not found.**. To ensure assessments undertaken within the export cable corridor study area are site specific, vessel traffic recorded infield, e.g., within Back Bay, has been excluded. Export cable corridor as referred to throughout this document is the offshore element only.

2.5 Assumptions

The shipping and navigation baseline and impact assessment has been undertaken with a conservative approach (a realistic worst case scenario), based on 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 offshore wind structures will not be finalized until acceptance of the COP, but should still fall within the PDE and maximum design scenario as assessed, thus ensuring that the risks associated with what is constructed are ALARP, regardless of the final parameters. Subsequently, as the PDE has been refined during the NSRA process, the maximum design scenario for shipping and navigation has been reviewed and refined as appropriate. The final maximum design scenario assessed within the 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 the NSRA. Similarly, any limitations associated with the referenced data sources are highlighted within the relevant sections.

3 Consultation

3.1 Summary of Issues Raised

Table 3.1 summarizes the issues raised during stakeholder consultation for the Project relevant to shipping and navigation. For each issue a response is provided and/or where the issue has been addressed in this NSRA, as appropriate. A list of the parties consulted is provided in Section 1.2. Extensive engagement with stakeholders specific to commercial and recreational fisheries has been ongoing since May 2019 and is detailed in Section 7.2 of the COP, Commercial and Recreational Fishing.

It is noted that consultation and stakeholder engagement will be ongoing beyond this NSRA and continue throughout the construction and operation of the Project. This is reflected in Section 21, where ongoing engagement with stakeholders is considered as an embedded mitigation measure.

Table 3.1 Summary of shipping and navigation issues raised during stakeholder consultation

Consultee	Date	Issue(s) Raised	Response to Issue and/or where Addressed in NSRA
DoD	04 Feb 2020	NOAA charts will need to be updated eventually to reflect the presence of the Project.	The charting of all infrastructure associated with the Project on relevant nautical charts and electronic charts is included as an embedded mitigation measure (see Section 21).
USCG	02 Jun 2020	It should be made clear whether the spacing between WTGs is measured from tip-to-tip or center-to-center.	Where the spacing between offshore wind structures has been stated the reference point has been included (center-to-center) (see Section 4.2.1)
		VMS data is not a requirement for commercial fisheries in the area and therefore may not provide as much additional data as it would elsewhere (such as New England).	VMS data has been assessed but only to enhance and validate other data sources, noting this caveat from the USCG (see Section 6.4).
		Information relating to the size of vessels in the area should be incorporated into the NSRA.	AIS data has been assessed in terms of vessel size (both length and draft) in the area (see Section 6.2.2).

Consultee	Date	Issue(s) Raised	Response to Issue and/or where Addressed in NSRA
		Consideration should be made for the inclusion of the fairway system proposed in the ACPARS.	Given the proximity of the Wind Development Area to a deep draft route forming part of the ACPARS fairways, the ACPARS fairways have been incorporated into the post wind facility commercial traffic routing (see Section 6.7.4).
		Impacts relating to SAR should be considered, noting that a spacing of 0.6 nm (1.1 km) between offshore wind structures may be a challenge for helicopter pilots conducting SAR operations at night although there is no official guidance on this matter.	Impacts on SAR services have been assessed (see Section 18). The minimum spacing between offshore wind structures is 0.75 nm (1.5 km) center-to-center (see Section 4.2.1) and this has been considered in the assessment of impacts on SAR services.
USCG	27 Jul 2020	Safety buffers for the ACPARS fairways are incorporated into the fairway widths.	N/A
AWO	30 Jul 2020	The baseline data for use as input to the NSRA and assessment approach is considered both thorough and appropriate.	N/A
		Information should be provided as to whether export cables will be buried.	The export cables will be buried, with external protection utilized where burial depths are not feasible and residual risk remains (see Section 4.3).
		There is no need for anchoring in the areas associated with the Project.	Noted and considered in the assessment of impacts on anchored vessels (see Section 17).

Consultee	Date	Issue(s) Raised	Response to Issue and/or where Addressed in NSRA
		The recently announced Proposed Rule Making by the USCG relates to the ACPARS and should be accounted for in the array layout.	Given the proximity of the Wind Development Area to a deep draft route forming part of the ACPARS fairways, the ACPARS fairways have been incorporated into the post wind facility commercial traffic routing (see Section 6.7.4). It is noted that the array layout was modified prior to the commencement of the NSRA to avoid the placement of offshore structures within the area of overlap between the Wind Development Area and the ACPARS fairways (see Section 6.7.4).
		To the best of the AWO's knowledge there are no conflicts with tug/tow vessels and the Project and tugs would not transit through the array regardless of the WTG size selected and the spacing between WTGs provided.	Push/pull (tug) vessels have been considered within the characterization of the baseline (see Section 6.2.3.4). Push/pull vessels have been considered within the assessment of impacts relating to commercial vessels (see Section 13) and have been deviated around the array as per the methodology for future case commercial traffic routing (see Section 6.7.4).
		The potential impacts to Radio Detection and Ranging (Radar) use should be addressed in the NSRA.	Potential impacts on the use of marine Radar have been considered (see Section 8.9).
Port of Virginia	31 Jul 2020	Engagement with the U.S. Navy, commercial fisheries and Virginia Pilots is critical since these stakeholders will want to know the laydown space required.	The USCG, DoD, commercial fisheries (through the Fisheries Liaison Officer) and Virginia Pilots have been included in stakeholder consultation (see Section 1.2).

Consultee	Date	Issue(s) Raised	Response to Issue and/or where Addressed in NSRA
		The process for the NSRA seems mature and sensible and there are no concerns. The Project presents less conflict than the nearby Dominion lease area due to the location.	N/A
		Ports in the area are witnessing larger vessels with numbers therefore down, although volumes of cargo are up. Also, a large part of the waterfront is coal exports which may decrease over the long-term given recent industry trends.	Two conservative scenarios of potential growth in commercial shipping movements of 10% and 20% have been applied, although the general trend towards fewer movements being made by larger vessels and recent trends in the coal exports industry has been acknowledged (see Section 6.7.1).
VMA	07 Aug 2020	Recommend working with NOAA and the USCG early in developing a plan to chart the cables (even prior to installation) as well as how to protect the cables during installation, prior to cable burial.	The charting of all infrastructure associated with the Project (including cables) on relevant nautical charts and electronic charts in conjunction with NOAA is included as an embedded mitigation measure (see Section 21). The undertaking of a CBRA prior to the commencement of construction and a Cable Installation Plan are also included as embedded mitigation measures and will involve consultation with the USCG (see Section 21).
		The VMA are willing to host a stakeholder meeting in the future to solicit feedback on the Project, including routing, charting, lighting, construction plans etc.	This meeting occurred on 11 Sep 2020 (see Section 3.2). Ongoing engagement with stakeholders is included as an embedded mitigation measure (see Section 21).

Consultee	Date	Issue(s) Raised	Response to Issue and/or where Addressed in NSRA
		As vessels grow larger there has been some decrease in traffic levels for certain vessel types. However, it is preferable to assume conservative increases in vessel traffic levels given the possible future upgrades of ports.	Two conservative scenarios of potential growth in commercial shipping movements of 10% and 20% have been applied, although the general trend towards fewer movements being made by larger vessels has been acknowledged (see Section 6.7.1).
WSC	11 Aug 2020	It should be explained what action will be taken if, as the NSRA progresses, it is determined that there is too much risk associated with the Project.	If a risk is unacceptable then mitigation options are considered to reduce the risk with a cost-benefit analysis applied where required in line with the standard five-step risk assessment applied by the IMO.
		WSC members will stay well clear of the array and not navigate internally within the array.	Noted and has been considered in defining the methodology for future case commercial traffic routing (see Section 6.7.4).
Chamber of Shipping of America	17 Aug 2020	Taking into account the location of the Project, there is sufficient room for vessels to maneuver around the Wind Development Area.	Noted and has been considered in the assessment of deviations and vessel to vessel collision risk (see Section 12).
		The width of the ACPARS fairways is likely greater than what is needed based on vessel activity. The only commercial shipping in the area is on the southern approach to the Port of Virginia but there is sufficient room to pass either landward or seaward of the Wind Development Area.	Noted and has been considered in defining the methodology for future case commercial traffic routing through the ACPARS fairways (see Section 6.7.4).

Consultee	Date	Issue(s) Raised	Response to Issue and/or where Addressed in NSRA
		Recommend that a communication plan is developed during the construction phase to describe how the construction works will occur, e.g., type of vessel transits, relevant ports.	The promulgation of information relating to the Project and activities via Notices to Mariners and other appropriate means is included as an embedded mitigation measure (see Section 21). Also, ongoing engagement with stakeholders is included as an embedded mitigation measure (see Section 21).
		No comments on the baseline data for use as input to the NSRA or the assessment methodology.	N/A
Port of Virginia	02 Sep 2020	In terms of traffic levels for the future case, increases in container vessel activity of 5% and 10% are suggested with this considered a conservative balance.	Two conservative scenarios of potential growth in commercial shipping movements of 10% and 20% have been applied, noting that this incorporates all forms of vessel traffic (not containerships only) (see Section 6.7.1).
VMA	08 Sep 2020	The 10% and 20% traffic growth for the future case are reasonable when considering all vessel types calling on the ports of Virginia (container, bulk, tanker, etc.)	Two conservative scenarios of potential growth in commercial shipping movements of 10% and 20% have been applied, noting that this incorporates all forms of vessel traffic (see Section 6.7.1).
Virginia Pilots Association	09 Sep 2020	Export cables should be charted as soon as possible and be included in Local Notice to Mariners to avoid damage to the cables due to anchoring.	The promulgation of information relating to the Project and activities via Notices to Mariners and other appropriate means is included as an embedded mitigation measure (see Section 21).

Consultee	Date	Issue(s) Raised	Response to Issue and/or where Addressed in NSRA
		The future case traffic growth assumptions (10% and 20%) are difficult to predict but the trend has been for larger vessels (with deeper drafts).	Two conservative scenarios of potential growth in commercial shipping movements of 10% and 20% have been applied, although the general trend towards fewer movements being made by larger vessels has been acknowledged (see Section 6.7.1).
		Information is requested in relation to the base ports for support vessels during construction and operation, and how traffic will be managed.	Various ports in the Chesapeake Bay will be utilized for staging of structure components and construction vessels but the location of operation and maintenance facilities has not yet been determined (see Section 4.5). Marine coordination and the promulgation of information relating to the Project and activities via Notices to Mariners and other appropriate means are included as embedded mitigation measures (see Section 21).
USCG	17 Sep 2020	The ACPARS fairways as shown reflect the USCG's understanding in terms of how they will appear, including the inclusion of safety buffers of the width shown.	N/A
		The NSRA approach and methodology is satisfactory including the size of the study areas and use of multiple datasets including AIS-B. Survey work undertaken in the Wind Development Area during the period of data collection should be considered.	Project survey vessels and third party survey vessel traffic determined to be temporary in nature (e.g., survey vessels) has been removed from the vessel traffic data and explicitly noted (see Section 6.1) to avoid data analysis being incorrectly skewed.

Consultee	Date	Issue(s) Raised	Response to Issue and/or where Addressed in NSRA
		Clarity is requested in relation to the 10% and 20% traffic growth for the future case in terms of whether the models will consider a value between 10% and 20% or if both 10% and 20% scenarios will be modelled.	Two conservative scenarios of potential growth in commercial shipping movements of 10% and 20% have been applied, with each of these independent of each other (see Section 6.7.1).
USCG	17 Sep 2020	The Project will cause interference to High Frequency Radars resulting in a decrease in the accuracy and reliability of wind and surface current data available to the USCG during SAR planning and thus decrease the ability to accurately predict the drift of persons or objects in the marine environment.	Effects on High Frequency Radar are assessed as part of a separate assessment (see Section 7.6 of the COP, Aviation and Radar).
		The effect of the Project on marine Radar, particularly in relation to vessels engaged in fishing activity, should also be considered.	Potential impacts on the use of marine Radar have been considered (see Section 8.9), noting that impacts relating to fishing vessels engaged in fishing activities are assessed as part of the commercial fisheries assessment (see Section 7.2 of the COP, Commercial and Recreational Fishing).
		The spacing between offshore wind structures will significantly degrade the USCG's ability to locate small search objects from the air.	Noted and considered in the assessment of impacts on emergency response capability (see Section 18).

Consultee	Date	Issue(s) Raised	Response to Issue and/or where Addressed in NSRA
		The analysis of historical SAR incidents should consider a larger area than the Wind Development Area alone since SAR cases often involve a search of many square miles.	The Wind Development Area and export cable corridor study areas have been applied to the SAR incident data to ensure that incidents defined outside of the Wind Development Area and export cable corridor but which may have involved some degree of search within said areas are accounted for (see Section 9.1.2).
DoD	25 Sep 2020	AIS on military vessels is often disabled due to concerns about national security but the Wind Development Area is well sited such that active military vessels in proximity can avoid the Wind Development Area. Additionally, most of the military activity in the Wind Development Area is air-related.	Noted and considered in the characterization of military vessel traffic (see Section 6.2.3.2) and the assessment of impacts on military vessels (see Section 14).
		There is a lot of unexploded ordnance (UXO) in the area and the first line of defense with regards to UXO is the USCG.	UXO is considered in Section 5.1.6.
USCG	12 July 2021	Agreed that, following updates to the PDE, vessel traffic data from 2019 can still be used to remain consistent with NVIC 01-19 (USCG, 2019) and avoid any potential reductions in vessel numbers during 2020 associated with COVID.	Noted.

3.2 Regular Operators

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 regular operators within the vicinity of the Wind Development Area. For the purposes of this process, a regular operator was defined as an operator overseeing multiple vessels observed as regularly utilizing the area 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:

- Carnival;
- CMA CGM;
- Crowley Maritime;
- Dowa Line;
- Evergreen Marine;
- Hapag-Lloyd;
- Maersk;
- Mediterranean Shipping;
- Mitsui O.S.K. Lines;
- Royal Caribbean;
- Seaspan;
- Spliethoff; and
- Wilhelmsen.

Additionally, the WSC and AWO agreed to distribute the same information among their respective membership for feedback and the VMA offered to host a meeting in which their members could provide feedback. Participants in this meeting (held 11 Sep 2020) included CV International, Vane Brothers, Hapag-Lloyd, Cape Shipping, and McAllister Towing.

No feedback has been received with regards to the Project to date by the regular operators contacted directly. 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.

4 Project Design Envelope

This section 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 identified impacts have been assessed.

4.1 Project Boundaries

An overview of the location of the Wind Development Area is shown in **Error! Reference source not found.**. The Wind Development Area is located approximately 24 nm (44 km) east of Currituck Beach, North Carolina (NC) and covers an area of 19,441 hectares (57 square nautical miles [nm^2]). Charted water depths within the Wind Development Area range from approximately 14 to 21 fathoms (26 to 38 meters [m]).

A detailed view of the Wind Development Area is presented in Figure 4.2. Bounding coordinates (given in World Geodetic System 1984 Universal Transverse Mercator Zone 18 North [N]) for the Wind Development Area are then provided in Table 4.1, the positions of which are included in Figure 4.2[6].

[6] This is not an exhaustive list of coordinates for the Wind Development Area but rather key coordinates which form an area bounding the Wind Development Area.

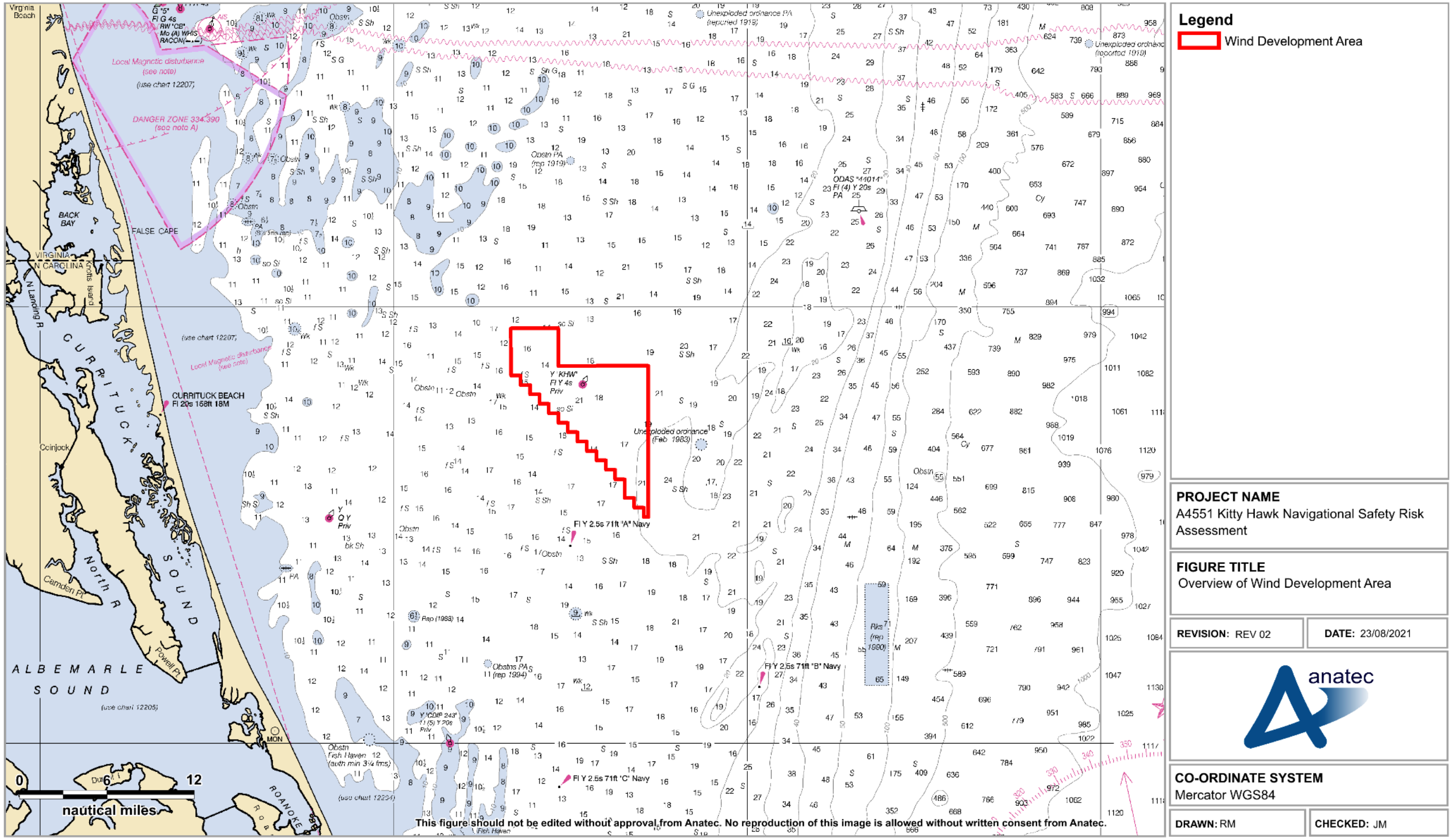

Figure 4.1 Overview of Wind Development Area

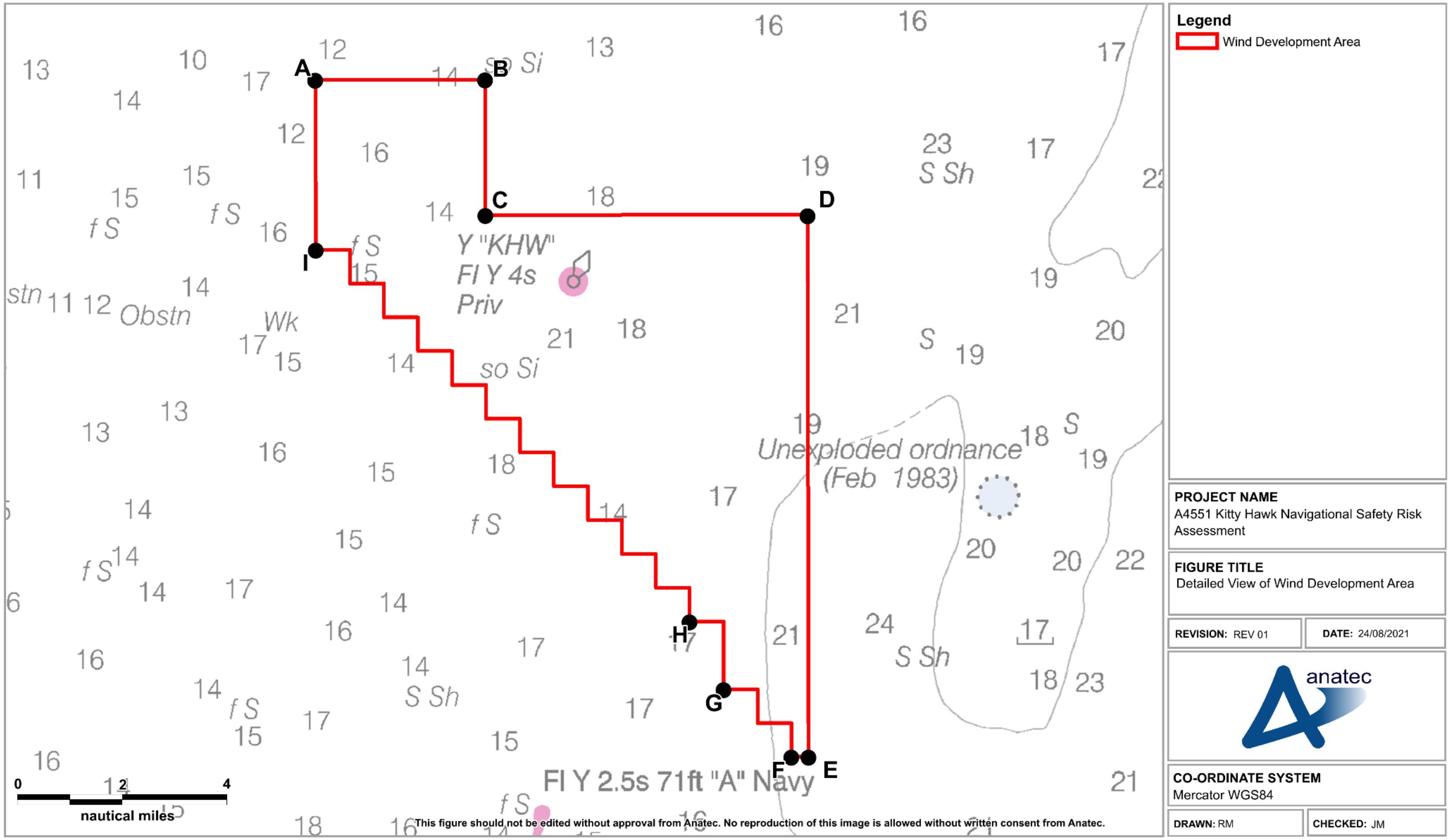

Figure 4.2 Detailed view of Wind Development Area

Table 4.1 Bounding coordinates for the Wind Development Area (World Geodetic System 1984 Universal Transverse Mercator Zone 18N)

Point	Latitude	Longitude
A	36° 28‘ 33.66” N	075° 20’ 05.59” W
B	36° 28‘ 34.27” N	075° 16’ 04.47” W
C	36° 25‘ 58.49” N	075° 16’ 03.94” W
D	36° 25' 58.13” N	075° 08' 26.07” W
E	36° 15' 36.16” N	075° 08' 24.95” W
F	36° 15‘ 36.10” N	075° 08’ 48.99” W
G	36° 16’ 53.86‘’ N	075° 10’ 25.35” W
H	36° 18’ 11.69” N	075° 11’ 13.64” W
I	36° 25’ 18.94” N	075° 20’ 04.75” W

4.2 Array Infrastructure

4.2.1 Array Layout

The final location of offshore wind structures will not be determined until acceptance of the COP; the array layout is influenced by various constraints in addition to shipping and navigation, such as geology, offtake, wind resource, and other environmental and social impacts. For the purposes of this NSRA, an **indicative array layout** considered the maximum design scenario for shipping and navigation has been adapted and is presented in Figure 4.3. Although the final array layout may differ from the indicative array layout, the outcome of the subsequent impact assessment for shipping and navigation is not anticipated to result in any greater impact significance than that concluded in this NSRA.

In particular, no offshore wind structures will be located within the proposed ACPARS fairways, noting that following early consultation the indicative array layout was amended to account for this navigational feature.

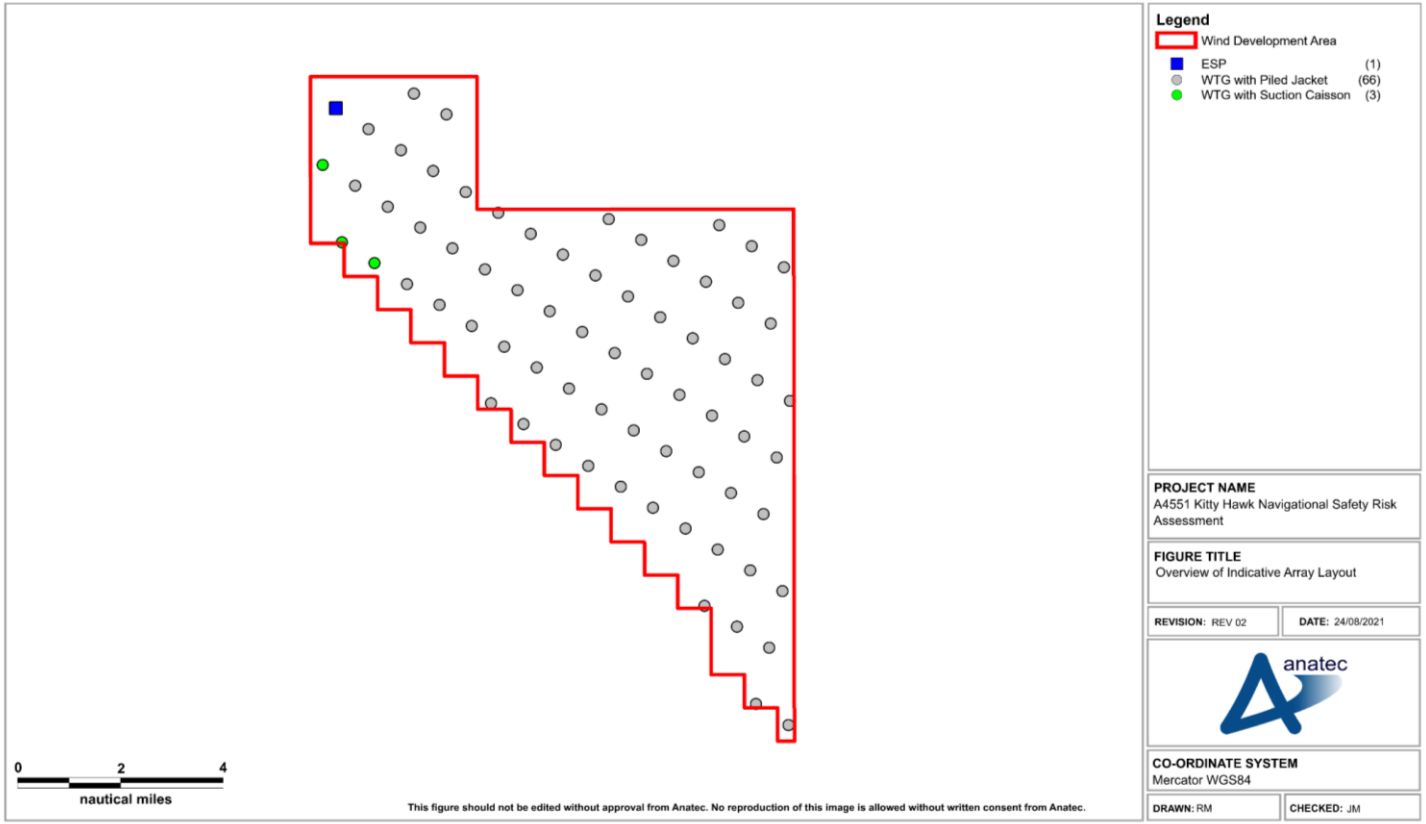

Figure 4.3 Overview of indicative array layout[7]

[7] WTGs with proposed suction caisson foundations have been identified due to the larger sea surface dimensions which has a minor influence on allision risk compared to piled jackets.

The array layout incorporates 70 structures, consisting of 69 WTGs and one Electrical Service Platform (ESP) which, as part of the maximum design scenario, has been placed at the location in the northwest corner of the Wind Development Area where the offshore export cable corridor meets the Wind Development Area. Although the ESP may be placed elsewhere within the final array layout, it is assumed that it will take one of the WTG locations presented in Figure 4.3. The minimum spacing between offshore wind structures is approximately 0.75 nm (1.4 km) center-to-center with this spacing uniform throughout the array layout. The array layout comprises a full build out of the Wind Development Area and includes two main lines of orientation which are consistent across all offshore wind structures:

- At a bearing of approximately 123°/303° with a uniform spacing center-to-center of 0.75 nm (1.4 km); and
- At a bearing of approximately 52°/232° with a uniform spacing center-to-center of 1.15 nm (2.1 km).

The surface buoy platform located within the Wind Development Area will be removed prior to the start of construction (Kitty Hawk Wind, LLC, 2020) (further details in Section 5.1.4).

4.2.2 Specifications

The array layout considered to be the maximum design scenario is the maximum number of offshore wind structures under consideration within the PDE (to maximize vessel deviations and exposure to allision risk).

To further maximize allision risk exposure, the WTG foundation type considered the maximum design scenario is whichever covers the greatest area at the sea surface. From the options available, this was 39×39 m (127 x 127 ft) for the four-legged piled jacket and 52.5×52.5 m (172 x 172 ft) for the four-legged suction caisson jacket at the sea surface, noting that a maximum of three suction caisson jacket structures may be built. Other foundation types under consideration include monopiles, three-legged piled jackets, and three-legged suction caisson jackets. It is noted that floating foundations are not under consideration.

For the ESP, the maximum design scenario is considered the maximum topside dimensions which are 80×50 m (262.5 x 164 ft).

The orientation of the offshore wind structures has been assumed to be at a bearing of 30° from true north, since this is perpendicular to the predominant wind direction and therefore further maximizes exposure to allision risk from NUC vessels.

Table 4.2 and Table 4.3 summarize the key WTG and ESP specifications relevant to shipping and navigation which have been adapted in the maximum design scenario, respectively. Following this, Figure 4.4 presents a diagram showing the various WTG dimensions.

Table 4.2 WTG specifications for shipping and navigation maximum design scenario

Parameter	Specifications by Foundation Type	
	Four-Legged Suction Caisson Jacket	Four-Legged Piled Jacket
Number (including alternative locations)	3	66
External dimensions at Highest Astronomical Tide (HAT)	52.5×52.5 m (172 x 172 ft)	39×39 m (127 x 127 ft)
Foundation orientation (from true north)	30°	30°
Hub height (above Mean Sea Level [MSL])	175 m (574 ft)	175 m (574 ft)
Maximum blade tip height (above Mean Sea Level)	317.5 m (1,042 ft)	317.5 m (1,042 ft)
Minimum blade clearance (above HAT)	27 to 33 m* (88.5 to 108 ft)	27 to 33 m*(88.5 to 108 ft)
Rotor diameter	285 m (935 ft)	285 m (935 ft)

(*) Therefore the minimum WTG blade clearance above MHHW is greater than 89 ft (27 m).

Table 4.3 ESP specifications for shipping and navigation maximum design scenario

Parameter	Specification
Number	1
Topside dimensions	80×50 m (262.5 x 164 ft)
Topside orientation (from true north)	30°

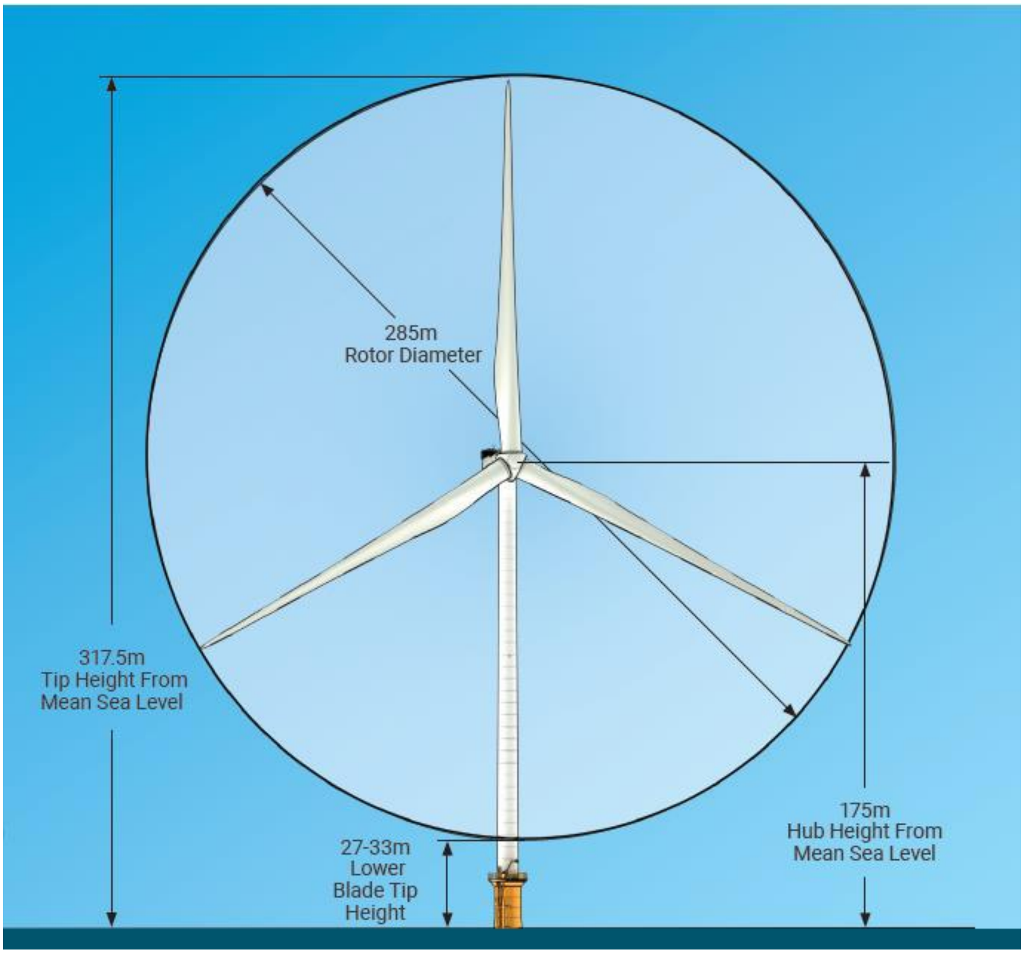

Figure 4.4 Conceptual rendering of maximum WTG dimensions

4.2.3 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 requiring SAR intervention. The contents of the *Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response* (MCA, 2016) (which is referenced by Annex 5 of MGN 654 [MCA, 2021]) 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 and the Company will shut down individual turbine(s) as directed. This is in order to reduce visual distraction, physical collision, and turbulence risk to SAR helicopters and/or rescue boats during SAR operations. The ability for WTGs to be yawed to a more favorable position for SAR operations may also be considered. Further details regarding shut down procedures will be provided in the Safety Management System (SMS) prior to construction. Both the shut down of WTGs and the SMS are included as embedded mitigation measures (see Section 21).

4.3 Submarine Cables

There are two main types of submarine cable which are required to support the Project: inter-array cables and export cables. These cable types are considered in the following subsections.

4.3.1 Inter-Array Cables

The inter-array cables will carry the energy produced by the WTGs to the ESP and will be arranged in a series of cable 'strings' that interconnect a grouping of WTGs to the ESP. The number and precise arrangement of inter-array cables will be dependent on factors such as the final array layout and voltage capacity, with a maximum total length of inter-array cables required of 130 nm (240 km).

The target burial depth will be 1.5 to 2.5 m (5 to 8 ft) below stable seabed, with consideration for additional cable protection where burial depths are not feasible and residual risk remains.

4.3.2 Offshore Export Cables

The offshore export cables will transfer the energy from the ESP to the landfall at Sandbridge Beach in Virginia Beach, Virginia (VA). Two offshore export cables will be installed within an offshore export cable corridor of 1.1 nm (2.0 km) width, as shown in Figure 4.5. The offshore export cable corridor has a total length of 43 nm (80 km).

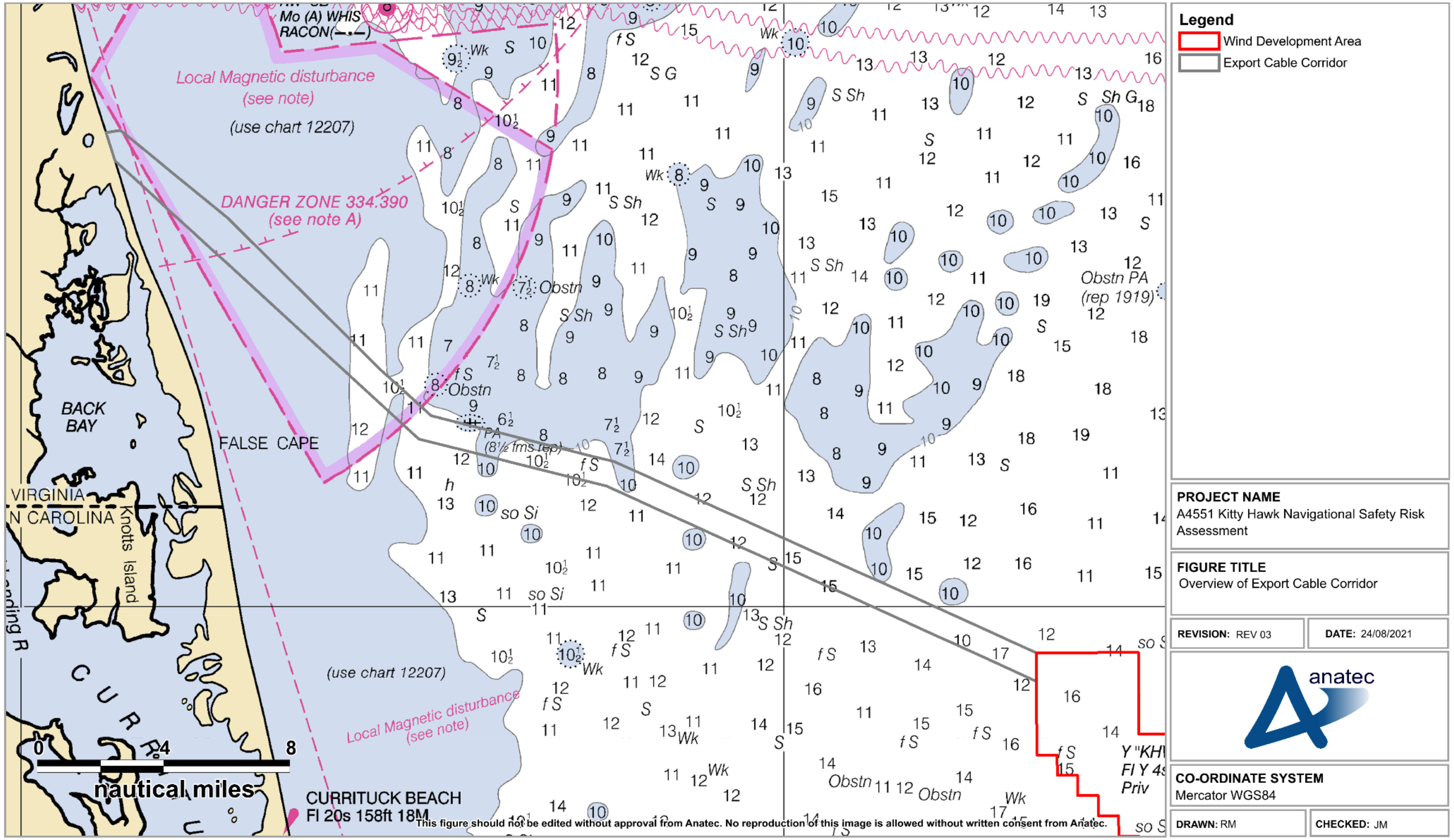

Figure 4.5 Overview of export cable corridor

The precise location of the offshore export cables within the offshore export cable corridor has not yet been determined, but it is anticipated that the two offshore export cables will typically be separated by with the distance dependent on the site-specific conditions (e.g., water depth and seabed constraints).

As per the inter-array cables, the offshore export cables will be buried, with external protection[8] utilized where burial depths are not feasible and residual risk remains. The target burial depth will be determined based on the final CBRA, stakeholder feedback (most notably from the U.S. Army Corps of Engineers [USACE]) and geotechnical conditions but is expected to be approximately 1.5 m to 2.5 m. It is anticipated that external protection[6] will be required for approximately 5 to 8% of the offshore export cable route, pending information received from additional surveys.

4.4 Marine Coordination

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

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

The SMS produced by the Project will define emergency procedures and who in the event of an incident would take the role of managing the response from a Project perspective. In coordination and cooperation with the relevant authorities, they would be responsible for the management and 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

The Project may utilize various ports in the Lower Chesapeake Bay area (i.e., Hampton Roads, VA; Elizabeth River, VA; Cape Charles, VA; and Cape Henry, VA) for staging of structure components and construction vessels during the construction phase. Other ports may be used depending on the development of the U.S. supply chain.

During the operation and maintenance phase, operation and maintenance facilities will be located near existing ports to allow for mobilization of vessels performing operation and maintenance activities. This will be the central location from which marine coordination will

[8] External protection options under consideration include rock armor, rock filled bags, pre-cast concrete block mattresses, concrete and grout filled bags, sand bags, tire filled nets, frond mats, tire mats, rubber mats, bitumen mattresses, and glass fiber reinforced polymer.

be undertaken. The following locations are under consideration for accommodating the operation and maintenance facilities:

- Portsmouth, Virginia;
- Newport News, Virginia;
- Cape Charles, Virginia; and
- Chesapeake, Virginia.

The operation and maintenance support activities will be manned 24 hours a day with personnel equipped with charts indicating the position and unique identification number of each offshore wind structure. This information will also be provided to the USCG along with the contact telephone number for the operation and maintenance support activities.

4.6 Timescales

4.6.1 Construction

An indicative offshore construction schedule for the Project is provided in Table 4.4. 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 noted that onshore construction is anticipated to commence in Q1 2027.

Table 4.4 Indicative offshore construction schedule

Activity	2027				2028				2029			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WTG foundation Installation												
Transition piece installation												
WTG erection												
WTG commission												
ESP foundation installation												
ESP topside												
Offshore export cable installation												
Inter-array cable installation												

4.6.2 Operation and Maintenance

Noting the conditions outlined in Section 4.6.1, the start of operations is anticipated at the end of Q4 2026. The Project is expected to operate up to 35 years after construction is completed. Per 30 CFR § 585.235(a)(3) and Addendum B of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf of Lease Area OCS-A 0508, the operations term of the Project is 25 years, commencing on the date of COP approval. Two years before the end of operations term, the Company may request renewal of its Lease in accordance with 30 CFR §§ 585.425 through 429.

4.7 Maximum Design Scenario

Table 4.5 outlines the maximum design scenario under consideration in the NSRA for the Wind Development Area and offshore export cable corridor in each phase of the Project. The application of a maximum design scenario ensures that any refinement to PDE will not increase the significance of the impacts identified.

It is noted that the USCG has the existing authority to establish safety zones up to 12 nm offshore. 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.

Table 4.5 Overview of shipping and navigation maximum design scenario

Phase	Project Element	Description of Maximum Design Scenario
Construction	Wind Development Area (WTGs, ESP, inter-array cables)	▪ 1.75 years of construction in one continuous phase; ▪ Buoyed construction area around the array location for the full duration of the construction works determined in consultation with the USCG and BOEM; and ▪ Use of flexible, temporary safety zones of 1,640 feet (ft) (500 m) radius.
	Offshore export cable corridor (offshore export cables)	▪ One year of construction in one continuous phase; and ▪ Use of flexible, temporary safety zones of 1,640 ft (500 m) radius for cable lay vessels.
Operation and maintenance	Wind Development Area (WTGs, ESP, inter-array cables)	▪ The Project is expected to operate up to 35 years after construction is completed. Per 30 CFR § 585.235(a)(3) and Addendum B of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf of Lease Area OCS-A 0508, the operations term of the Project is 25 years, commencing on the date of COP approval. Two years before the end of operations term, the Company may request renewal of its Lease in accordance with 30 CFR §§ 585.425 through 429; ▪ Total developable area of up to approximately 48,000 acres (57 nm^2) with array layout as per Figure 4.3; ▪ Up to 66 WTGs with four-legged piled jacket foundations and sea surface dimensions of 39x39 m; ▪ Up to three WTGs with four-legged suction caisson jacket foundations and sea surface dimensions of 52.5×52.5 m; ▪ One ESP with topside dimensions of 80×50 m located internally within the array; ▪ Minimum spacing center-to-center between structures of 0.75 nm (1.4 km);

Phase	Project Element	Description of Maximum Design Scenario
		▪ All structures oriented at a bearing of 30° from true north; ▪ Up to approximately 130 nm (241 km) of inter-array cabling with a targeted burial depth of 1.5 m with additional cable protection where required; and ▪ Use of flexible, temporary safety zones of 1,640 ft (500 m) for vessels undertaking maintenance operations.
	Offshore export cable corridor (offshore export cables)	▪ The Project is expected to operate up to 35 years after construction is completed. Per 30 CFR § 585.235(a)(3) and Addendum B of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf of Lease Area OCS-A 0508, the operations term of the Project is 25 years, commencing on the date of COP approval. Two years before the end of operations term, the Company may request renewal of its Lease in accordance with 30 CFR §§ 585.425 through 429; ▪ Two offshore export cables located within an offshore export cable corridor of width 1.1 nm (2.0 km) and length 43 nm (80 km); ▪ Typical separation between offshore export cables of 100 m; ▪ Targeted burial depth of 1.5 m with additional cable protection where required; and ▪ Use of flexible, temporary safety zones of 1,640 ft (500 m) for vessels undertaking maintenance operations.
Decommissioning	Wind Development Area (WTGs, ESP, inter-array cables)	▪ 1.75 years of decommissioning in one continuous phase; ▪ Buoyed decommissioning area around the array location for the full duration of the decommissioning works determined in consultation with the USCG and BOEM; and ▪ Use of flexible, temporary safety zones of 1,640 ft (500 m) radius.
	Offshore export cable corridor (offshore export cables)	▪ One year of decommissioning in one continuous phase; ▪ Use of flexible, temporary safety zones of 1,640 ft (500 m) for cable lay vessels; and ▪ Cables left in situ but in a manner such that navigational safety is not compromised.

5 Waterway Characteristics

5.1 Navigational Features

This section provides an overview of existing navigational features which have a role in dictating the movement of vessels in the region. It is noted that the ACPARS fairways – which have not yet been implemented and therefore cannot be considered an existing navigational feature – are introduced as part of the characterization of the future case baseline (see Section 6.7.4).

5.1.1 International Maritime Organization Routing Measures

The IMO adopted routing measures within the vicinity of the Wind Development Area are shown in Figure 5.1. The Chesapeake Bay IMO routing measure is located approximately 30 nm north west of the Wind Development Area and was "*established to aid navigation and to prevent collisions"* (NOAA, 2020).

The measure consists 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 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.

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

5.1.2 Pilotage

Figure 5.2 also shows the pilotage area located off Cape Henry which overlaps the precautionary area where the Southern and Eastern Approaches of the Chesapeake Bay IMO routing measure converge. Pilotage is compulsory for all foreign vessels and U.S. vessels under register in the foreign trade, and is "*optional for U.S. 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–Virginia border as shown in Figure 5.3. The full extent of the Regulated Navigation Area, which extends as far north as the Virginia–Maryland border, is shown as an inset in Figure 5.3.

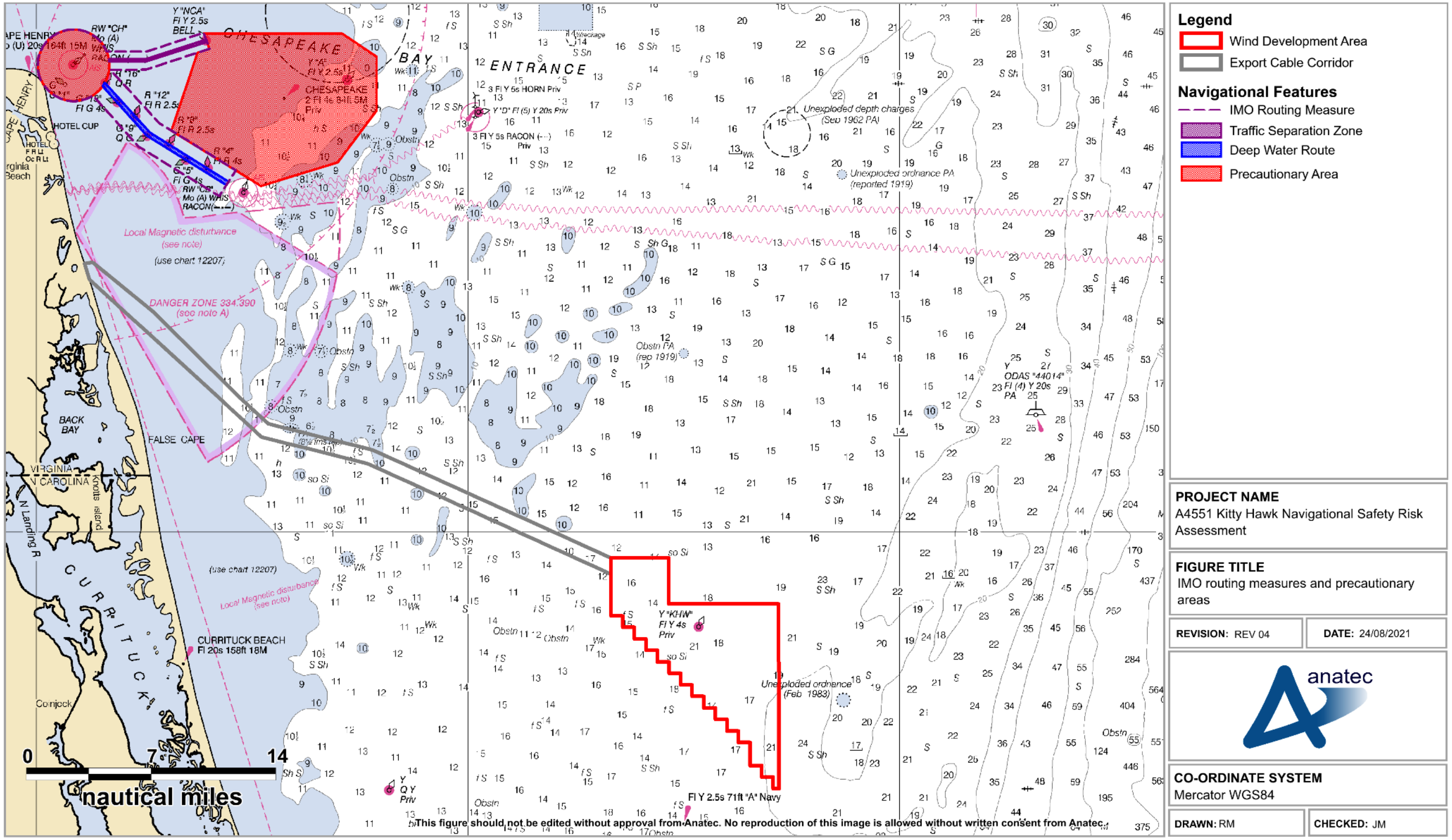

Figure 5.1 IMO routing measures and precautionary area

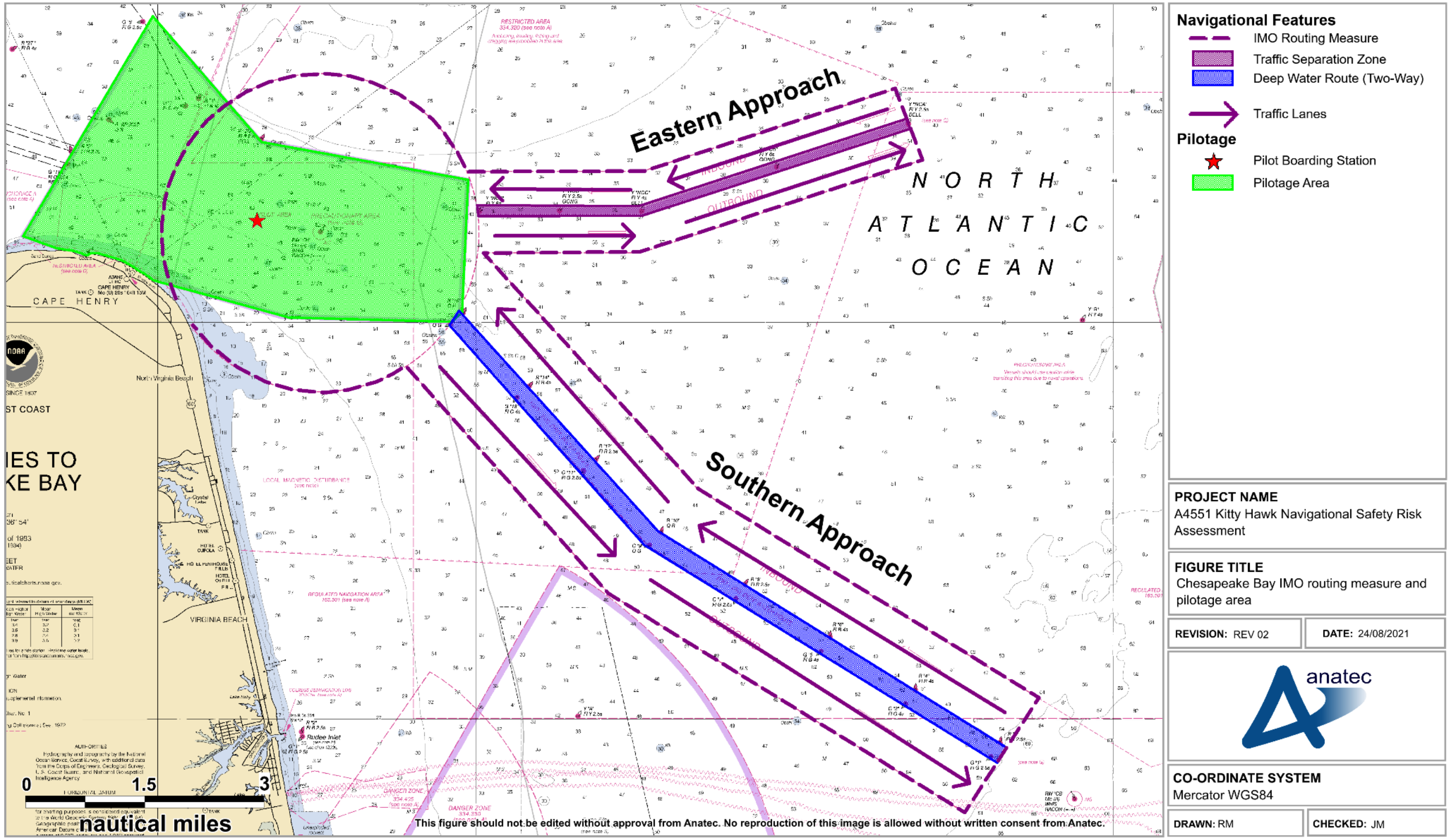

Figure 5.2 Chesapeake Bay IMO routing measure and pilotage area

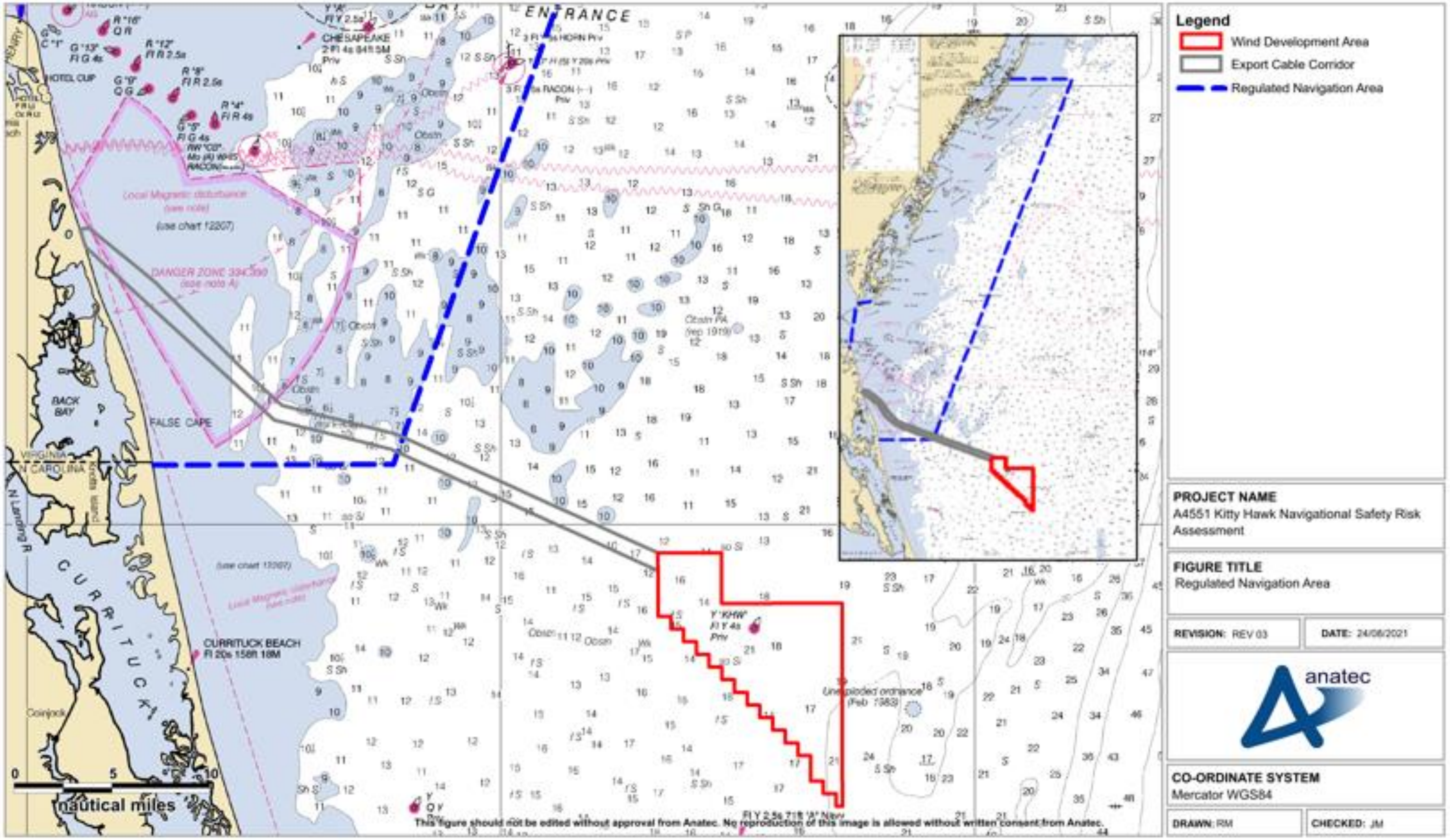

Figure 5.3 Regulated Navigation Area

The Regulated Navigation Area is located approximately 14 nm from the Wind Development Area and intersects the offshore export cable corridor.

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[9], 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 Aids to Navigation

Aids to navigation identified within the vicinity of the Wind Development Area are shown in Figure 5.4. While not strictly classed as an aid to navigation, ODAS Buoy 44014 has been included.

[9] 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.

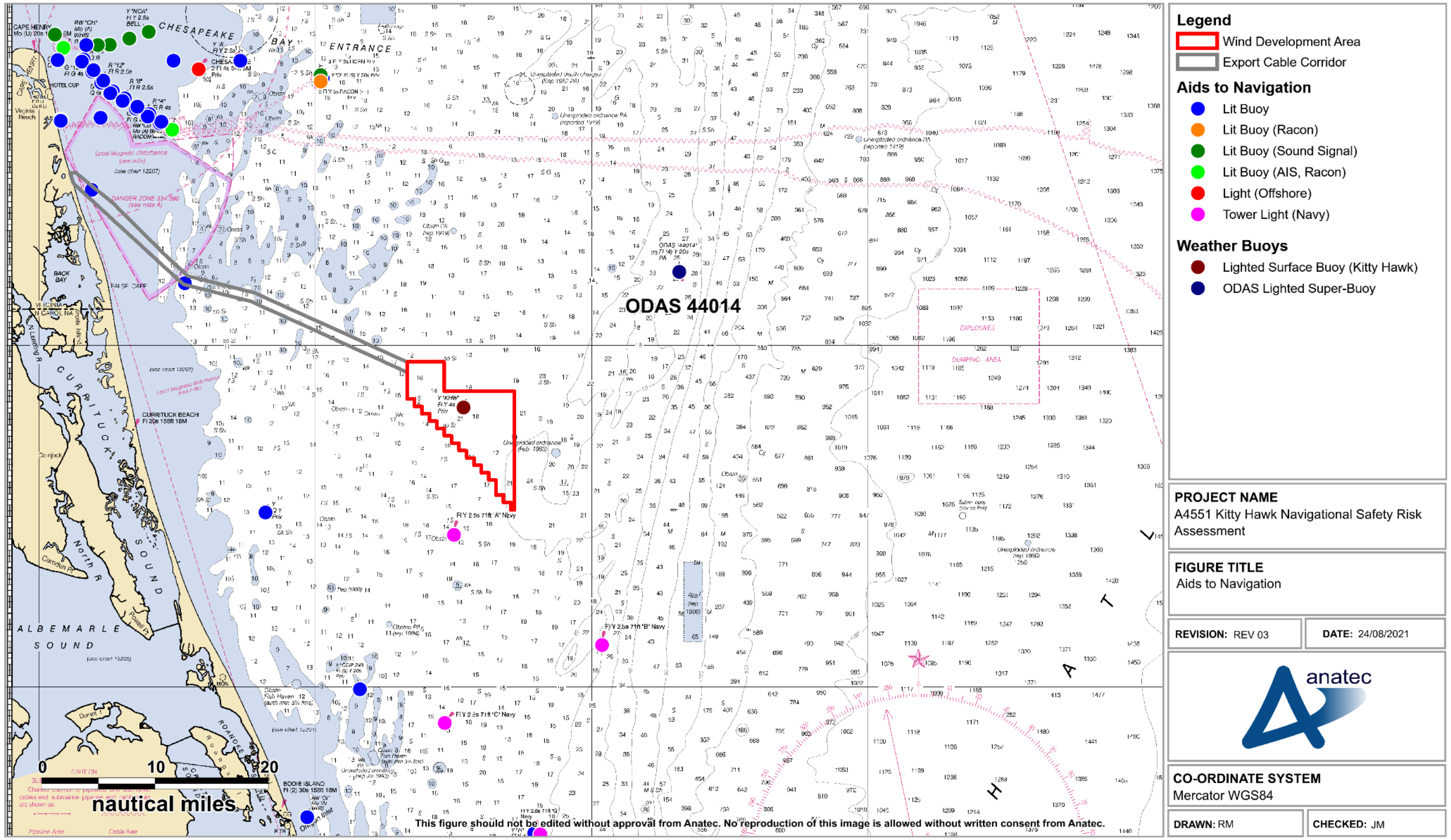

Figure 5.4 Aids to Navigation

The majority of aids to navigation within the region are those marking the Chesapeake Bay IMO routing measure. These include lights, sound signals and other forms of electronic marking such as AIS and Radar Beacon (Racon).

There is a surface buoy platform located within the Wind Development Area. This consists of meteorological equipment which is lit and equipped with an AIS transponder. The buoy was deployed by the Company in June 2020 and is expected to remain deployed through 2021 but is expected to be removed prior to the start of construction (Kitty Hawk Wind, LLC, 2020).

Navy Air Combat Maneuvering Range Tower Light A, located approximately 4.9 nm (9.1 km) south west of the Wind Development Area, is discussed further in Section 5.1.8.

There are two aids to navigation located within the offshore export cable corridor, both of which are lit buoys:

- The Dam Neck Firing Zone Lighted Buoy B (USCG, 2019), noting that "*fixed-mount gunnery operations have not been conducted there [in the firing zone] for over 30 years*" (USACE, 2019); and
- The False Cape Lighted Buoy 4A (USCG, 2019), alerting to shallow waters, noting that "*several spots with depths of 10 to 17 feet are 0.8 to 1.5 miles offshore from False Cape*" (NOAA, 2019).

5.1.5 Restricted and Danger Areas

Restricted areas identified in the vicinity of the Wind Development Area are shown in Figure 5.5, including dump sites for dredged material.

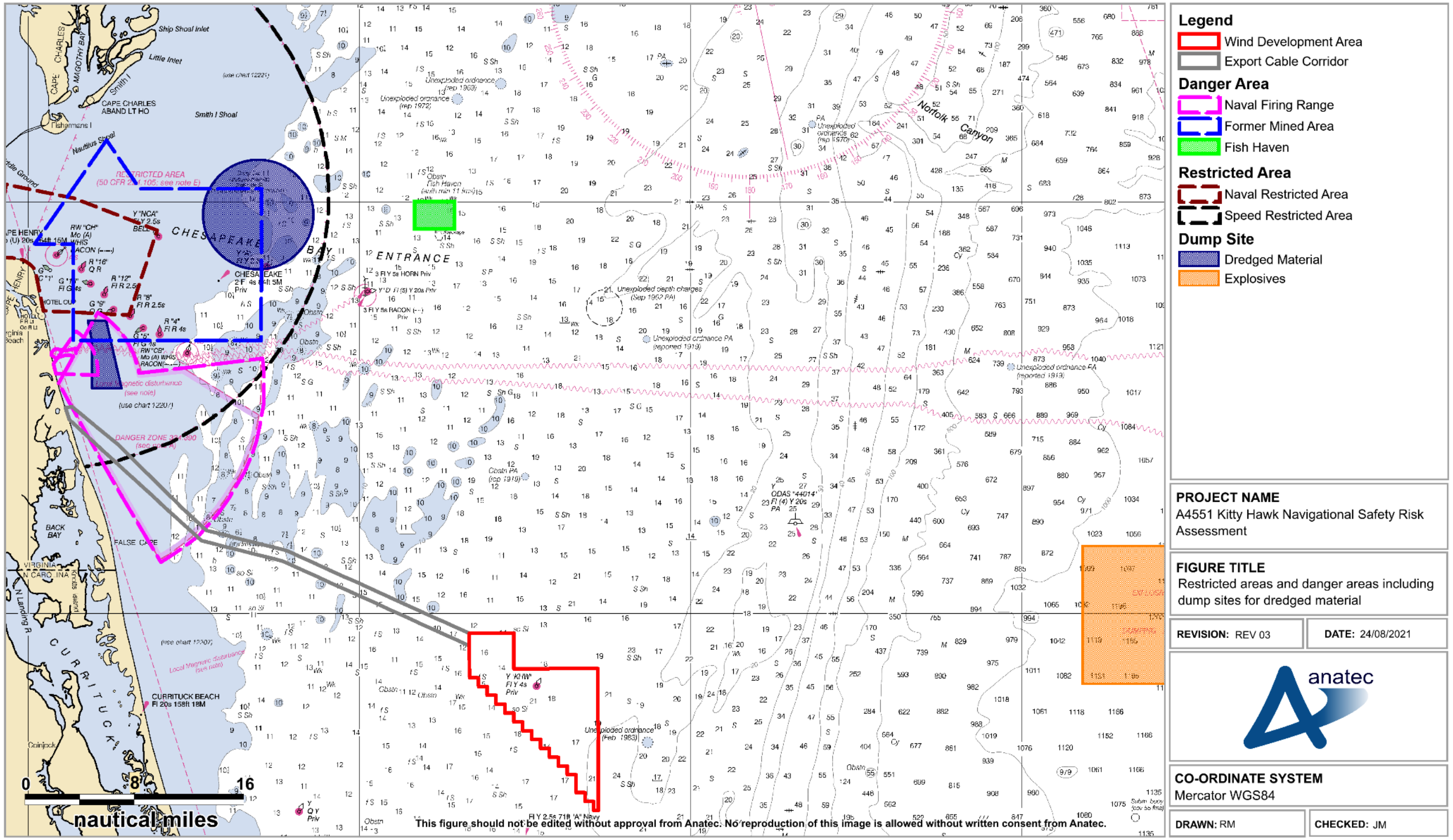

Figure 5.5 Restricted and danger areas including dump sites for dredged material

From 33 CFR § 334.320, "*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.*" The naval restricted area is located approximately 6.9 nm (13 km) north of the closest point of the offshore export cable corridor, and approximately 34 nm (63 km) from the Wind Development Area.

From 50 CFR § 224.105, a seasonal speed restricted area for the protection of North Atlantic right whales is defined by an area of radius 20 nm (37 km) centered 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.*"

Although the former mined area is open to unrestricted surface navigation, 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, anchoring, dredging, trawling and any bottom disturbing activities should be conducted with caution due to the potential of UXO and other munitions and explosives of concern on the bottom[10]. The presence of UXO within the Wind Development Area study area is considered in Section 5.1.6.

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

5.1.6 Unexploded Ordnance

There are a number of charted positions of UXO in the region. These include one such ordnance located approximately 3.4 nm (6.3 km) east of the Wind Development Area, which was reported in 1983 but remains unconfirmed. As confirmed by the DOD during consultation (see Section 3.1), the first line of defense with regards to UXO is the USCG.

5.1.7 Military Areas and Transit Routes

The Wind Development Area lies within the Virginia Capes Operating Area (OPAREA), as shown in Figure 5.6.

The OPAREA is used for various surface, subsurface and air-to-surface military exercises. The submarine transit lanes between the OPAREA boundaries are "*areas where submarines may navigate underwater, including transit corridors designated for submarine travel.*" (NOAA, 2019). It is noted that from consultation with the DOD (see Section 3.1), most of the military activity in the Wind Development Area is air-related.

5.1.8 Existing Surface Infrastructure

The Coastal Virginia Offshore Wind (CVOW) Pilot Project (Lease Area OCS-A 0497) lies approximately 21 nm (39 km) north of the Wind Development Area, as shown in Figure 5.7.

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

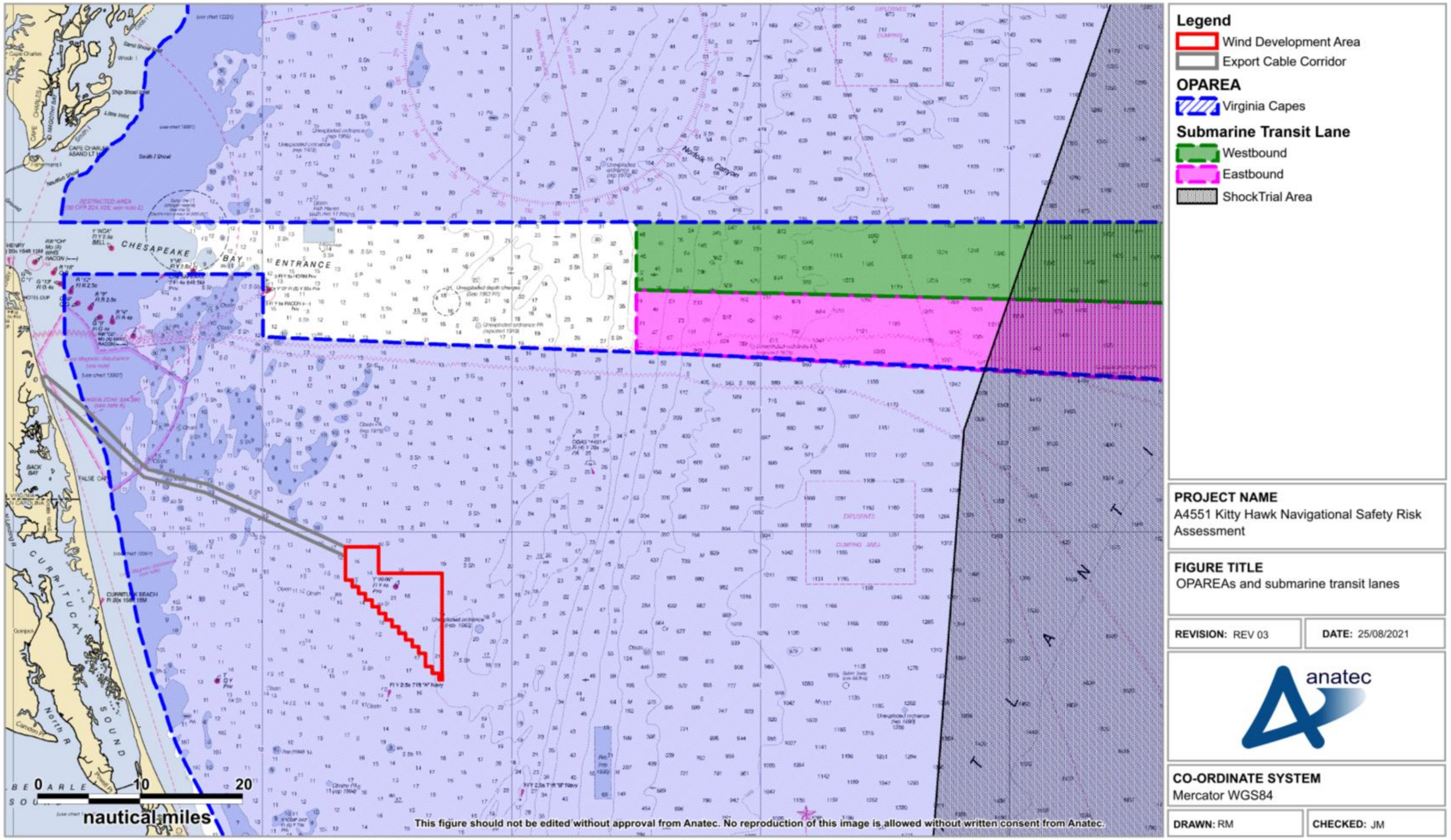

Figure 5.6 OPAREAs and submarine transit lane

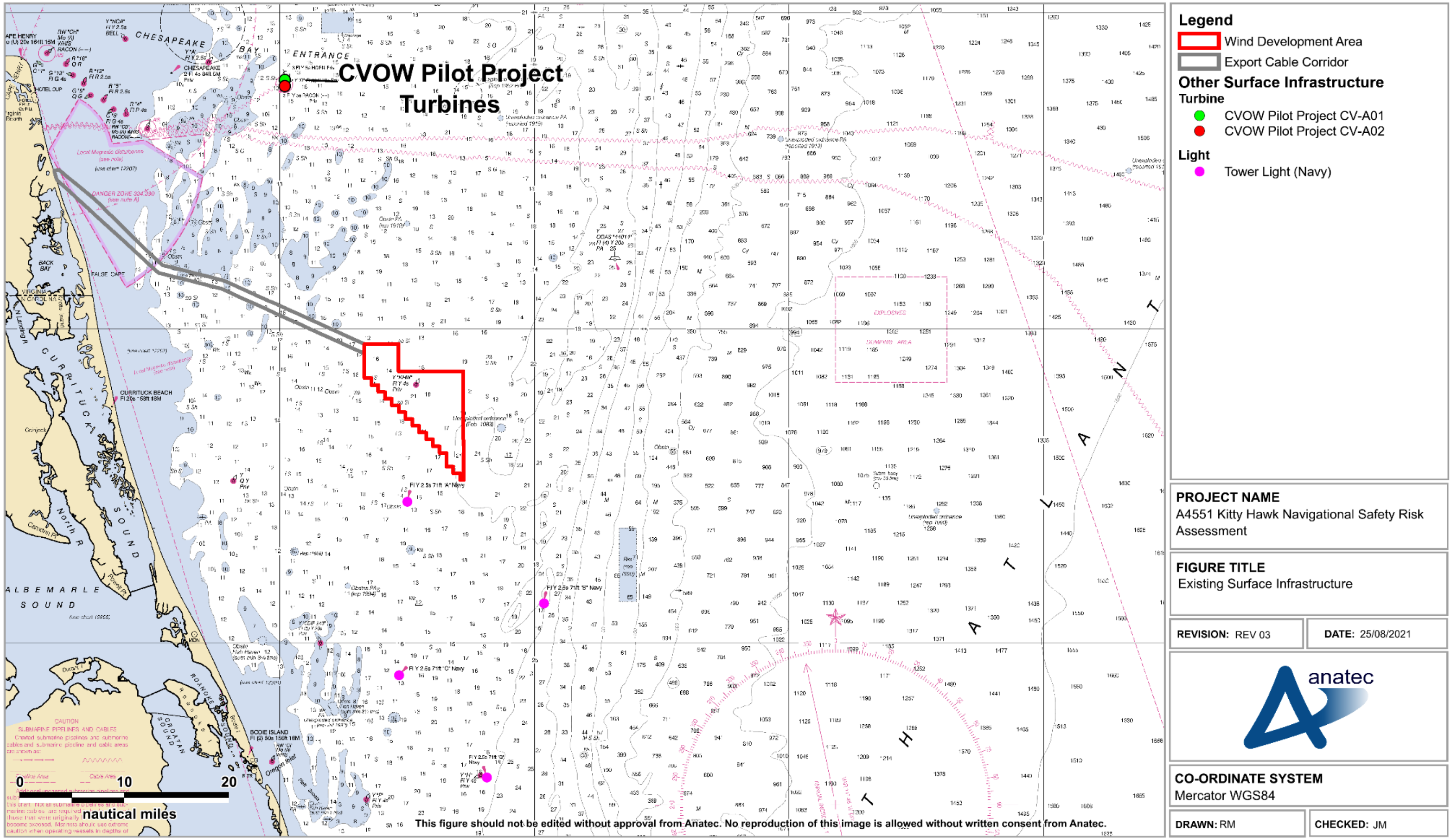

Figure 5.7 Existing surface infrastructure

The CVOW Pilot Project (Lease Area OCS-A 0497) consists of two 6 MW WTGs at the western extent of the CVOW Lease Area (Lease Area OCS-A 0483). These WTGs were installed in summer 2020 and began generating power in fall 2020. For the remainder of the CVOW Lease Area (Lease Area OCS-A 0483), a COP was submitted in December 2020 (see Section 10).

As noted in Section 5.1.4, Navy Air Combat Maneuvering Range Tower Light A is located approximately 4.9 nm (9.1 km) south west of the Wind Development Area. Standing at 71 ft (21.6 m), this tower is maintained by the U.S. Navy. Three similar structures – Navy Air Combat Maneuvering Range Tower Lights B, C and G – are located further south of the Wind Development Area. It is unknown whether these towers will be removed during the lifetime of the Project.

5.1.9 Wrecks and Obstructions

Subsurface wrecks and obstruction data was available from the Office of Coast Survey's AWOIS (NOAA, 2016). NOAA provides both positions of wrecks and obstructions from within the AWOIS records, and also charted wreck positions.

All available data within the Wind Development Area and offshore export cable corridor study areas (based both on the AWOIS and charted wrecks) are shown in Figure 5.8. 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 10 wrecks and four obstructions within the Wind Development Area study area (none of which are within the Wind Development Area itself) and three wrecks and two obstructions within the export cable corridor study area.

5.1.10 Submarine Cables and Pipelines

Submarine cables, including the CVOW Pilot (Lease Area OCS-A 0497) cable alignment and telecom cables constructed after 2016, run east to west approximately 4.1 nm (7.6 km) north of the northern extremity of the export cable corridor. The Wind Development Area is located approximately 18 nm (33 km) south of the cables.

5.1.11 Ports

A selection of U.S. ports relevant to shipping and navigation (regular destinations for vessels broadcasting on AIS) for the Project are presented in Figure 5.9. It is noted that Figure 5.9 does not depict all ports in the region.

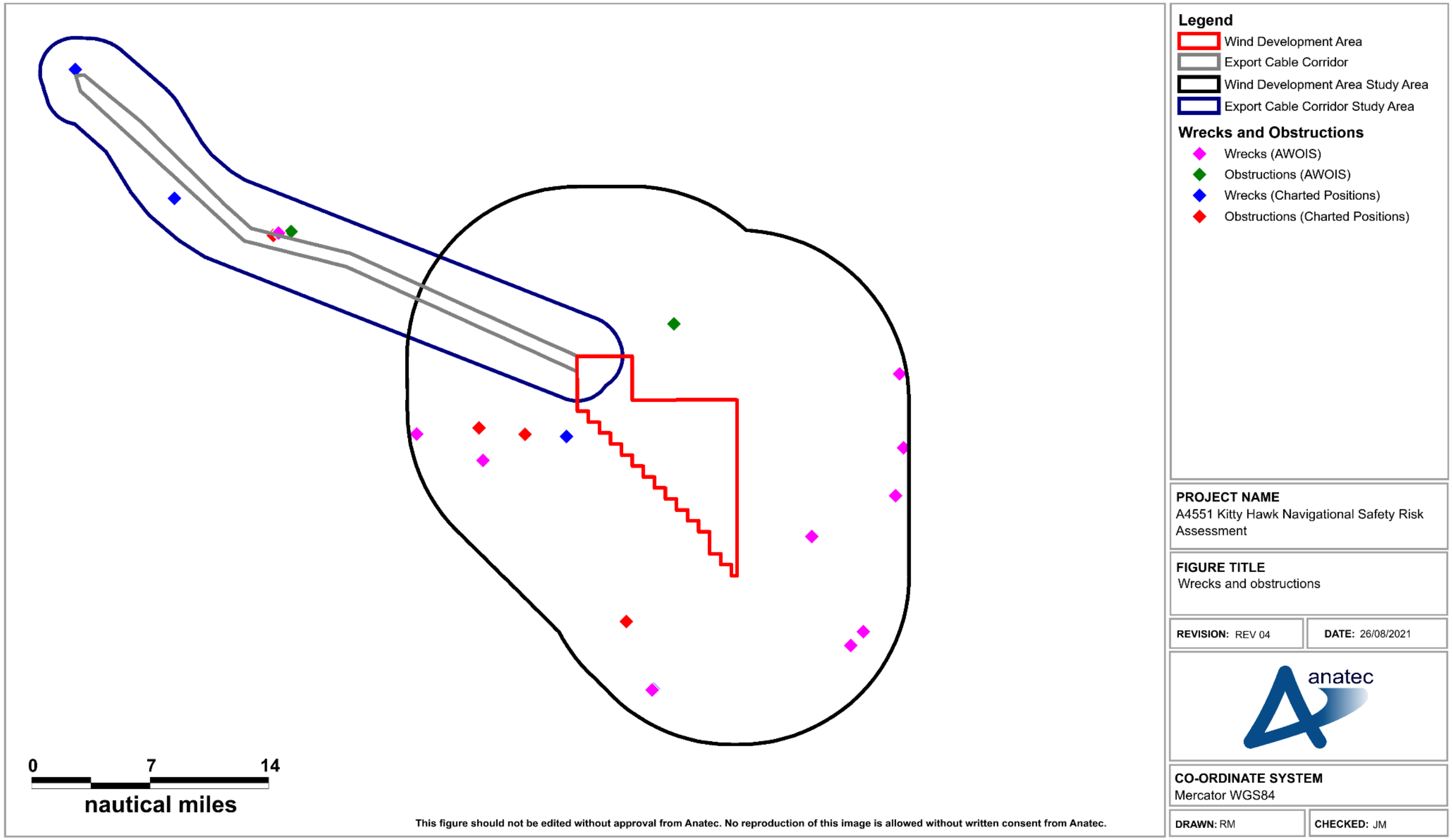

Figure 5.8 Wrecks and obstructions

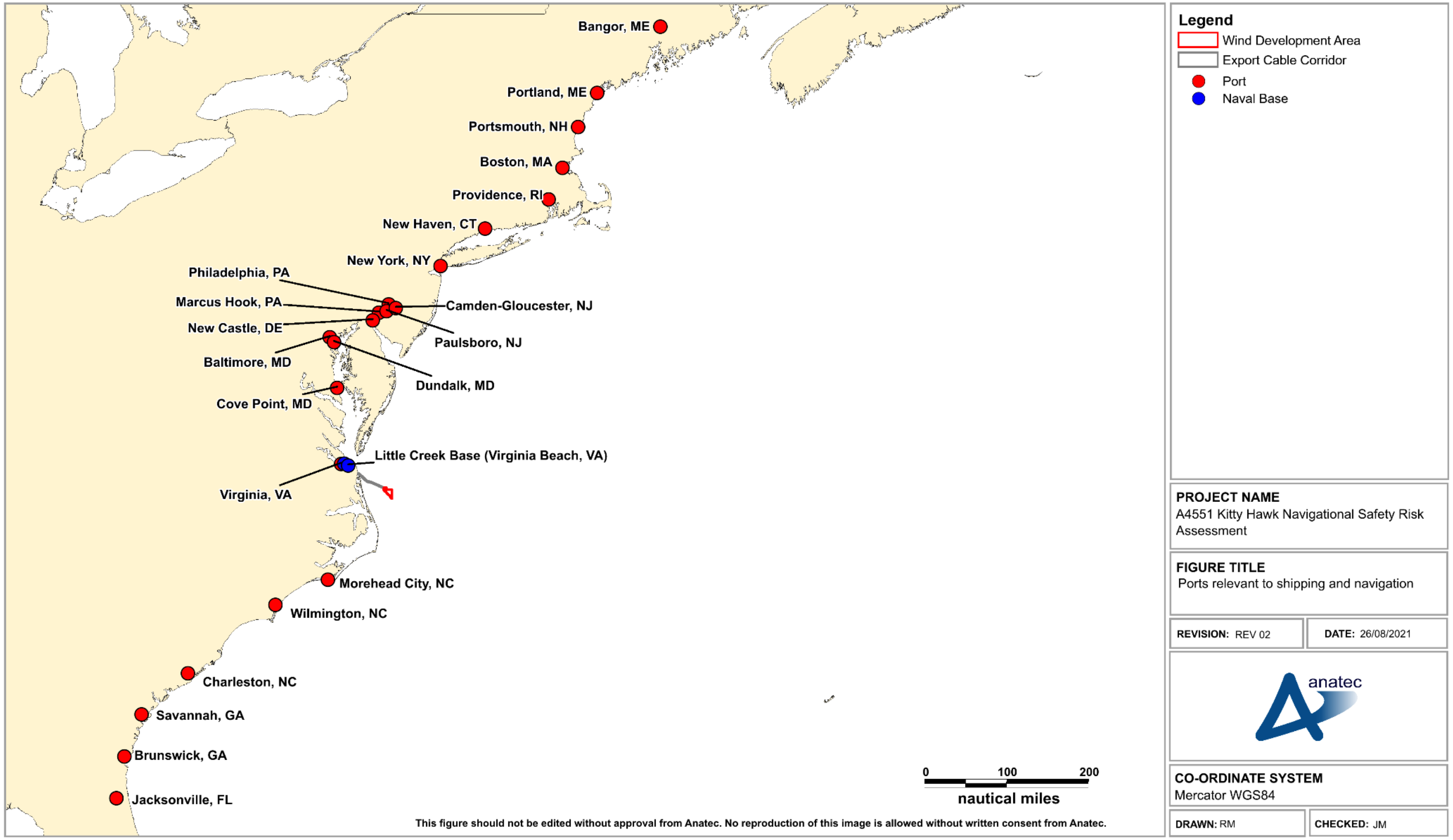

Figure 5.9 Ports relevant to shipping and navigation

Base–Little Creek, the major operating base for the Amphibious Forces in the U.S. Navy's Atlantic Fleet, is located approximately 49 nm (91 km) north west of the Wind Development Area. The closest commercial port relevant to shipping and navigation is Norfolk, VA located approximately 51 nm (94 km) north west of the Wind Development 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, Maryland (MD); Norfolk, VA; Charleston, NC; Savannah, NC and Jacksonville, Florida (FL).

Since the Wind Development Area is located outside the 12 nm (22 km) Territorial Sea limits, it does not fall under the jurisdiction of any port.

5.2 Bathymetry Data

5.2.1 Wind Development Area

The charted water depths within the Wind Development Area are presented in Figure 5.10, 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 5.10 for clarity.

Water depths are shallowest towards the north western extent of the Wind Development Area (approximately 84 ft [26 m]) and increase to the east and south to a maximum of 126 ft (38 m) at the south eastern extent.

5.2.2 Export Cable Corridor

The charted water depths within the offshore export cable corridor are presented in Figure 5.11, based on NOAA charts 12207 and 12208.

Water depths are shallowest in the nearshore area (approximately 4 ft [1.2 m]) and increase in the seaward direction to a maximum of 102 ft (31 m) at the eastern extent where the offshore export cable corridor meets the Wind Development Area.

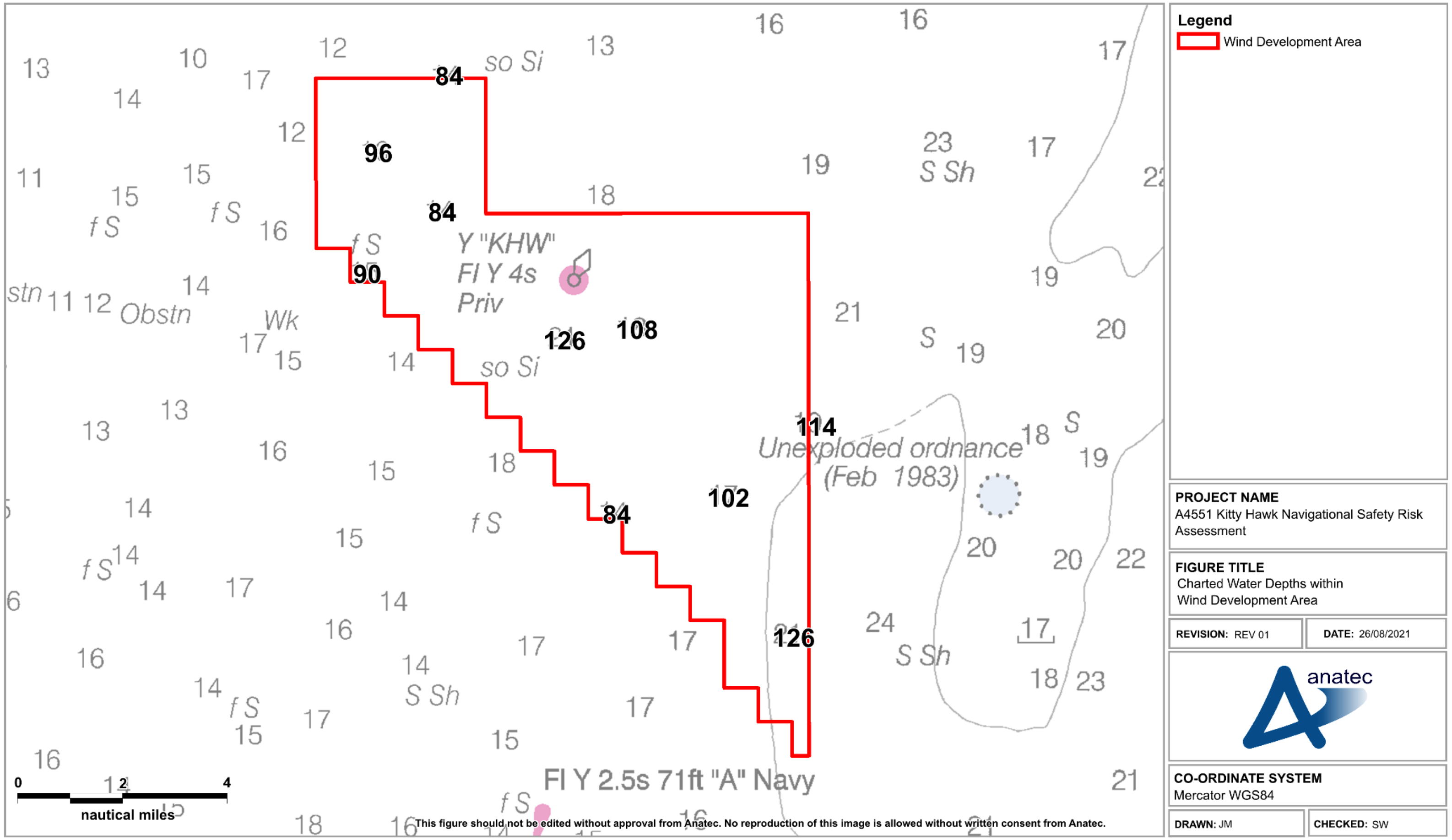

Figure 5.10 Charted water depths within Wind Development Area

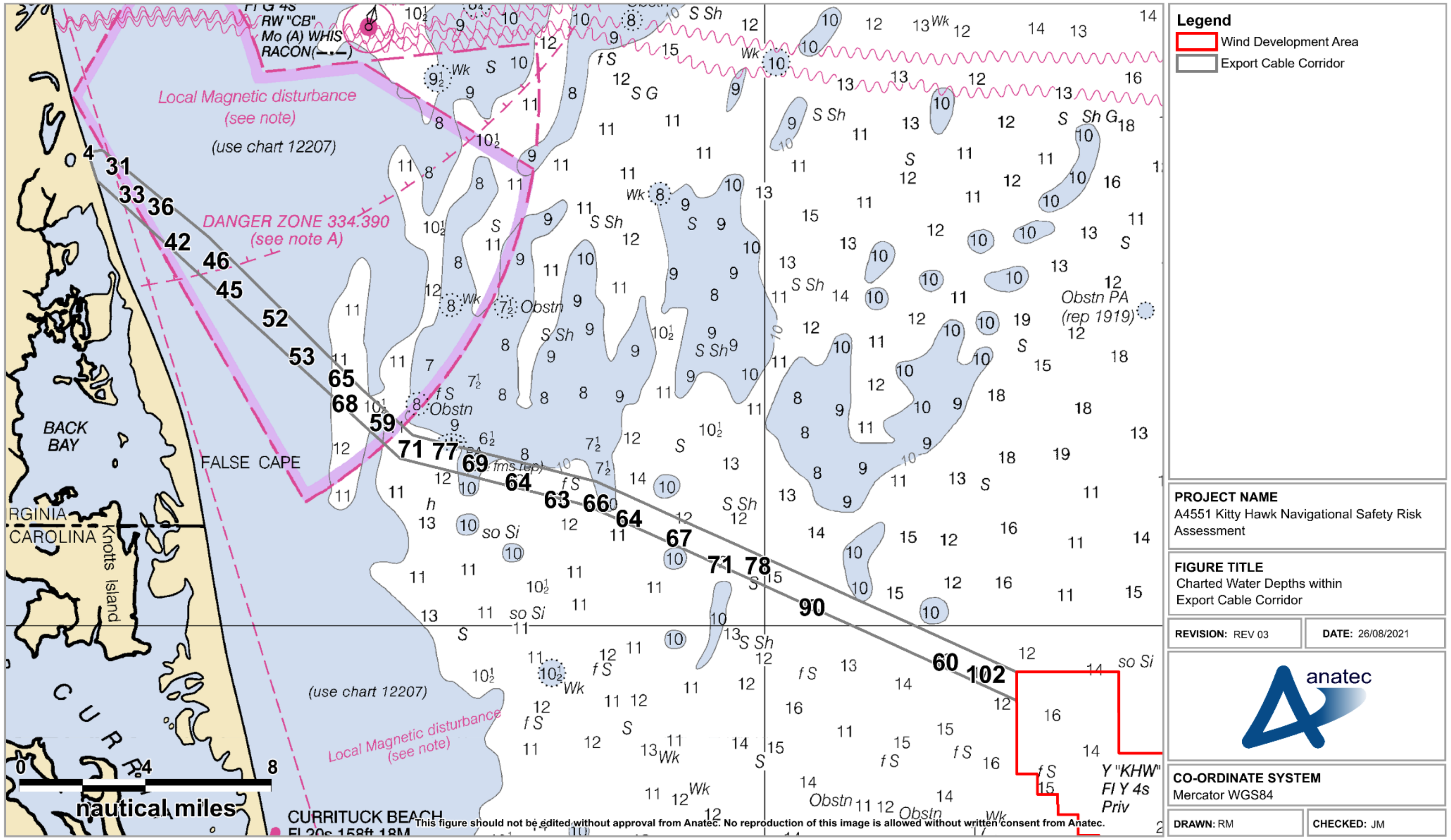

Figure 5.11 Charted water depths within offshore export cable corridor

5.3 Meteorological Ocean Data

This section provides a high-level overview of meteorological and oceanographic statistics for the region incorporating the Wind Development Area and offshore export cable corridor. This data has been used as input to the collision, allision and grounding risk modelling in Section 1 as appropriate.

5.3.1 Wind

Long-term historical wind data provided by the National Center for Environmental Prediction Climate Forecast System Reanalysis atmospheric model over a 40-year period between 1979 and 2019 for a location near the center of the Wind Development Area has been compiled. The resultant all-year wind rose is presented in Figure 5.12, which shows the percentage of observations per 30° sector.

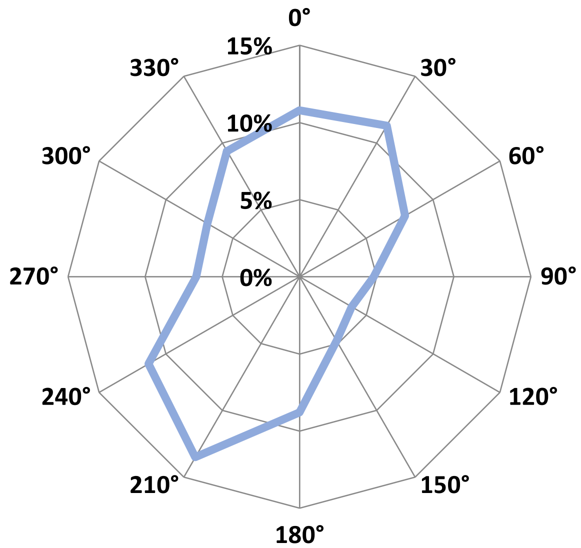

Figure 5.12 All-year wind direction breakdown (National Center for Environmental Prediction, 1979 to 2019)

The predominant wind direction was observed to be south westerly, i.e., from the south west.

For the purposes of data validation, wind direction probabilities were also calculated based on medium-term historical wind data provided by a NDBC ionomer foam buoy over a 10-year period between 2010 and 2019 for a location approximately 18 nm north east of the Wind Development Area. The resultant all-year wind rose is presented in Figure 5.13, noting that erroneous observations have been excluded.

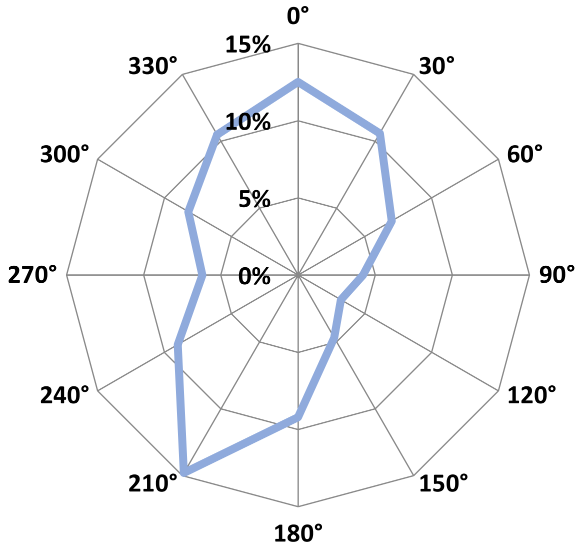

Figure 5.13 All-year wind direction breakdown (NDBC, 2010 to 2019)

Overall, there was considered to be good correlation between the two datasets, with the predominant wind direction south westerly in both cases (with a comparable share of the total observations).

There was also considered to be reasonable correlation between the National Center for Environmental Prediction data and the data published in the *United States Coast Pilot 4* (NOAA, 2019) which indicated that in the majority of months the predominant wind direction was either south westerly or northerly. It is noted that the Coast Pilot data covers a large area and is therefore less reliable on a local scale.

5.3.2 Wave

Long-term historical significant wave height data provided by the ECMWF over a 40-year period between 1979 and 2019 for a location approximately 5 nm (9.3 m) north east of the Wind Development Area has been complied. The resultant all-year sea state breakdown is presented in Table 5.1.

Table 5.1 All-year sea state breakdown (ECMWF, 1979 to 2019)

Significant Wave Height (m)	Sea State	Proportion (%)
<1	Calm	21.8
1 to 5	Moderate	77.8
≥5	Severe	0.4

For the purposes of data validation, sea state probabilities were also calculated based on medium-term historical wind data provided by a waverider buoy over a 10-year period between 2010 and 2019 (NDBC, 2019) for a location approximately 16 nm (30 km) south west of the Wind Development Area. Noting that erroneous observations were excluded, the probability of a calm sea state was 50.9%, a moderate sea state was 49.0% and a severe sea state was 0.1%. This is markedly different from the ECMWF data which suggests a higher probability of a moderate sea state. However, given that the ECMWF data provides a more conservative input and is more local to the Wind Development Area, it is considered suitable for use in the collision, allision, and grounding risk modelling.

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 the visibility can be expected to be less than 1,000 m) is 3%.

It is noted that *United States Coast Pilot 4* (NOAA, 2021) also provides visibility details for the area and indicates that the percentage of visibility being less than 0.5 nm (< 900 m) is less than 3% except for late winter and spring; during March, April and May the probability of visibility being less than 0.5 nm (< 900 m) ranges between approximately 2% to 5%.

Given that the COLLRISK models (see Section 2.1.5) are calibrated against a definition of poor visibility being less than 1,000 m, the 3% value has been utilized, noting that this is considered as aligning with the Coast Pilot values.

5.3.4 Tidal Streams

Tidal speed and direction data provided by an NDBC ionomer foam buoy over a four-year period between 2010 and 2013 and located approximately 18 nm (33 km) north east of the Wind Development Area has been considered. 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 (NDBC, 2010 to 2013)

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

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

5.3.5 Tropical Cyclones

Tropical cyclones are an annual occurrence on the U.S. Atlantic coast, with the area specific to the Project "*subject to strong wind and rough seas from both tropical and extratropical storms*" (NOAA, 2019).

A density grid for tropical cyclone exposure provided by NOAA is presented in Figure 5.14, where the exposure has been quantified using intersecting storm tracks, overlapping wind intensity areas and mathematical return intervals. Following this, Figure 5.15 provides an indication of the density at a more localized level (within 50 nm [93 km]) with suitably defined density ranges.

The Wind Development Area is located in an area with a high exposure to tropical cyclones. However, when considering a localized view the exposure is within the lower bands owing to the sheltered location of the Wind Development Area when compared to areas further offshore. This is aligned with the findings of the Climatic Conditions Report which is provided as Appendix L to the COP.

Tropical cyclone data since 1900 provided by NOAA's *Historical Hurricane Tracks* database (NOAA, 2021) and plotted using data provided by the Multipurpose Marine Cadastre is presented in Figure 5.16 within a 50 nm (93 km) area around the Wind Development Area. The tracks are based upon six-hourly positions.

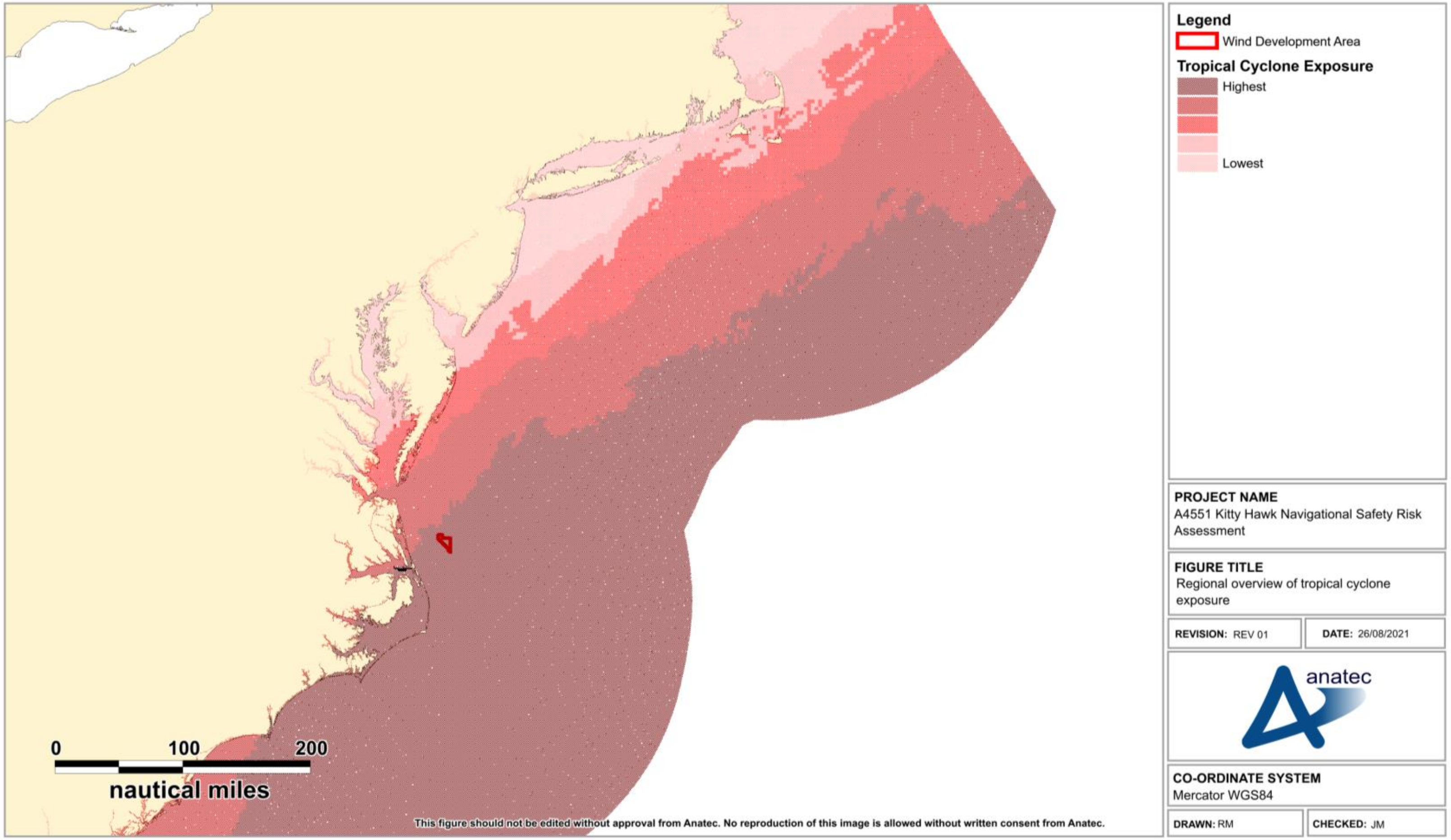

Figure 5.14 Regional overview of tropical cyclone exposure

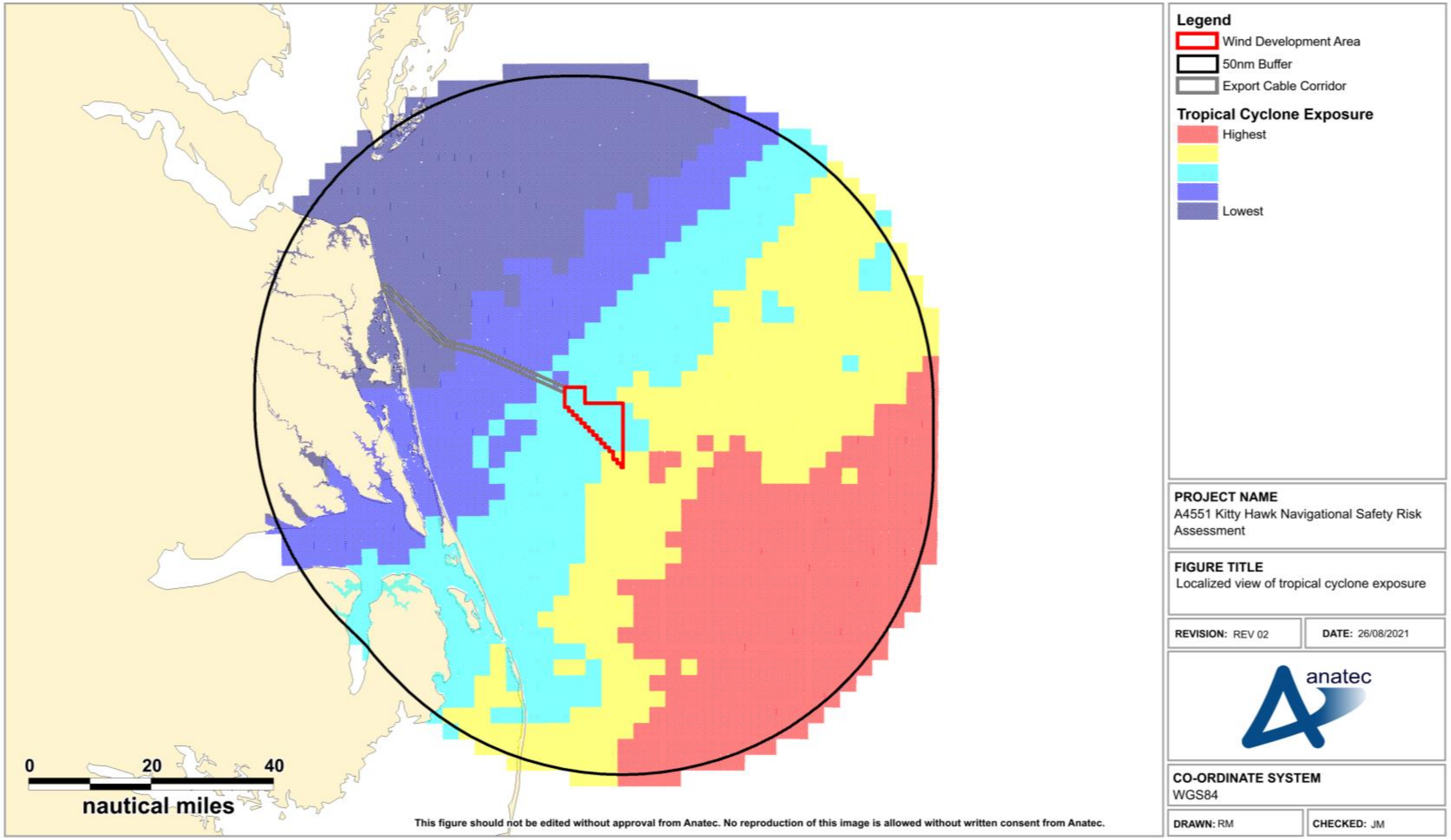

Figure 5.15 Localized view of tropical cyclone exposure

Figure 5.16 NOAA Historical Hurricane Tracks (1900 to 2021) (Geographical Locations from Multipurpose Marine Cadastre)

A total of 10 tropical cyclones (mapped centre) were recorded intersecting the Wind Development Area, breaking down as follows:

- *Hurricane Gloria* (Category 2) in September 1985;
- Eight extratropical storms with the latest in September 2007; and
- One tropical depression in July 1964.

It is noted that no tropical cyclones have been recorded within the Wind Development Area since 2007. 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 Wind Development Area during that time (mapped centre), the likelihood of such an instance is low. In terms of the wider 50 nm area around the Wind Development Area, four Category 3 hurricanes (mapped centre) have passed through, all seaward of the Wind Development Area and with the latest occurring in September 1993, i.e., there have been no major hurricanes within (mapped centre) 50 nm (93 km) of the Wind Development Area in the past 28 years.

Based on the low frequency of tropical cyclones at the Wind Development 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, 2021) relevant to 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, New Jersey (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.*

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 turbine icing.

5.3.6.1 Air Temperature

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 5.17.

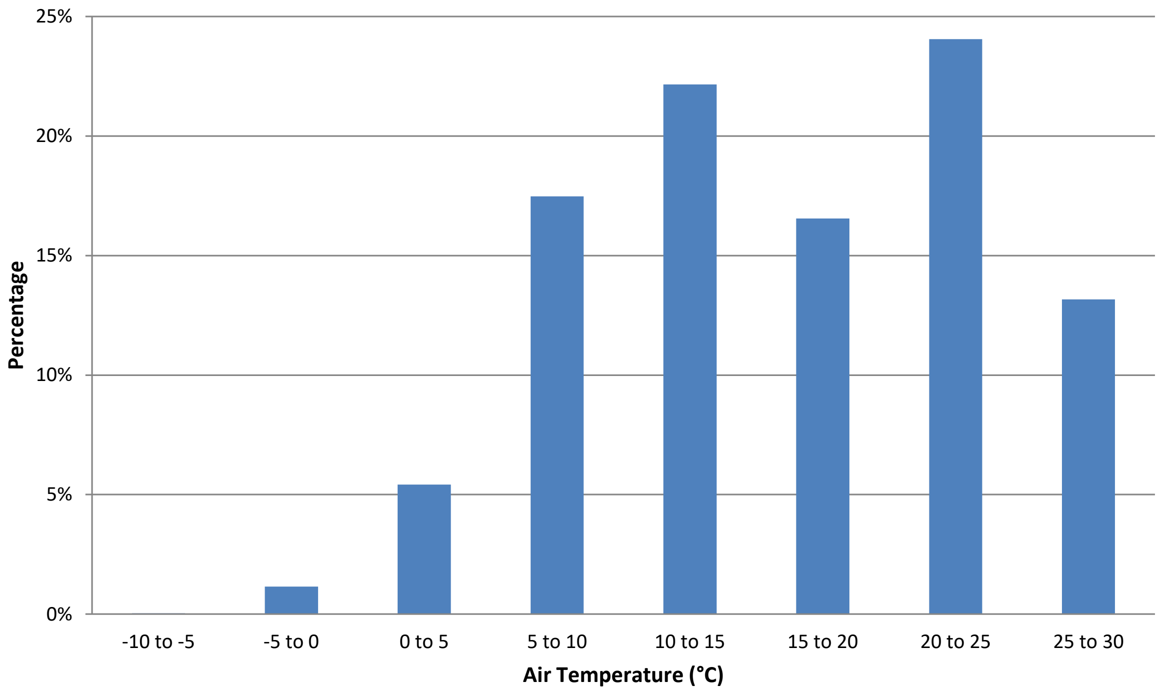

Figure 5.17 Air temperature distribution (ODAS Buoy 44014, 2000 to 2019)

The average air temperature during the 20-year period is 16.1°C, i.e., well above conditions which could give rise to turbine icing. The air temperature fell below 0°C approximately 1% of the time during this period.

5.3.6.2 Humidity

The distribution of relative humidity percentage, from ODAS Buoy 44014, based upon data recorded over a 20-year period between 2000 and 2019, is presented in Figure 5.18. These distributions are normalized by temperature above and below 0°C.

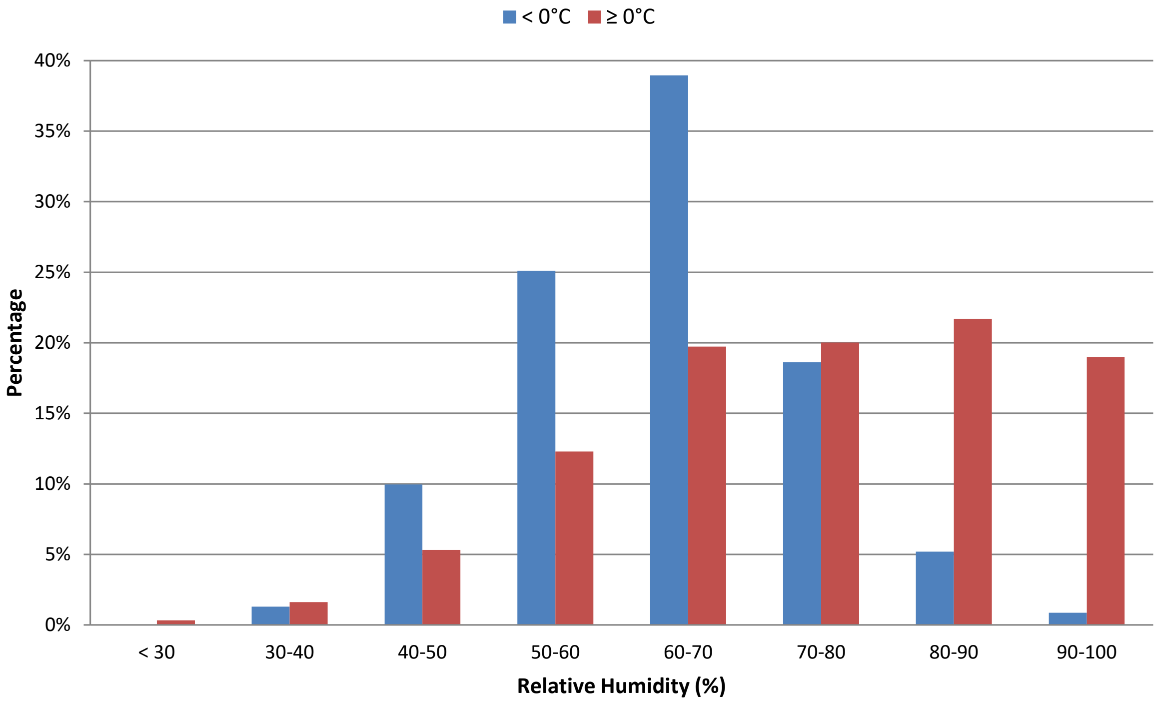

Figure 5.18 Relative humidity percentage (ODAS Buoy 44014, 2000 to 2019)

It can be seen that at temperatures below 0°C, the relative humidity distribution is lower than for temperatures above 0°C. Less than 1% of instances of sub-zero temperatures coincide with a relative humidity above 95%.

5.3.6.3 Wind Speed

The wind speed distribution for the Wind Development Area, from Oceanweather 14945, based upon data recorded over a 40-year period between 1979 and 2018, is presented in Figure 5.19.

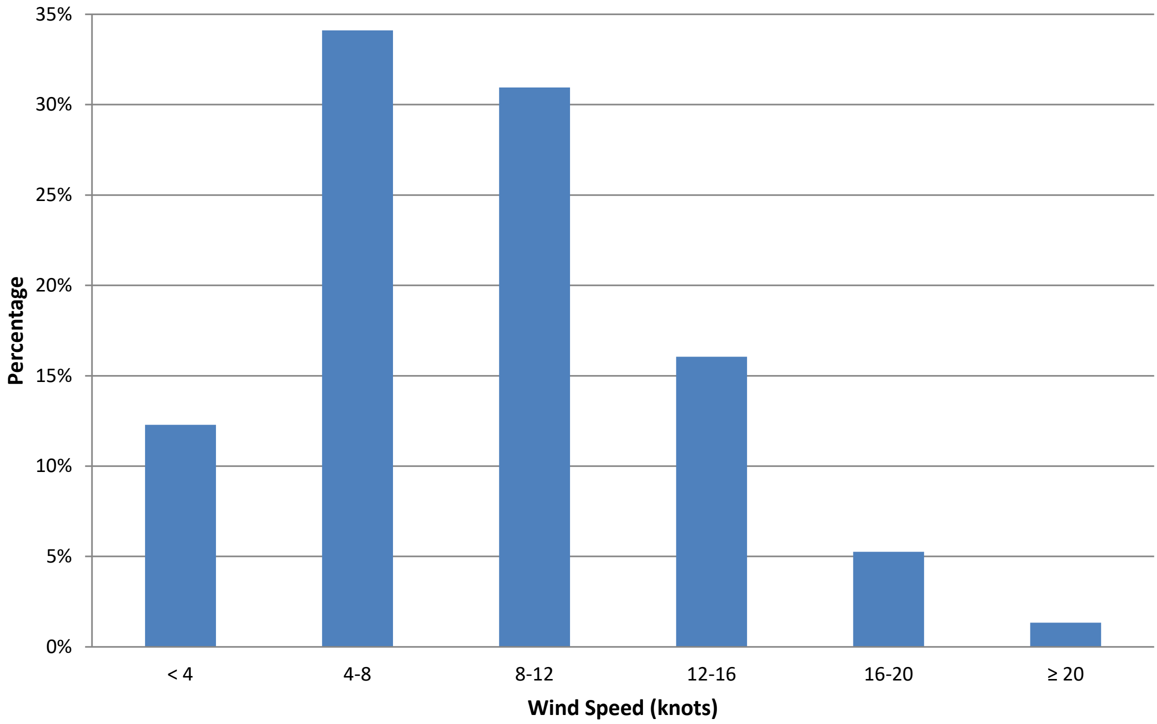

Figure 5.19 Wind speed distribution (Oceanweather 14945, 1979 to 2018)

Although approximately 46% of wind speed recordings were below 8 knots, only approximately 12% were 4 knots or less; in particular, wind speeds of less than 2 knots represented approximately 2% of the distribution.

From the data sets presented and analyzed and model data, the conditions favorable to ice accretion on WTG blades (sub-zero temperatures, fog and/or relative humidity greater than 95%, and wind speeds less than 5 meters per second (m/s)) were found to occur in 18 hourly observations during four individual storm events over the period of records. It is considered unlikely that any appreciable ice accretion actually occurred during these events due to the transitory nature of sub-zero temperatures in the Wind Development Area, as well as the presence of salt air in the marine environment.

Therefore, there is not anticipated to be any significant impacts on shipping and navigation relating to ice, both in terms of sea ice and ice throw from WTGs.

6 Maritime Traffic and Vessel Characteristics

6.1 AIS Overview

Two primary AIS vessel traffic datasets have been used to characterize vessel traffic movements within and in proximity to the Wind Development Area, as per Section 1.3. These are:

- AIS data recorded via coastal receivers between January and December 2019 (12 months), hereby referred to as the 'survey period'; and
- AIS data recorded via satellite receivers during the survey period.

It is noted that the 12-month dataset predates the global impact on the shipping industry of the COVID-19 pandemic and has been agreed with the USCG as suitable for the purposes of establishing the vessel traffic baseline.

Any recorded data from vessels determined to be engaged in works considered as temporary (e.g., survey work) has been excluded from the data analysis in this section only. This includes the *Gerry Bordelon* (undertaking geophysical surveys for the Project), *Thomas Jefferson* and *Henry B. Bigelow* (both undertaking surveys for NOAA) and *Hugh R. Sharp* (undertaking surveys for the University of Delaware College of Earth, Ocean & Environment). Figure 6.1 presents a plot of such vessel traffic. These tracks have been excluded due to their temporary nature and the potential for them to distort routing patterns. Survey vessels are considered within the subsequent impact assessment.

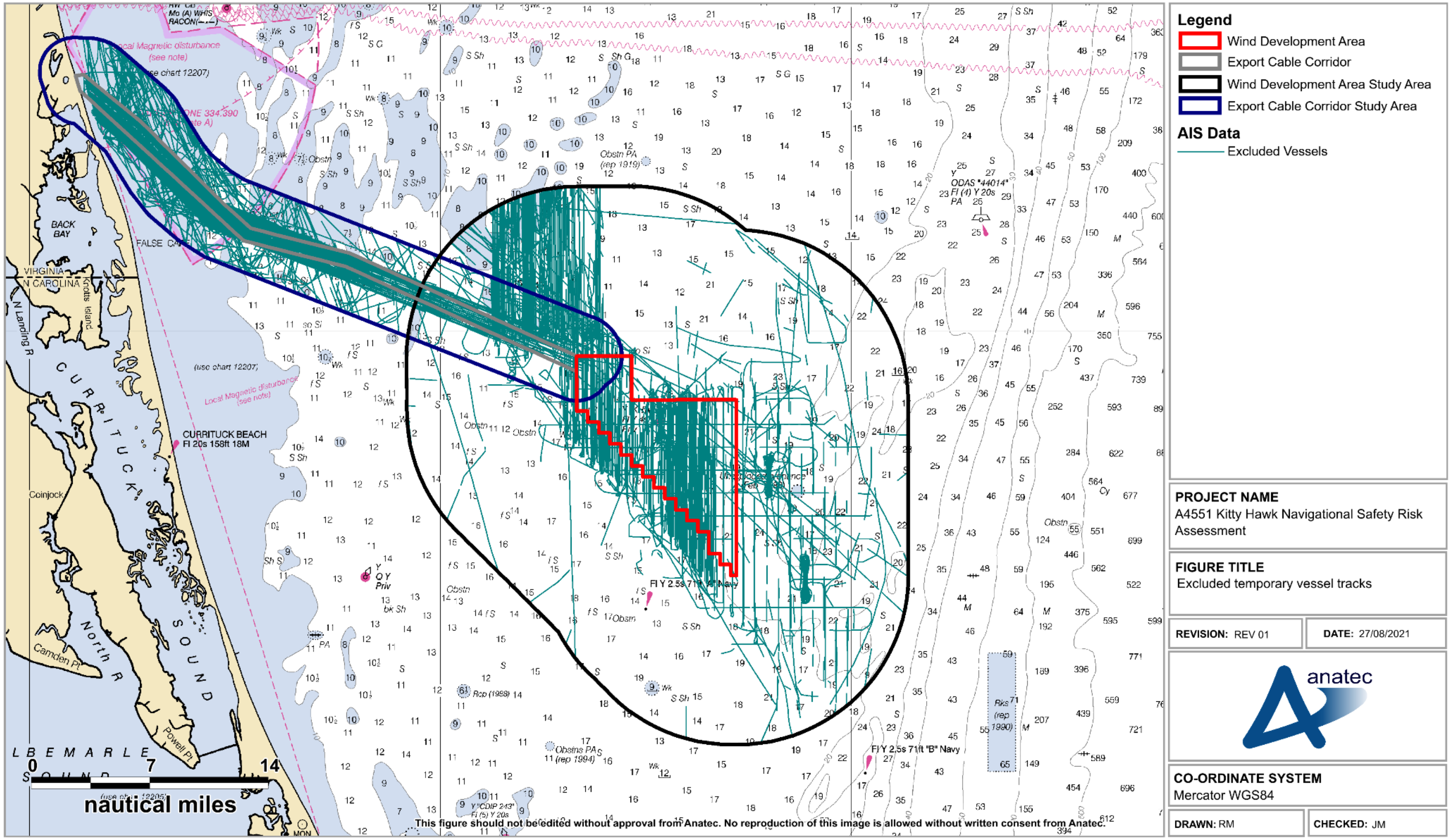

Figure 6.1 Excluded temporary vessel tracks within Wind Development Area study area (12 months January to December 2019)

6.1.1 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* (IMO, 2002), 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;
- Receive automatically such information from similarly fitted vessels; and
- Exchange data with shore-based support activities.

The SOLAS legislation has been translated in the U.S. Flag State legislation by the CFR. It requires that the following vessels shall carry an AIS Class A device:

I. A self-propelled vessel of 65 ft (20 m) or more in length, engaged in commercial service;
II. A towing vessel of 26 ft (8 m) or more in length and more than 600 horsepower, 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; and
    - Do not operate at speeds in excess of 14 knot.
- Vessels identified in regulation IV above engaged in dredging operations.

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

6.1.2 Data Coverage

To ensure that vessel traffic coverage of the study area was as comprehensive as was feasible with the available data, the long-term AIS data collected by both satellite and coastal receivers was compiled for the analysis in this section. It should be considered that the collection frequency of the satellite receivers was less than that of the coastal receivers, but that the range of the coastal receivers was sufficient that degradation of vessel traffic coverage further offshore was limited.

It should be considered that the following factors can also 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.

Broken AIS tracks were observed regularly in the dataset where AIS transmissions were briefly lost; however the effect on overall data coverage is considered limited, noting that vessel counts have been undertaken based on daily unique vessels rather than individual tracks (see Section 6.2.1).

Since 12 months of data has been assessed in this section, any seasonal variations in vessel traffic levels or behaviors are accounted for.

6.1.3 Vessel Dimension Units

The *USCG AIS Encoding Guide* (USCG, 2015) requires vessel dimensions transmitted via AIS to be in meters (rather than feet). However, vessels transmitting their dimensions in feet were observed within the AIS data assessed in this NSRA. Although Anatec has made reasonably practical efforts to ensure that all vessel dimensions have been converted into a consistent unit system (dimensions within this report are presented primarily in feet, with metric units also included for reference in brackets where appropriate), 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.

6.2 Wind Development Area Automatic Identification System Data

Figure 6.2 presents a plot of the vessel tracks recorded on AIS within the Wind Development Area study area throughout the survey period, color-coded by vessel type. Following this, Figure 6.3 presents the corresponding vessel density heat map for the same dataset.

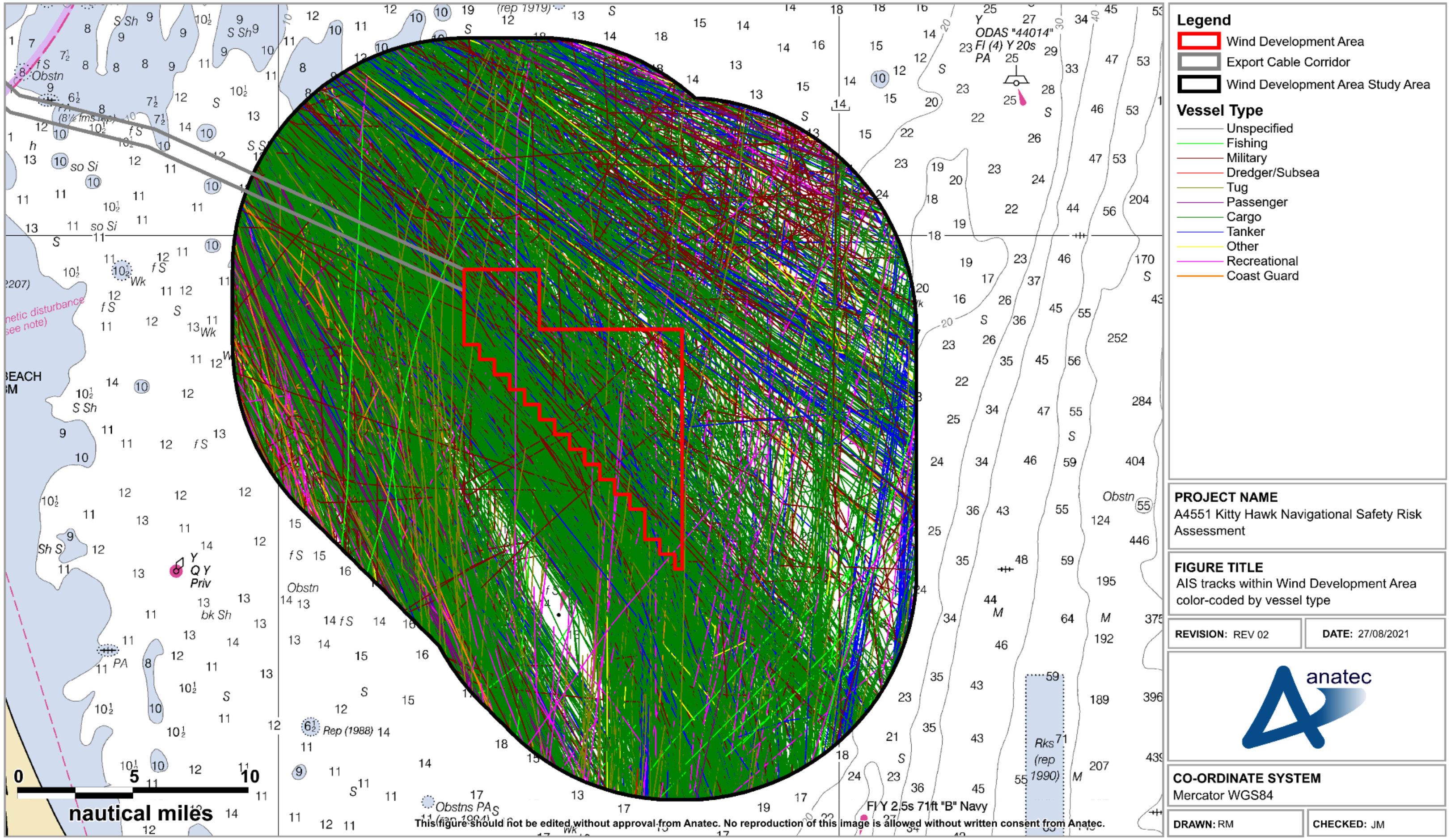

Figure 6.2 AIS tracks within Wind Development Area study area color-coded by vessel type (12 months January to December 2019)

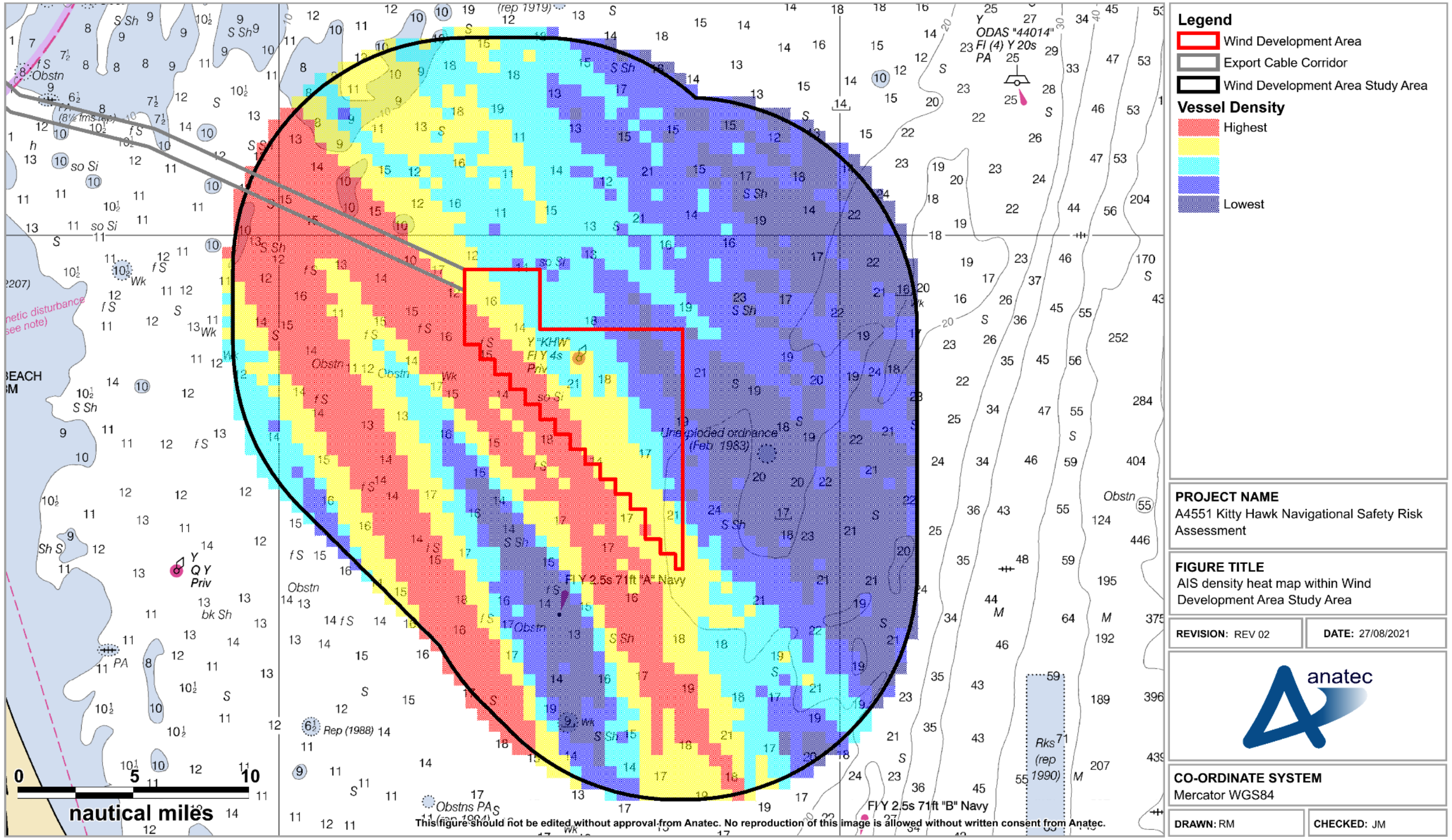

Figure 6.3 AIS density heat map within Wind Development Area study area (12 months January to December 2019)

It can be seen that there are two high density routes in and out of Chesapeake Bay (specifically the Chesapeake Bay IMO routing measure) to the north west of the Wind Development Area study area, with one of these routes intersecting the western periphery of the Wind Development Area. These routes are dominated by commercial vessels (primarily cargo vessels but also tankers and passenger vessels). Further details pertaining to specific vessel types are provided in Section 6.2.3 and a description of the main routes within the Wind Development Area study area is provided in Section 1.1.

6.2.1 Vessel Count

Figure 6.4 presents the sum of the daily unique vessel counts per month within both the Wind Development Area study area and the Wind Development Area itself.

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

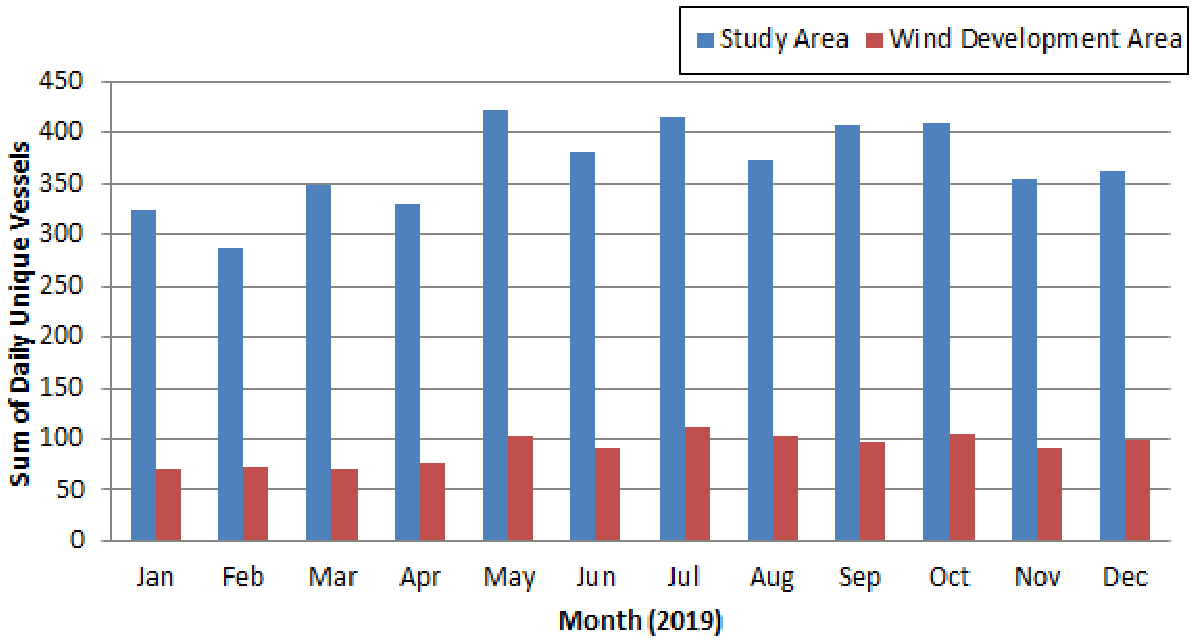

Figure 6.4 Sum of daily unique vessel counts per month

Throughout the survey period an average of approximately 368 unique vessels were recorded per month within the Wind Development Area study area, corresponding to an average of 12 unique vessels per day. The busiest month of 2019 was May, with an average of 14 unique vessels per day, while the busiest individual days were 29 May and 28 July, each with 25 unique vessels recorded. Figure 6.5 presents a plot of the vessel tracks recorded on AIS within the Wind Development Area study area on one of the busiest days – 28 July 2019 – color-coded by vessel type.

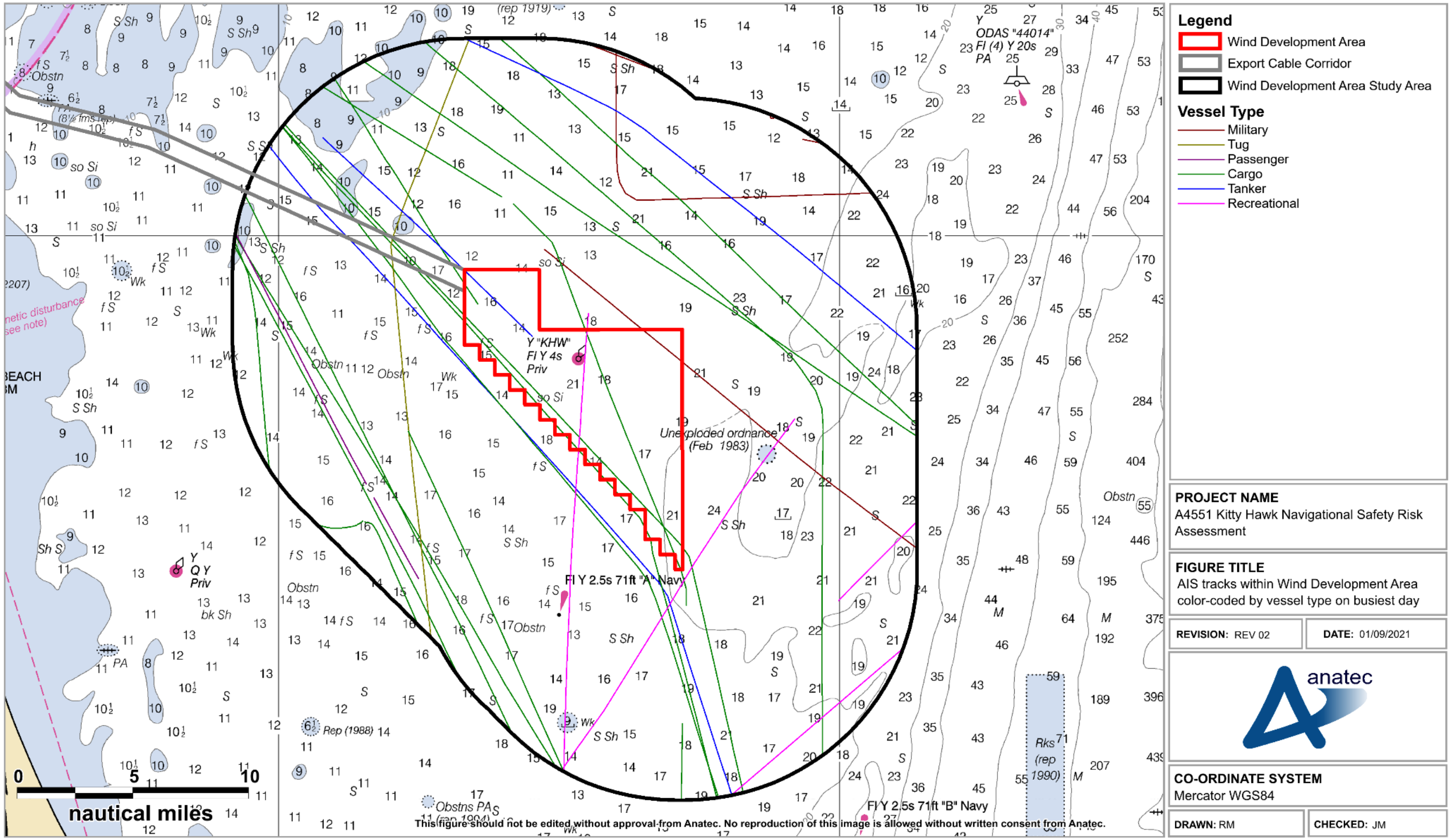

Figure 6.5 AIS tracks within Wind Development Area study area color-coded by vessel type (busiest day, 28 July 2019)

When considering only those vessel tracks intersecting the Wind Development Area, there was an average of 91 unique vessels recorded per month, equating to an average of three unique vessels per day. The busiest month of 2019 was July, with an average of three to four unique vessels per day, while the busiest individual day was 19 May, with 10 unique vessels recorded. Overall, approximately 25% of vessel tracks recorded within the Wind Development Area study area intersected the Wind Development Area itself.

6.2.2 Vessel Size

6.2.2.1 Vessel Length

Figure 6.8 presents a plot of the vessel tracks recorded within the Wind Development Area study area throughout the survey period, color-coded by vessel length. Following this, Figure 6.8 presents the corresponding distribution of vessel lengths. It is noted that less than 0.1% of vessel tracks could not be associated with a valid length and have therefore been excluded from the analysis.

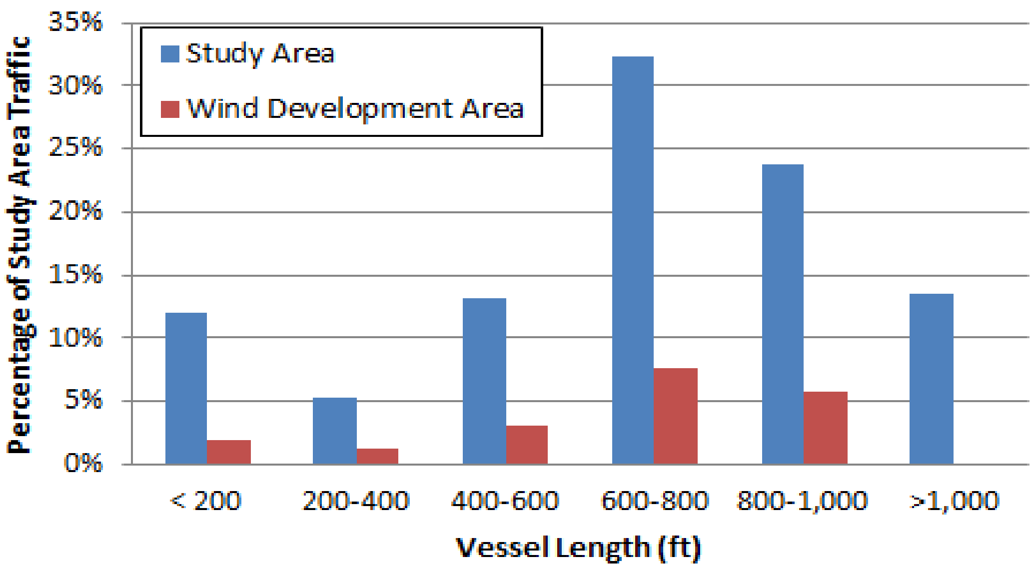

Figure 6.6 Vessel length distribution

Excluding those vessel tracks without a valid length, the average length of vessels recorded within the Wind Development Area study area throughout the survey period was 690 ft (210 m). The majority of vessels were greater than 500 ft (152 m) length, with such vessels primarily transiting cargo vessels.

When considering only those vessel tracks intersecting the Wind Development Area, the average length of vessels was 746 ft (227 m), with the majority of vessels again greater than 500 ft (152 m) length. The increase in the average length may be attributed to the presence of main routes operated by larger commercial traffic which pass through the Wind Development Area, whereas smaller craft (fishing vessels and recreational vessels) were infrequently recorded intersecting the Wind Development Area.

The longest vessels recorded within the Wind Development Area study area were two 1,211 ft (369 m) Neopanamax containerships, travelling between Baltimore, MD and Colón, Panama in a north–south direction. One of these vessels also intersected the Wind Development Area itself.

6.2.2.2 Vessel Draft

Figure 6.7 presents a plot of the vessel tracks recorded within the Wind Development Area study area throughout the survey period, color-coded by vessel draft. It is noted that approximately 8% of vessel tracks did not broadcast a valid draft. Figure 6.9 presents the corresponding distribution of vessel drafts, excluding the tracks which could not be associated with a valid draft.

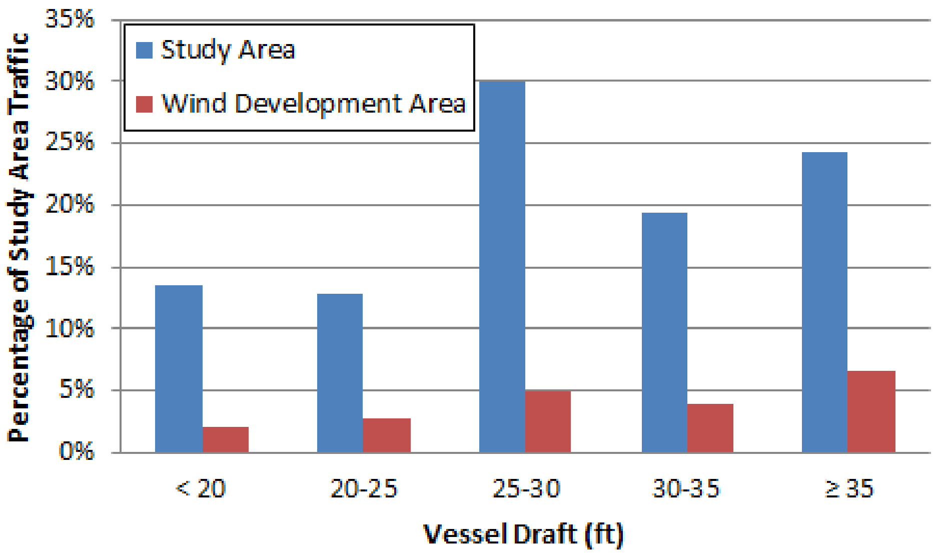

Figure 6.7 Vessel Draft Distribution (12 months January to December 2019)

Excluding those vessels not broadcasting a valid draft (generally smaller vessels), the average draft recorded within the Wind Development Area study area was 29 ft (8.8 m). The deepest draft recorded in the Wind Development Area study area was 50 ft (15 m), recorded by three bulk carriers.

When considering only those vessel tracks intersecting the Wind Development Area, the average draft of vessels was 30 ft (9.2 m). The deepest draft recorded in the Wind Development Area itself was 48 ft (15 m), recorded by a bulk carrier.

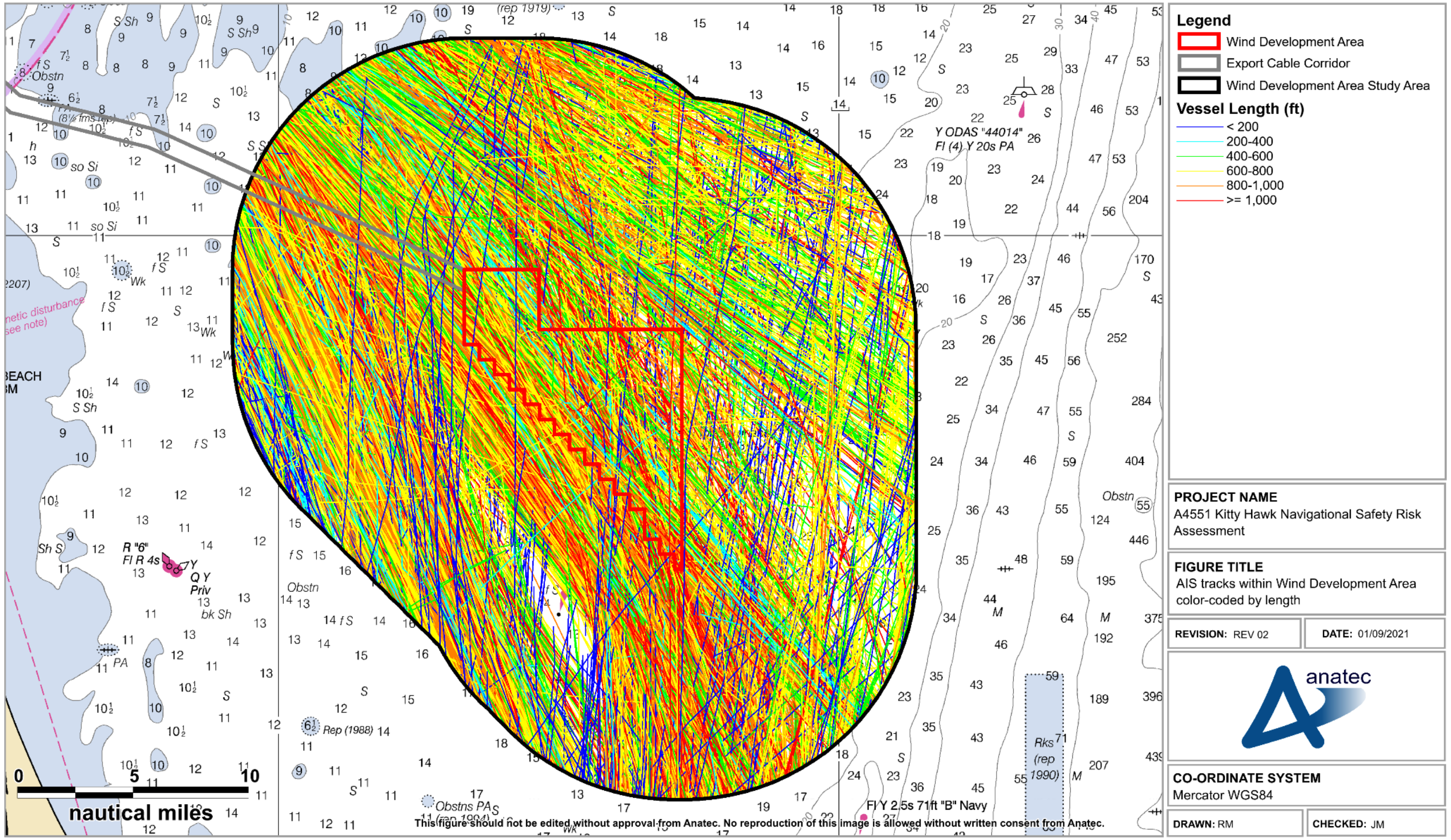

Figure 6.8 AIS tracks within Wind Development Area study area color-coded by length (12 months January to December 2019)

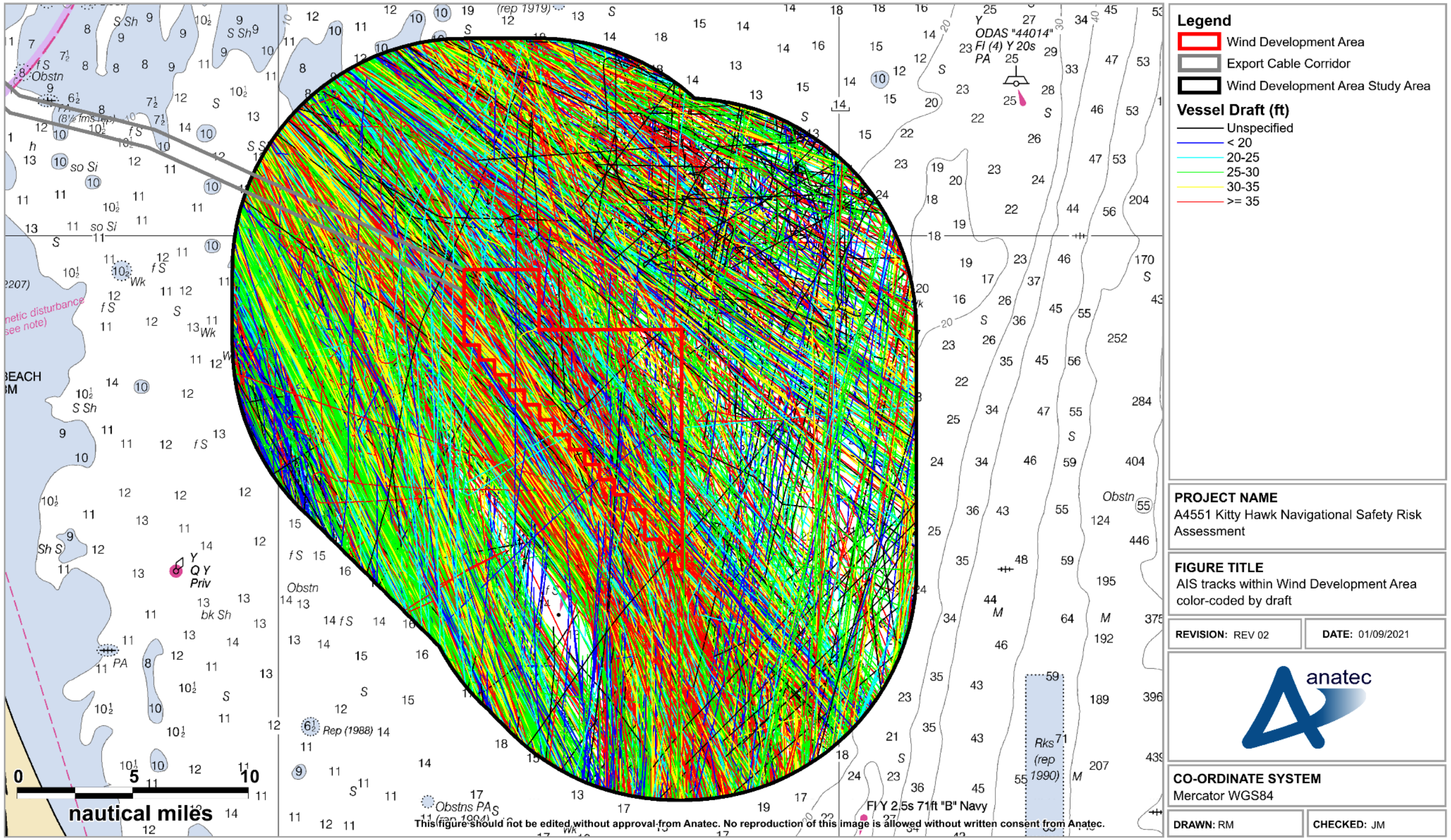

Figure 6.9 AIS tracks within Wind Development Area study area color-coded by draft (12 months January to December 2019)

6.2.3 Vessel Type

Figure 6.10 presents the distribution of the main vessel types within both the Wind Development Area study area and the Wind Development Area itself.

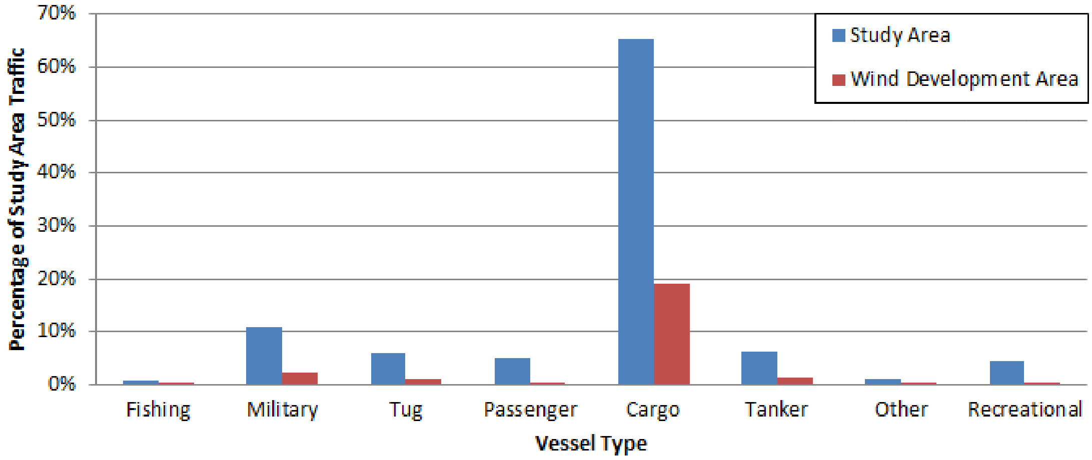

Figure 6.10 Main vessel type distribution

Throughout the survey period the most frequently recorded vessel types within the Wind Development Area study area were cargo vessels (representing approximately 65% of all recorded traffic) followed by military vessels (11%) and tankers (6%).

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

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

6.2.3.1 Cargo Vessels

Figure 6.11 presents a plot of the cargo vessel tracks recorded within the Wind Development Area study area throughout the survey period. Cargo vessels accounted for 65% of traffic within the Wind Development Area study area. Cargo vessels intersecting the Wind Development Area itself accounted for 19% of traffic within the Wind Development Area study area.

Given the high proportion of cargo vessel traffic, Figure 6.12 presents a plot of the cargo vessel tracks recorded on the busiest day for cargo vessels (14 Dec 2019) for context.

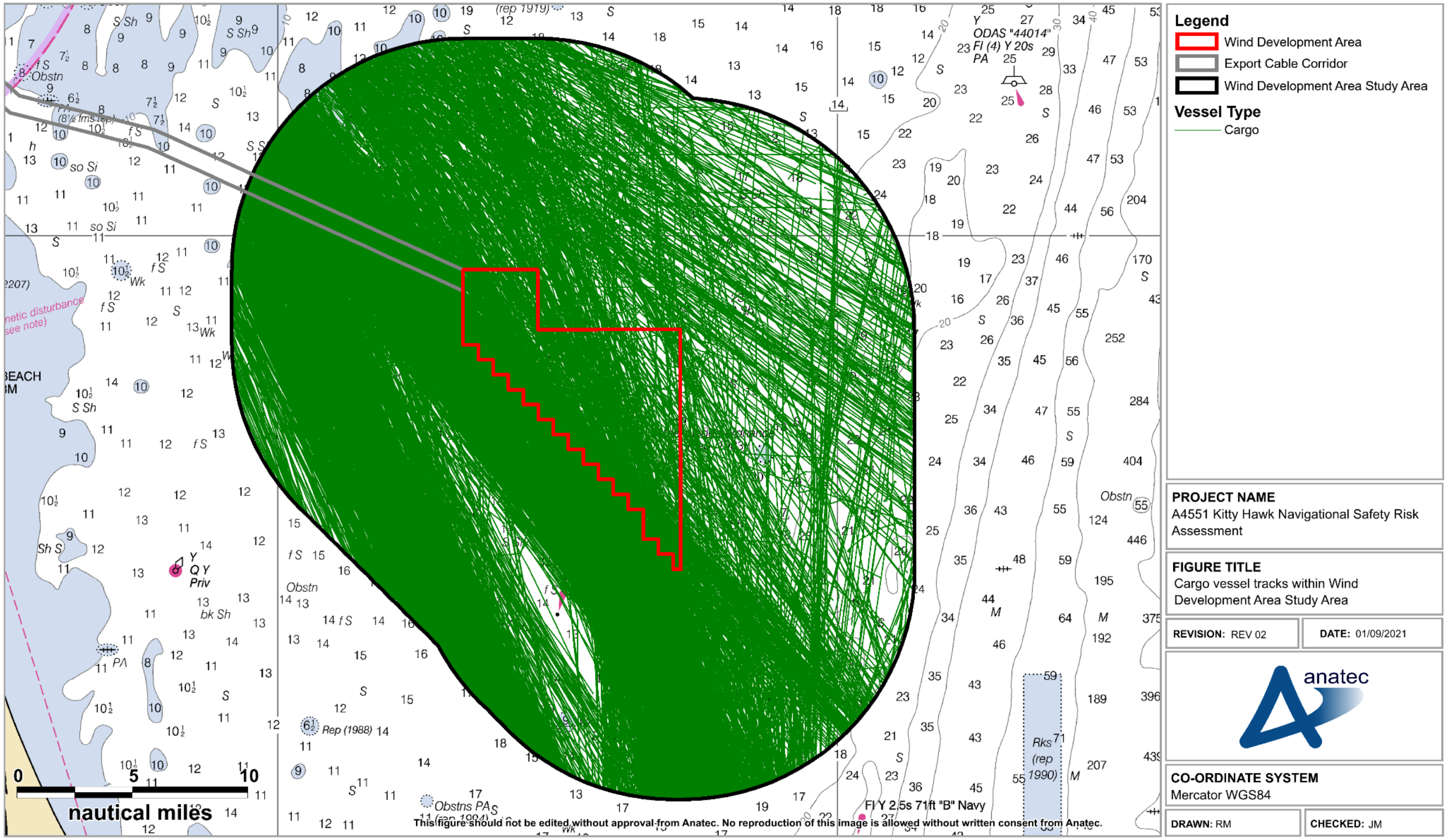

Figure 6.11 Cargo vessel tracks within Wind Development Area study area (12 months January to December 20

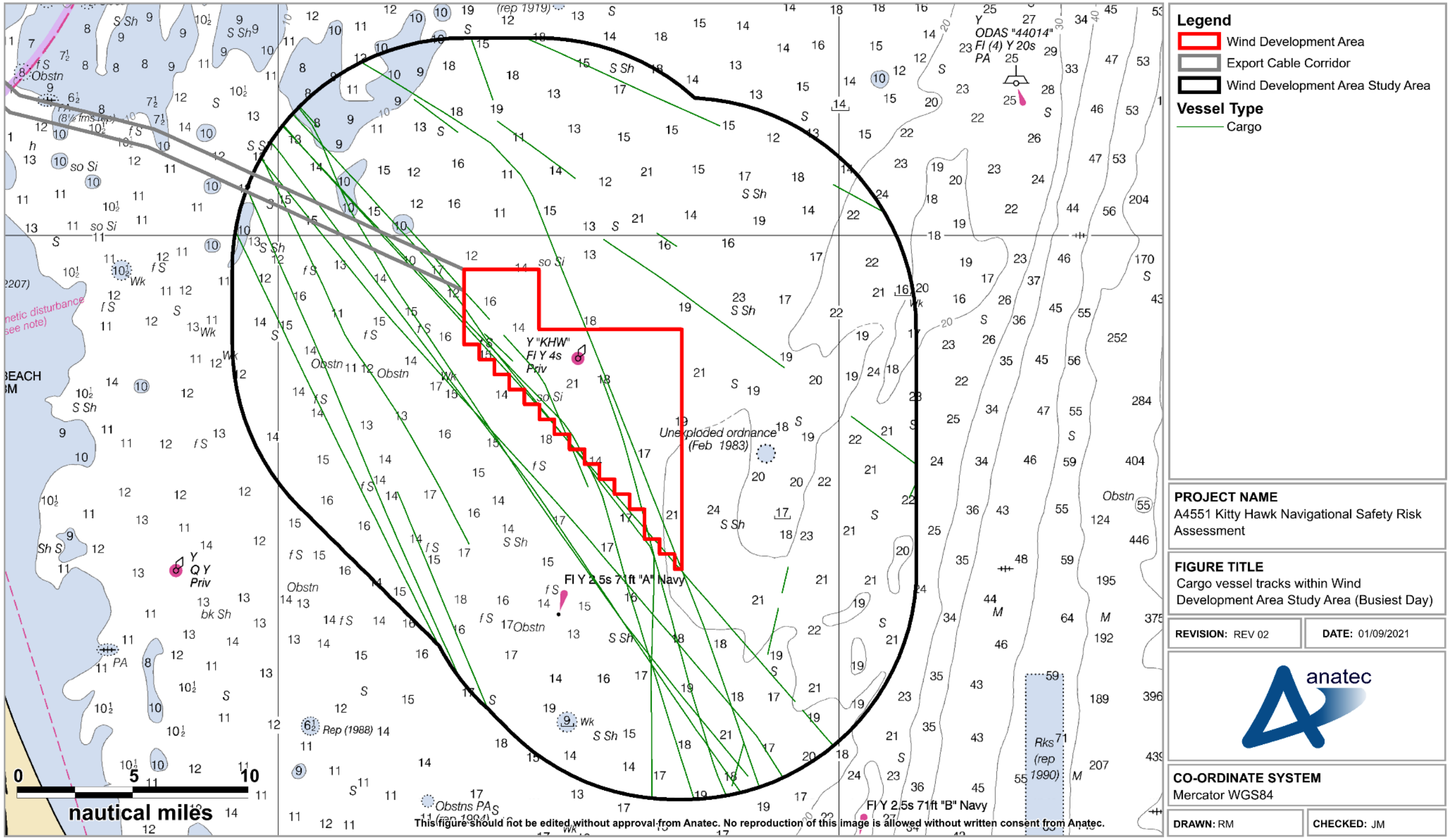

Figure 6.12 Cargo vessel tracks within Wind Development Area study area (busiest day, 14 December 2019)

Throughout the survey period, an average of eight unique cargo vessels per day was recorded within the Wind Development Area study area and two per day within the Wind Development Area itself. Containerships were the most frequently recorded cargo vessel type within the Wind Development Area study area (48%) followed by vehicle carriers (23%) and bulk carriers (13%). The busiest day featured 19 unique cargo vessels, seven of which passed through the Wind Development Area itself.

Cargo vessels were most prominently recorded routing in and out of ports located within Chesapeake Bay to the north west of the Wind Development Area study area and following the U.S. Atlantic coast.

6.2.3.2 Military Vessels

Figure 6.13 presents a plot of the military vessel tracks recorded within the Wind Development Area study area throughout the survey period, including USCG operated vessels. Military vessels, such as combat vessels and replenishment oilers, and USCG vessels accounted for approximately 11% of traffic within the Wind Development Area study area.

It is noted that, as raised by the DoD during consultation, military vessels often disable their AIS due to concerns about national security and therefore the military vessel movements shown in this section may not be comprehensive; however, it is assumed to be sufficient for this analysis based on feedback from the DoD.

Throughout the survey period an average of one unique military vessel per day was recorded within the Wind Development Area study area and one every four days within the Wind Development Area itself. Military vessels varied in size, although approximately 58% of military vessels were between 500 ft (152 m) and 700 ft (213 m) length.

The majority of military vessels were inbound or outbound from Norfolk, VA and the Joint Expeditionary Base–Little Creek within Chesapeake Bay. A minority of military vessels were transiting southbound headed for Morehead City, NC and Jacksonville, FL. A significant proportion of military traffic was undertaking military operations, noting that the Wind Development Area study area is located within the OPAREA described in Section 5.1.7.

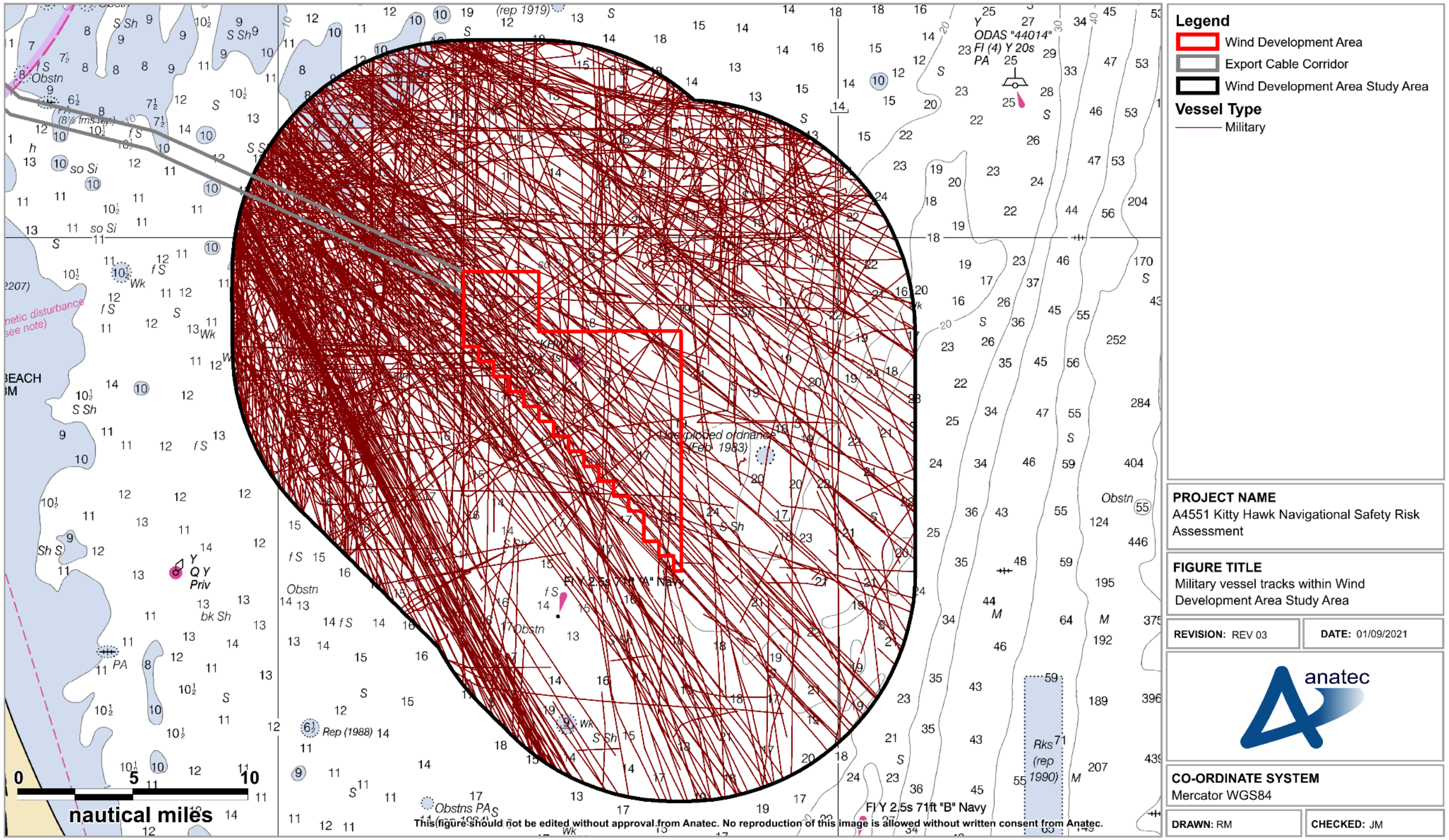

Figure 6.13 Military vessel tracks within Wind Development Area study area (12 months January to December 2019)

6.2.3.3 Tankers

Figure 6.14 presents a plot of the tanker tracks recorded within the Wind Development Area study area throughout the survey period. Tankers accounted for approximately 6% of traffic within the Wind Development Area study area.

Throughout the survey period an average of one unique tanker per day was recorded within the Wind Development Area study area and one in six days within the Wind Development Area itself. Combined chemical and oil tankers were the most frequently recorded tanker type within the Wind Development Area study area (33%) followed by liquid natural gas carriers (28%) and chemical tankers (21%).

As with cargo vessels, tankers were most prominently recorded routing in and out of ports located within Chesapeake Bay to the north west of the Wind Development Area study area, predominantly following the U.S. Atlantic coast and infrequently transiting to international ports in Central and South America.

6.2.3.4 Push/Pull Vessels

Figure 6.15 presents a plot of the push/pull vessel (tug) tracks recorded within the Wind Development Area study area throughout the survey period.

Throughout the survey period an average of one unique push/pull vessel every one to two days was recorded within the Wind Development Area study area and one in seven to eight days within the Wind Development Area itself.

Push/pull vessels were most prominently recorded transiting in a north–south direction following the U.S. Atlantic coast. Although routing in and out of ports located within Chesapeake Bay to the north west of the Wind Development Area study area was observed, this was far less frequent than for cargo vessels and tankers, and was more prominent at the western extent of the Wind Development Area study area.

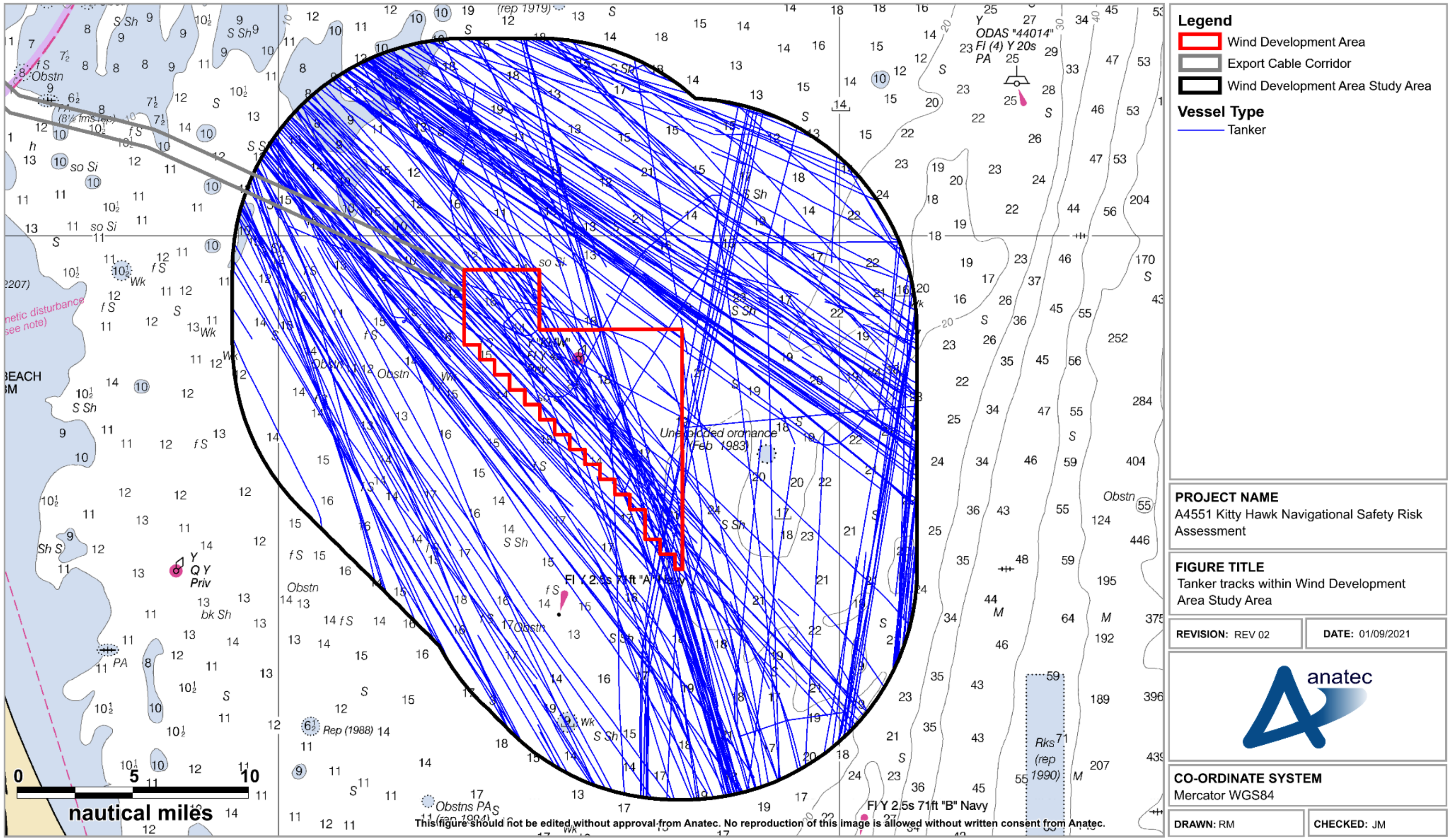

Figure 6.14 Tanker tracks within Wind Development Area study area (12 months January to December 2019)

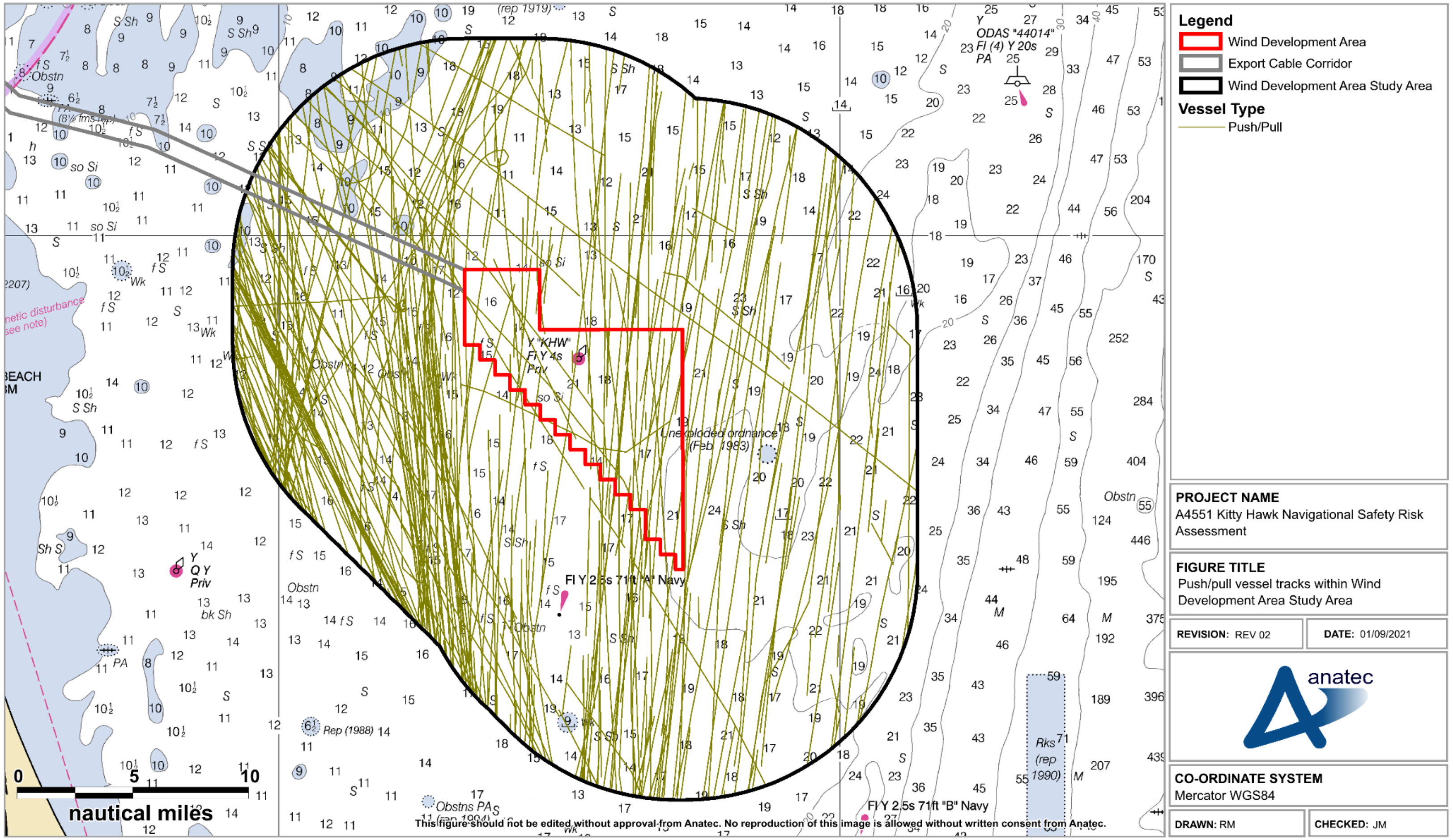

Figure 6.15 Push/pull vessel tracks within Wind Development Area study area (12 months January to December 2019)

6.2.3.5 Passenger Vessels

Figure 6.16 presents a plot of the passenger vessel tracks recorded within the Wind Development Area study area throughout the survey period. Passenger vessels accounted for approximately 2% of traffic within the Wind Development Area study area.

Throughout the survey period an average of one unique passenger vessel every one to two days was recorded within the Wind Development Area study area although the presence of passenger vessels within the Wind Development Area itself was limited.

The majority of these tracks belonged to the cruise ship *Carnival Pride*, which runs seven-day round-trip cruises throughout the year. The majority of these trips are between Baltimore, MD and the Bahamas and Turks and Caicos Islands. This route can be seen at the western extent of the Wind Development Area study area, transiting in a north–south direction.

The *Carnival Pride* also runs a seven-day round-trip between Baltimore, MD and Bermuda three times a year. This route can be seen passing north west–south east at the northern extent of the Wind Development Area study area. It is noted that the *Carnival Pride* did not transit through the Wind Development Area itself.

There are a number of tracks belonging to the cruise ship *Grand Celebration* in which the vessel was observed making the same loop out of the nearshore area on multiple occasions over several days in May 2019. The *Grand Celebration* usually runs two-day round trip cruises between Palm Beach, FL and the Bahamas; the tracks recorded within the Wind Development Area study area may be related to training or testing, noting that the navigational status broadcast by the vessel throughout this time was "*under way using engine*".

6.2.3.6 Recreational Vessels

Figure 6.17 presents a plot of the recreational vessel tracks recorded within the Wind Development Area study area throughout the survey period. Recreational vessels accounted for approximately 4% of traffic within the Wind Development Area study area.

An average of one unique recreational vessel every two days was recorded within the Wind Development Area study area and one every 14 days within the Wind Development Area itself.

It is not clear how many recreational vessels voluntarily carry AIS transmitters but it is likely only to be a minority of the total number; therefore this data only provides an indication of activity in the area but does provide a general impression of transits.

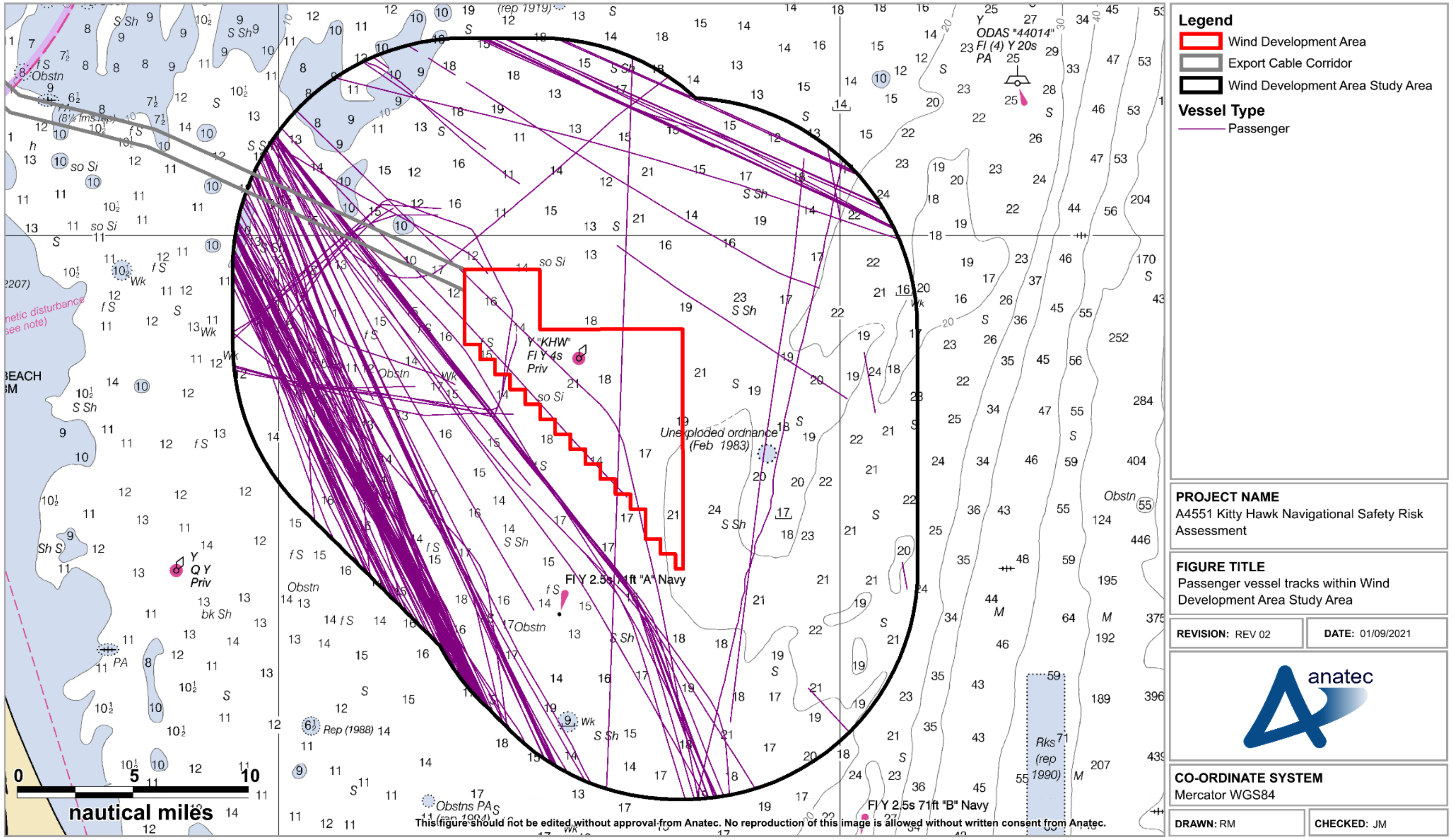

Figure 6.16 Passenger vessel tracks within Wind Development Area study area (12 months January to December 2019)

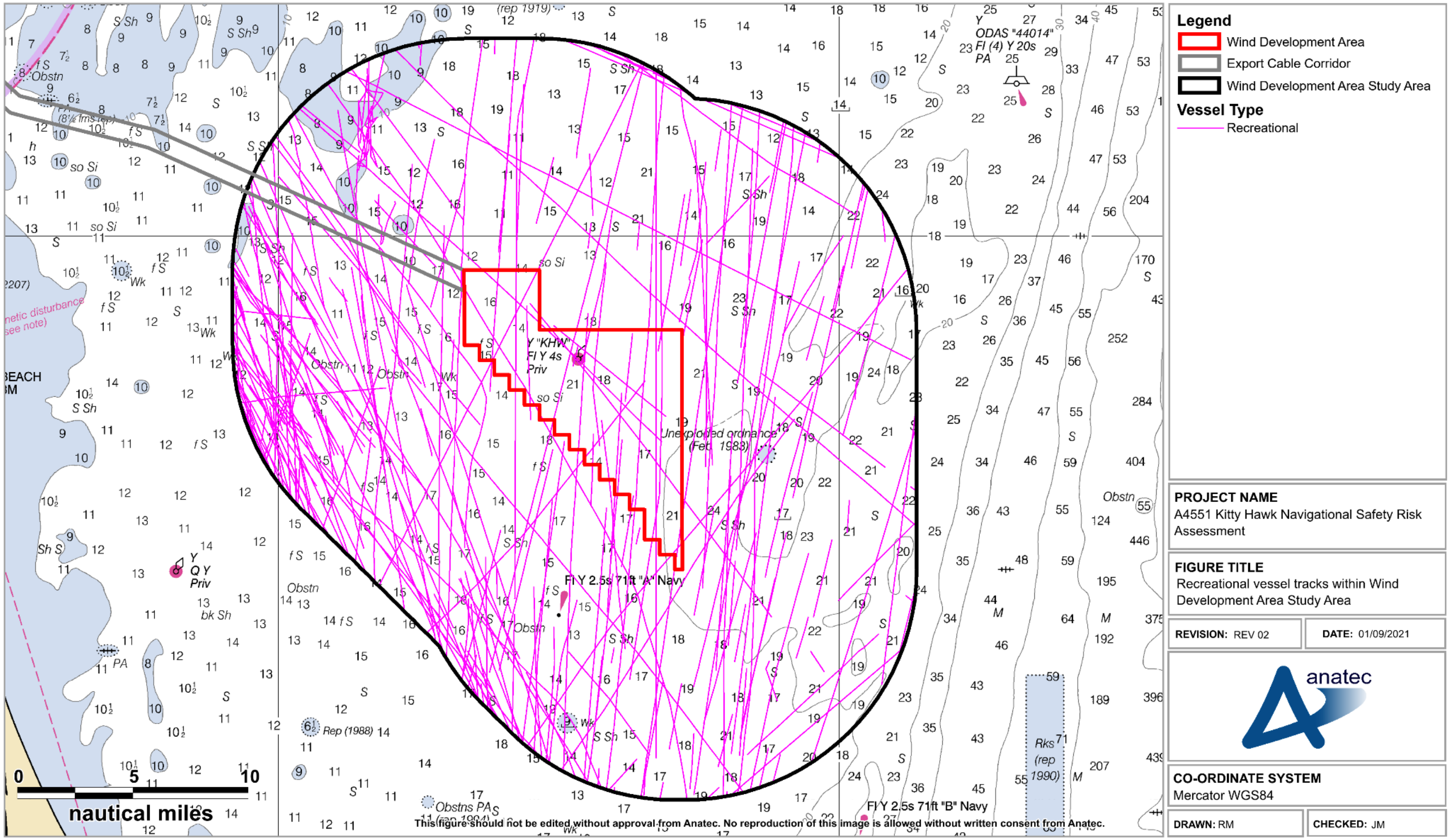

Figure 6.17 Recreational vessel tracks within Wind Development Area study area (12 months January to December 2019)

6.2.3.7 Fishing Vessels

Figure 6.18 presents a plot of the fishing vessel tracks recorded within the Wind Development Area study area throughout the survey period. Fishing vessels accounted for approximately 1% of traffic throughout the survey period.

As inferred in Section 1.1.1, the AIS carriage requirements do not extend to smaller craft such as some fishing vessels. The AIS data alone is therefore not considered to provide a comprehensive characterization of fishing vessel movements within and in proximity to the Wind Development Area. Section 6.4 and Section 6.5 provide analysis of additional fishing vessel data including non-AIS traffic.

Throughout the survey period an average of one unique fishing vessel every nine days was recorded within the Wind Development Area study area. During the survey period, only one fishing vessel track intersected the Wind Development Area.

Based upon the nature of the vessel tracks (straight line transits) and the average speeds (all of which are greater than 5 knots), fishing vessels were in transit through the Wind Development Area study area rather than engaged in fishing activity. Transits were primarily in a south west–north east direction at the south eastern extent of the Wind Development Area study area (clear of the Wind Development Area itself) or in a north–south direction following the U.S. Atlantic coast.

6.2.3.8 Anchored Vessels

Anchored vessels can be identified based upon the AIS navigational status which is programmed on the AIS transmitter on-board a vessel. Information is manually entered into the AIS; therefore, it is common for vessels not to update the navigational status if they are anchored for only a short period of time. For this reason, vessels which travelled at a speed of less than 1 knot for more than 30 minutes were also examined for patterns characteristic of anchoring.

After applying these criteria, three vessels (all cargo vessels) were deemed to be at anchor, as shown in Figure 6.19, with the closest located approximately 2.7 nm (5.0 km) south of the offshore export cable corridor.

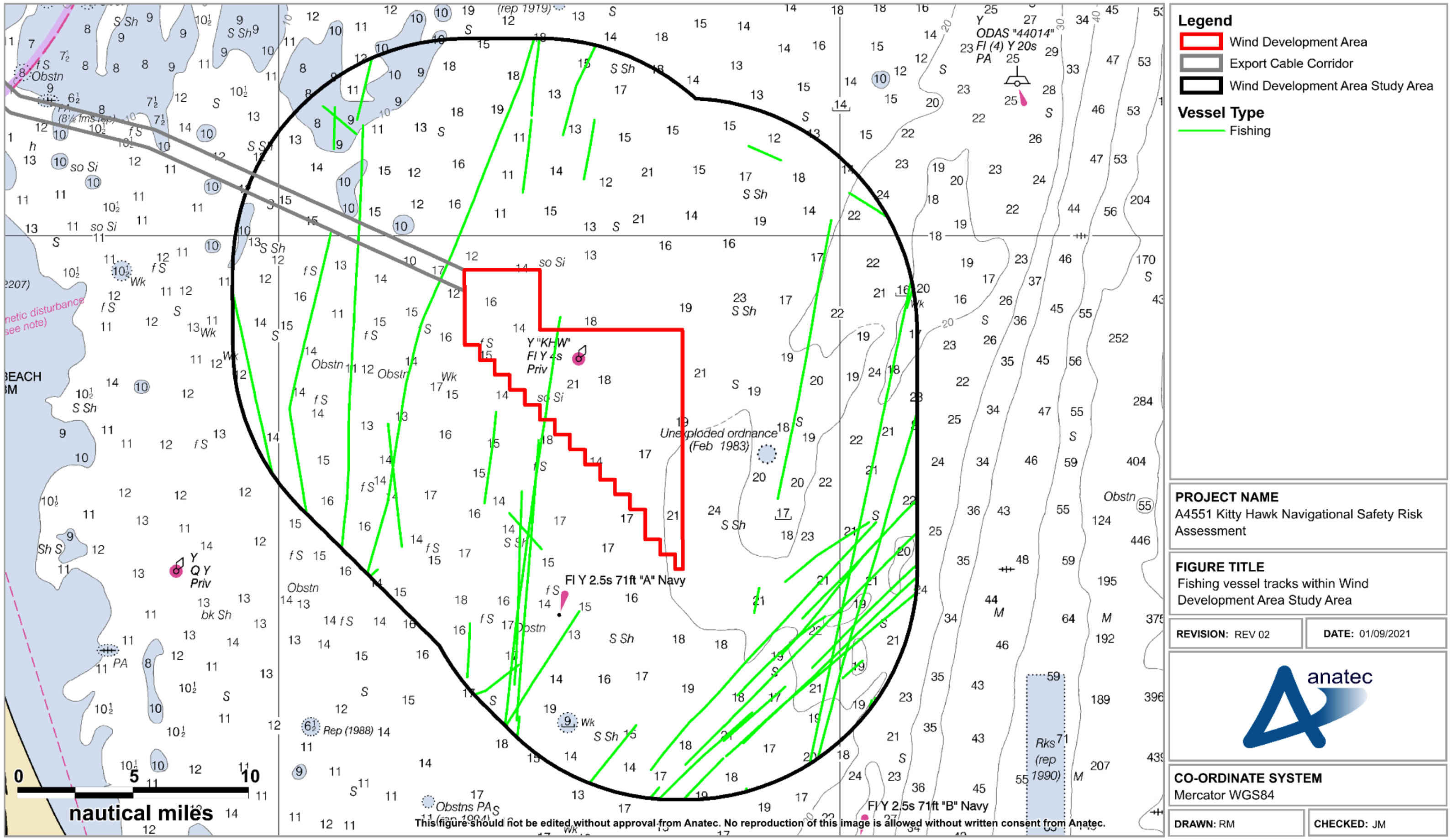

Figure 6.18 Fishing vessel tracks within Wind Development Area study area (12 months January to December 2019)

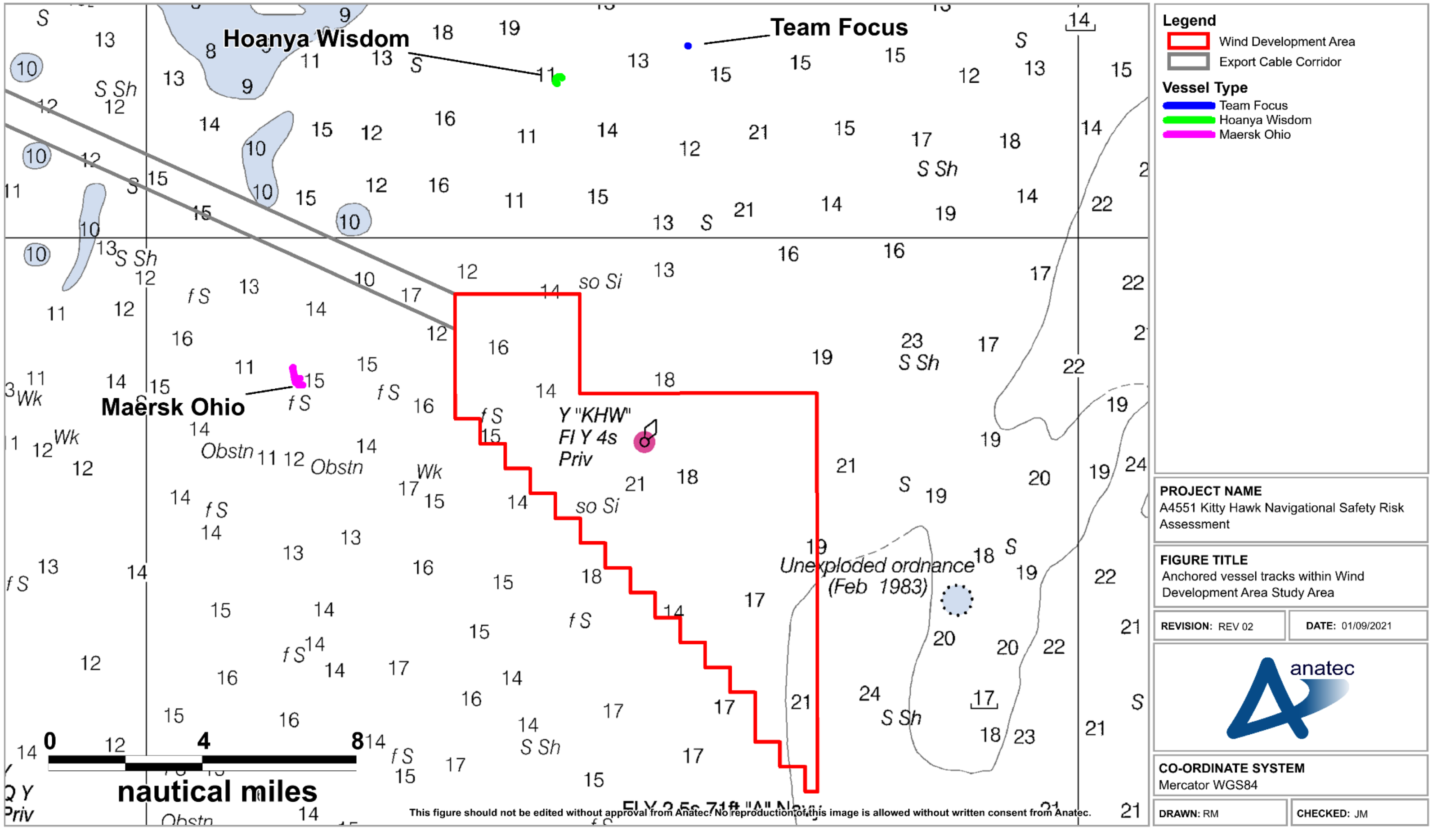

Figure 6.19 Anchored vessel tracks within Wind Development Area study area (12 months January to December 2019)

6.3 Vessel Routing

6.3.1 Methodology for Main Route Identification

The vessel traffic data collected was used to identify the main commercial vessel routes intersecting the Wind Development Area study area. The routes were identified statistically with cases of commercial vessels (including 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 654 [MCA, 2021]) from the median line of the route as shown in Figure 6.20. The 90th percentile method assumes that the route width covers the 90% of vessels that are nearest the median line.

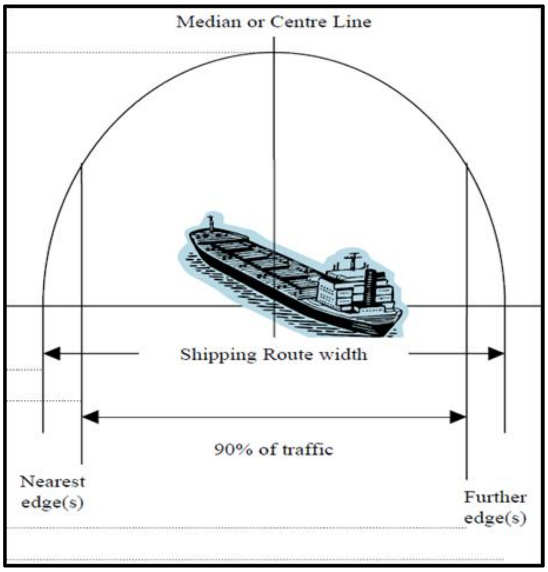

Figure 6.20 Illustration of main route calculation (MCA, 2021)

It is noted that the identification of main routes assists the assessment of key commercial vessel movements within the Wind Development Area study area; however all individual vessel tracks have been incorporated into the risk assessment (see Section 12).

6.3.1.1 Pre Wind Facility Main Routes

Applying the methodology outlined in Section 6.3.1, a total of 11 main routes were identified and are presented in Figure 6.21 alongside the corresponding 90th percentiles.

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.

No adverse weather routing was identified for commercial vessels.

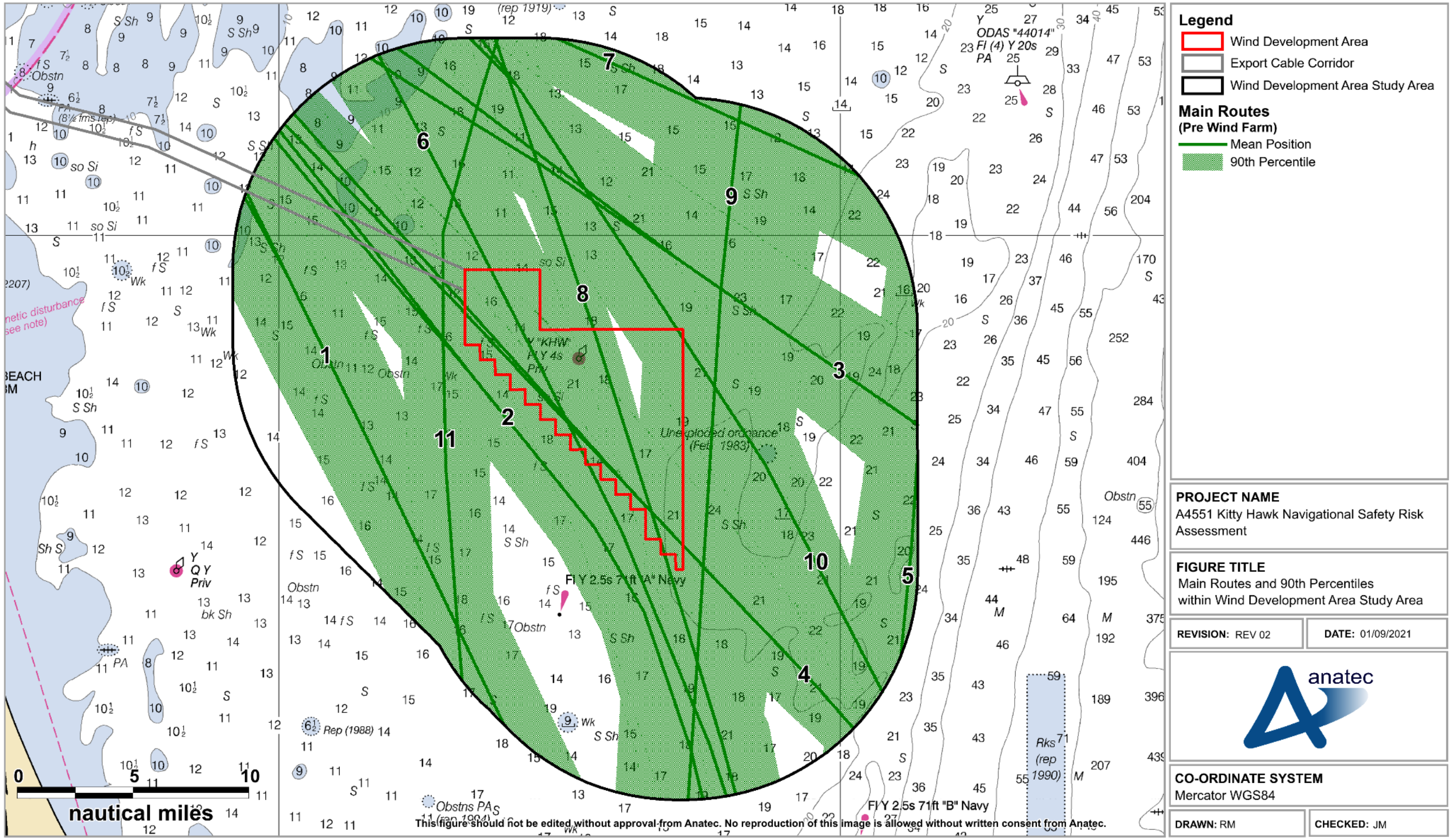

Figure 6.21 Pre wind facility main routes and 90th percentiles within Wind Development Area study area

Table 6.1 Overview of main routes

Route Number		Volume of Traffic	Most Frequent Destinations	Description
1		3 to 4 per day	▪ Baltimore, MD ▪ Norfolk, VA ▪ Newport News, VA ▪ Base–Little Creek, VA ▪ Charleston, South Carolina (SC) ▪ Savannah, Georgia (GA) ▪ Jacksonville, FL ▪ New Orleans, Louisiana (LA) ▪ Brunswick, GA ▪ Wilmington, NC	Primarily a cargo vessel (72%) and passenger vessel (16%) route out of the Southern Approach of the Chesapeake Bay IMO routing measure and following the U.S. Atlantic coast landward of Navy Tower Light A; 67% of traffic is southbound.
2		2 to 3 per day	▪ Baltimore, MD ▪ Norfolk, VA ▪ Newport News, VA ▪ Dundalk, MD ▪ Charleston, SC ▪ Savannah, GA ▪ Jacksonville, FL ▪ Brunswick, GA ▪ Wilmington, NC ▪ Manzanillo (Panama)	Primarily a cargo vessel (90%) route out of the Southern Approach of the Chesapeake Bay IMO routing measure and following the U.S. Atlantic coast seaward of Navy Tower Light A.
3		1 per day	▪ Baltimore, MD ▪ Norfolk, VA ▪ Charleston, SC ▪ Savannah, GA ▪ Houston, Texas (TX) ▪ Cove Point, MD ▪ Panama ▪ Kingston (Jamaica) ▪ Brazil	Primarily a cargo vessel (60%) and tanker (25%) route out of the Southern Approach of the Chesapeake Bay IMO routing measure and either following the U.S. Atlantic coast clear of shallower waters or headed to/from ports in Central and South America.
4		1 per day	▪ Baltimore, MD ▪ Norfolk, VA ▪ Charleston, SC ▪ Savannah, GA ▪ Jacksonville, FL ▪ New Orleans, LA	Primarily a cargo vessel (78%) route out of the Southern Approach of the Chesapeake Bay IMO routing measure and following the U.S. Atlantic coast clear of shallower waters.

Route Number		Volume of Traffic	Most Frequent Destinations		Description
5		1 per day	▪ New York Bay ▪ Delaware Bay	▪ Charleston, SC ▪ Savannah, GA ▪ Jacksonville, FL ▪ Wilmington, NC ▪ Galveston, TX ▪ Cape Canaveral, FL	Primarily a cargo vessel (65%) and tanker (20%) route out of ports in Delaware Bay and New York Bay and following the U.S. Atlantic coast clear of shallower waters, in some cases to the Gulf of Mexico; 69% of traffic is southbound.
6		1 per day	▪ Baltimore, MD ▪ Norfolk, VA	▪ Charleston, SC ▪ Savannah, GA ▪ Jacksonville, FL	Primarily a cargo vessel (90%) route out of the Southern Approach of the Chesapeake Bay IMO routing measure and following the U.S. Atlantic coast seaward of Navy Tower Light A.
7		1 every 2 days	▪ Baltimore, MD ▪ Norfolk, VA ▪ Base–Little Creek, VA	▪ Bermuda ▪ Brazil ▪ Europe	Primarily a cargo vessel (59%) and passenger vessel (17%) route out of the Southern Approach of the Chesapeake Bay IMO routing measure and either headed to/from ports in Central and South America or ports in Europe.
8		1 every 2 days	▪ Baltimore, MD ▪ Norfolk, VA ▪ Dundalk, MD	▪ Charleston, SC ▪ Savannah, GA	Primarily a cargo vessel (90%) route out of the Southern Approach of the Chesapeake Bay IMO routing measure and following the U.S. Atlantic coast seaward of Navy Tower Light A.
9		1 every 2 days	▪ Norfolk, VA ▪ New York, NY ▪ Delaware Bay ▪ Base–Little Creek, VA	▪ Charleston, SC ▪ Savannah, GA ▪ Wilmington, NC ▪ Miami, FL ▪ San Juan (Panama)	Primarily a push/pull vessel (48%) and cargo vessel (25%) route out of ports in Delaware Bay and New York Bay and either following the U.S. Atlantic coast clear of shallower waters or headed to/from ports in Central America; 66% of traffic is southbound.
10		1 every 4 days	▪ Baltimore, MD ▪ Norfolk, VA	▪ Charleston, SC ▪ Savannah, GA	Primarily a cargo vessel (89%) route out of the Southern Approach of the Chesapeake Bay IMO routing measure and following the U.S. Atlantic coast clear of shallower waters.
11		1 every 5 days	▪ New York Bay ▪ Delaware Bay ▪ Bangor, ME ▪ Cove Point, MD	▪ Charleston, SC ▪ New Orleans, LA ▪ Galveston, TX ▪ San Juan (Panama)	Push/pull vessel route out of ports in Delaware Bay and New York Bay and either following the U.S. Atlantic coast, in some cases to the Gulf of Mexico, or headed to/from ports in Central America.

6.4 Wind Development Area Vessel Monitoring System Data

From 50 CFR § 660.14, any fishing vessel registered for use with a limited entry 'A' endorsed permit, that uses non-groundfish trawl gear, or uses open access gear for groundfish is required to have a VMS. It is noted that during consultation the USCG suggested that this carriage requirement does not typically apply to commercial fisheries in the area and as such may not provide as much additional data as elsewhere.

6.4.1 Mid-Atlantic Ocean Data Portal

VMS data from 2015 and 2016 (Mid-Atlantic Ocean Data Portal, 2018) has been assessed. Noting the caveat from the USCG, this data has been utilized only to enhance and validate the fishing vessel baseline established by the AIS data and it is acknowledged that the VMS data alone is insufficient to characterize fishing vessel movements in the area.

Figure 6.22 presents a cumulative plot of fishing density based on VMS data for vessels with groundfish permits that are subject to VMS requirements, noting that these species are not specifically targeted in the study area. There are 13 species of groundfish distributed throughout the Mid-Atlantic region, as further described below:

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

Following this, Figure 6.23 presents the VMS data filtered to show only those vessels where the speed over ground was recorded as less than 4 knots, i.e., activity more likely to represent active fishing activity rather than transits.

Figure 6.24 presents a similar plot for vessels with scallop permits that are subject to VMS requirements. Following this, Figure 6.25 presents the VMS data filtered to show only those vessels where the speed over ground was recorded as less than 5 knots, again to provide an indication of active fishing activity.

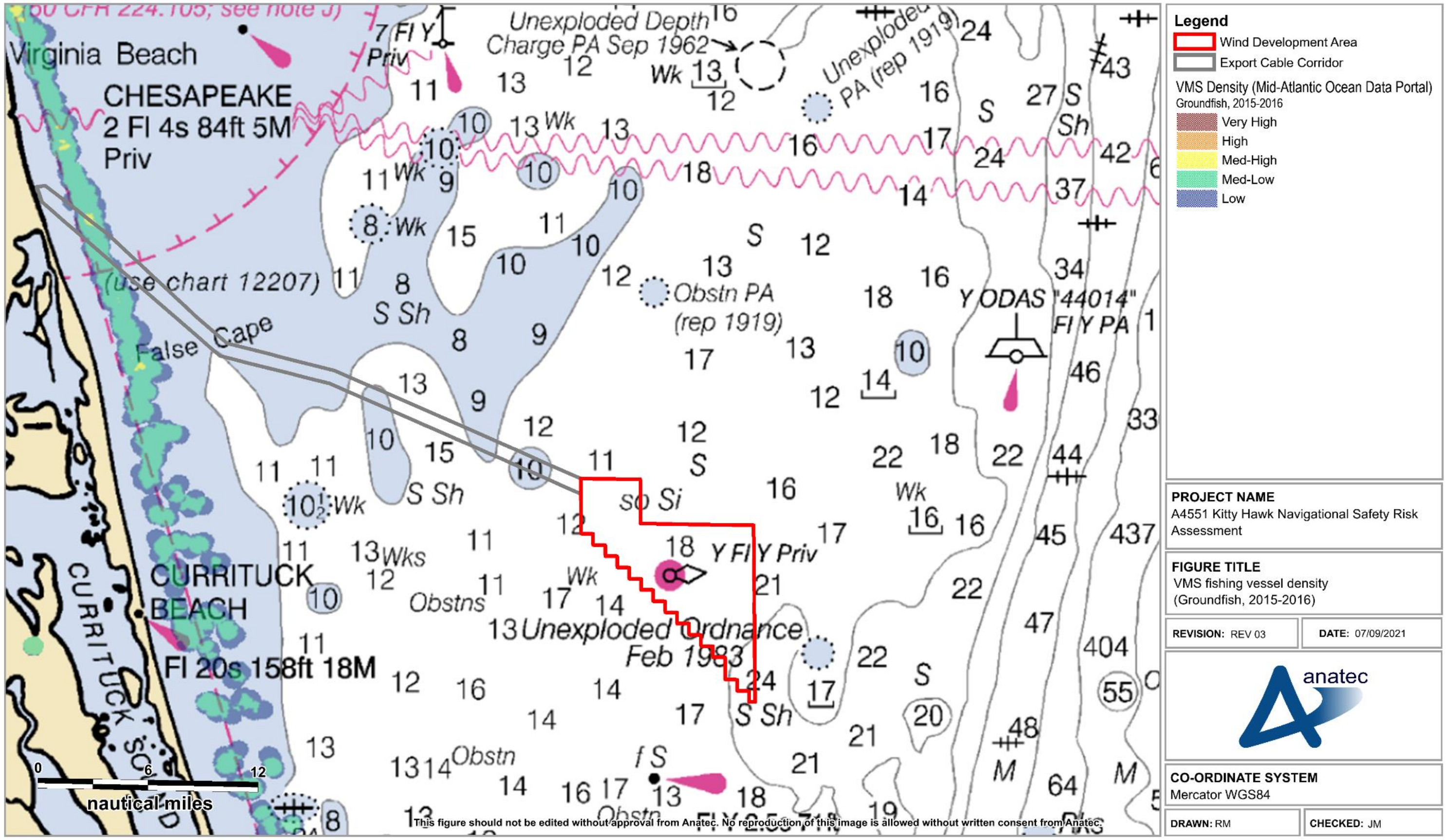

Figure 6.22 VMS fishing vessel density[11] (groundfish, 2015 to 2016) (Mid-Atlantic Ocean Data Portal, 2018)

[11] Inclusive of vessels in transit or engaged in fishing

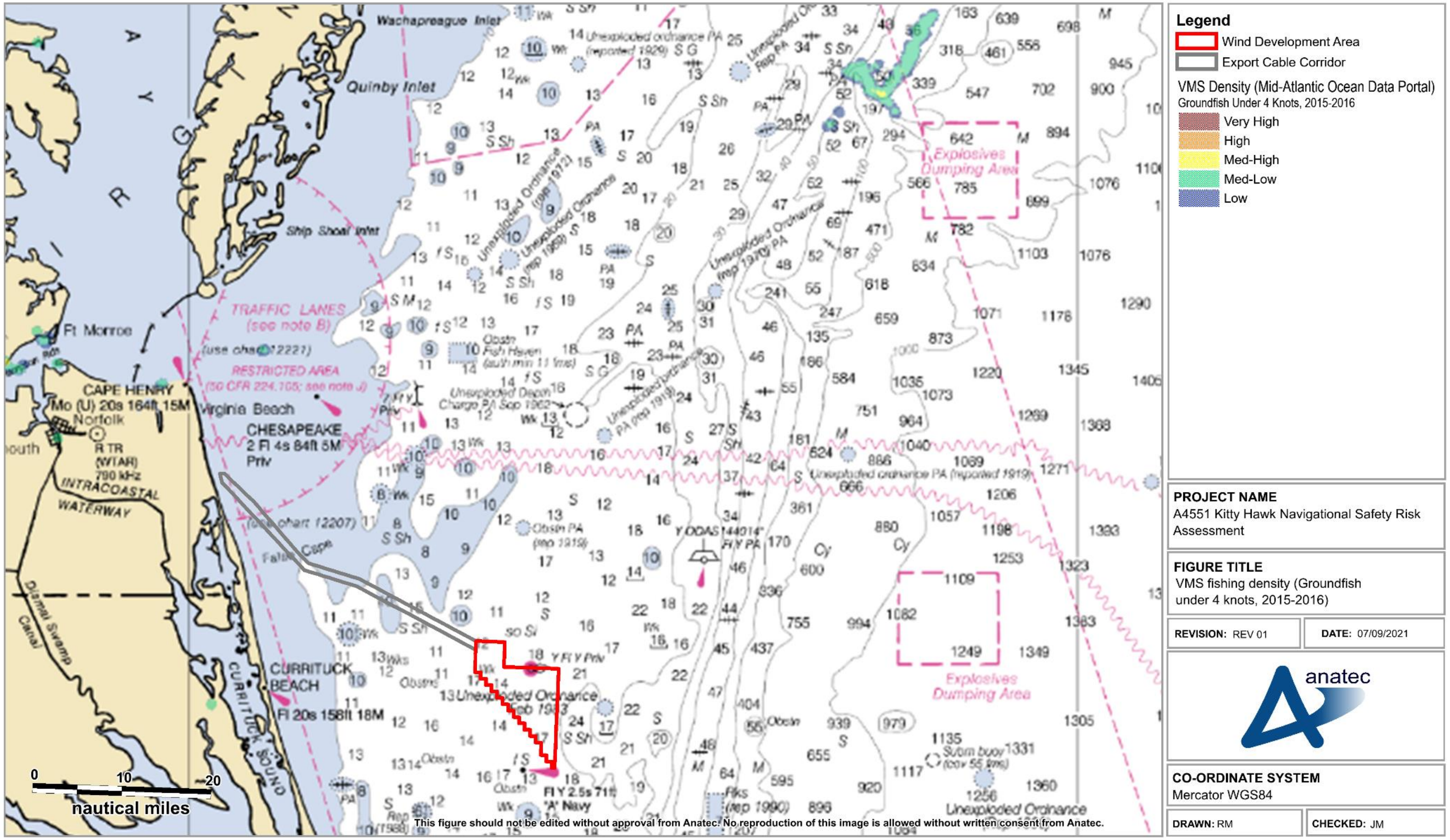

Figure 6.23 VMS fishing density (groundfish under 4 knots, 2015 to 2016) (Mid-Atlantic Ocean Data Portal, 2018)

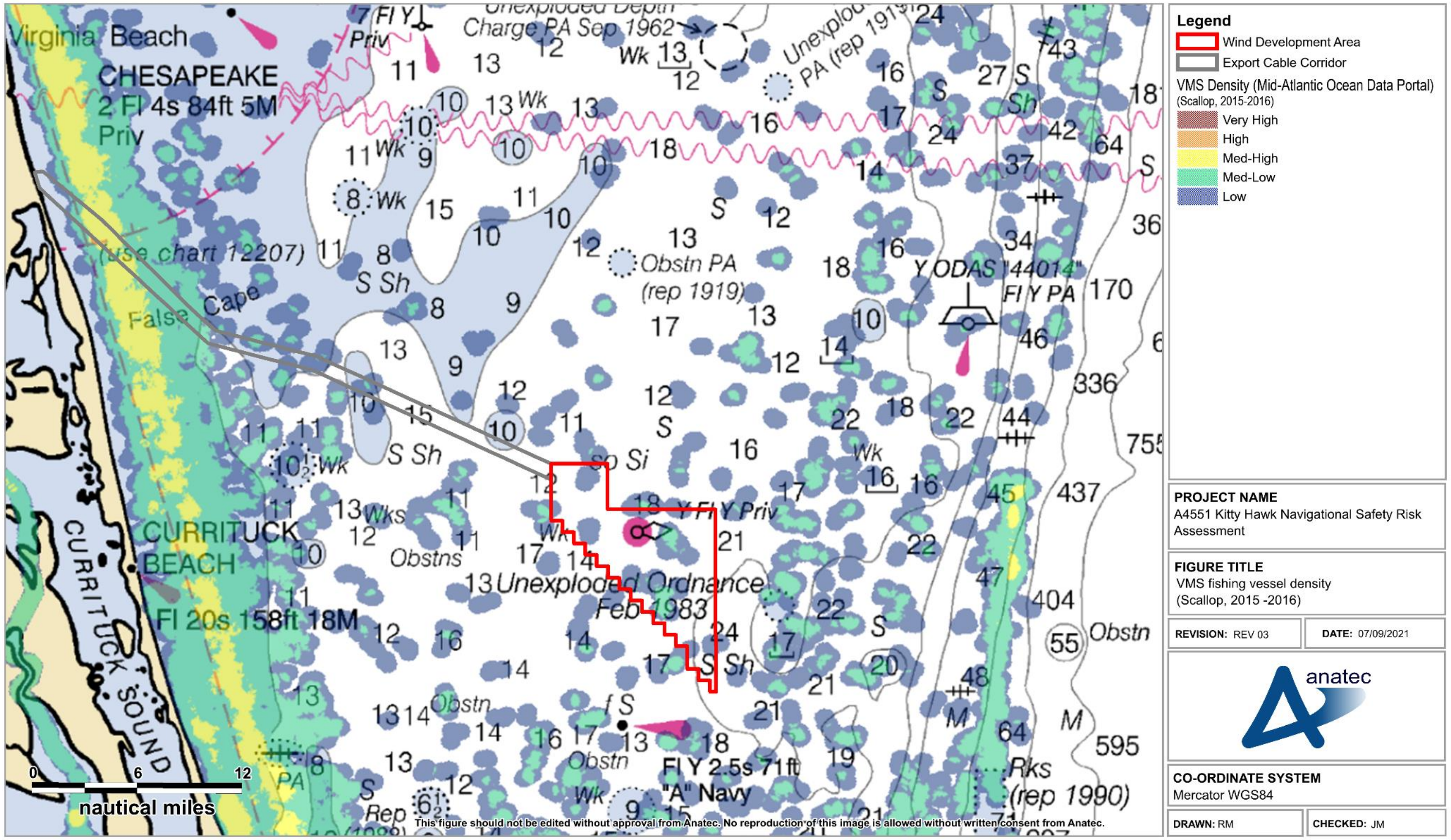

Figure 6.24 VMS fishing vessel density[12] (scallop, 2015 to 2016) (Mid-Atlantic Ocean Data Portal, 2018)

[12] Inclusive of vessels in transit or engaged in fishing.

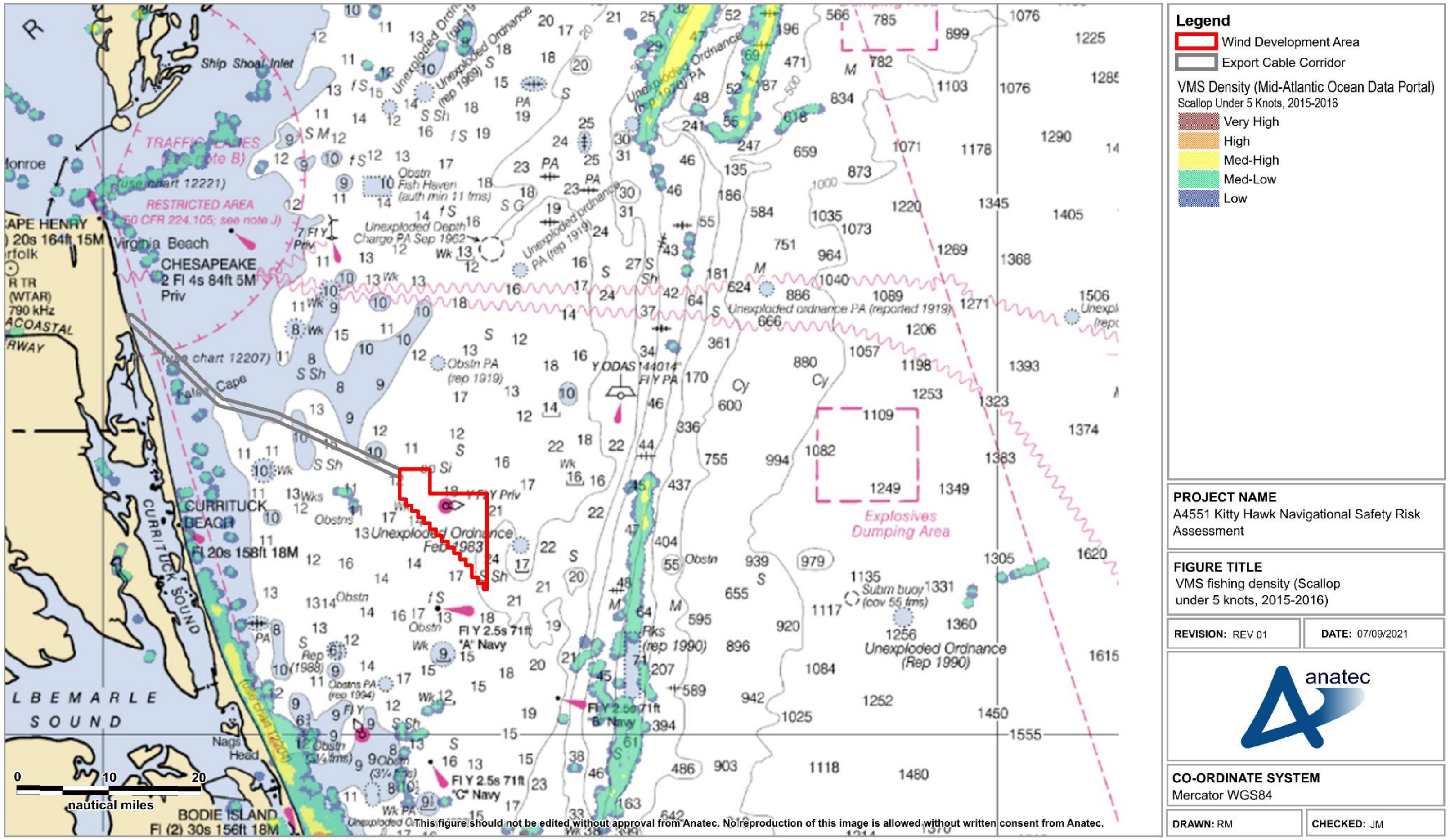

Figure 6.25 VMS fishing density (scallop under 5 knots, 2015 to 2016) (Mid-Atlantic Ocean Data Portal, 2018)

It can be seen from the VMS data that groundfish fishing vessel activity occurs inshore of the Wind Development Area, with a medium-low density of groundfish fishing vessels intersecting the nearshore portion of the offshore export cable corridor. With the speed over ground filter applied this vessel activity is characteristic of fishing vessels in transit rather than actively fishing. Active groundfish fishing is more frequent further north along the northern canyons in the mid-Atlantic region.

Scallop fishing vessel activity is more frequent in the region both along the coast and further offshore, with a larger portion of the export cable corridor intersected by scallop fishing vessel activity including at a medium-high density. Scallop fishing vessel activity can also be seen at low and medium-low density within the Wind Development Area, although at this distance offshore the activity is sporadic. With the speed over ground filter applied, the vessel activity within and in proximity to the Wind Development Area is characteristic of fishing vessels in transit rather than actively fishing. The speed-filtered fishing inshore and offshore of the Wind Development Area in Figure 6.25 is understood to be fishing activity for other species (e.g. shrimp and squid) by vessels that hold sea scallop permits.

VMS data from 2015 and 2016 for fishing of other species (including herring, squid, monkfish, surfclam and ocean quahog) have also been assessed, with activity negligible in proximity to the Wind Development Area in all cases.

6.4.2 VMS Polar Histograms

BOEM have provided VMS data analysis in the form of polar histograms covering the period of 2014 to 2019 (noting 2019 is partial) for the Wind Development Area. The data provides a breakdown of vessel course within the Wind Development Area by both activity (i.e., fishing or transiting) and fishery type. Activity has been determined by applying a speed threshold, with speeds below four knots assumed to be associated with vessels actively fishing, and speeds above four knots assumed to be associated with vessels in transit (except for sea scallop fishery where a five knot threshold is assumed). It should be considered that this approach may misrepresent activity of a minority of vessels.

Each histogram is split into 72 bins, with each bin representing a 5° range (e.g., 0 to 5°, 5 to 10° etc.). Each bin then shows the unique number of VMS transmissions with average course falling within the corresponding range.

The histograms for all fisheries are shown in Figure 6.26 and Figure 6.27 for vessels actively fishing and actively transiting respectively.

In summary, the data showed the majority of fishing vessels within the Wind Development Area were recorded at transiting speeds as opposed to actively fishing, with transits primarily from vessels that were approximately north / south bound.

Vessels associated with the monkfish, northeast multispecies, and Atlantic sea scallop, as well as the squid, mackerel, and butterfish fisheries, were all recorded within the site; however all associated transmissions were at speeds suggesting transit as opposed to active fishing. The only transmissions at potential fishing speeds were from vessels transmitting as

"*Declared Out of Fishery*" (DOF) and as such it is likely that such vessels were not actively engaged in fishing at the time.

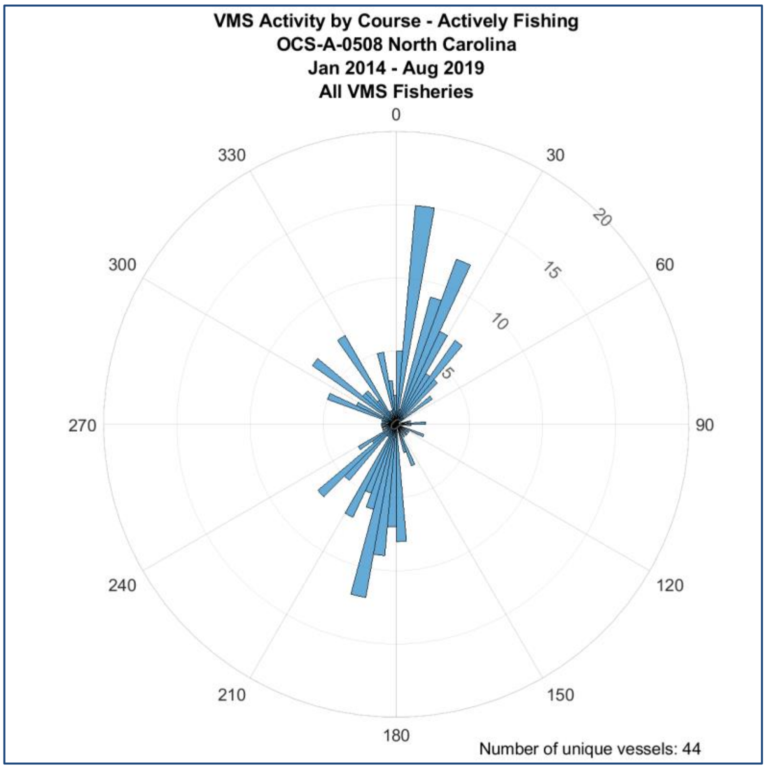

Figure 6.26 VMS Polar Histogram – All Fisheries Actively Fishing (BOEM, 2021)

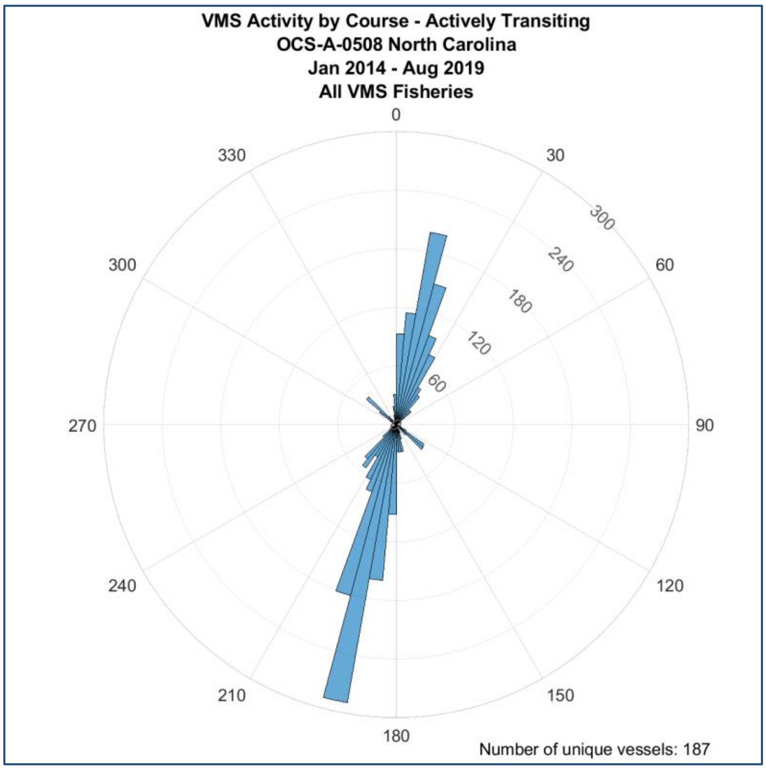

Figure 6.27 VMS Polar Histogram – All Fisheries Actively Transiting (BOEM, 2021)

6.5 Wind Development Area Visual Observation Data

During a period in 2020, the *Gerry Bordelon* survey vessel was on-site undertaking geophysical surveys. While on-site, the *Gerry Bordelon* also recorded visual observations of vessels not broadcasting on AIS. This data is understood to be opportunistic but is meant to supplement other data sets considered in this NSRA. Figure 6.28 presents a plot of the visual observations recorded while the survey vessel was on-site.

Throughout the survey period, seven vessels not broadcasting on AIS were recorded by visual observation. Five of these were recreational vessels with one military vessel and one fishing vessel. Details of the visual sightings, as recorded in log sheets during the surveys, are provided in Table 6.2.

Table 6.2 Summary of visual observations during *Gerry Bordelon* surveys

Date	Time (Local)	Description	Length (ft)	Speed (knots)	Course
30 May 2020	18:00	Motor yacht	100	15	NE
01 Jun 2020	00:23	Warship	120	7	44°
02 Jun 2020	18:20	Sailboat	65	6	N
06 Jun 2020	20:15	Sport fishing vessel	45-50	20-25	NW
08 Jun 2020	06:38	Center console	20	20	ESE
12 Jun 2020	19:19	Sport fishing vessel	50-60	30+	NE
25 Jul 2020	09:20	Fishing vessel	40	22	205°
	15:45			10	120°

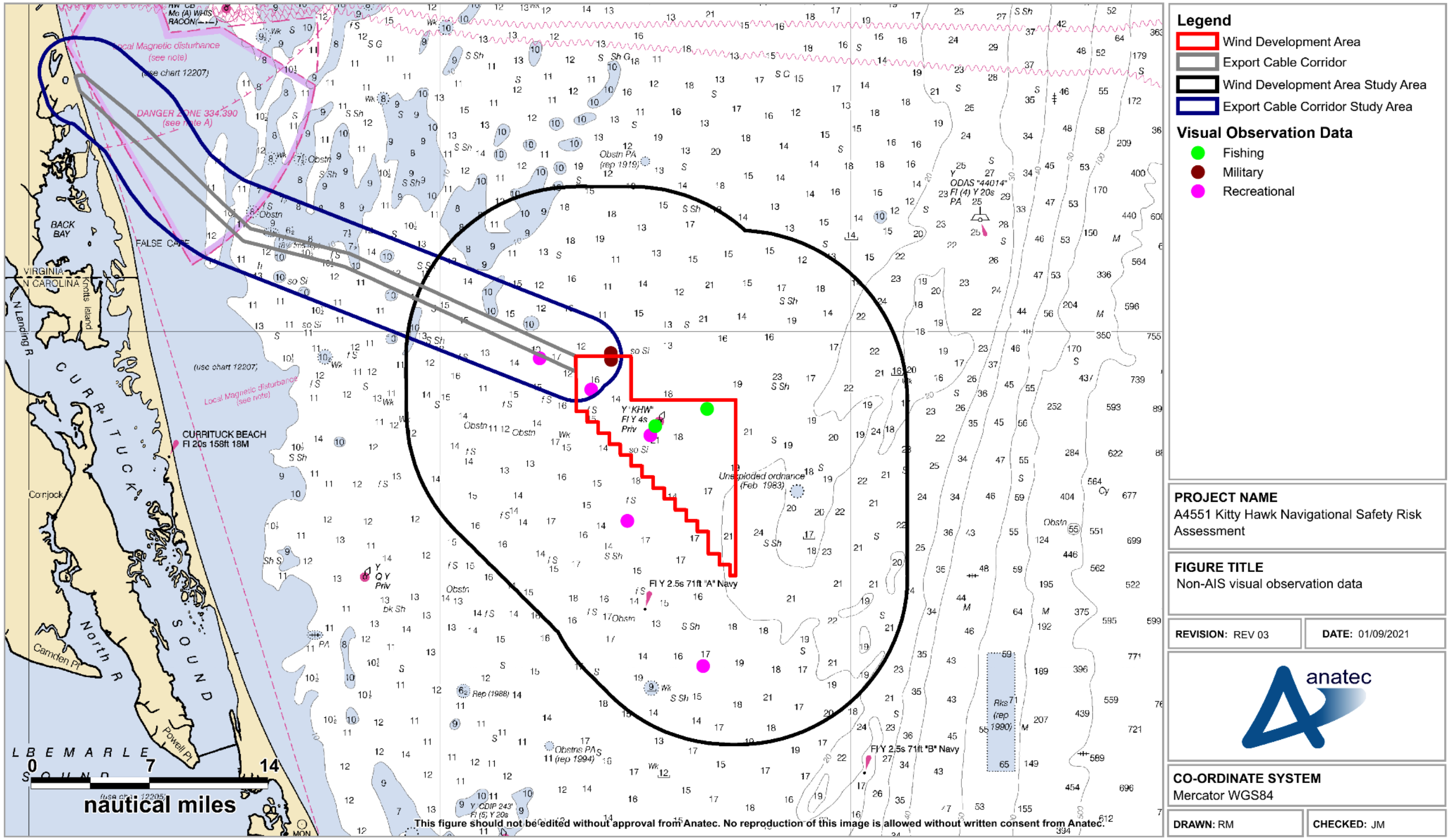

Figure 6.28 Non-AIS visual observation data

6.6 Export Cables Automatic Identification System Data

In addition to the assessment of traffic within the vicinity of the Lease Area, further high-level assessment has been undertaken of traffic deemed relevant to the offshore export cables. Given key impacts to the offshore export cables surround anchor interaction and under keel clearance, the assessment has focused on vessel drafts and levels and locations of anchoring activity.

6.6.1 Overview

Figure 6.29 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 6.30 presents the corresponding vessel density heat map for the same dataset.

The same density intervals have been used for the vessel density heat map for the export cable corridor study area as for the Wind Development Area study area in Figure 6.3.

On average, 13 unique vessels per day were recorded within the export cable corridor study area. The vessel density was greatest in proximity to the Wind Development Area where the high density routes in and out of Chesapeake Bay described in Section 6.2 cross the export cable corridor.

There is moderate to high vessel density in the nearshore area where primarily recreational and push/pull vessels, as well as fishing vessels, transit in a north–south direction.

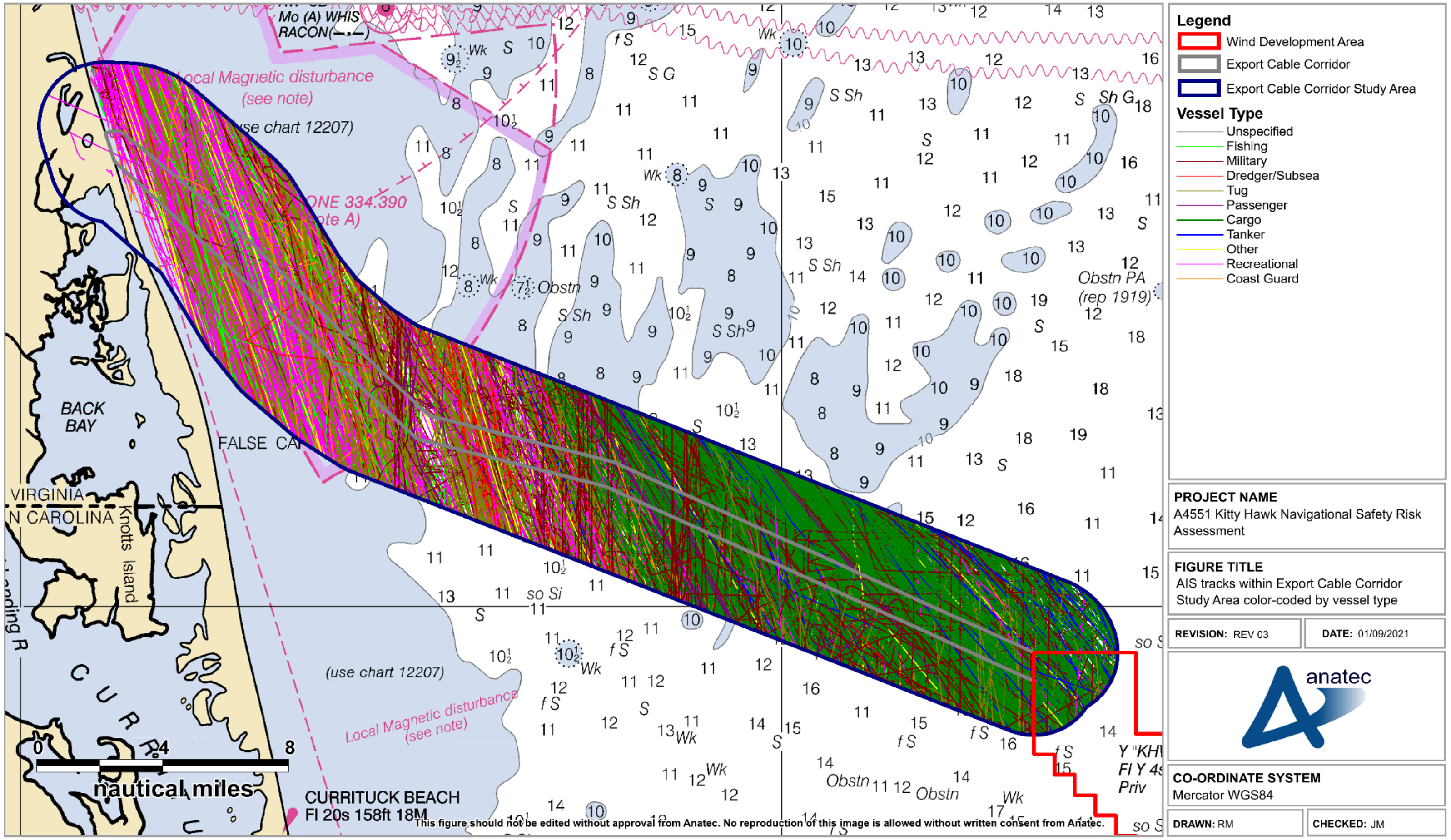

Figure 6.29 AIS tracks within export cable corridor study area color-coded by vessel type (12 months January to December 2019)

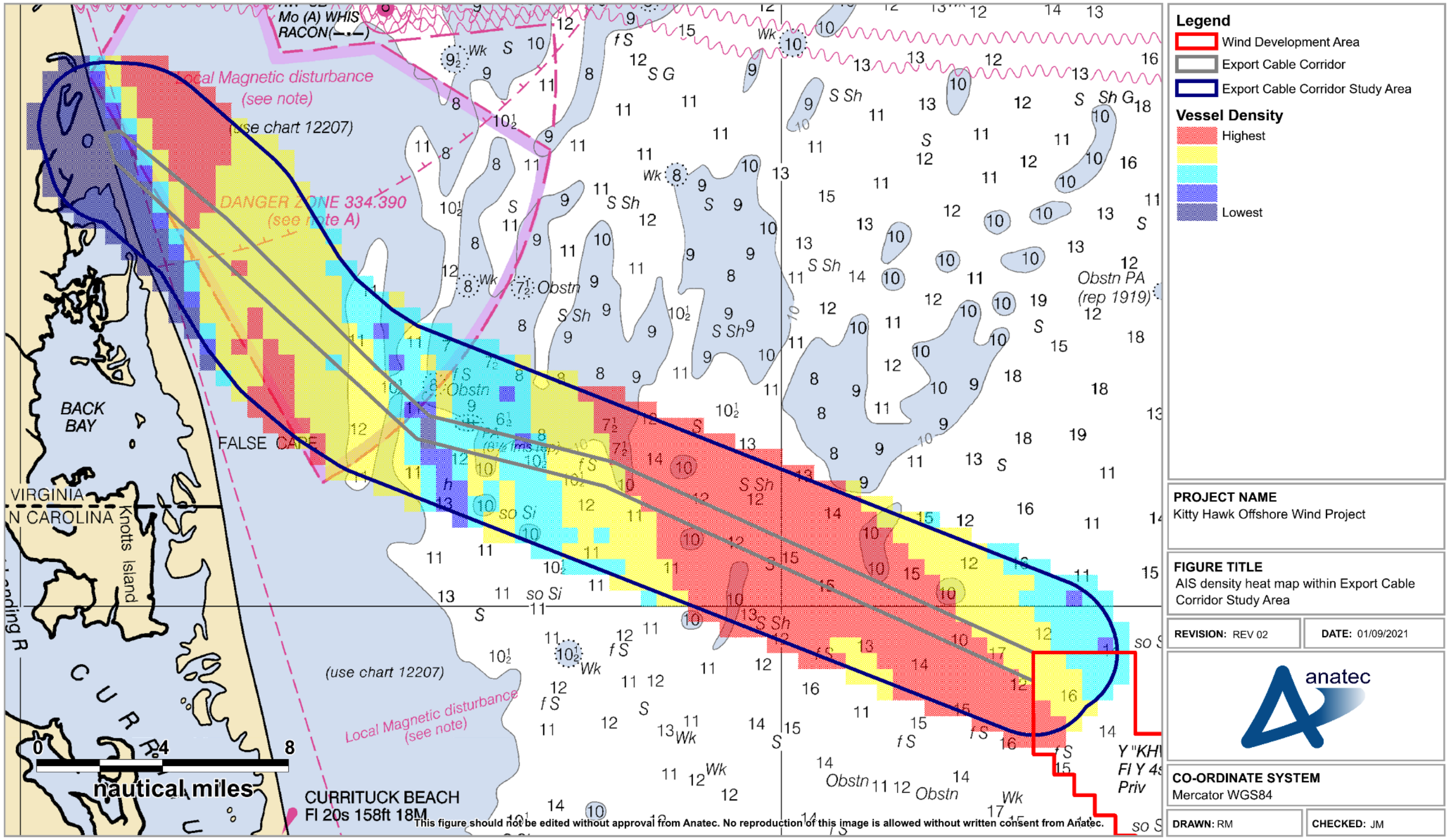

Figure 6.30 AIS density heat map within export cable corridor study area (12 months January to December 2019)

6.6.2 Vessel Draft

In the year of AIS data analyzed within the export cable corridor study area, approximately 21% of vessels recorded did not broadcast a valid draft via AIS. This included all Class B vessels (since draft data is not available for Class B) and a minority of Class A vessels. The vessel tracks broadcasting a valid draft within the export cable corridor study area are presented in Figure 6.31.

Excluding those vessels not broadcasting a valid draft (generally smaller vessels), the average draft recorded within the export cable corridor study area was 25 ft (7.6 m). The deepest draft recorded in the export cable corridor study area was 48 ft (15 m), recorded 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 15 ft [4.6 m]) with deeper-drafted vessels only observed further offshore to utilize the Deep Water Route in the Southern Approach of the Chesapeake Bay IMO routing measure.

6.6.3 Anchored Vessels

Vessels at anchor within the export cable corridor study area have been identified using the methodology described in Section 6.2.3.8.

After applying these criteria, three vessels (two military vessels and one cargo vessel) were deemed to be at anchor, as shown in Figure 6.32, with one located within the export cable corridor.

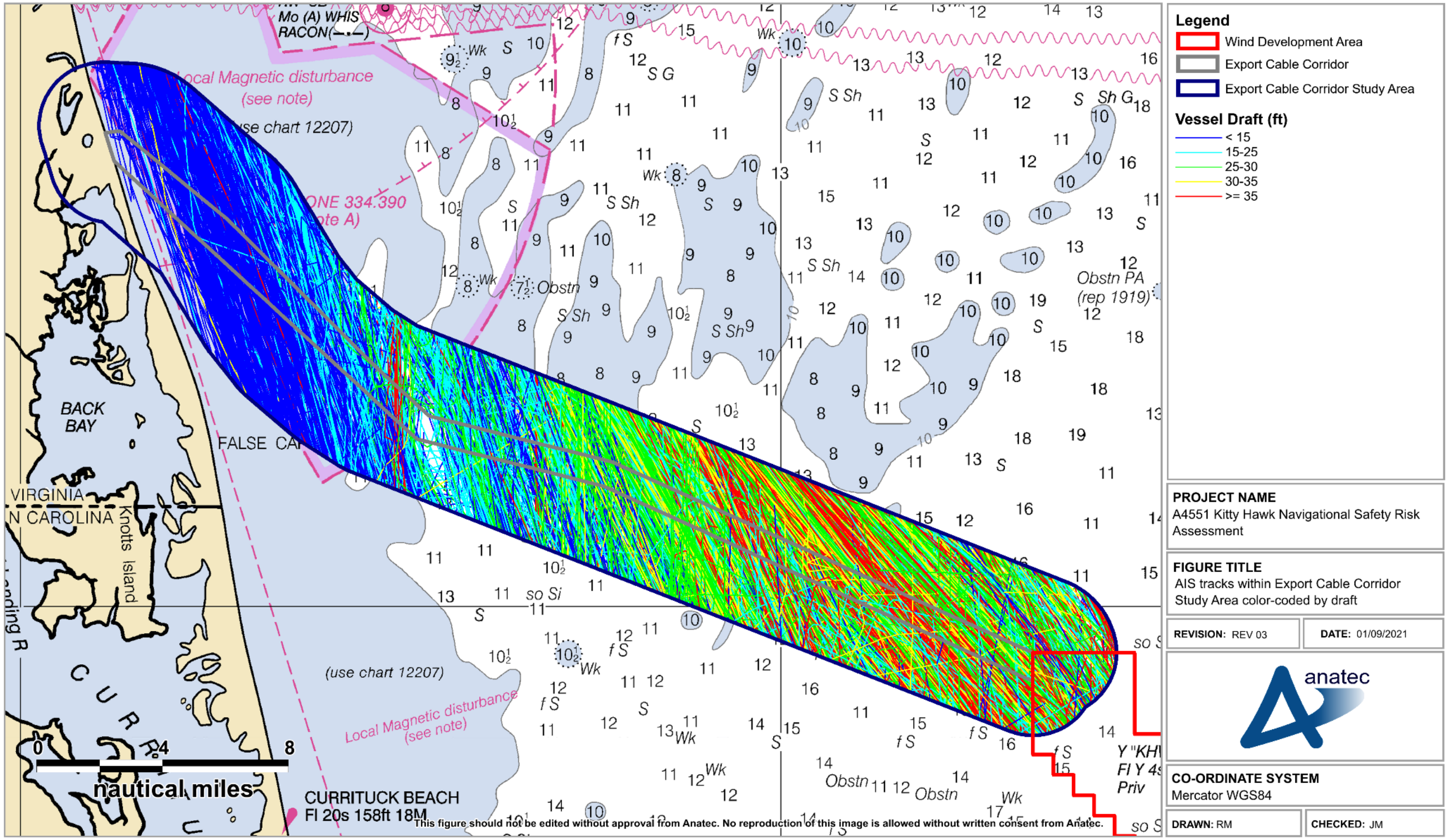

Figure 6.31 AIS tracks within export cable corridor study area color-coded by draft (excluding unspecified)

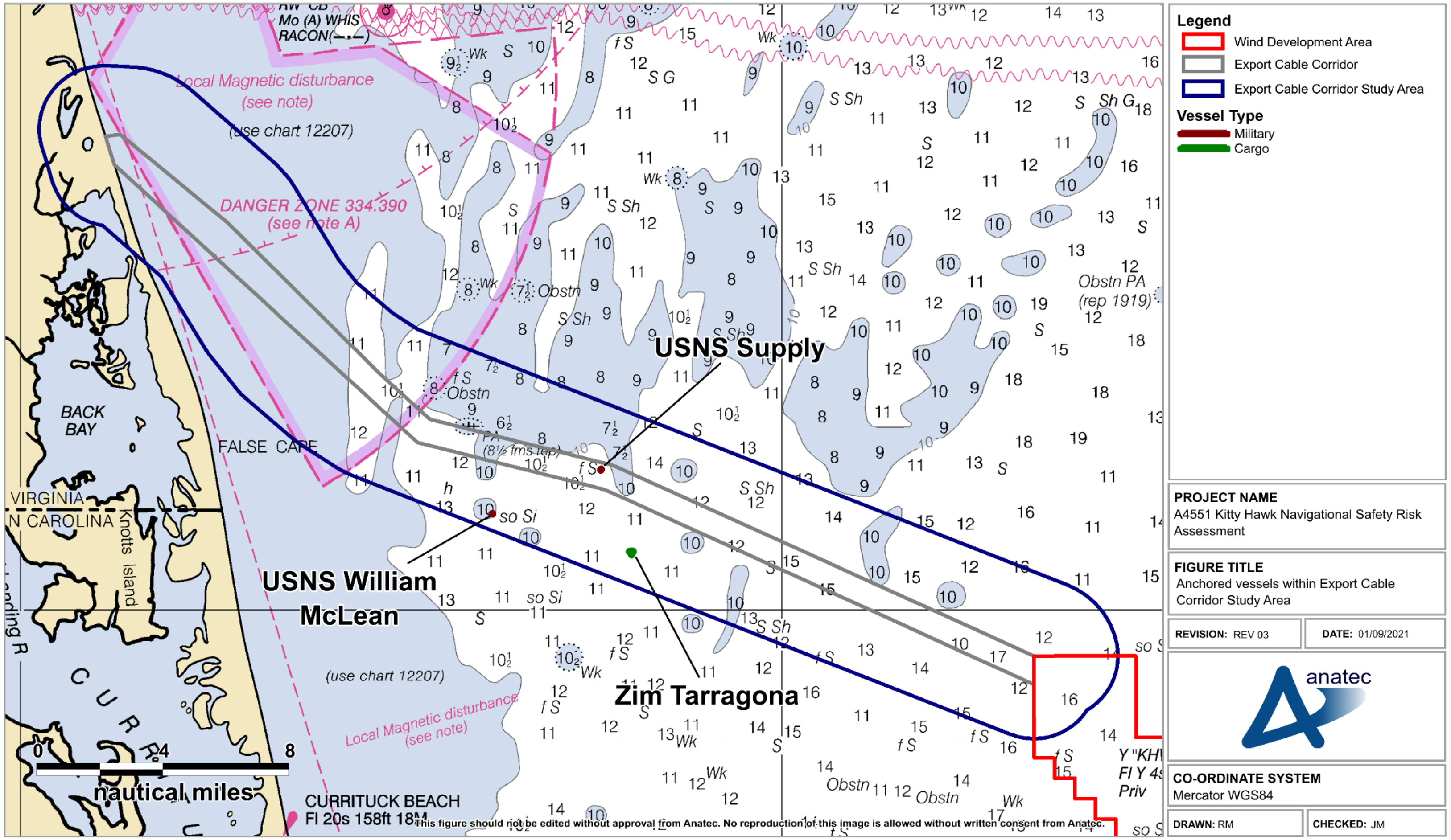

Figure 6.32 Anchored vessels within export cable corridor study area

6.7 Future Case Maritime Traffic

The current level and nature of vessel traffic as outlined in previous sections is considered to be the base case scenario within the collision, allision and grounding risk modelling (see Section 1). This subsection outlines the level and nature of vessel traffic anticipated for the future case scenario. This involves estimating the potential growth in shipping movements and traffic types as well as any foreseeable changes in the marine environment relevant to the Project.

6.7.1 Increases in Commercial Vessel Activity and Military Vessel Activity

From 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). Additionally, the Port of Virginia noted during consultation that recent industry trends indicate that coal exports from ports in the area are decreasing. Nevertheless, the Port of Virginia suggested that 5% and 10% increases in containership activity would represent a conservative assumption on vessel traffic growth, noting that container growth often relates to larger and therefore fewer vessel movements overall.

Given the uncertainty associated with long-term forecasting of vessel traffic growth, including the potential for any major new developments in U.S. ports, two conservative and independent scenarios of potential growth in commercial shipping movements of 10% and 20% have been applied directly to the base case as a set increase of traffic volume. For the purposes of the future case, these potential growth values have been applied to dry bulk, wet bulk, vehicle carriers and containerized cargo vessels, passenger vessels, marine aggregate dredgers and push/pull (tug) vessels, as well as military vessels.

This increase is in line with the assessment of other renewable developments, is aligned with the suggestion from the Port of Virginia (noting that the 10% and 20% growth is applied to all commercial vessels and not just containerships), and was considered reasonable by the VMA and Virginia Pilot Association during consultation. With the trends outlined above considered, these assumptions are considered highly conservative and in reality future case traffic growth fluctuates up and down depending on seasonality and cargo and industry trends.

6.7.2 Increases in Commercial Fishing Vessel Activity

Due to the large number of direct and indirect factors and the level of AIS coverage for fishing vessels, there is uncertainty associated with the long-term forecasting of vessel traffic growth. Therefore, again to ensure a conservative approach, a 10% and 20% growth in transiting fishing vessel movements has been considered. 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 7.2 of the COP, Commercial and Recreational Fishing).

6.7.3 Increases in Recreational Vessel Activity

There are no major developments currently known of which may impact the activity of recreational vessels in the study area i.e., yachts, motor cruisers. Therefore, based on the discussion presented, no notable growth in recreational vessel movements has been considered, noting that recreational vessels have not been quantitatively modelled in Section 1 but future case scenarios have been considered in Section 15.

It is noted that there could 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 Project is sited, it is expected that greater increases in recreational vessel activity in the study area would be associated with favorable weather conditions.

6.7.4 Methodology for Commercial Traffic Routing

Following construction of the Project, commercial vessels will likely have to deviate around the array. This is supported by the WSC which suggested that its members will stay well clear of the array and not navigate internally within the array. It is not possible to consider all options and so 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. It is not anticipated that any changes to vessel emission requirements will result in variations to routing patterns in proximity to the Wind Development Area.

Given the proximity of the Wind Development Area to a deep draft route forming part of the ACPARS fairways, as shown in Figure 6.33, these have been incorporated into the post wind facility commercial traffic routing[13]. The full width of the deep draft route (approximately 6.4 nm [12 km]) has been utilized for those routes deviated along the deep draft route, irrespective of the width of the route in the pre wind facility scenario. This methodology ensures that a worst case is under consideration for the assessment of allision risk due to the Project. It is noted that as per consultation with the USCG (see Section 3.1), the ACPARS fairways as illustrated in Figure 6.33 are inclusive of a safety margin within which surface infrastructure should not be located and no blade overfly should be allowed.

[13] It is noted that no offshore wind structure will be placed within the overlap between the Wind Development Area and the ACPARS deep draft route.

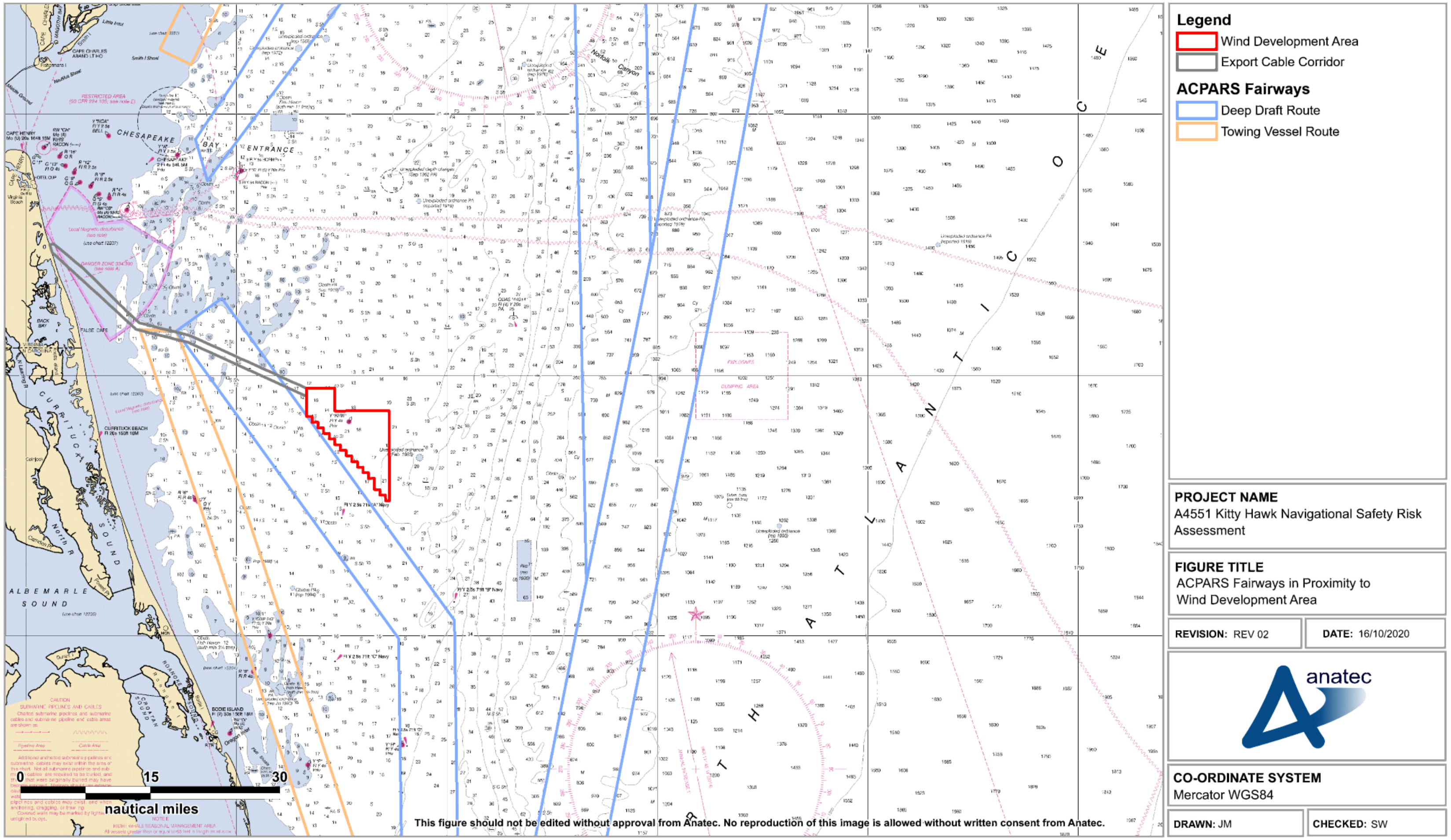

Figure 6.33 ACPARS fairways in proximity to Wind Development Area

Internal and external studies undertaken by Anatec at a number of offshore wind facilities 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 established offshore wind facilities 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 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 Wind Development Area has been assumed when re-routing commercial traffic around the array.

This methodology for the re-routing of commercial traffic is applicable to the assessment of cumulative routing post wind facility in addition to the Project in isolation scenario.

6.7.5 Post Atlantic Coast Port Access Route Study Scenario

As noted in Section 6.7.4, the proposed ACPARS fairways have been incorporated into the post wind facility commercial traffic routing. 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 some of the re-routing considered in Section 11.3 is a consequence of this scenario (i.e., the presence of the proposed ACPARS fairways) rather than the presence of the Project. This has been acknowledged where appropriate in Section 11.3.

7 Facility Characteristics

It is noted that the specific locations of lighting and marking features (where not applied across all WTGs) have not been determined given that a final array layout has not yet been determined. However, as stated the Company will comply with BOEM's lighting and marking guidance subject to final design decisions and where required will work with USCG, BOEM, and the FAA to achieve equivalent levels of aids to navigation safety performance if the 2021 guidance is not practical given final design.

Offshore wind structures associated with the Project will be lit and marked in line with the guidance provided in COMDTINST M16500.7A (A*ids to Navigation Manual*) (USCG, 2015) and will also comply with *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020) and the *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM, 2021).

WTG and general array characteristics applied in order to satisfy the USCG guidance includes the features outlined in this section. In addition, the offshore wind structures will also comply with Federal Aviation Administration (FAA) requirements, namely the appropriate lighting of structures exceeding 200 ft (61 m) height.

This process will cover:

- Marine lighting;
- Aids to navigation;
- Aviation lighting; and
- Safety markings such as paint colors.

As a minimum, the Project will:

- Be marked as an offshore wind farm with relevant structures marked as Significant Peripheral Structures (SPS) and intermediate Peripheral Structures (IPS).
- Be marked during construction, any temporary incomplete offshore wind structures will be marked with quick yellow obstruction lights.
- Consider the following aids to navigation for WTGs/ESP:
  - Marking with Racons;
  - Additional use of Radar reflectors and Radar target enhancers;
  - Sound signals; and
  - AIS.
- Have aeronautical obstruction lights that are compatible with night vision imaging systems.
- Have visual aids to support hover referencing which will be applied as per FAA, USCG and BOEM requirements.
- Be marked during the construction and/or operation and maintenance phases by navigational buoyage (as required/agreed).
- Have a unique alphanumeric marking scheme which will be determined in coordination with the USCG and will follow the rows of the array where possible; and
- Have air draft values which will be marked on the WTGs.

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 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 (QinetiQ and MCA, 2004). 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) when operated close to offshore wind structures.

The offshore wind structures had no noticeable effect on voice communications within the wind facility 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 SAR trials carried out at North Hoyle (MCA, 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 facility and communications were reported as very clear, with no apparent degradation of performance. Communications with the service vessel located within the wind facility were also fully satisfactory throughout the trial.

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

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

Taking into consideration these reports and the absence of any reported issues at existing developments, the Project is anticipated to have no significant impact upon VHF communications.

8.2 Very High Frequency Direction Finding

During the North Hoyle Offshore Wind Farm trials, the VHF Direction Finding (DF) equipment carried in the trial boats did not function fully when very close to WTGs (within 164 ft ([50 m]). This is deemed to be a relatively small-scale impact due to the limited use of VHF DF equipment and the fact that interference occurs within the rotor sweep area and will therefore have no impact on operational or SAR activities (QinetiQ and MCA, 2004).

Throughout the 2005 SAR trials carried out at North Hoyle, the Sea King radio homer system was tested. The Sea King[14] 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 target vessel within the array, 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 offshore developments.

Taking into consideration these reports and the absence of any reported issues at existing developments, the Project is anticipated to have no significant impact upon VHF DF.

8.3 Rescue 21

Rescue 21 is the USCG command, control and DF communications system. The system includes:

- DF capability that provides SAR responders with lines of bearing to vessels in distress;
- Digital Selective Calling support, which allows mariners with Digital Selective Calling 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 Digital Selective Calling equipped vessels; and
- Automated transmission of urgent marine information broadcasts.

Figure 8.1 presents the line of sight coverage for the Rescue 21 system in proximity to the Project location.

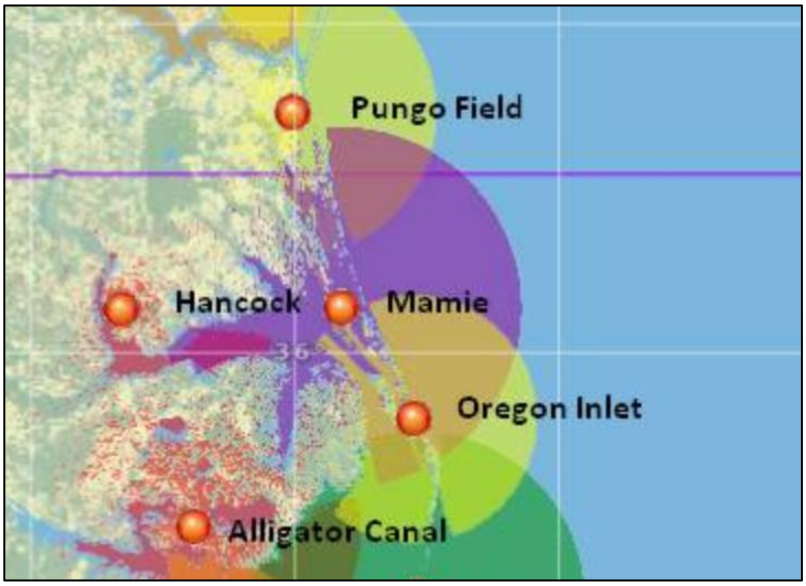

Figure 8.1 Rescue 21 regional coverage of VHF antennas based on geographical line of sight (USCG)

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

The Project is primarily covered by the shore-based antenna at Mamie, NC, noting that given the distance of the Project offshore there may not be comprehensive coverage of the Wind Development Area.

Given that the Rescue 21 system is VHF based and no adverse effects have been found with regard to VHF use (see Section 8.1), there is not anticipated to be any impact on Rescue 21 systems during or following the construction of the Project.

8.4 Automatic Identification System

No significant issues with interference to AIS transmission from offshore wind facilities has been observed or reported at existing developments to date, including the trials undertaken at North Hoyle (QinetiQ and MCA, 2004).

In theory there could be interference when there is a structure located between the transmitting and receiving antennas (i.e., blocking the line of sight) of the AIS. However, with no such issues reported at existing developments to date, 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 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, the international channel, are in English. NAVTEX 518 Kilohertz 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 including Chesapeake, VA.

Although no specific trials have been undertaken, no significant effect on NAVTEX has been noted at existing developments and therefore no effects are expected to arise due to 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 and it was stated that “*no problems with basic GPS reception or positional accuracy were reported during the trials*” (QinetiQ and MCA, 2004).

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*’.

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 throughout the world.

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 is currently in use outside of the U.S.

Based on technology used for Loran it is assumed that since similar systems are not expected to be impacted by the array 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.

Export and inter-array cables for the Project will be alternating current. Studies indicate that alternating current does not emit an electromagnetic field 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 undertaken (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 (QinetiQ and MCA, 2004).

8.9 Marine Radar

Summaries of trials and studies undertaken in relation to Radar effects from offshore wind facilities in the UK and U.S. are provided in the following subsections. It is important to note that since the time of the discussed trials and studies, WTG 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 a greater minimum spacing than 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.

8.9.1 UK Trials

During the early years of offshore renewables in 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.

Trials undertaken at North Hoyle (QinetiQ and MCA, 2004) identified areas of concern regarding the potential impact on marine and shore-based Radar systems due to the large vertical extent 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. 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, as illustrated in Figure 8.2.

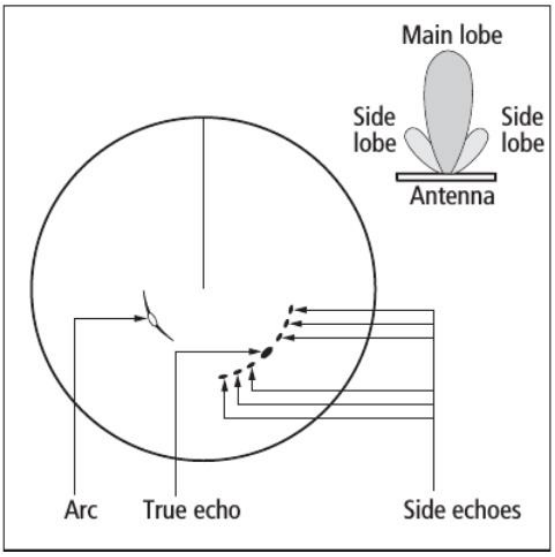

Figure 8.2 Side lobes

Multiple reflected echoes are returned from a real target by reflection from some object in the Radar beam. 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, as illustrated in Figure 8.3.

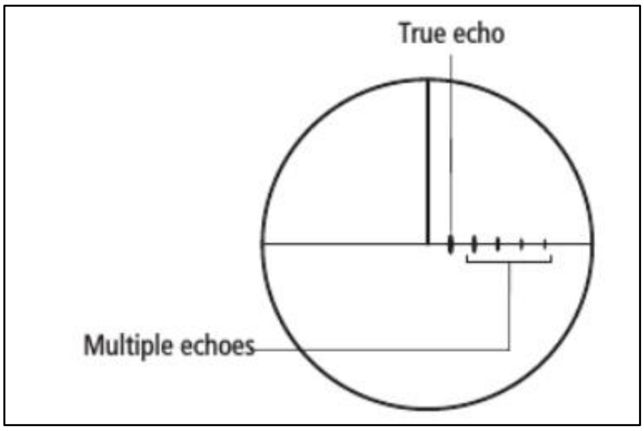

Figure 8.3 Multiple reflected echoes

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 facilities – noting it is intended not 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 offshore wind facilities has grown, the MCA have refined their guidance, offering more flexibility within the most recent version contained in MGN 654 (MCA, 2021). MGN 654 has been used within this NSRA to assist consideration of Radar impacts given that the U.S. guidance does not yet have specific detail.

A second set of trials conducted at the Kentish Flats Offshore Wind Farm in 2006 (British Wind Energy Association, 2007) also found that Radar antennas which are sited unfavorably with respect to elements of the vessel's 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, UK, on marine Radar systems (Atlantic Array, 2012) considered a wider spacing of offshore wind structures 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 offshore wind structures and safe navigation.
- Even in the maximum design scenario with Radar operator settings artificially set to be poor, there was significant clear space around each offshore wind structure that did 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 was 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 8.1) between the offshore wind structures in order to minimize the effect of multipath and other ambiguities.
- The potential Radar interference was 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 not broadcasting on AIS which are usually fishing vessels and recreational craft).
- The performance of a vessel's Automatic Radar Plotting Aid 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 facilities 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 such as 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 buffers presented in Table 8.1 are based on primarily on MGN 654 (MCA, 2021) but also consider the content of MGN 371 (MCA, 2008), MGN 543 (MCA, 2016) and MGN 372 (MCA, 2008). This information has been used given that U.S. guidance does not contain specific information relating to Radar interference. It is noted that this information is intended to be used on a case-by-case basis noting that since these trials were undertaken spacing within offshore wind facilities has increased.

Table 8.1 Distances at which impacts on marine Radar occur

Distance at Which Effect Occurs (nm)	Identified Effect
0.5	▪ Intolerable impacts can be experienced at under 0.5 nm. ▪ X-Band Radar interference is intolerable under 0.25 nm (0.46 km). ▪ Vessels may generate multiple echoes on shore-based Radars under 0.45 nm (0.83 km)
1.5	▪ Under MGN 654, impacts on Radar are considered to be tolerable with mitigation between 0.5 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 around 1.5 nm (2.8 km), with progressive deterioration in the Radar display as the range closes. Where a main vessel route 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 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 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, 2017).

For the purposes of SAR within the array 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 Trials

A simulation study into effects of OREI on marine Radar was commissioned by the USCG (USCG, 2008) for the purpose of assessing navigational safety impacts associated with the Cape Wind Project. The study concluded that while all targets within an offshore wind facility 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 array.

8.9.3 Experience from Existing Developments

The evidence from mariners operating in the vicinity of existing offshore wind facilities 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 Offshore Wind Farm and Greater Gabbard Offshore Wind Farm in the UK, relative to the nearby Sunk TSS. Despite the proximity of these existing developments to the TSS, there have been no reported incidents or issues raised by mariners who operate in the region. The interference 'areas' presented in Figure 9.4 are as per the information provided in Table 8.1.

Figure 8.4 Illustration of potential Radar interference at Galloper and Greater Gabbard

As indicated by Figure 8.4, vessels utilizing the Sunk TSS East will experience some Radar interference based on the available guidance. Both projects are operational, and each of the Sunk TSS East lanes is used by 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.

AIS information can also be used to verify the targets of larger vessels (generally vessels above 65 ft (20 m) 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 2% of the vessel traffic recorded within the Wind Development Area study area was below 65 ft (20 m) length, and approximately 1% within the Wind Development Area itself. There are increasing numbers 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 an offshore wind facility.

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 will not create any effects in addition to those already identified from existing developments (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 Offshore Wind Facility

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

8.10 Sound Navigation Ranging Systems

No evidence has been found to date with regard to existing offshore wind facilities 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 an offshore wind facility at a distance of 1,150 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 due to the Project.

There are therefore no indications that the sound level of the Project will have a significant influence on marine safety, including the ability of the USCG to undertake rescue missions and the health of vessel crews.

8.11.2 Underwater Noise

Increases in underwater noise associated with the construction or decommissioning phases will be temporary and mitigated as required.

During the operation and maintenance phase of the Project, the subsea noise levels generated by WTGs are not anticipated to have any significant impact as they are designed to work in pre-existing noisy environments, noting that a robust underwater noise assessment is being undertaken (see Section 4.5 of the COP and Appendix P to the COP).

8.12 Existing Aids to Navigation

Aids to navigation identified within the vicinity of the Wind Development Area are shown in Figure 5.4. Excluding the surface buoy platform associated with the Project, the only aid to navigation within 5 nm (9.2 km) of the Wind Development Area is Navy Tower Light A. There are no navigational buoys within 10 nm (18.5 km) and the Wind Development Area is therefore anticipated to have no associated impact on offshore aids to navigation. Likewise, given the distance of the Wind Development Area offshore there is not anticipated to be any associated impact on onshore aids to navigation.

On the contrary, it is noted that the array itself will form an aid to navigation given its lighting and marking. PATONs will be submitted to the USCG at appropriate stages of the Wind Development Area buildout.

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	No anticipated impacts. Not impacted by array layout design.	Screened out	Screened out
	VHF DF	No notable degradation and therefore no anticipated impacts. Not impacted by array layout design.	Screened out	Screened out
	Rescue 21	No anticipated impacts. Not impacted by array layout design.	Screened out	Screened out
	AIS	No anticipated impacts. Not impacted by array layout design.	Screened out	Screened out
	NAVTEX	No anticipated impacts. Not impacted by array layout design.	Screened out	Screened out
	GPS	No anticipated impacts. Not impacted by array layout design.	Screened out	Screened out
Electromagnetic fields	Subsea cables	No anticipated impacts. Not impacted by array layout design.	Screened out	Screened out
	WTGs	No anticipated impacts. Not impacted by array layout design.	Screened out	Screened out
Marine Radar	Use of marine Radar	Vessels have sufficient sea room to distance themselves from the array in line with the "*Shipping Route Template*" to mitigate any effects.	Screened out	Screened out
Noise	WTG generated noise	No anticipated impacts. Not impacted by array layout design.	Screened out	Screened out
	Sound Navigation Ranging System	No anticipated impacts. Not impacted by array 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 U.S. 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 and Sector North Carolina) 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 Wind Development Area (and therefore deemed relevant to the Project) are shown in Figure 9.2.

The closest USCG station to the Wind Development Area is Air Station Elizabeth City located approximately 36 nm (67 km) to the west. 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 9.1. The Jayhawk operates at speeds between 125 and 140 knots and has a range of 300 nm (556 km).

Figure 9.1 Photo of MH-60T Jayhawk helicopter (USCG, 2016)

The closest small boat station to the Wind Development Area is Oregon Inlet located approximately 34 nm (63 km) to the south west.

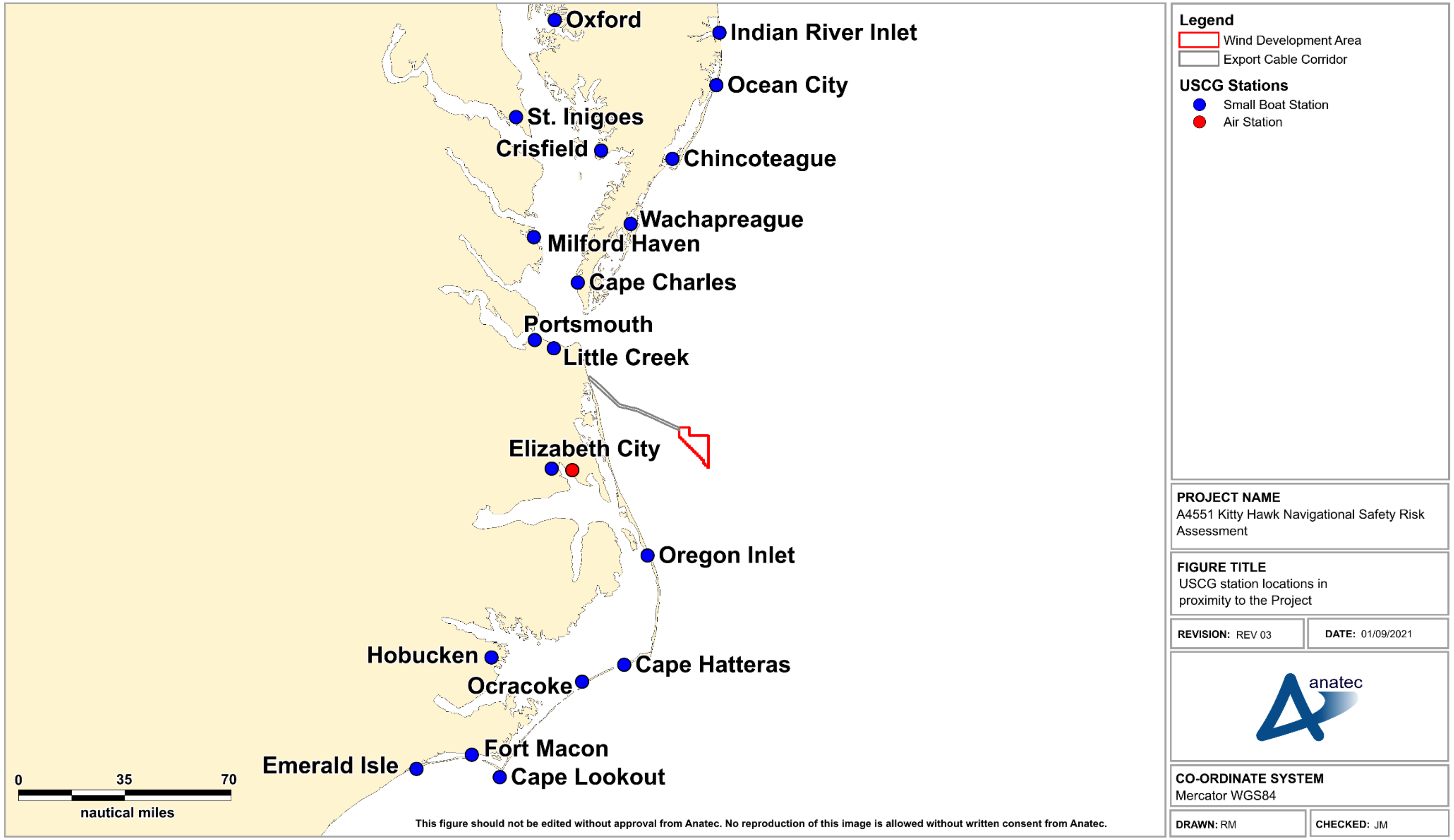

Figure 9.2 USCG station locations in proximity to the Project

9.1.2 Search and Rescue Incident Response

The locations of SAR incidents (where a location was identifiable) within the Wind Development Area and export cable corridor study areas 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 Wind Development Area and export cable corridor study areas ensure that incidents defined outside of the Wind Development Area and export cable corridor but which may have involved some degree of search within said areas are accounted for.

A total of six responses to SAR related incidents were recorded between 2010 and 2019 within the Wind Development Area study area, none of which were located within the Wind Development Area itself. Five of the incidents involved vessel malfunctions, with the other involving an injury to personnel.

Within the export cable corridor study area, a total of three SAR incidents were recorded between 2010 and 2019, none of which were located within the export cable corridor itself. Two of the incidents involved vessel malfunctions, with the other involving an injury to personnel.

9.1.3 Pollution Incident Response

The locations of pollution incidents within the Wind Development Area and export cable corridor study areas 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.

Two responses to pollution related incidents were recorded between 2010 and 2019 within the Wind Development Area study area, neither of which occurred within the Wind Development Area itself. One incident involved an oil spill and was not treated as a serious incident; the other was a serious incident occurring in 2018, in which a large number of containers including one carrying sulfuric acid fell from a containership travelling between Norfolk, VA and Charleston, SC (Maritime Executive, 2018). Aircraft crews – including from Air Station Elizabeth City – were sent to conduct a search for the container.

Within the export cable corridor study area, one response to a pollution related incident was recorded between 2010 and 2019 within the export cable corridor study area, outside the export cable corridor itself. The incident involved an oil spill.

9.1.4 Collision, Allision and Grounding Incidents

The locations of collision, allision and grounding incidents within the Wind Development Area and export cable corridor study areas responded to by the USCG between 2010 and 2019 are shown in Figure 9.5.

No collision, allision or grounding incidents were recorded between 2010 and 2019 within the Wind Development Area study area.

One incident was recorded between 2010 and 2019 within the export cable corridor study area, relatively close to shore, involving a collision which resulted in a vessel taking on water. This incident involved one injury to a person and the actual total loss of a vessel.

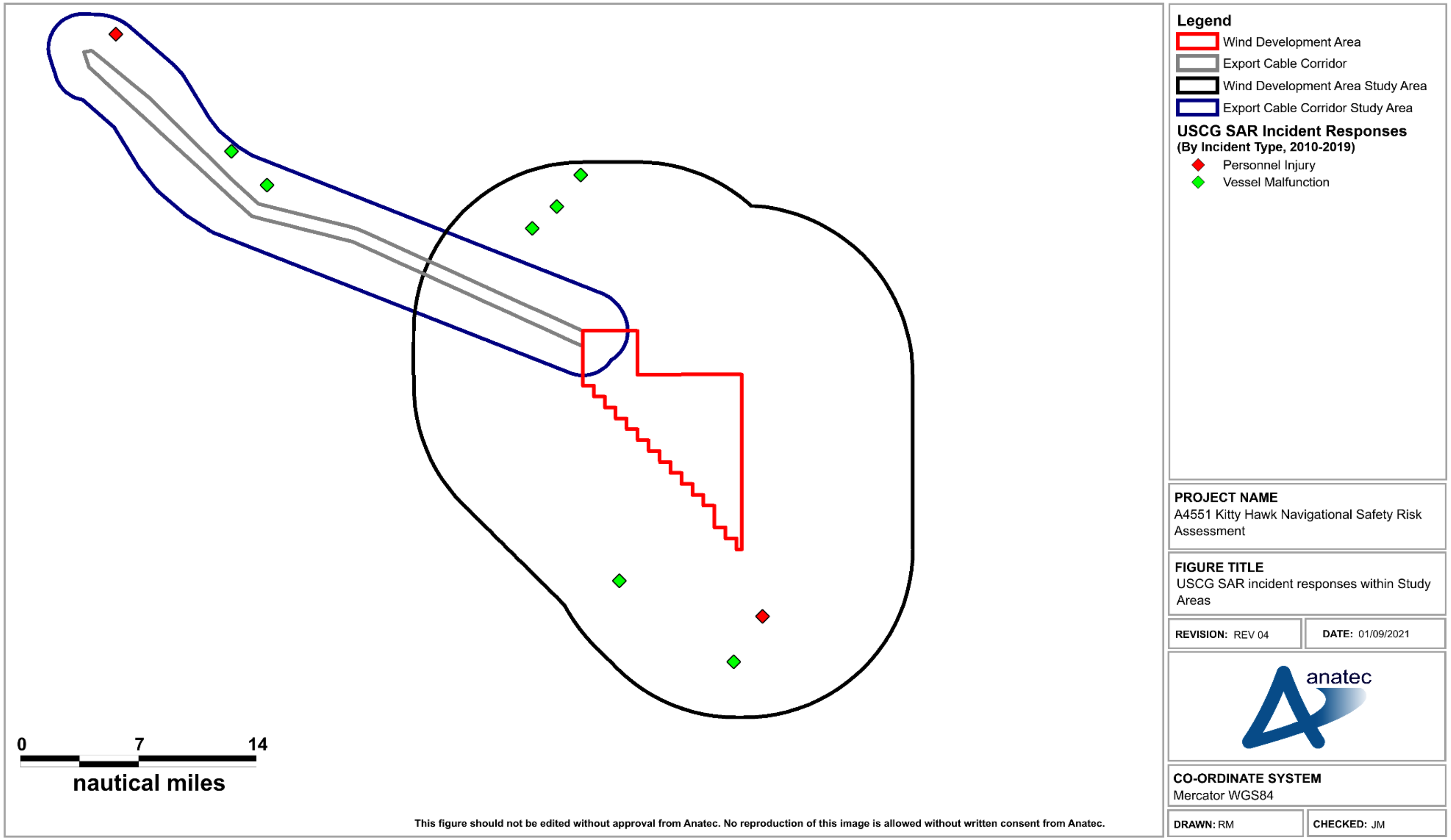

Figure 9.3 USCG SAR incident responses within Wind Development Area and export cable corridor study areas (MISLE, 2010 to 2019)

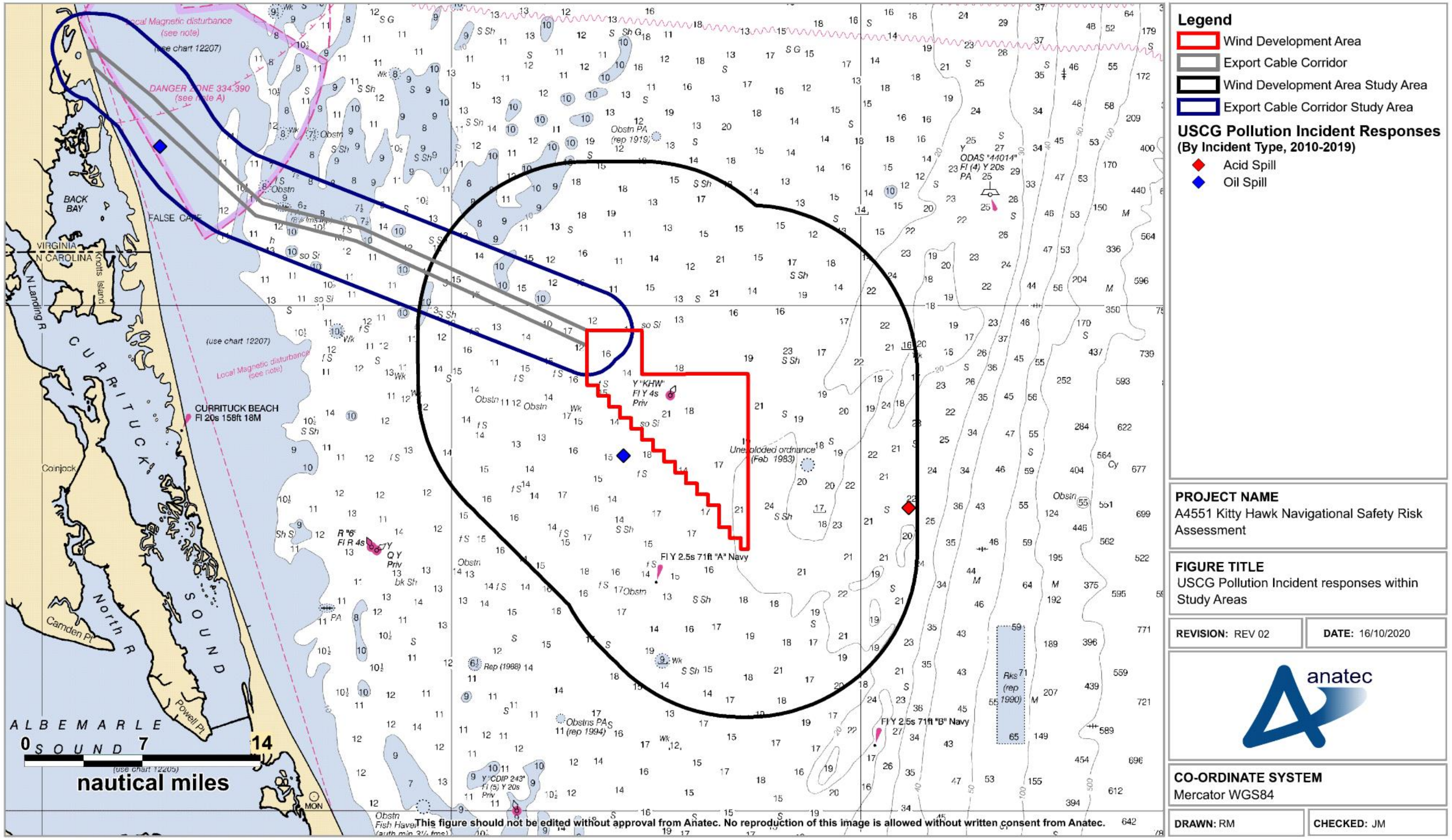

Figure 9.4 USCG pollution incident responses within Wind Development Area and export cable corridor study areas (MISLE, 2010 to 2019)

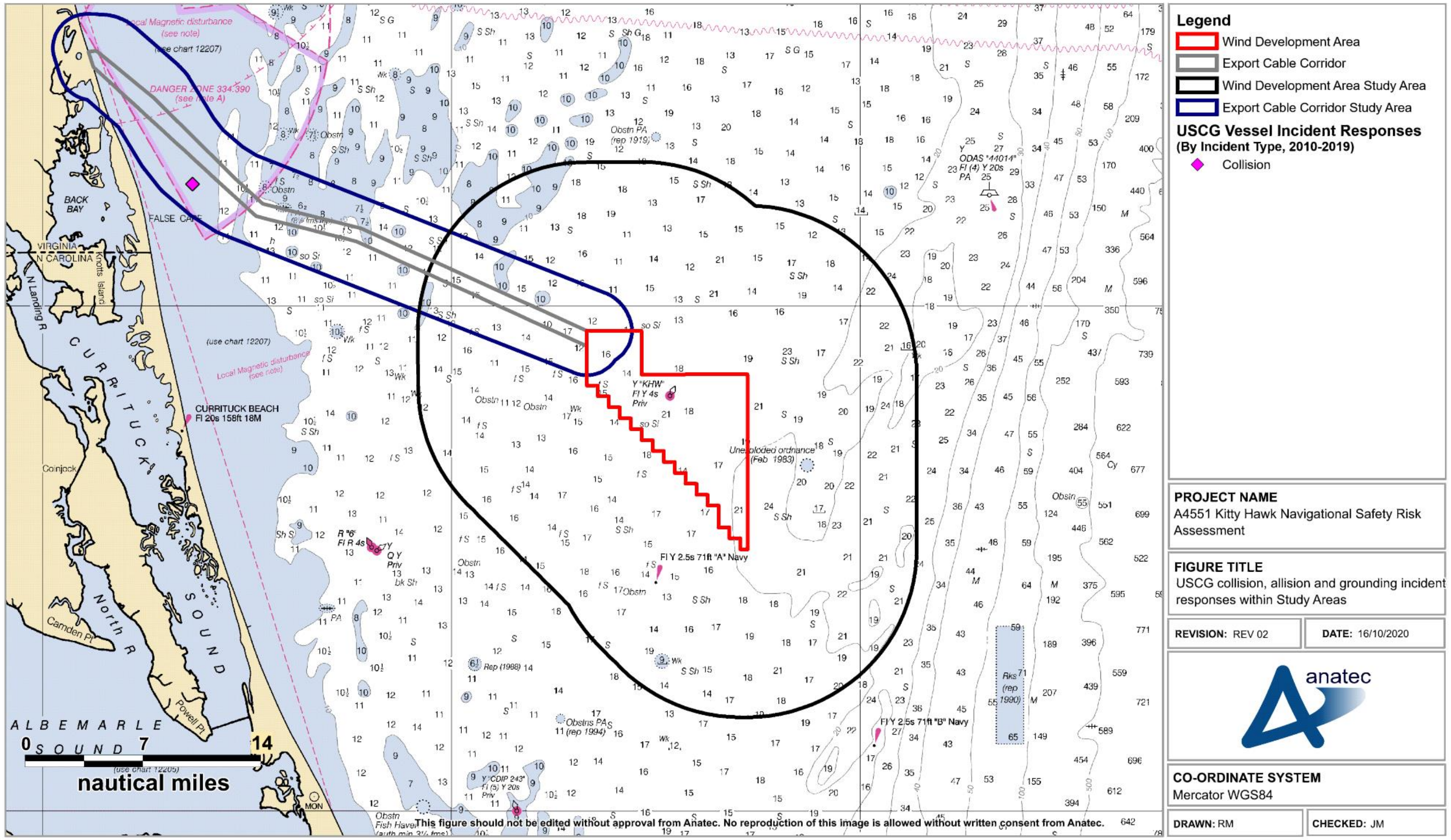

Figure 9.5 **USCG collision, allision and grounding incident responses within Wind Development Area and export cable corridor study areas (MISLE, 2010 to 2019)**

9.2 Historical Offshore Wind Facility Collision and Allision Incidents

9.2.1 United Kingdom

As of September 2021, 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 2020). These developments consist of approximately 16,600 fully operational WTG years (including years for now decommissioned developments).

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

To date there have been nine reported[15] 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 1,850 years per WTG allision incident in the UK[16], noting that this is a conservative value given that only 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 facility 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 that occurred near the Block Island Offshore Wind Farm, the only currently operational offshore wind facility in the U.S. 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 facility, it is understood from a review of publicly available information that a case study was/is

[15] Reported to an accident investigation branch or an anonymous reporting service. Unconfirmed incidents have not been considered noting that to date only one further alleged incident has been rumoured but there is no evidence to confirm.
[16] As of 01 Sep 2021.

undertaken by the USCG to determine if the presence of the wind facility 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 Cumulative Development Screening

Prior to the assessment of the cumulative effect by impact, it is necessary to determine the degree to which each cumulative feature in the region should be considered. Table 10.1 presents details of the cumulative developments including assigned tiers based on the methodology outlined in Section 2.2. Following this, Figure 10.1 presents the location of the cumulative developments relative to the Project, color-coded by tier. It is noted that there are no potential developments located south of the Wind Development Area.

As per Section 2.2, no planned areas of use other than offshore wind development areas have been identified.

Table 10.1 Screened in cumulative developments and associated tiers

Development	Lease Area	Lease Area Status	Development Status*	Distance from Wind Development Area (nm)	Data Confidence	Tier
Kitty Hawk Rest of Zone	OCS-A 0508	Active	Not submitted	0	High	1
CVOW Commercial	OCS-A 0483	Active	Submitted	21	High	1
CVOW Pilot	OCS-A 0497	Active	Operational	25	High	1
MarWin	OCS-A 0490	Active	Submitted	109	High	2
Skipjack	OCS-A 0519	Active	Submitted	125	High	2
Garden State Offshore Energy	OCS-A 0482	Active	Not submitted	130	High	2

(*) As of 01 Sep 2021.

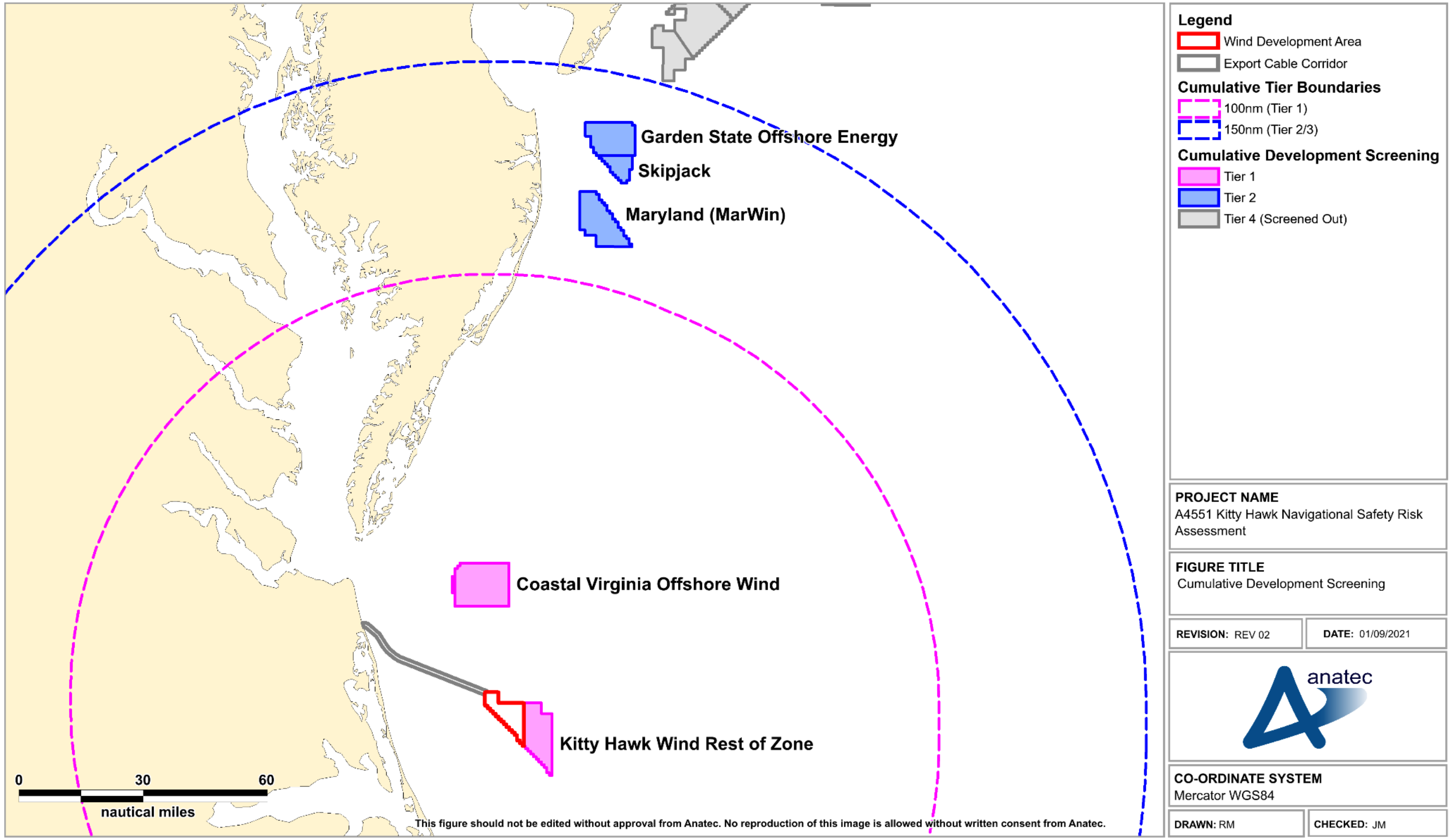

Figure 10.1 Cumulative development screening

11 Collision, Allision and Grounding Risk Modelling

This section provides a quantitative assessment of potential interactions associated with the development of the Project. A base case and future case assessment 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 is only one part of the NSRA, and feeds into the qualitative assessment introduced in Section 12. Given that 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 makes potential vessel traffic growth assumptions as per Section 1.1.

Quantitative assessment results are generally reported as a return period (i.e., expected number of years between occurrences[17]), although Section 11.4 also reports the annual frequency (i.e., number of expected occurrences per year, the inverse of the return period). This is a standard method of presenting the results of NSRA modelling relating to offshore installations.

11.1 Pre Wind Facility

11.1.1 Encounters

This section presents a quantitative assessment of encounter levels within the vicinity of the Wind Development Area, based on modelling of one year of AIS data (see Section 6.2).

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. On this basis, the program checks the position of each AIS transmission for any further transmissions from other vessels recorded at positions within 1 nm (1.9 km) and within 60 seconds. Where any such instance is identified, the program extracts all associated transmissions from the associated vessels.

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.

[17] 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.

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. 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). On this basis, encounters caused by the likes of dual towing operations (i.e., towing operations involving two push/pull (tug) vessels) have been removed. Where there was any doubt as to whether or not an encounter should be classed as genuine, it has been retained.

The output of the Encounters program is shown in Figure 11.1, in the form of an encounter density heat map within the Wind Development Area study area.

There was an average of approximately one encounter every three days[18] observed throughout the survey period. There was only one day on which more than one encounter was observed, this being 30 Jul 2019 with two unique encounters; these involved a tanker encountering a military vessel and two military vessels encountering one another.

Overall, cargo vessels (76%) were the most frequent type of vessel involved in an encounter, followed by military vessels (13%). Encounters were primarily located in the western half of the Wind Development Area study area.

11.1.2 Vessel to Vessel Collision Risk

To assess vessel to vessel collision risk pre wind facility, the main routes identified (see Section 6.3.1.1) 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. 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.

Following the running of the model, Figure 11.2 presents the vessel to vessel collision risk heat map within the Wind Development Area study area.

[18] It is noted that the same two vessels may encounter each other on multiple occasions on the same day whereas the vessel count used in Section 6.2.1 only considered a vessel once per day irrespective of the number of tracks (to avoid over reporting).

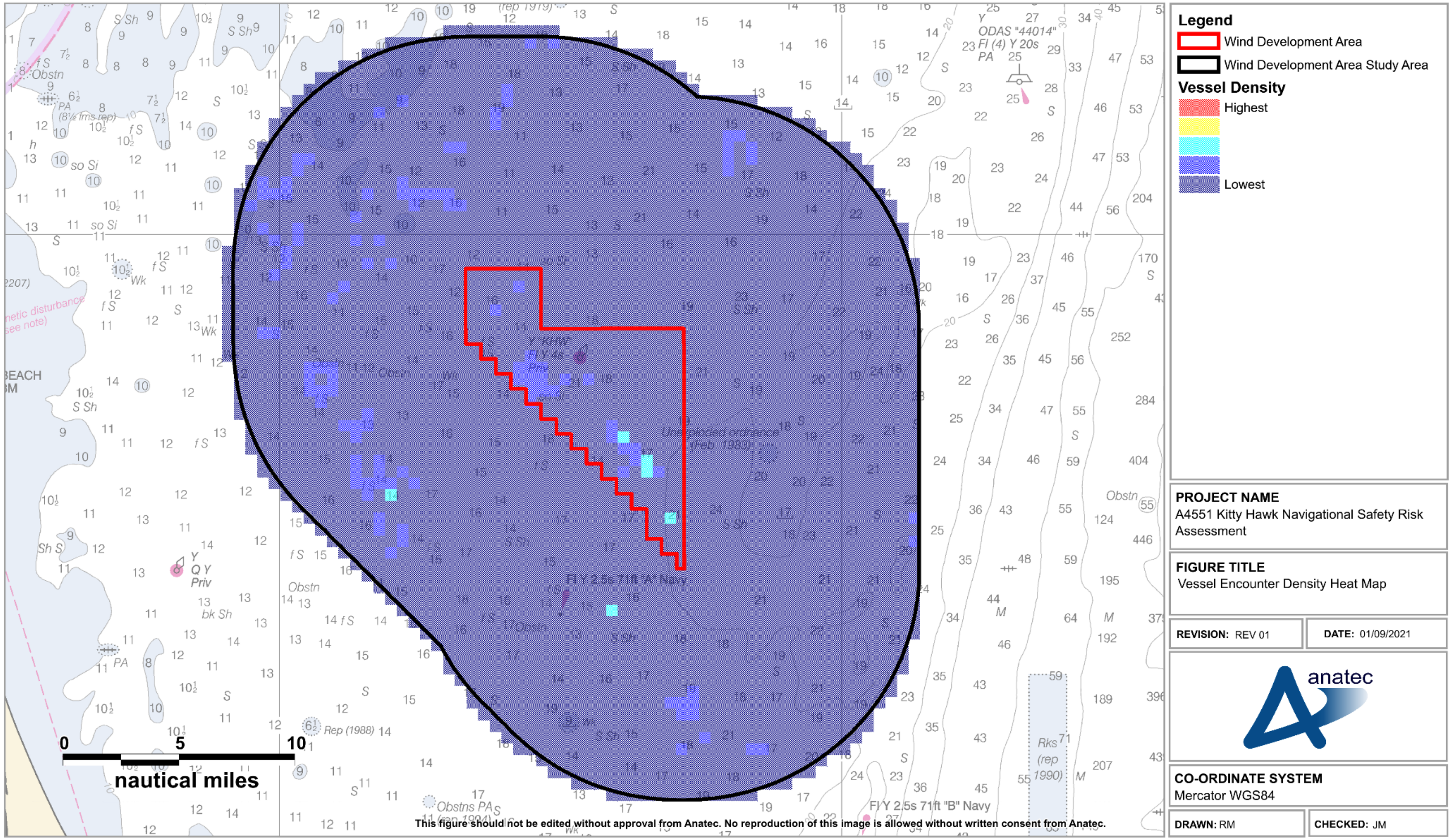

Figure 11.1 Vessel encounter density heat map within Wind Development Area study area (12 months January to December 2019)

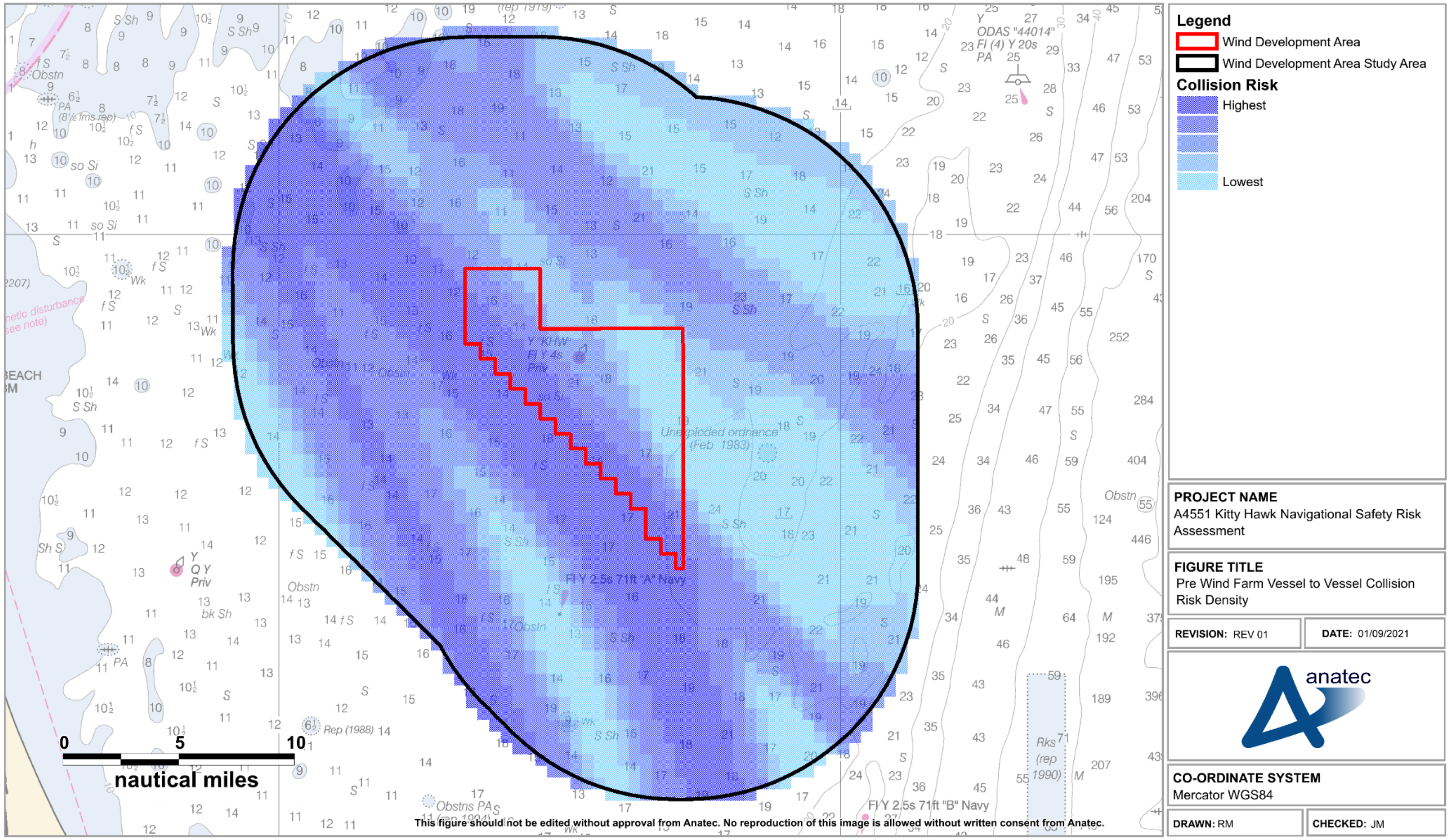

Figure 11.2 Pre wind facility vessel to vessel collision risk density heat map within Wind Development Area study area

For the base case scenario, it was estimated that the annual collision return period was one in 215 years within the Wind Development Area study area. As indicated in Figure 11.2, the majority of this risk is associated with routes passing north west-south east including through the Wind Development Area.

Assuming a 10% traffic increase to represent potential future vessel traffic trends (see Section 6.7.1), it was estimated that the annual collision return period would increase to one in 177 years, corresponding to an increase of approximately 18% compared to the base case. For a 20% traffic increase, it was estimated that the annual collision return period would increase to one in 149 years, corresponding to an increase of approximately 31% compared to the base case.

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 9.1.

11.2 Post Atlantic Coast Port Access Route Study

Although not yet implemented, the proposed ACPARS fairways (and in particular the deep draft route passing alongside the Wind Development Area) may be in use prior to the installation of the Project. No direct modelling of this scenario has been undertaken, but the scenario is referenced in Section 11.3 where appropriate in terms of changes to routing, collision risk and allision risk which are attributable (either fully or partially) to the presence of the proposed ACPARS fairways.

In particular, it is noted that:

- The largest main route deviation is wholly associated with re-routing through the proposed ACPARS deep draft route (see Section 11.3.1); and
- Approximately 77% of the total collision risk is associated with the area occupied by the proposed ACPARS deep draft route (see Section 1.1.1).

11.3 Post Wind Facility

11.3.1 Main Route Deviations

Figure 11.3 presents the anticipated mean positions of the main routes identified in Section 6.3.1.1 (see Figure 6.21) following installation of the Project. These deviations follow the methodology outlined in Section 6.7.4, including the mean position of routes being set to a minimum of 1 nm from the Wind Development Area and utilization of the ACPARS fairways where appropriate.

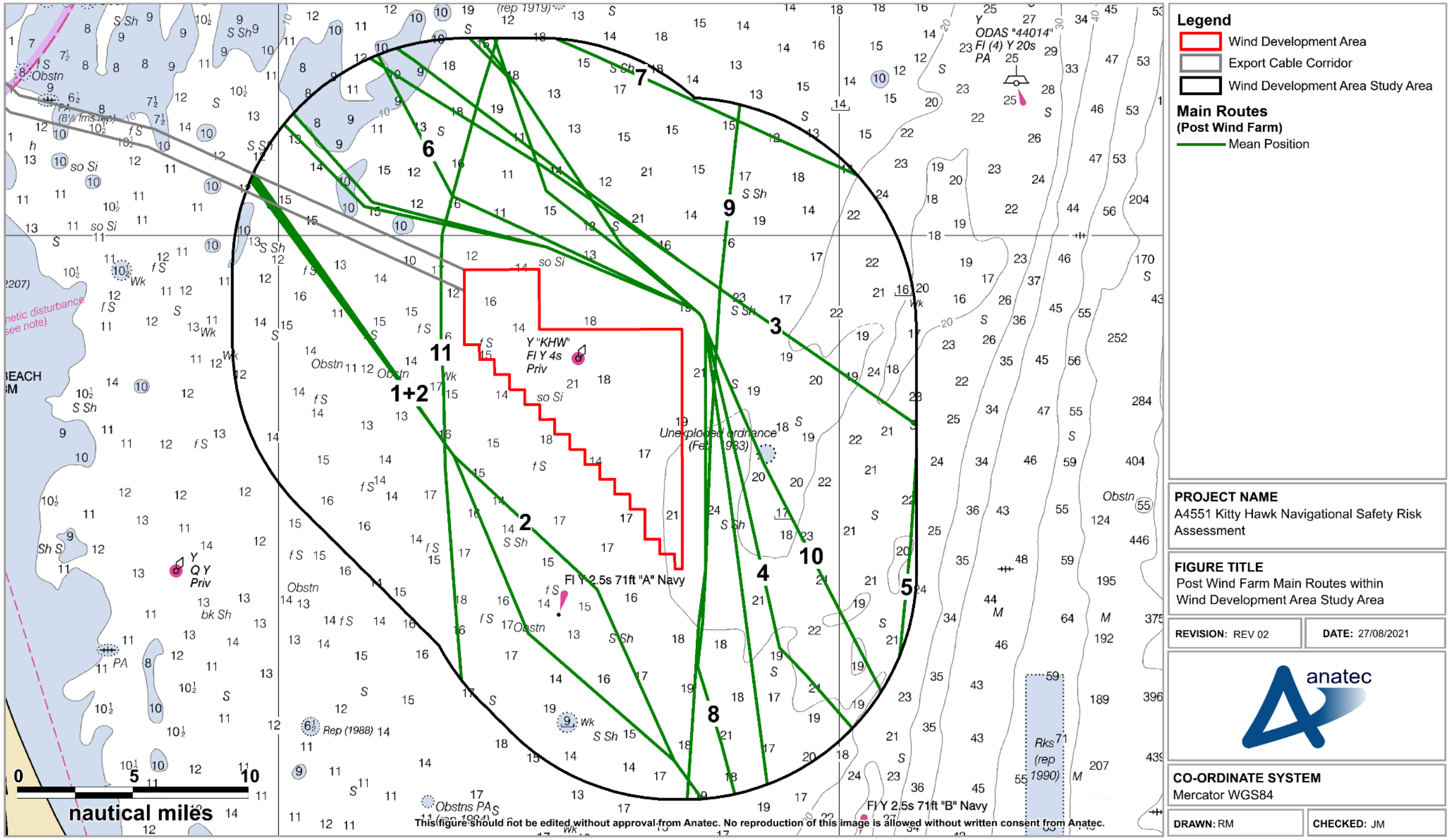

Figure 11.3 Post wind facility main routes within Wind Development Area study area

A deviation may be required for eight out of the 11 main routes identified, with the magnitude of the deviation ranging between a decrease for Route 2 and 8.2 nm (15 km) for Route 1. However, it is noted that the deviation for Route 1 is wholly associated with re-routing through the proposed ACPARS deep draft route.

Appendix D presents a comparison of the pre and post wind facility mean positions for each individual main route where a deviation was deemed necessary along with additional commentary on the changes.

Table 11.1 provides a summary of the change in route length for those main routes deviated.

Table 11.1 Summary of post wind facility main route deviations

Route Number	Change in Route Length (nm)
1*	8.2
2*	-0.9
4	3.9
6	3.9
8	2.2
9	<0.1
10	0.3
11	<0.1

(*) Deviation is either fully or partially associated with re-routing through the proposed ACPARS deep draft route.

11.3.2 Simulated Automatic Identification System

Using the post wind facility main routes, their associated standard deviations from the mean position and the average number of vessels on each route, Anatec's AIS Track Simulator has been used to gain insight into the potential post wind facility re-routed vessel traffic following the installation of the Project.

Figure 11.4presents 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).

It is noted that the main routes consider only regular routing commercial traffic and therefore irregular routing commercial traffic and non-commercial traffic is excluded.

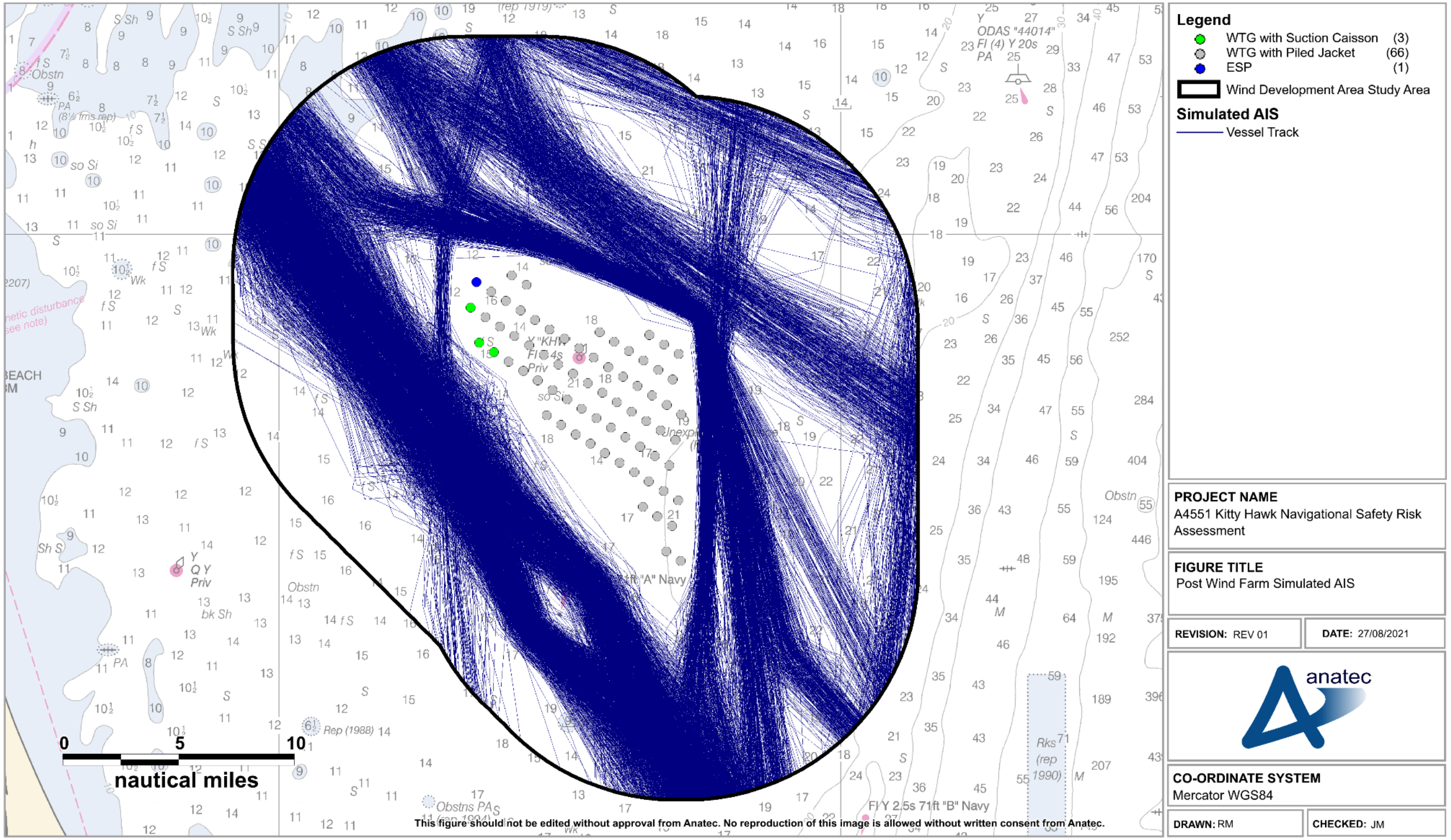

Figure 11.4 Post wind facility simulated AIS within Wind Development Area study area

11.3.3 Vessel to Vessel Collision Risk

Using the post wind facility routing (see Section 11.3.1) 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 Wind Development Area following the installation of the Project has been assessed.

Following the running of the model, Figure 11.5 presents the vessel to vessel collision risk heat map within the Wind Development Area study area. Following this, Figure 11.6 presents a similar heat map based on the change in vessel to vessel collision risk between the base case pre wind facility and base case post wind facility scenarios.

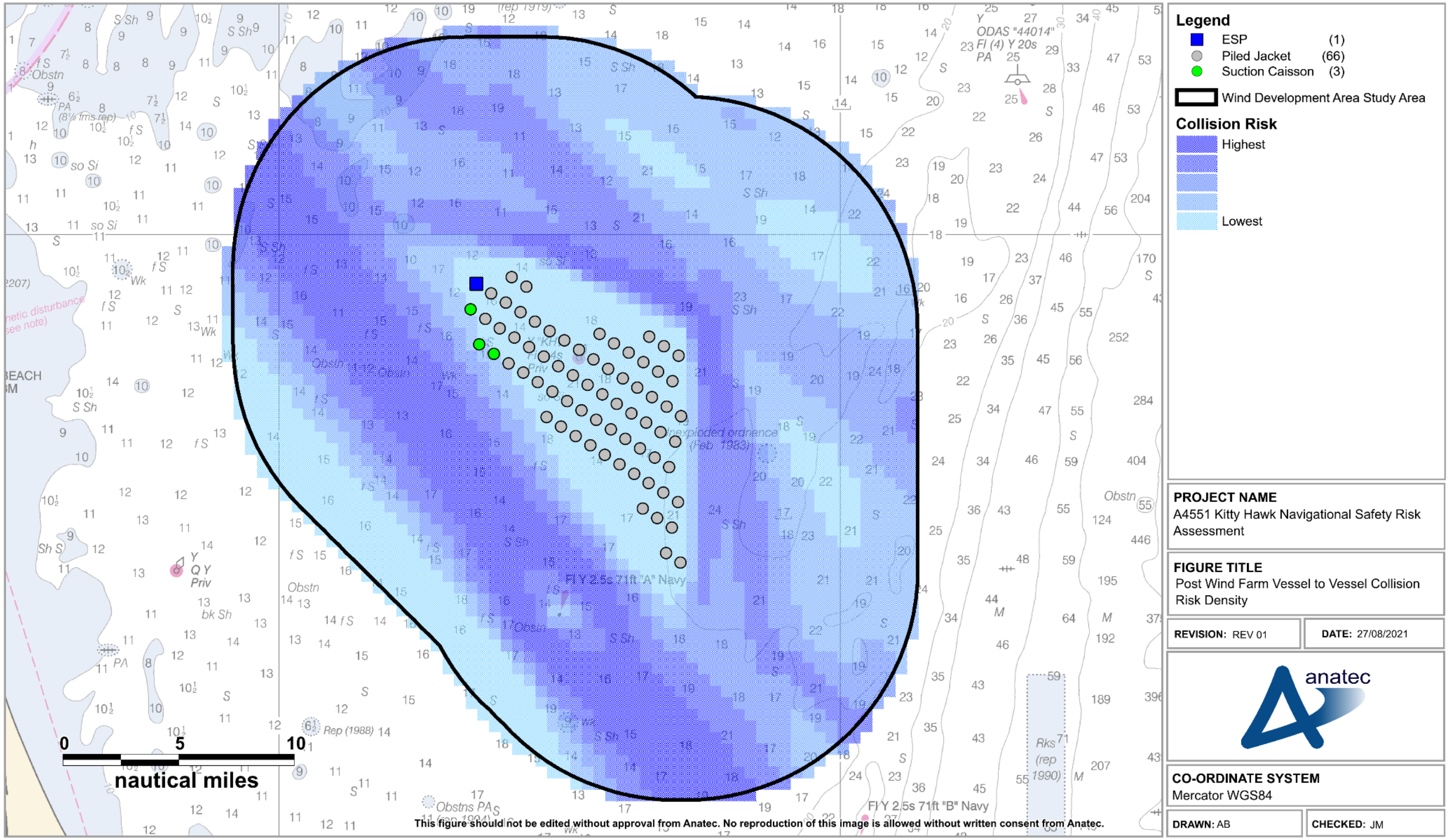

Figure 11.5 Post wind facility vessel to vessel collision risk density heat map within Wind Development Area study area

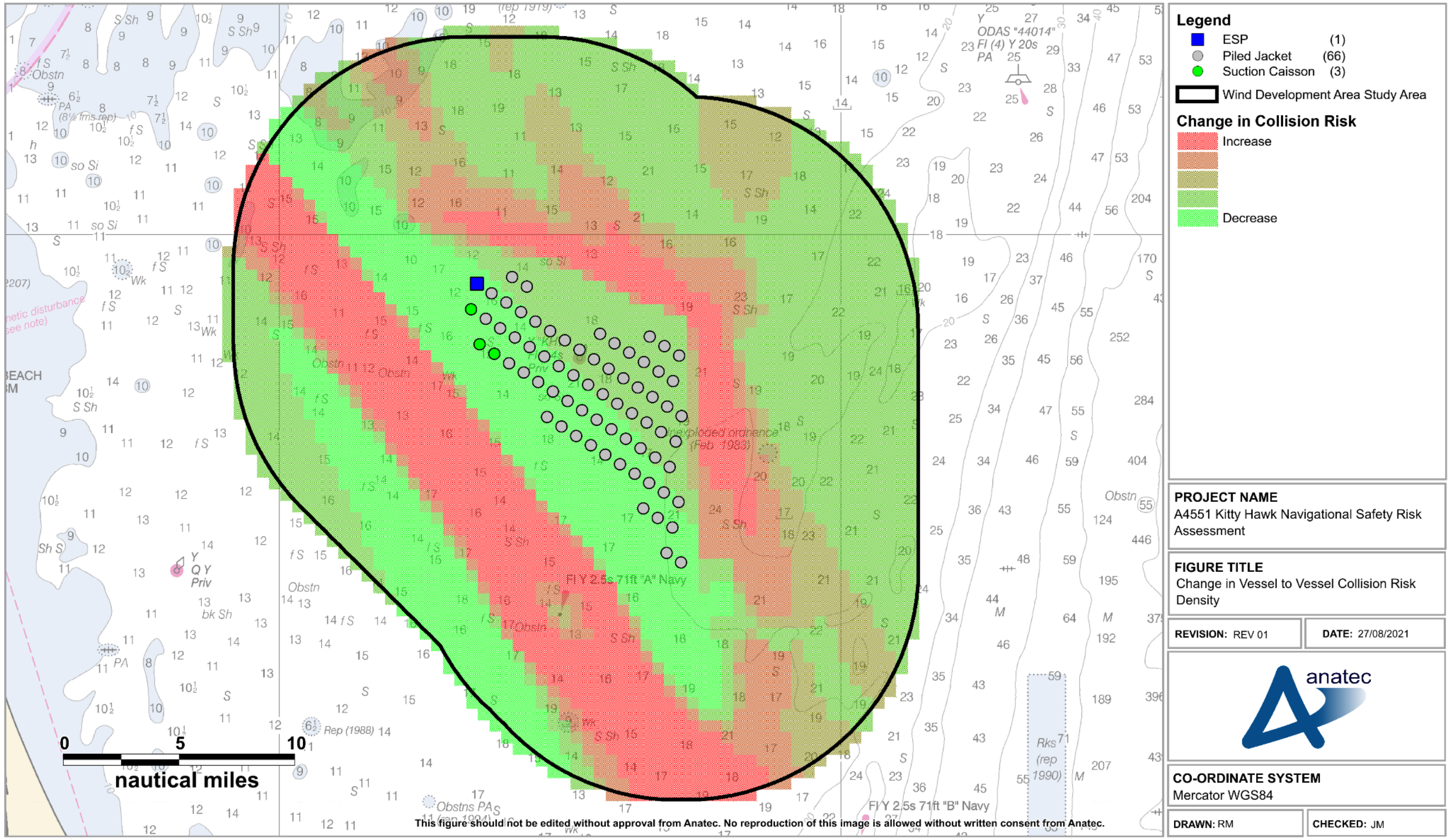

Figure 11.6 Change in vessel to vessel collision risk density heat map within Wind Development Area study area

For the base case scenario, it was estimated that the annual collision return period was one in 135 years within the Wind Development Area study area. This represents a 59% increase in annual collision frequency compared to the pre wind facility base case result. As indicated in Figure 11.5, the majority of the post wind facility collision risk is associated with the ACPARS deep draft route that runs parallel to the south west boundary of the Wind Development Area (approximately 77% of the total collision risk is associated with the area occupied by the ACPARS deep draft route). There is also a notable level of collision risk (and subsequent potential choke point) around the north eastern corner of the Wind Development Area.

Assuming a 10% traffic increase to represent potential future vessel traffic trends (see Section 6.7.1), it was estimated that the annual collision return period would increase to one in 112 years, corresponding to an increase of approximately 59% from the corresponding pre wind facility scenario. For a 20% traffic increase, it was estimated that the annual collision return period would increase to one in 94 years, corresponding to an increase of approximately 58% from the corresponding pre wind facility scenario.

As noted in Section 11.1.2, 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.

11.3.4 Powered Vessel to Structure Allision Risk

Using the post wind facility routing (see Section 11.3.1) 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 an offshore wind structure, 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 severe sea state and has been calibrated against historical maritime incident data.

To ensure a maximum design scenario is considered, no account has been made for the potential for one offshore wind structure to shield another.

Following the running of the model, Figure 11.7 presents the powered vessel to structure allision risk for each individual offshore wind structure.

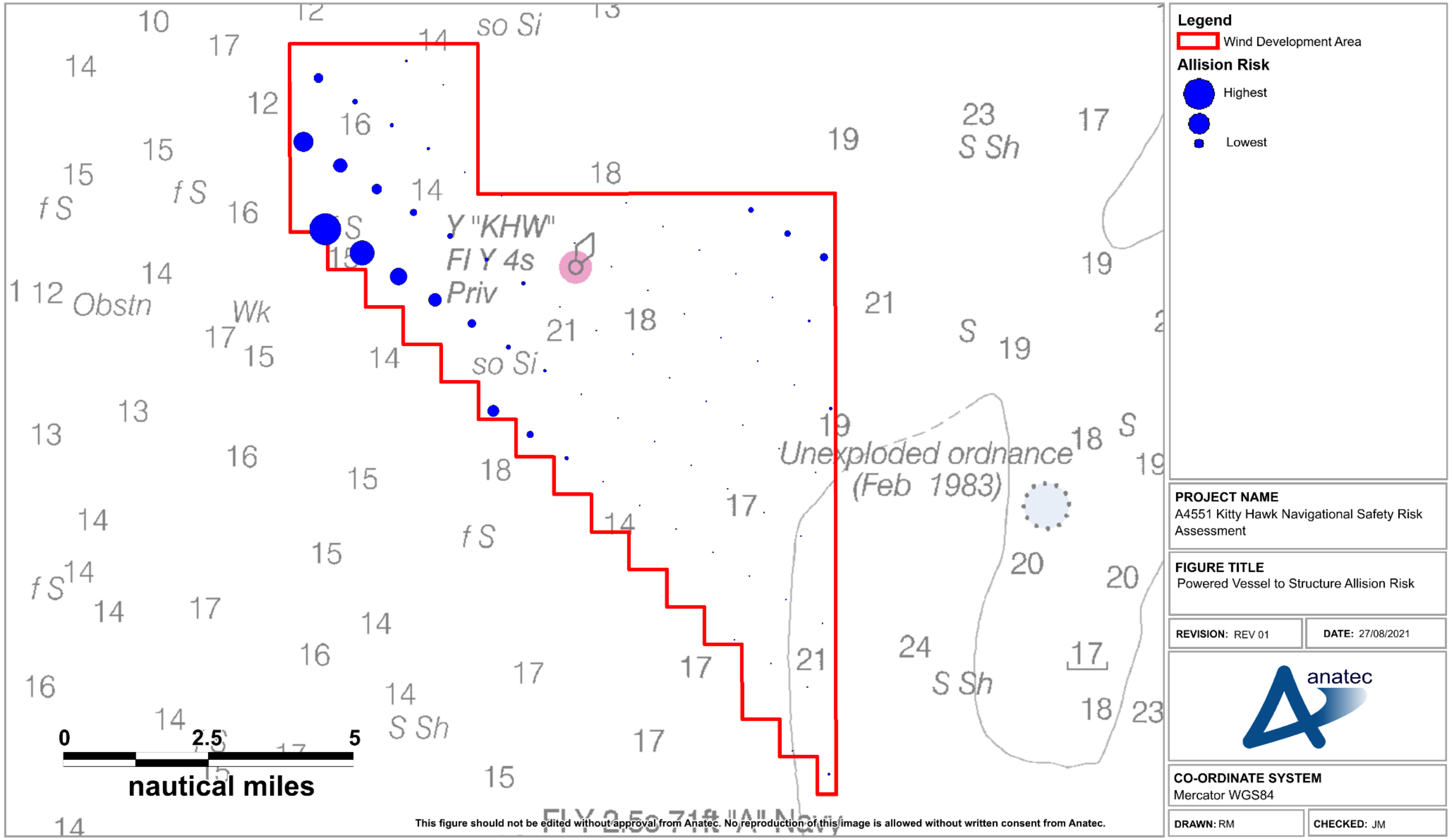

Figure 11.7 Powered vessel to structure allision risk per offshore wind structure

For the base case scenario, it was estimated that the annual powered allision return period across all offshore wind structures was one in 294 years. As indicated in Figure 11.7, the majority of the post wind facility powered allision risk is associated with structures at the western extent of the Wind Development Area. The greatest annual powered allision return period associated with any individual structure was one in 1,200 years.

Assuming a 10% traffic increase to represent potential future vessel traffic trends (see Section 6.7.1), it was estimated that the annual powered allision return period would be one in 268 years. For a 20% traffic increase, it was estimated that the annual powered allision return period would be one in 245 years.

11.3.5 Drifting Vessel to Structure Allision Risk

Using the post wind facility routing (see Section 11.3.1) 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 an offshore wind structure, leading to an allision. The COLLRISK drifting 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 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 structures (up to 10 nm [18.5 km] from the perimeter). 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 Wind Development Area was estimated. The probability of a vessel drifting towards an offshore wind structure 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 the offshore wind structure. 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.

Following the running of the model, Figure 11.8 presents the drifting vessel to structure allision risk for each individual offshore wind structure. It is noted that different range brackets have been used to present the drifting allision results than were used for the powered allision results (see Figure 11.7) and therefore the figures are not directly comparable.

For the base case scenario, it was estimated that the annual drifting allision return period across all offshore wind structures was one in 1,749 years. As indicated in Figure 11.8, the majority of the post wind facility drifting allision risk is associated with structures along the southern boundary, and particularly the structures at the western extent where the ACPARS deep draft route is closest to the Wind Development Area. The greatest annual drifting allision return period associated with any individual structure was one in 14,400 years.

Assuming a 10% traffic increase to represent potential future vessel traffic trends (see Section 6.7.1), it was estimated that the annual drifting allision return period would be one in 1,590 years. For a 20% traffic increase, it was estimated that the annual drifting allision return period would be one in 1,457 years.

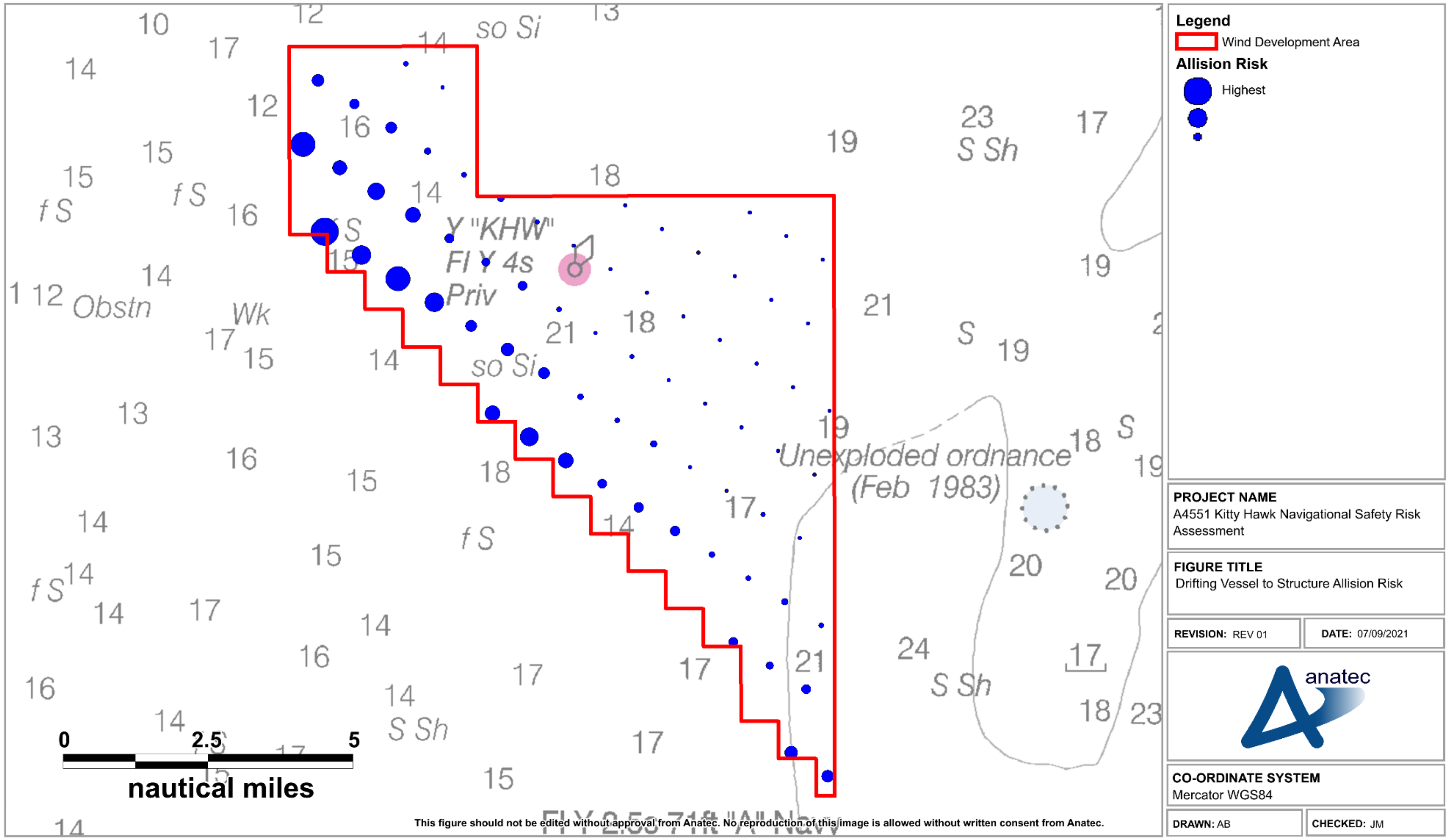

Figure 11.8 Drifting vessel to structure allision risk per offshore wind structure

11.3.6 Fishing Vessel to Structure Allision Risk

Using the 12 months of AIS data (see Section 6.2.3.7) as input to the fishing allision function of Anatec's COLLRISK modelling software suite, the potential fishing vessel to structure allision risk following the installation of the Project has been assessed.

A fishing vessel allision is classified separately from other allisions since, unlike in the case of the commercial traffic characterized via the main routes, fishing vessels may be either in transit or actively fishing within the area. Moreover, fishing vessels could be observed internally within the array in addition to externally. The COLLRISK fishing allision model uses vessel numbers, sizes (length and beam), array layout, and structure dimensions. 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.

Following the running of the model, Figure 11.9 presents the fishing vessel to structure allision risk for each individual offshore wind structure. It is noted that, as previously, different range brackets have been used to present the fishing vessel allision results than were used for the other allision results and therefore the figures are not directly comparable.

For the base case scenario, it was estimated that the annual fishing vessel allision return period across all offshore wind structures was one in 1,440 years. As indicated in Figure 11.9, the majority of the post wind facility fishing vessel allision risk is associated with structures within the north western portion of the Wind Development Area. The greatest annual fishing vessel allision return period associated with any individual structure was one in 10,000 years.

Assuming a 10% traffic increase to represent potential future vessel traffic trends (see Section 6.7.2), it was estimated that the annual fishing vessel allision return period would be one in 1,332 years. For a 20% traffic increase, it was estimated that the annual fishing vessel allision return period would be one in 1,239 years.

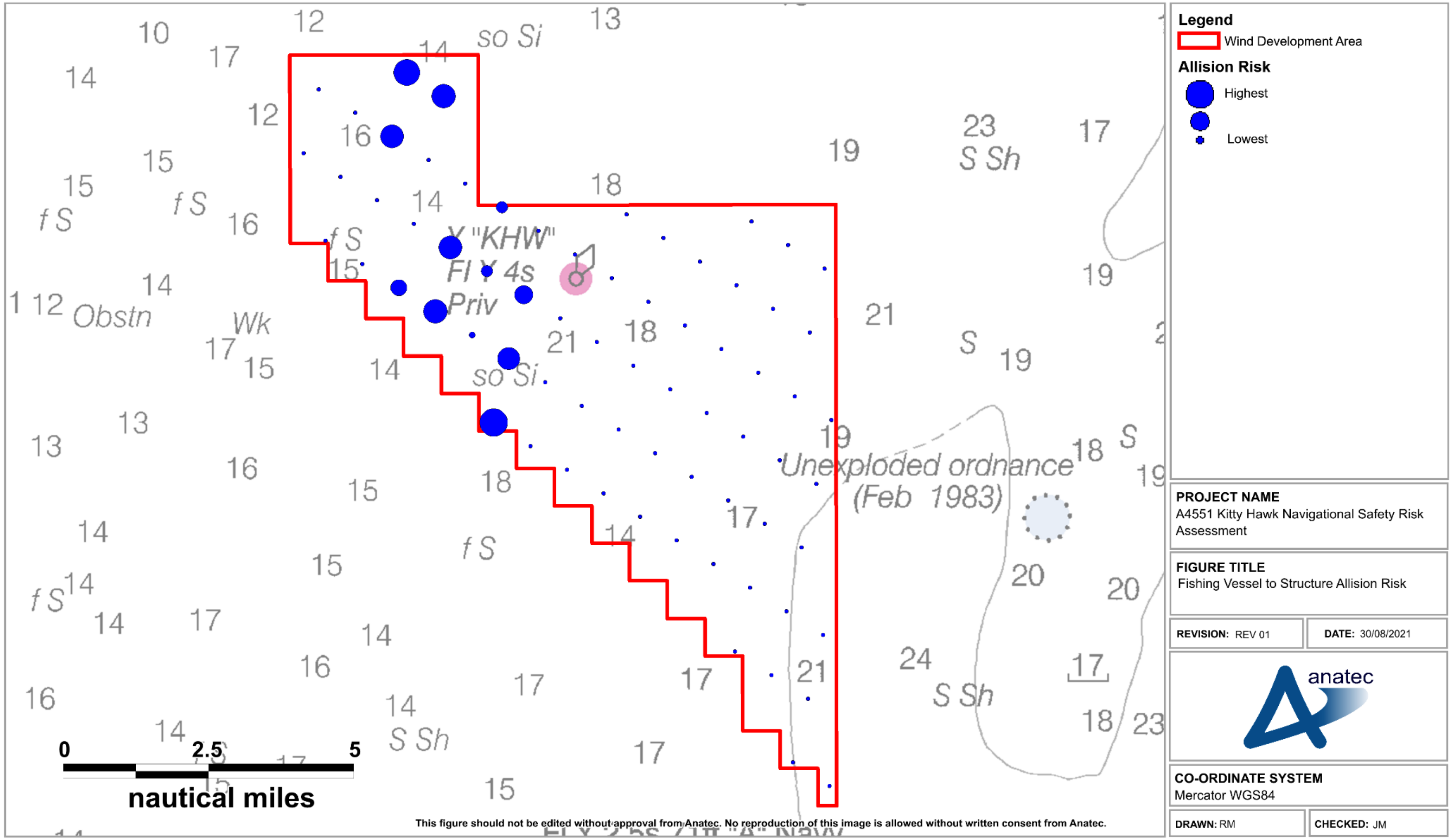

Figure 11.9 Fishing vessel to structure allision risk per offshore wind structure

11.3.7 Vessel Grounding Risk

The only underwater devices forming part of the Project are the inter-array and export cables. As noted in Section 4.3, there is potential for the inter-array and export cables to require protection where burial depths are not feasible and residual risk remains. The maximum height of cable protection (above the seabed) is estimated to be no more than 1 m. Should this 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 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 (including some quantification) based on the information available at the time of writing has been undertaken.

With respect to the Wind Development Area:

- Water depths within the Wind Development Area range between approximately 84 and 126 ft (26 and 38 m) over MLLW.
- The Project is located approximately 30 nm (56 km) offshore in an area with significant available sea room.
- The most heavily trafficked deviated routes in the post wind facility scenario are located within the ACPARS deep draft route and therefore will not be directly affected by any changes to water depths resulting from the Project.
- The largest vessel draft broadcast throughout the vessel traffic survey of the Wind Development Area was 48 ft (15 m).

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

With respect to the export cable corridor:

- Navigable water depths within the export cable corridor range between approximately 31 and 102 ft (9.4 and 31 m), noting that there are shallower waters at the landfall location but from the vessel traffic survey data these are not navigated.
- Vessels primarily cross the export cable corridor rather than navigate along it and therefore are located within the export cable corridor for only short durations.
- The largest vessel draft broadcast throughout the vessel traffic survey of the export cable corridor was 48 ft (15 m), but drafts in the shallower nearshore area were exclusively less than 15 ft (4.6 m).

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

Furthermore, from the SAR incident data reported in the MISLE database (see Section 9.1.2), there have been no grounding incidents responded to by the USCG SAR services within the Wind Development Area and export cable corridor study areas over the 10-year period between 2010 and 2019, indicating that the likelihood of a grounding incident occurring in proximity to the Project is very low, and would most probably not be a direct consequence of the Project itself.

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 highly unlikely.

11.4 Risk Results Summary

A summary of the collision and allision risk modelling results is provided in Table 11.2. The annual frequency of each risk is presented alongside the corresponding return period for all three scenarios assessed (base case, future case with 10% traffic growth and future case with 20% 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). Looking specifically at the results of the future case modelling, it is noted that a 20% increase in traffic levels creates a change in total risk levels of 28%; however, both the 10% and 20% increases are within acceptable levels.

Table 11.2 Summary of annual collision and allision frequency results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Facility	Post Wind Facility	Change
Vessel to vessel collision	Base case	4.66×10^{-3} (215 years)	7.39×10^{-3} (135 years)	2.73×10^{-3} (79 years)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Facility	Post Wind Facility	Change
	Future case (10%)	5.64×10^{-3} (177 years)	8.94×10^{-3} (112 years)	3.31×10^{-3} (66 years)
	Future case (20%)	6.71×10^{-3} (149 years)	1.06×10^{-2} (94 years)	3.89×10^{-3} (55 years)
Powered vessel to structure allision	Base case	N/A	3.40×10^{-3} (294 years)	3.40×10^{-3} (294 years)
	Future case (10%)	N/A	3.74×10^{-3} (268 years)	3.74×10^{-3} (268 years)
	Future case (20%)	N/A	4.08×10^{-3} (245 years)	4.08×10^{-3} (245 years)
Drifting vessel to structure allision	Base case	N/A	5.72×10^{-4} (1,749 years)	5.72×10^{-4} (1,749 years)
	Future case (10%)	N/A	6.29×10^{-4} (1,590 years)	6.29×10^{-4} (1,590 years)
	Future case (20%)	N/A	6.86×10^{-4} (1,457 years)	6.86×10^{-4} (1,457 years)
Fishing vessel to structure allision	Base case	N/A	6.95×10^{-4} (1,440 years)	6.95×10^{-4} (1,440 years)
	Future case (10%)	N/A	7.51×10^{-4} (1,332 years)	7.51×10^{-4} (21,332 years)
	Future case (20%)	N/A	8.07×10^{-4} (1,239 years)	8.07×10^{-4} (1,239 years)
Total	**Base case**	**4.66×10^{-3} (215 years)**	**1.21×10^{-2} (83 years)**	**7.39×10^{-3} (132 years)**

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Facility	Post Wind Facility	Change
	Future case (10%)	5.64×10^{-3} (177 years)	1.41×10^{-2} (71 years)	8.43×10^{-3} (106 years)
	Future case (20%)	6.71×10^{-3} (149 years)	1.62×10^{-2} (62 years)	9.46×10^{-3} (87 years)

11.5 Consequences Assessment

11.5.1 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 maybe severe, including events with PLL. For larger commercial vessels an allision incident would likely result in the collapse of the offshore wind structure before it is able to significantly damage the hull of the vessel. 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 offshore wind structure 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 results presented in this section to historical data regarding collision and allision incidents and oil pollution. In summary, the overall annual increase in PLL estimated due to the impact of the development on passing vessels is approximately one fatality per 11,900 years, assuming no increase in traffic. In terms of individual risk to people, the incremental increase estimated due to the impact of the development for the base case (and future cases) is negligible. Given these very low results the fatality risk resulting from the development 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 seven 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 U.S. 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 (0.005%).

11.5.2 Structure Integrity

As discussed in Section 9.2.1, there have been nine reported allision incidents with WTGs in UK offshore wind facilities to date, and none have resulted in reported material WTG damage. It should be considered that eight of the vessels involved were project vessels for the offshore wind facility itself, and the other 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, 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 11.3.4).

A study into potential oil spills associated with the Cape Wind Energy Project (Schmidt Etkin, 2006) found that should vessels of 1,200 gross tons 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 Wind Development Area, however as discussed above, the potential for such an allision is low.

In the event of an allision with an offshore wind structure, an assessment of the residual structural integrity would be undertaken, with the results submitted to the USCG.

11.6 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 of routing undertaken in this NSRA.

11.6.1 Tier 1

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

- Additional project(s) built within the remainder of the Lease Area (referred to as Kitty Hawk Wind Rest of Zone);
- CVOW Commercial (Lease Area OCS-A 0483); and
- CVOW Pilot (Lease Area OCS-A 0497).

The main routes identified as passing within the Wind Development Area study area (see Section 6.3.1.1) were examined for potential interaction with the Tier 1 developments, and it was determined that the following interactions would occur:

- A route passing east-west to the north of the Wind Development Area (Route 3) which was not affected by the presence of the Project in isolation will be displaced following the construction of Kitty Hawk Wind Rest of Zone;
- Routes anticipated to pass seaward of the Wind Development Area when considered in isolation (Routes 4, 6, 8, 9 and 10) will be further displaced following the construction of Kitty Hawk Wind Rest of Zone; and
- A route anticipated to pass landward of the Wind Development Area when considered in isolation (Route 11) will be displaced seaward of CVOW Commercial (Lease Area OCS-A 0483) when passing further north.

Figure 11.10 presents the anticipated mean positions of the main routes identified in Section 6.3.1.1 (see Figure 6.21) for the Tier 1 cumulative scenario. These deviations follow the methodology outlined in Section 6.7.4, including the mean position of routes being set to a minimum of 1 nm (1.9 km) from developments and utilization of the ACPARS fairways where appropriate. Those routes entering Chesapeake Bay have been terminated at the entrance to Chesapeake Bay. It should be noted that only main routes within the Wind Development Area study area are shown, with any main routes outside the Wind Development Area study area not included.

Table 11.3 provides a summary of the change in route length for those main routes deviated compared to two scenarios: pre wind facility and the Project in isolation post wind facility.

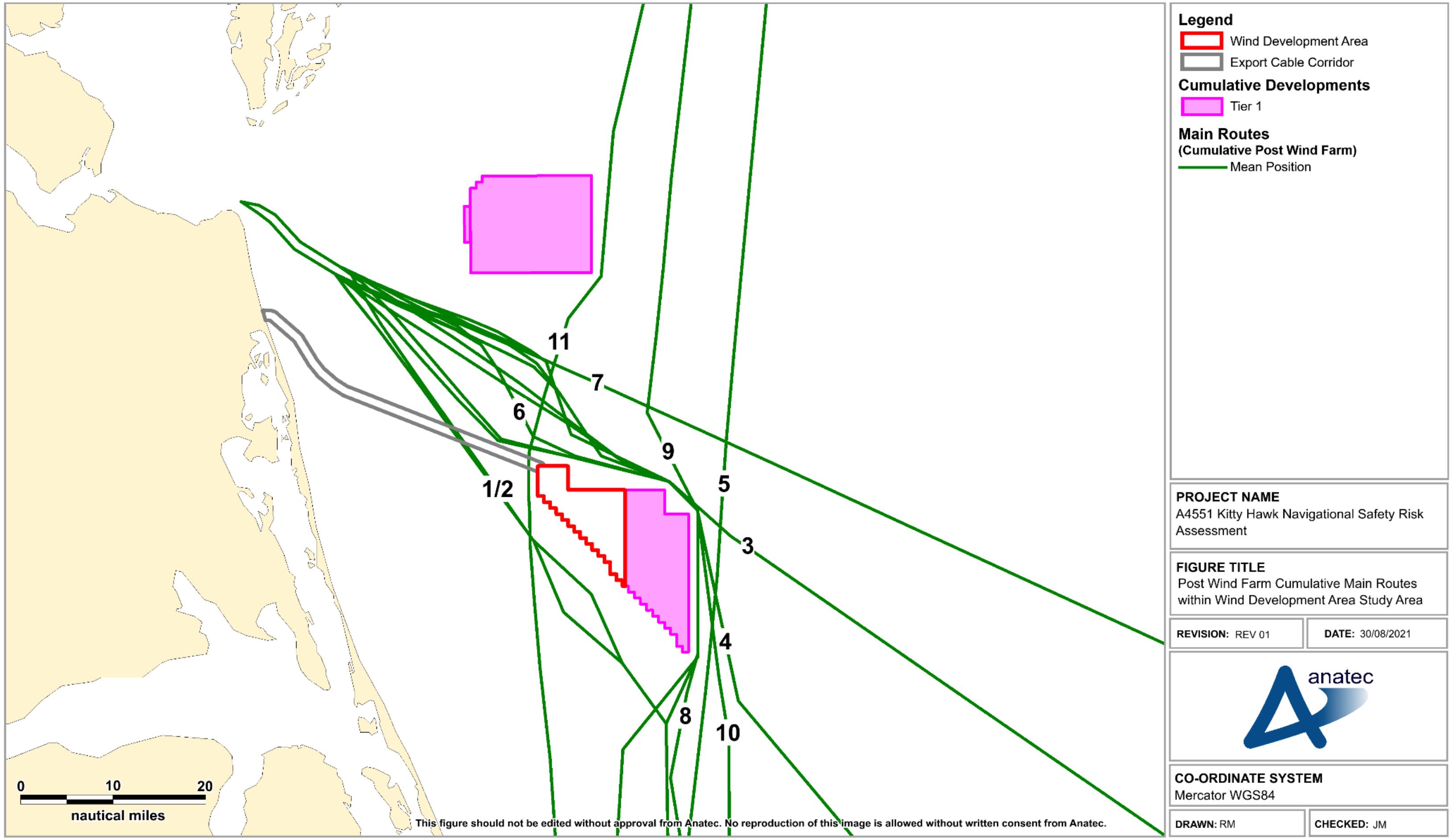

Figure 11.10 Post wind facility cumulative main routes within Wind Development Area study area

Table 11.3 Summary of cumulative post wind facility main route deviations

Nature of Deviation	Route Number	Change in Route Length (nm)	
		From Pre Wind Facility	From Post Wind Facility (Project in Isolation)
New displacement due to presence of Kitty Hawk Wind Rest of Zone	3	0.2	0.2
Additional displacement due to presence of Kitty Hawk Wind Rest of Zone	4	6.1	2.0
	6	9.3	5.4
	8	6.7	4.3
	9	4.1	4.1
	10	3.2	2.9
Additional displacement due to presence of CVOW Commercial (Lease Area OCS-A 0483)	11	0.7	0.7

11.6.2 Tier 2

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

- MarWin (Lease Area OCS-A 0490);
- Skipjack (Lease Area OCS-A 0519); and
- Garden State Offshore Energy (Lease Area OCS-A 0482).

The Tier 2 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 have been anticipated to adapt. For relevant vessel traffic not using the ACPARS fairways, the distance both from the Wind Development Area and Tier 1 developments to the Tier 2 developments is considered to be sufficient to allow the magnitude of additional deviations to be minimized.

11.6.3 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 Wind Development Area.

11.6.4 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.

12 Introduction to Impact Assessment

The following sections use the characteristics (waterway, maritime traffic and facility), quantitative assessment and the outputs of consultation 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 is considered separately in the following sections to ensure that a specific assessment is undertaken for each specific user. The potential users considered are as follows:

- Commercial vessels;
- Military vessels;
- Recreational vessels;
- Commercial fishing vessels;
- Anchored vessels;
- Emergency responders; and
- Port access and services.

It has been assumed that the embedded mitigation summarized in Section 21 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 2.1.2. Where necessary, additional mitigation is then introduced to bring impacts to within ALARP parameters (see Section 2.1.3).

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**.

13 Impact Assessment for 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 16.

13.1 Vessel Deviations

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

13.1.1 Qualification of Risk

The analysis of post wind facility vessel routing determined that seven out of the 11 main routes identified from the vessel traffic data may be required to deviate due to the presence of the array when assuming a minimum mean passing distance of 1 nm (1.9 km), with a further route anticipated to deviate from its pre wind facility course in order to follow the ACPARS deep draft route. For routes where the deviation was affected by the presence of the array, the largest increase was 4.1 nm (7.6 km). This increase was noted for two routes which deviate seaward of the Wind Development Area.

The deviations applied are considered minor (in terms of navigational safety impact on operators) given the available sea room all around the Wind Development Area, with this judgement supported by consultation undertaken with the Chamber of Shipping of America. The only further consideration for safe navigation in proximity to the Wind Development Area is Navy Tower Light A located to the south (within the ACPARS deep draft route). Additionally, 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 a construction vessel and schedule notification system – and the presence of infrastructure on relevant nautical charts and electronic charts.

13.1.1.1 Level of Stakeholder Concern

No consultation feedback received during the NSRA process, including that from regular operators, raised concerns associated with commercial vessel deviations, including during a meeting with the VMA’s membership where the post wind facility main route deviations were shown. It is noted that the USCG were content with the approach to conducting the NSRA, including the baseline data used as the basis for deviating commercial traffic (see USCG meeting summary (17 September 2020) in Section 3).

13.1.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Charting of infrastructure;

- Construction vessel and schedule notification system; and
- Promulgation of information (including Notice to Mariners).

It is noted that third party traffic will be monitored by AIS during the construction and decommissioning phases to review how the deviations anticipated in this NSRA compare with the actual changes to vessel traffic movements and ensure that the mitigations put in place to manage the effects of those deviations are working effectively.

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 commercial 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

Taking into account the anticipated post wind facility vessel routing, the likelihood of an encounter between two vessels in proximity to the Wind Development Area due to the presence of the array is considered likely given that the re-routing includes multiple main routes passing around the north eastern corner of the array; however it is unlikely that an encounter will develop into a collision incident.

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).

The quantitative assessment of collision risk post wind facility estimated a collision return period for all routing vessels of approximately one in 135 years for base case traffic levels, representing a 59% increase in annual collision frequency compared to the pre wind facility scenario.

Although the quantitative assessment suggests that a collision incident could possibly occur, the quantitative assessment does not take account of the promulgation of information relating to the Project and the presence of infrastructure on relevant nautical charts and electronic charts. This will assist with passage planning, noting that the post wind facility routing considered in this assessment is a worst case, whereas in reality vessels may choose to pass at a greater distance from the array, utilizing the available sea room all around the Wind Development Area, particularly during the construction and decommissioning phases. This will reduce the likelihood of a collision incident. Also, given the minimum spacing between offshore wind structures (approximately 0.75 nm [1.4 km] center-to-center) there are not expected to be any issues with offshore wind structures 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). As a high-level computation, a vessel in transit at 6 knots would take approximately 17 seconds to travel 52.5 m[19], the greatest foundation width considered in the maximum design scenario (see Section 4.2.2). Therefore, 5.5 seconds is the maximum duration for which a vessel may be blocked by an offshore wind structure (noting that ESP will share the same foundation dimensions) with this duration converging to zero as the vessel length increases to 17 m, after which point no total blocking of the view would occur.

In cases where vessels do pass in proximity to the array, the array will be lit and marked in compliance with COMDTINST M16500.7A (USCG, 2015), *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020), and *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM, 2021), with PATONs also potentially deployed to mark any working areas (where deemed appropriate by risk assessment), thus maximizing mariner awareness of the array when in proximity, both in day and night conditions. It is also noted that no collision incidents involving a third party vessel as a result of the presence of an offshore wind facility have been reported in the UK to date, despite the UK's status as the global leader in offshore wind production.

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. If pollution were to occur, then an Oil Spill Response Plan undertaken by the Project would be implemented to minimize the environmental effects noting that laden tankers are equipped with additional safety features including double hulls.

13.2.1.1 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 and involving 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 and all Project vessels will carry operational AIS pursuant to USCG and AIS carriage requirement. A construction vessel and schedule notification system will be implemented to assist with the promulgation of information. 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 with risk assessments undertaken for the transportation of foundations prior to the start of the construction phase, and comply with health and safety requirements including IMO conventions. Furthermore, safety zones of up to 1,640 ft (500 m) radius around construction and decommissioning activities may be applied for (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.

[19] 6 knots ≈ 3.1 metres per second ⇒ over 52.5 m a time of 17 seconds

13.2.1.2 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.

13.2.1.3 Level of Stakeholder Concern

No consultation feedback received during the NSRA process, including that from regular operators, raised concerns associated with collision risk, including during a meeting with the VMA's membership where the post wind facility main route deviations were shown. It is noted that the USCG were content with the approach to conducting the NSRA, including the baseline AIS data used as the basis for deviating commercial traffic.

13.2.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- 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;
- Lighting and marking;
- Marine coordination for Project vessels;
- Minimum advisory safe passing distances;
- Oil Spill Response Plan;
- Project vessel AIS carriage;
- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures;
- Promulgation of information (including Notice to Mariners); and
- Risk assessment for foundation transportation.

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 commercial vessel under power experiencing an allision with an offshore wind structure.

13.3.1 Qualification and Quantification of Risk

Taking into account the anticipated post wind facility vessel routing, the likelihood of a vessel utilizing one of the main routes in proximity to the Wind Development Area experiencing an allision with an offshore wind structure while under power is considered possible given that the re-routing includes multiple main routes passing at the minimum 6,076 ft (1 nm) mean distance from the array, noting that internal and external studies undertaken by Anatec indicate that commercial vessels generally avoid transiting internally within arrays. This likelihood is reflected by the results of the quantitative assessment of powered allision risk which estimated a powered allision return period for all routing vessels of approximately one in 294 years for base case traffic levels. The majority of the risk was associated with structures at the western extent of the Wind Development Area.

Although a powered allision is considered possible to occur the quantitative assessment does not take account of the promulgation of information relating to the Project – including a construction vessel and schedule notification system – and the presence of infrastructure on relevant nautical charts and electronic charts. Additionally, the array will be lit and marked in compliance with COMDTINST M16500.7A (USCG, 2015), *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020), and *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM, 2021), with PATONs also potentially deployed to mark any working areas (where deemed appropriate by risk assessment), thus maximizing mariner awareness of the array when in proximity, both in day and night conditions.

Furthermore, safety zones of up to 1,640 ft (500 m) radius around construction and decommissioning activities may be applied for (see Section 21) and a project safety vessel will be deployed during the construction and decommissioning phases (where deemed appropriate by risk assessment) and will be able to advise vessels on an allision course with an offshore structure and contact the USCG on VHF-CH 16 if necessary.

Should a powered allision incident occur, it is anticipated that the impact energy would primarily be absorbed by the offshore structure rather than the vessel, noting the high level of construction standards for commercial vessels operating at sea. Based on expert opinion, consideration of other types of historical incidents, operational speeds and impact energies 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 an Oil Spill Response Plan undertaken by the Project would be implemented to minimize the environmental effects noting that laden tankers are equipped with additional safety features including double hulls.

13.3.1.1 Lesson Learned

To date there have been nine reported powered allision incidents with an offshore wind structure in the UK, corresponding to 1,850 years per WTG allision incident, but none have involved a third party commercial vessel.

13.3.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- 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;
- Lighting and marking;
- Oil Spill Response Plan;
- Promulgation of information (including Notice to Mariners);
- Use of a project safety vessel; and
- Use of PATONs.

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 commercial vessel NUC alliding with an offshore structure in an emergency situation.

13.4.1 Qualification and Quantification of Risk

An assessment of historical NUC incidents (see Section 9.1.4) showed that over the 10-year period studied, there were no incidents of a vessel NUC responded to by the USCG within 10 nm (18.5 km) of the Wind Development Area. It is acknowledged that an NUC vessel may not inform the USCG of the incident, but the non-reporting would also indicate no dangerous situation has occurred and the vessel restored power without further incident.

Quantitative assessment of drifting allision risk estimated a drifting allision return period for all routing vessels of approximately one in 1,749 years for base case traffic levels. The majority of the risk was associated with structures along the southern boundary, and particularly the structures at the western extent where the ACPARS deep draft route is closest to the Wind Development Area. The drop-off in allision risk associated with structures located internally within the array reflects internal and external 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. This is supported by consultation feedback from the WSC who suggested their members would stay well clear of the array and not navigate internally within the array.

Should a drifting allision incident occur, it is anticipated that the impact energy would primarily be absorbed by the offshore wind structure rather than the vessel, noting the high level of construction standards for 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 a drifting allision incident resulting in pollution then an Oil Spill Response Plan undertaken by the Project would be implemented to minimize the environmental effects noting that laden tankers are equipped with additional safety features including double hulls.

13.4.1.1 Lesson Learned

In comparison to existing offshore wind developments the drifting allision risk associated with the Project is considered to be low. For example, Greater Gabbard and Galloper in the UK are located immediately adjacent to the Sunk TSS, as shown in Figure 13.1.

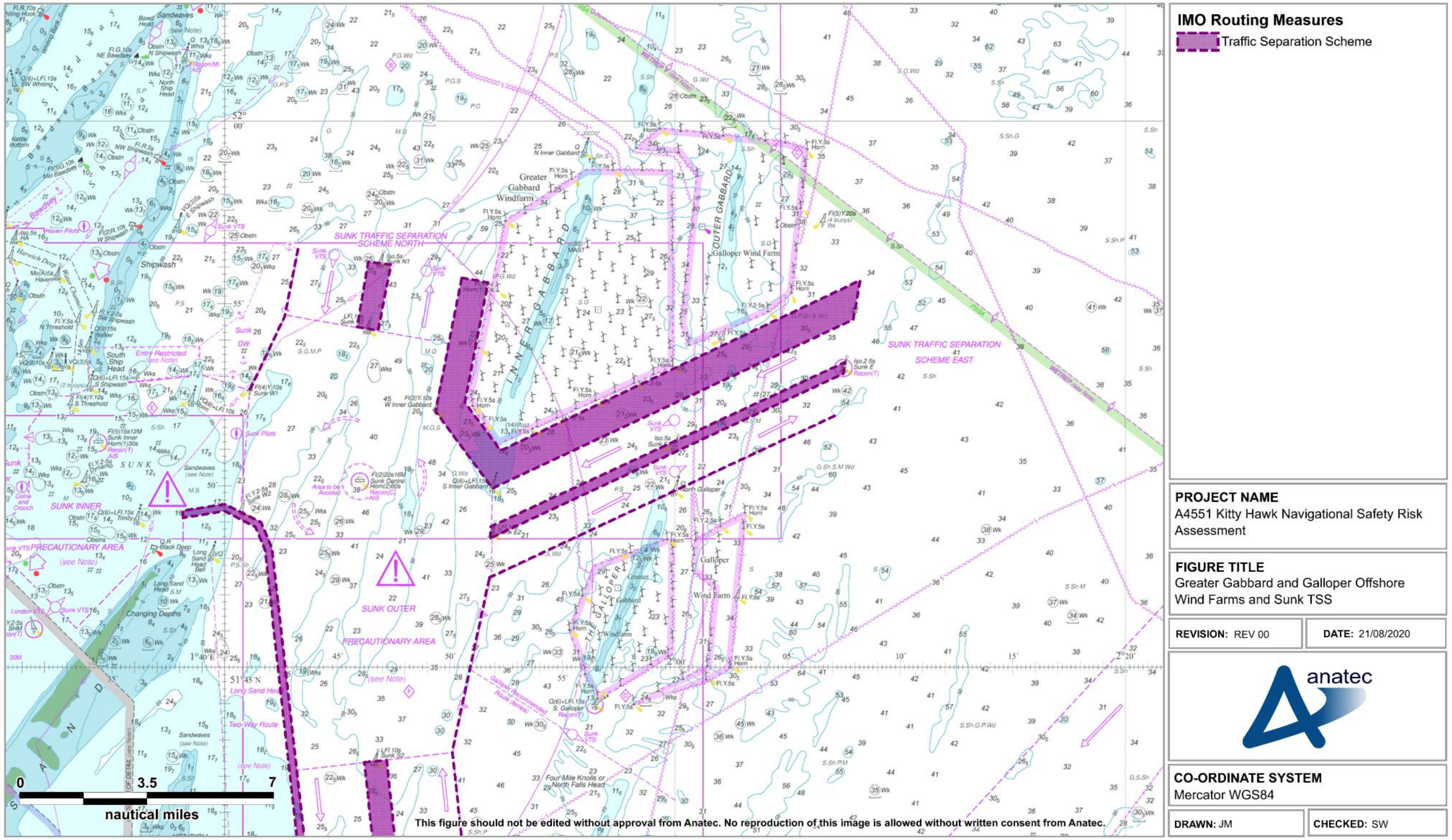

Figure 13.1 Greater Gabbard and Galloper Offshore Wind Farms and Sunk TSS

The Sunk TSS is a busy IMO routing measure (approximately five transits per day in each direction in the Sunk East TSS) and therefore incurs a much greater drifting allision risk for the developments. 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 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. 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.

13.4.1.2 Weather or Tidal Effects

Should a 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 array. However, in cases where the vessel does drift towards the array, it is likely that the vessel will first initiate its own emergency plans that may include the use of thrusters (where power is still available) and anchors to prevent an allision occurring. Vessels associated with the Project would seek to assist (including the project safety vessel if present during the construction and decommissioning phases) and operational SAR procedures would be implemented. 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.

13.4.1.3 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Oil Spill Response Plan;
- Operational SAR procedures;
- Provision of self-help capability; and
- Use of a project safety vessel.

13.4.1.4 Impact Significance

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

14 Impact Assessment for Military Vessels

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

14.1 Deviations

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

14.1.1.1 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 6.3.1). Therefore, surface military vessels in transit are incorporated into the assessment undertaken in Section 13.1. With regards subsurface military vessels, the designated transit lanes for submarines are located well north of the Wind Development Area, and therefore there is not expected to be any notable submarine presence in proximity to the array.

Military vessels engaged in military exercise were observed in the vessel traffic data, noting that the Wind Development Area is located within the Virginia Capes OPAREA. Although the presence of the array will result in the displacement of military exercises, it is noted that only approximately one military vessel was recorded on AIS within the Wind Development Area every four days across the 12-month survey period. It is acknowledged that there may be a presence of military vessels not broadcasting on AIS, but it is noted that no concerns have been raised with respect to military operations by the USCG during consultation to date, but engagement with the USCG will continue throughout the life of the Project. Taking into account the embedded mitigation measures considered for the equivalent impact on commercial vessels (which are also directly applicable to military vessels), and that only approximately 0.2% of the total area covered by the Virginia Capes OPAREA overlaps the Wind Development Area, the overall effect on military exercises is not considered significant.

14.1.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Charting of infrastructure;
- Construction vessel and schedule notification system;
- Monitoring of third party vessels;
- Ongoing engagement with stakeholders; and
- Promulgation of information (including Notice to Mariners).

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 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.

14.2.1 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 6.3.1) 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. This will be heightened by continued engagement by the Company with the USCG throughout the life of the Project.

14.2.1.1 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- 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;
- Lighting and marking;
- Marine coordination for Project vessels;
- Minimum advisory safe passing distances;
- Oil Spill Response Plan;
- Project vessel AIS carriage;
- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures;
- Promulgation of information (including Notice to Mariners); and
- Risk assessment for foundation transportation.

14.2.1.2 Impact Significance

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

14.3 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 an offshore wind structure.

14.3.1 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 6.3.1) 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 noted that only approximately 0.2% of the total area covered by the Virginia Capes OPAREA overlaps the Wind Development Area and therefore there it is sufficient alternative sea space within which military exercises may be safely undertaken without any substantial allision risk. Additionally, the DoD suggested during consultation that the Wind Development Area is well sited such that active military vessels can avoid the Wind Development Area and most of the military activity in the Wind Development Area is air-related.

It is also 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 by the Company with the USCG throughout the life of the Project, particularly with regard to specific operations which may be undertaken in proximity to the array.

14.3.1.1 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- 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;
- Lighting and marking;
- Marine pollution contingency planning;
- Oil Spill Response Plan;
- Promulgation of information (including Notice to Mariners);
- Use of a project safety vessel; and
- Use of PATONs.

14.3.1.2 Impact Significance

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

14.4 Drifting Vessel to Structure Allision Risk

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

14.4.1 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 6.3.1) 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 (including the project safety vessel if present during the construction and decommissioning phases) and operational SAR procedures would be implemented. 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.

As with commercial vessels, should a drifting allision incident occur, it is anticipated that the impact energy would be primarily absorbed by the offshore wind structure 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 an Oil Spill Response Plan undertaken by the Project would be implemented to minimize the environmental effects.

14.4.1.1 Lesson Learned

For the nine allision incidents reported in the UK to date (noting that these involved vessels under power), the worst consequences reported has 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.

14.4.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Oil Spill Response Plan;
- Operational SAR procedures;
- Provision of self-help capability; and
- Use of a project safety vessel.

14.4.2.1 Impact Significance

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

15 Impact Assessment for Recreational Vessels

For the purposes of this impact assessment, recreational vessels are considered to be yachts, motor cruisers and recreational fishing vessels on day trips or coastal transits. They do not include fixed or mobile gear commercial fishing vessels which are assessed separately in Section 16.

15.1 Deviations

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

15.1.1.1 Qualification of Risk

The volume of recreational vessel traffic within and in proximity to the Wind Development Area is currently very low compared to nearshore areas of the U.S. Atlantic coast, with AIS data and visual observations from a survey vessel on-site indicating that there is infrequent recreational vessel presence. 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).

There will be no restrictions on recreational vessel movements internally within the array other than the possible presence of active safety zones of 1,640 ft (500 m) radius around construction and decommissioning activities (see Section 21). Likewise, a minimum advisory safe passing distance from cable laying vessels will be implemented.

Should a recreational vessel choose to deviate around the array then, as with other vessel traffic types, there is available sea room all around the Wind Development Area, with the only further consideration for safe navigation in proximity to the Wind Development Area being Navy Tower Light A located to the south (within the ACPARS deep draft route). The magnitude of any deviation is expected to be small, with the precise magnitude dependent on the course being sailed by each individual vessel. Additionally, 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 – including a construction vessel and schedule notification system – and the presence of infrastructure on relevant nautical charts and electronic charts.

15.1.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Charting of infrastructure;
- Construction vessel and schedule notification system; and
- Promulgation of information (including Notice to Mariners).

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 recreational vessels 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 weather is 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 lead to such action taking a greater time and therefore result in the vessel being more exposed to the adverse weather conditions.

The likelihood of adverse weather conditions to the extent of a tropical cyclone being defined is high over the lifetime of the Project based on historical tropical cyclone data which indicates that the Project is located in an area with high exposure. 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 Wind Development Area when compared to areas further offshore. Moreover, no major hurricanes have been recorded within the Wind Development Area in the 120 years to 2020.

As already noted, the volume of recreational vessel traffic within and in proximity to the Wind Development Area is currently very low, with such traffic primarily located nearshore along the U.S. Atlantic coast. From the limited AIS data for recreational vessels recorded, transits further offshore were primarily in a north-south direction and likely vessels on coastal transits.

For such north-south 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 even not making passage at all if the conditions were deemed too dangerous. However, it is likely based on good seamanship that in the majority of cases vessels would deviate around the array to access their preferred port without significantly increased journey times (based on routing calculations).

For recreational fishing vessels accessing the array for fish aggregation benefits, it is expected that greater increases in recreational vessel activity would be associated with favorable weather conditions, noting that these vessels and vessel operators are likely to be more familiar with the array and navigation within it during less favorable weather conditions.

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 charts and electronic charts.

15.2.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Charting of infrastructure; and
- Promulgation of information (including Notice to Mariners).

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 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.

15.3.1 Qualification of Risk

Given the low volume of recreational vessel traffic in comparison to other vessel types within and in proximity to the Wind Development Area, recreational traffic is not anticipated to be a significant contributor to collision risk due to the size of recreational vessel and the most likely consequences. Additionally, as already noted, there will be no restrictions on recreational vessel movements internally within the array other than the possible presence of active safety zones of 1,640 ft (500 m) radius around construction and decommissioning activities (see Section 21).

Should a recreational vessel choose to deviate around the array then, as with other vessel types, there is available sea room all around the Wind Development Area, with the only further consideration for safe navigation in proximity to the Wind Development Area being Navy Tower Light A located to the south (within the ACPARS deep draft route). Also, given the minimum spacing between offshore wind structures (approximately 0.75 nm [1.4 km] center-to-center) there are not expected to be any issues with offshore wind structures 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).

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 – including a construction vessel and schedule notification system – and the presence of infrastructure on relevant nautical charts and electronic charts. The array will also be lit and marked in compliance with COMDTINST M16500.7A (USCG, 2015), *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020), and *Guidelines for Lighting and Marking of Structures*

Supporting Renewable Energy Development (BOEM, 2021), with PATONs also potentially deployed to mark any working areas (where deemed appropriate by risk assessment), thus maximizing mariner awareness of the array when in proximity, both in day and night conditions. Masters of recreational vessels operating as far offshore as the Wind Development Area can be expected to have a high level of awareness and expertise.

15.3.1.1 Internal Array Navigation

For recreational 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 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. Furthermore, safety zones of up to 1,640 ft (500 m) radius around construction and decommissioning activities may be applied for (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.

Should an encounter occur involving a recreational vessel, the most likely consequences is that it would not result in any impact on vessel safety with collision avoidance action implemented and the vessels complying with international and flag state regulations (including the COLREGs and SOLAS). In the unlikely event that an encounter could 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 recreational vessels they are more susceptible to material damage than commercial vessels in a collision incident, but pollution effects from a recreational vessel involved in a collision would likely be less substantial than for commercial vessels. If pollution were to occur, then an Oil Spill Response Plan undertaken by the Project would be implemented to minimize the environmental effects.

15.3.1.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- 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 for Project vessels;
- Minimum advisory safe passing distances;

- Oil Spill Response Plan;
- Project vessel AIS carriage;
- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures;
- Promulgation of information (including Notice to Mariners); and
- Risk assessment for foundation transportation.

15.3.1.3 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 recreational vessel under power experiencing an allision with an offshore wind structure.

15.4.1.1 Qualification of Risk

Given the current very low volume of recreational vessel traffic within and in proximity to the Wind Development Area, there is anticipated to be a 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 – including a construction vessel and schedule notification system – and presence of infrastructure on relevant nautical charts 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).

Should a powered allision incident occur, it is anticipated that the impact energy would primarily be absorbed by the offshore wind structure rather than the vessel. Based on expert opinion, consideration of other types of historical incidents, operational speeds and impact energies, 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 but on the other hand 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 an Oil Spill Response Plan undertaken by the Project would be implemented to minimize the environmental effects.

15.4.1.2 Internal Array Navigation

There is also potential for recreational vessels to navigate internally within the array. For recreational vessels in general navigating internally within the array, the powered allision risk is significantly greater given the greater exposure to surrounding offshore wind structures.

As noted there could be an increase in future case recreational fishing given the benefit of aggregation around the foundations which could lead to a small increase in allision risk. However, it is noted that at the distance offshore at which the Project is sited, greater increases in recreational vessel activity in the study area would be associated with favorable weather conditions and those recreational fishing vessels are likely to be regular visitors to the array and therefore familiar with the layout/design mitigating the majority of potential allision incidents associated with the increase in numbers.

The array layout includes two main lines of orientation consistent across all internal offshore wind structures 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 offshore wind structures is 0.75 nm (1.4 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 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 Mean High Water Springs (MHWS)[20] requirement defined in MGN 654 (MCA, 2021) has been considered. The minimum WTG blade clearance above HAT for the Project is 89 ft (27 m), and therefore the minimum WTG blade clearance above MHHW is greater than 89 ft. Hence, this is considered to be sufficient air clearance for any recreational vessel navigating in proximity to a WTG to avoid an allision incident.

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 (MCA, 2008) 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), *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020), and *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM, 2021), with PATONs 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.

Furthermore, safety zones of up to 1,640 ft (500 m) radius around construction and decommissioning activities may be applied for (see Section 21) and a project safety vessel will

[20] Although NVIC 01-19 calls for the assessment of air clearance to consider MHHW, the use of MHWS can be considered an equivalent datum for the purposes of this assessment.

be deployed during the construction and decommissioning phases (where deemed appropriate by risk assessment) and will be able to advise vessels on an allision course with an offshore wind structure and contact the USCG on VHF-CH 16 if necessary.

15.4.1.3 Lesson Learned

It is also noted that there have been nine powered allision incidents with an offshore wind structure reported in the UK to date, corresponding to 1,850 years per WTG allision incident, but none have involved a recreational vessel.

15.4.1.4 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- 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;
- Lighting and marking;
- Minimum blade clearance;
- Oil Spill Response Plan;
- Promulgation of information (including Notice to Mariners);
- Use of a project safety vessel; and
- Use of PATONs.

15.4.1.5 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 recreational vessel NUC alliding with an offshore wind structure in an emergency situation.

15.5.1.1 Qualification of Risk

Given the current very low volume of recreational vessel traffic within and in proximity to the Wind Development Area and the potential for a vessel to have mechanical failure, there is anticipated to be a limited allision risk for drifting recreational vessels including with the potential increases in recreational fishing vessel numbers considered. 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).

15.5.1.2 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 array. 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 that this may not be a realistic option given the water depths in the area (84 to 126 ft [26 to 38 m] over MLLW). Vessels associated with the Project would seek to assist (including the project safety vessel if present during the construction and decommissioning phases) and operational SAR procedures would be implemented. 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, the minimum WTG blade clearance above HAT for the Project is 89 ft (27 m) and is considered to be a sufficient air clearance for any drifting recreational vessel with a mast to avoid a contact involving its mast.

Should a drifting allision incident occur, it is anticipated that the impact energy would primarily be absorbed by the offshore wind structure rather than the vessel. 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 drifting allision incident resulting in pollution then an Oil Spill Response Plan undertaken by the Project would be implemented to minimize the environmental effects.

15.5.1.3 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Minimum blade clearance;
- Oil Spill Response Plan;
- Operational SAR procedures;
- Provision of self-help capability; and
- Use of a project safety vessel.

15.5.1.4 Impact Significance

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

16 Impact Assessment for Commercial Fishing Vessels

16.1.1 Deviations

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

16.1.1.1 Qualification of Risk

The volume of commercial fishing vessel traffic within and in proximity to the Wind Development Area is very low, with AIS data, VMS data and visual observations from a survey vessel on-site all indicating that there is infrequent commercial fishing vessel presence, both in terms of transits and engagement in fishing activity. It is noted that the AIS data and VMS data are long-term data sources, and therefore incapsulate any seasonal variation. The AIS data analyzed within the export cable corridor study area indicates that the majority of commercial fishing vessel traffic in the region is located nearshore along the U.S. Atlantic coast. These findings are supported by the findings of the commercial fisheries assessment (see Section 7.2 of the COP) which indicated that the Wind Development Area is inshore of the most intensive trawl fisheries and offshore and north of other relatively intensive commercial fisheries.

There will be no restrictions on commercial fishing vessel movements internally within the array other than the possible presence of active safety zones of 1,640 ft (500 m) radius around construction and decommissioning activities (see Section 21). Likewise, a minimum advisory safe passing distance from cable laying vessels will be implemented.

Should a commercial fishing vessel choose to deviate around the array then, as with other commercial vessels, there is available sea room all around the Wind Development Area, with the only further consideration for safe navigation in proximity to the Wind Development Area being Navy Tower Light A located to the south (within the ACPARS deep draft route). The magnitude of any deviation is expected to be small, with the precise magnitude dependent on the destination fishing ground. Additionally, commercial 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 – including a construction vessel and schedule notification system – and the presence of infrastructure on relevant nautical charts and electronic charts.

16.1.1.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Charting of infrastructure;
- Construction vessel and schedule notification system; and
- Promulgation of information (including Notice to Mariners).

16.1.1.3 Impact Significance

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

16.2 Adverse Weather Deviations

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

16.2.1 Qualification of Risk

During adverse weather conditions, or when such weather is 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 lead to such action taking a greater time and therefore result in the vessel being more exposed to the adverse weather conditions.

As surmised for the equivalent impact for recreational vessels, at a local level the exposure to tropical cyclones is relatively lower owing to the sheltered location of the Wind Development Area when compared to areas further offshore.

As already noted, the volume of commercial fishing vessel traffic within and in proximity to the Wind Development Area is very low, with such traffic primarily located nearshore along the U.S. Atlantic coast. From the limited AIS data for commercial fishing vessels recorded, transits further offshore were primarily in a south west-north east direction to the south of the Wind Development Area or in a north-south direction.

For the south west-north east transits, the presence of the array is not anticipated to have any effect on the ability of commercial fishing vessels to return to port during adverse weather conditions given that such traffic passes well clear of the Wind Development Area. For the north-south transits, if it is deemed unsafe to transit internally through the array then any deviation is expected to be of low magnitude, with the precise magnitude dependent on the destination fishing ground. Commercial 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 even not making passage at all if the conditions were deemed too dangerous. However, it is likely, in most cases, that 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, commercial 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 charts and electronic charts.

16.2.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Charting of infrastructure; and
- Promulgation of information (including Notice to Mariners).

16.2.3 Impact Significance

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

16.3 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.

16.3.1 Qualification of Risk

Given the low volume of commercial fishing vessel traffic within and in proximity to the Wind Development Area, there is anticipated to be a limited increase in collision risk due to commercial fishing vessel displacement. Additionally, as already noted, there will be no restrictions on commercial fishing vessel movements internally within the array other than the possible presence of active safety zones of 1,640 ft (500 m) radius around construction and decommissioning activities (see Section 21).

Should a commercial fishing vessel choose to deviate around the array then, as with other commercial vessels, there is available sea room all around the Wind Development Area, with the only further consideration for safe navigation in proximity to the Wind Development Area being Navy Tower Light A located to the south (within the ACPARS deep draft route). Also, given the minimum spacing between offshore wind structures (approximately 0.75 nm [1.4 km] center-to-center) there are not expected to be any issues with offshore wind structures 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).

Commercial 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 – including a construction vessel and schedule notification system – and the presence of infrastructure on relevant nautical charts and electronic charts. The array will also be lit and marked in compliance with COMDTINST M16500.7A (USCG, 2015), *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020), and *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM, 2021), with PATONs also potentially deployed to mark any working areas (where deemed appropriate by risk assessment), thus maximizing mariner awareness of the array when in proximity, both in day and night conditions.

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 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 an Oil Spill Response Plan undertaken by the Project would be implemented to minimize the environmental effects.

16.3.1.1 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 of up to 1,640 ft (500 m) radius around construction and decommissioning activities may be applied for (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.

16.3.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- 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;
- Lighting and marking;
- Marine coordination for Project vessels;
- Minimum advisory safe passing distances;
- Oil Spill Response Plan;
- Project vessel AIS carriage;

- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures;
- Promulgation of information (including Notice to Mariners); and
- Risk assessment for foundation transportation.

16.3.3 Impact Significance

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

16.4 Powered Vessel to Structure Allision Risk

The presence of the Project may create a risk of a commercial fishing vessel (in transit) under power experiencing an allision with an offshore wind structure.

16.4.1 Qualification and Quantification of Risk

Given the very low volume of commercial fishing vessel traffic within and in proximity to the Wind Development 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 – including a construction vessel and schedule notification system – and presence of infrastructure on relevant nautical charts 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).

16.4.1.1 Internal Array Navigation

There is also potential for commercial fishing vessels to navigate internally within the array. For such vessels the powered allision risk is significantly greater given the greater exposure to surrounding offshore wind structures. The array layout includes two main lines of orientation consistent across all offshore wind structures which will assist with ensuring fishing vessels are able to safely navigate from one side of the array to the other. The minimum spacing center-to-center between offshore wind structures is 0.75 nm (1.4 km), which is considered sufficient for safe navigation 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 structures with much lower spacing.

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 1,440 years for base case traffic levels. The majority of risk was associated with structures within the north western portion of the Wind Development Area.

Should a powered allision occur, it is anticipated that the impact energy would primarily be absorbed by the offshore wind structure rather than the vessel[21]. The most likely

[21] Based on general principles of physics. Specific calculations would depend upon a range of parameters including vessel size, vessel speed and offshore wind structure size.

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 but on the other hand the 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 an Oil Spill Response Plan undertaken by the Project would be implemented to minimize the environmental effects.

The array will be lit and marked in compliance with COMDTINST M16500.7A (USCG, 2015), *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020), and *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM, 2021), with PATONs 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 commercial fishing vessel navigating internally becoming disoriented.

Furthermore, safety zones of up to 1,640 ft (500 m) radius around construction and decommissioning activities may be applied for (see Section 21) and a project safety vessel will be deployed during the construction and decommissioning phases (where deemed appropriate by risk assessment) and will be able to advise vessels on an allision course with an offshore wind structure and contact the USCG on VHF-CH 16 if necessary. The Project is also committed to ongoing consultation with commercial fishing stakeholders including use of a Fisheries Liaison Officer.

16.4.1.2 Lesson Learned

It is also noted that there have been nine powered allision incidents with an offshore wind structure reported in the UK to date, corresponding to 1,850 years per WTG allision incident with one involving a fishing vessel.

16.4.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- 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;
- Lighting and marking;
- Oil Spill Response Plan;
- Ongoing engagement with stakeholders;
- Promulgation of information (including Notice to Mariners);
- Use of a project safety vessel; and
- Use of PATONs.

16.4.3 Impact Significance

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

16.5 Drifting Vessel to Structure Allision Risk

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

16.5.1 Qualification of Risk

Given the very low volume of commercial fishing vessel traffic within and in proximity to the Wind Development 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).

16.5.1.1 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 array. 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 that for smaller commercial fishing vessels anchoring may not be a realistic option given the water depths in the area (84 to 126 ft [26 to 38 m] over MLLW). Vessels associated with the Project would seek to assist (including the project safety vessel if present during the construction and decommissioning phases) and operational SAR procedures would be implemented. 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 offshore wind structure rather than the vessel. 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 drifting allision incident resulting in pollution then an Oil Spill Response Plan undertaken by the Project would be implemented to minimize the environmental effects.

16.5.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Oil Spill Response Plan;
- Operational SAR procedures;
- Provision of self-help capability; and

- Use of a project safety vessel.

16.5.3 Impact Significance

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

17 Impact Assessment for Anchored Vessels

17.1 Displacement of Anchoring Activity

The presence of the Project may displace existing anchoring activity.

The level of anchoring activity within and in proximity to the Wind Development Area and export cable corridor is negligible, with AIS data indicating only six vessels at anchor throughout the 12-month survey period analyzed across the Wind Development Area and offshore export cable corridor study areas.

There are no designated anchorage areas within or in proximity to the Wind Development Area and export cable corridor and during consultation the AWO noted that there is no need for vessels to anchor in proximity to the Project.

Therefore, the likelihood of anchoring activity being displaced by the presence of subsea cables (inter-array or export cables) is considered to be negligible and no further assessment has been undertaken in this NSRA. However, it is noted that a Cable Installation Plan will be undertaken in consultation with the USACE and USCG.

17.2 Anchor Snagging and Contact Risk

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

17.2.1 Qualification of Risk

There is potential that a vessel may interact with infrastructure associated with the Project via its anchor. Since none of the WTG foundations under consideration include mooring or anchor lines, this impact is limited to the subsea cables. Examples of 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's presence, or the vessel incorrectly judges the position/location of the subsea cable.
- The anchor is deployed over a subsea cable accidentally via human error or mechanical failure.

As already noted, the level of anchoring activity within and in proximity to the Wind Development Area and export cable corridor is very low. Therefore, the likelihood of an anchor being knowingly deployed by a vessel in proximity to the Wind Development Area is considered very low.

Given the presence of the Project and other associated risks (such as collision and allision risk) the likelihood of emergency anchoring occurring may be greater than indicated in the baseline data. 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 charts and electronic charts. Given consultation feedback, the Project will seek to have the subsea cables charted as soon as possible, prior to the start of the construction phase.

Should the anchor of a vessel make contact with a subsea cable, the level of resulting damage is dependent on the penetration depth of the anchor (which itself depends on the vessel size and type of anchor), type of seabed, cable burial depth and protection. It is likely that damage would only be incurred by the subsea cable but should the anchor of a smaller vessel make contact, there is a risk of snagging. The worst case consequences are the loss of vessel stability and capsize, with PLL, but this is considered highly unlikely.

17.2.1.1 Cable Burial Risk Assessment

In order to minimize the risk of anchor interaction, inter-array cables will, where possible, be buried to a target depth of approximately 1.5 – 2.5 m below stable seabed and export cables will, where possible, be buried to a target depth of approximately 1.5 – 2.5 m below stable seabed. Where target burial depths cannot be met, additional external protection will be utilized and monitored periodically to ensure it remains effective. It is anticipated that external protection will be required for up to 8% of the offshore export cable route but will not result in any significant reduction in the navigable water depth.

Given the negligible level of anchoring activity within and in proximity to the Wind Development Area and export cable corridor, the foundation types under consideration and the measures which will implemented to minimize the risk of anchor interaction, the impact is not considered to be significant.

17.2.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Cable Burial Risk Assessment (CBRA);
- Charting of infrastructure; and
- Monitoring of cable burial and protection measures.

17.2.3 Impact Significance

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

18 Impact Assessment for Emergency Responders

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

18.1.1 Qualification of Risk

From historical SAR incident data, an average of one response every two years to SAR related incidents and one response every five years to pollution incidents were recorded between 2010 and 2019 within the Wind Development Area study area. Therefore, the likelihood of an incident requiring an emergency response (SAR and/or pollution) in proximity to the Wind Development Area is considered to be low. This is not considered likely to increase markedly due to the presence of the Project, noting the range of preventative embedded mitigation measures (see Section 21) designed to minimize the risk of an incident 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 shown in Section 9.1.1, there are a number of active USCG stations on the Virginia and North Carolina coast from which assets could be mobilized in the event of an incident. This includes Air Station Elizabeth City which, in the event of airborne assets being required in an emergency situation, would most likely be used for mobilization.

In the event of an incident occurring in proximity to the Wind Development Area, there is considered to be sufficient available sea room all around the Wind Development Area to ensure that response times are not affected significantly. Given that Air Station Elizabeth City is located approximately 36 nm (67 km) from the Wind Development Area and operates assets which can travel at speeds between 125 and 140 knots, it is anticipated that there will be no increased difficulty in satisfying the USCG's target two-hour response time including preparation.

In the unlikely event of multiple incidents occurring in proximity to the Wind Development Area simultaneously, there are considered to be sufficient USCG resources in the general area (both in terms of stations and units) to conclude that there will be no increased difficulty in satisfying the USCG's target two-hour response time including preparation.

In the event of an incident occurring within the array itself, the spacing between offshore wind structures (0.75 nm [1.4 km] measured center-to-center) and the two lines of orientation consistent across all structures will ensure that access to the sea area occupied by the array for SAR purposes is not compromised significantly.

Furthermore, an SMS created by the Project would be implemented in such a scenario and if deemed relevant an Oil Spill Response Plan undertaken by the Project would also be implemented to minimize the environmental effects. Any vessels on-site associated with the Project may be able to assist if required (in liaison with the USCG) and will likely have an increased level of response equipment onboard. Additionally, the Project will have its own SMS in place, including details pertaining to 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.

Finally, it is noted that the marine coordination and monitoring associated with the Project will have a positive effect on emergency response in the area and the USCG will be provided opportunity to undertake SAR trials within and in proximity to the array. The offshore wind structures themselves will provide a place of refuge and be marked in compliance with COMDTINST M16500.7A (USCG, 2015), and *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020), and *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM, 2021), thus enhancing SAR operation capability.

18.1.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Lighting and marking;
- Marine coordination for Project vessels;
- Oil Spill Response Plan;
- Operational SAR procedures;
- Provision of self-help capability;
- SMS; and
- USCG SAR trials.

18.1.3 Impact Significance

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

19 Impact Assessment for Ports and Services

The construction, maintenance and decommissioning activities associated with the Project may result in restricted access at those ports used for operations relating to the Project and disrupt port related activities.

19.1.1 Qualification of Risk

Given the distance of the Wind Development Area offshore (approximately 24 nm [44 km]) the effect of the presence of the Project itself is not expected to have any significant effect on access to ports in the area. However, the presence of vessel traffic associated with the Project has a low potential to restrict port access.

During the construction phase the staging of structure components and construction vessels will be undertaken at various ports in the Lower Chesapeake Bay area (i.e., Hampton Roads, VA; Elizabeth River, VA; Cape Charles, VA; and Cape Henry, VA)[22]. Smaller construction vessels such as Crew Transfer Vessels are not anticipated to cause access issues in these areas, but there is potential for larger vessels such as jack-up barges to restrict port access and/or pilotage operations (particularly in relation to the pilotage boarding station located within the precautionary area where the Southern and Eastern Approaches of the Chesapeake Bay IMO routing measure converge) while in transit to and from the Wind Development Area. Operational procedures such as designated routes to/from port will be established for Project vessels; these will be determined in consultation with key stakeholders including relevant ports and the USCG and promulgated to relevant parties. Designated routes may involve use of the Chesapeake Bay IMO routing measure, but given the significant volume of vessel traffic already utilizing this navigational feature it is not anticipated that the presence of construction traffic associated with the Project will have a significant effect on access or pilotage operations.

During the operation and maintenance phase the operation and maintenance facilities will be accommodated at any of four possible locations. These are located within Chesapeake Bay and therefore are not expected to result in any greater impact on access than the construction phase movements. Indeed, Project vessel activity will be lower during the operation and maintenance phase with activities involving larger vessels limited to maintenance works which will be temporary in nature. Smaller vessels will be more prominent, with a Service Operations Vessel (with the capability to accommodate personnel for medium-term periods) likely to be used to reduce round trips given the distance of the Wind Development Area offshore.

Works within the offshore export cable corridor (throughout all phases) will be restricted to selected locations at any one time, i.e., activities associated with the Project will not be undertaken along the entire offshore export cable route simultaneously but rather in a

[22] At this time potential ports for decommissioning cannot be determined; details will be incorporated into a separate NSRA specific to decommissioning which will be produced prior to the start of the decommissioning phase (see Section 2.1.1).

phased manner. Further measures pertaining to the installation of the offshore export cables will be detailed in a Cable Installation Plan produced in consultation with the USACE and USCG.

Throughout all phases, Project vessel movements will be managed through marine coordination to minimize disruption (as far as is feasible) to third party traffic. Project vessels will comply with international and flag state regulations (including the COLREGs and SOLAS) with risk assessments undertaken for the transportation of foundations prior to the start of the construction phase. Also, close contact with the Port of Virginia will be maintained throughout all phases of the Project.

19.1.2 Relevant Embedded Mitigation

Relevant embedded mitigation measures which have been identified to reduce risk are as follows (further detail on mitigation is included in Section 21):

- Cable Installation Plan;
- Marine coordination for Project vessels;
- Ongoing engagement with stakeholders;
- Project vessel compliance with international and flag state regulations;
- Project vessel operational procedures;
- Promulgation of information (including Notice to Mariners); and
- Risk assessment for foundation transportation.

19.1.3 Impact Significance

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

20 Cumulative Effect Assessment by Impact

20.1 Deviations

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

From the cumulative routing assessment (see Section 11.6), the presence of Kitty Hawk Wind Rest of Zone will result in the displacement of one main commercial route which was not affected by the presence of the Project in isolation (see Figure 11.10). For this route, the increase in route length was 0.2 nm (0.37 km) and therefore there is anticipated to be limited effect on the passage of such vessels including journey time. Additionally, the deviation is considered reasonable since there is available sea room to the north for this deviation to be applied with the only further consideration for safe navigation in proximity to the Wind Development Area being the Navy Tower Light B located to the south.

The presence of Kitty Hawk Wind Rest of Zone will also result in the further displacement of five main commercial routes which were anticipated to pass seaward of the Wind Development Area when considered in isolation. For these routes, the largest increase in route length was 9.3 nm (17 km) compared to the pre wind facility scenario and 5.4 nm (10 km) compared to the Project in isolation scenario. This is a notable increase in journey distance and would require increases in speeds in order to maintain existing journey times. However, accounting for the most prominent destination ports on these routes (Charleston, SC; Savannah, GA and Jacksonville, FL) the total length of a typical transit on these routes out of Chesapeake Bay is estimated to be around 450 nm (833 km) and therefore a 9.3 nm (17 km) increase would equate to a total route length increase of approximately 2%. Also, from a navigational safety perspective, the deviation is considered reasonable since there is available sea room to the east for this deviation to be applied with the only further consideration for safe navigation in proximity to the Wind Development Area being Navy Tower Light B located to the south.

The presence of CVOW Commercial (Lease Area OCS-A 0483) will result in the further displacement of one main commercial route which was anticipated to pass landward of the Wind Development Area when considered in isolation. For this route, the increase in route length was 0.7 nm (1.3 km) (similar to the deviation for the Project in isolation since the deviation in that scenario was minimal). Therefore, there is anticipated to be limited effect on the passage of vessels on this route including journey time. However, the route is required to pass port side and starboard side of each development in turn, creating greater complexity and constraint on the route in terms of available sea room. Vessels on this route are push/pull vessels which in terms of planned passage planning are able to action deviations around cumulative developments and are more likely to be familiar with routing in proximity to offshore infrastructure.

20.1.1 Relevant Embedded Mitigation

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, ensuring that vessel awareness when passing north-south with infrastructure on both sides is elevated.

20.1.2 Impact Significance

With these embedded mitigation measures considered, the impact is assessed to be Tolerable with Mitigation and within ALARP parameters. This means that the impact can be considered manageable from a safety perspective so long as the additional mitigation measures are applied.

20.2 Increased Vessel to Vessel Collision Risk

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

Given that only one main commercial route associated with the Project passes in proximity to CVOW Commercial (Lease Area OCS-A 0483) (and is only deviated by a small distance), there is not considered to be any significant potential for increased vessel to vessel encounters due to the additional presence of CVOW Commercial (Lease Area OCS-A 0483).

The presence of Kitty Hawk Wind Rest of Zone results in more substantial deviations and therefore has the potential to increase vessel to vessel encounters. However, since the affected routes are the same as those considered for passing seaward of the Project in the assessment of the Project in isolation, the vessel to vessel collision risk is not anticipated to be much higher than suggested in the assessment of the Project in isolation.

However, it is noted that in the cumulative scenario the extension of developments south does result in the creation of a more pronounced choke point for routing traffic at the south eastern corner of Kitty Hawk Wind Rest of Zone where some routes are anticipated to turn sharply to rejoin their original pre wind facility course. Therefore, the collision risk at this location can be expected to be greater, although it is emphasized that the deviations considered in this assessment are a worst case (see Section 6.7.4) and in reality vessels are less likely to make such sharp turns but rather straighten their route to gradually rejoin their original pre wind facility course, thus minimizing the collision risk.

20.2.1 Relevant Embedded Mitigation

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 across both the Project and Kitty Hawk Wind Rest of Zone will be in place for Project vessels.

20.2.2 Impact Significance

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

20.3 Powered and Drifting Vessel to Structure Allision Risk

The presence of cumulative developments may create a risk of a vessel under power or NUC experiencing an allision with an offshore wind structure.

Given that only one main commercial route associated with the Project passes in proximity to CVOW Commercial (Lease Area OCS-A 0483) (and only averages one transit every five days), there is not considered to be any significant potential for an allision incident due to the additional presence of CVOW Commercial (Lease Area OCS-A 0483).

Since there are a number of routes anticipated to pass in proximity to Kitty Hawk Wind Rest of Zone there is potential for increased allision risk associated with the additional presence of Kitty Hawk Wind Rest of Zone. However, the level to which the allision risk will increase will depend on the build out scenario and therefore cannot be assessed in detail at this stage. For example, a full build out of the remainder of the Lease Area would result in the allision risk associated with the eastern periphery of the Project being significantly reduced since offshore wind structures on this periphery would essentially become internal structures and be shielded by Kitty Hawk Wind Rest of Zone.

20.3.1 Relevant Embedded Mitigation

Mitigation measures associated with the equivalent impacts for the assessment of the Project in isolation are also applicable for this cumulative impact; in particular, it will ensure that lighting and marking of the Project and Kitty Hawk Wind Rest of Zone is consistent, with the two developments considered as a single entity for such purposes.

20.3.2 Impact Significance

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

21 Embedded Mitigation Measures

As referenced throughout Sections 12 through 20, 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 21.1 for ease of reference and completeness; Table 21.1 also includes a summary of how each measure manages risk.

It should be noted that the assessment completed by BOEM prior to the Company's acquisition of the Lease in 2017 was a critical early-stage mitigation in siting the overall Lease Area so as to avoid major constraints identified during the process. Constraints were identified by regulators and other stakeholders as further detailed in the Revised Environmental Assessment (2015).

Table 21.1 Embedded mitigation measures

Mitigation Measure	Details	How Mitigation Measure Manages Risk
Application and use of safety zones up to 1,640 ft (500 m) radius during construction and decommissioning	Offshore, safety zones will be established, as applicable[23],surrounding the construction areas of Project components such as foundations, WTGs, the ESP, and the offshore export and inter-array cables. Where feasible, a minimum advisory safe passing distance for cable laying vessels will be implemented, as per the COLREGs. Where USCG safety zone authorities are not applicable, the Company will use project safety vessels to promote awareness of these activities and the safety of the construction equipment and personnel.	Protects Project vessels from passing third party vessels, minimizing collision risk. Protects third party vessels from offshore wind structures under construction, minimizing powered allision risk.
CBRA	A CBRA is being 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.	Helps determine a target burial depth for subsea cables and additional external protection, to minimize anchor snagging and contact risk.

[23] 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. Project construction is not anticipated to commence within two years of the passage of the Act; however, the authority may be extended or made permanent. The Company will continue to monitor the results of this pilot program and any implementing regulations to determine where safety zones may be applicable during Project construction. Where applicable, safety zones will extend up to 500 m around construction sites, per 33 CFR § 147.15. All areas will be marked and lit in accordance with USCG requirements and monitored by a project safety vessel that will be available to assist local mariners.

Mitigation Measure	Details	How Mitigation Measure Manages Risk
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 within port approaches.	Assists in ensuring disruption is minimized, including access to ports used for operations relating to the Project.
Charting of infrastructure	All infrastructure associated with the Project will be charted on the relevant nautical charts and electronic charts in conjunction with NOAA. The Company 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 to Sector Virginia Waterways Management (virginiawaterways@uscg.mil) and NOAA Mid-Atlantic Navigation Manager (midatlantic.navmanager@noaa.gov) no later than three months before export cable installation begins in order to propose early inclusion on nautical charts and Local Notice to Mariners.	Assists third party vessels to passage plan in advance, thus minimizing deviations, collision risk and powered allision risk. Assists third party vessels in determining suitable anchoring locations, minimizing anchor snagging and contact risk.
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), *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance* (USCG, 2020), and *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (BOEM, 2021). Additionally, Federal Aviation Administration requirements for the lighting of structures over 200 ft (61 m) will be adhered to. AIS will be used to mark structures within the Wind Development Area, pending additional guidance from USCG.	Assists third party vessel awareness of the Project to minimize collision risk and powered allision risk. Assists emergency responders to undertake SAR operations as efficiently as possible.
Marine coordination for Project vessels	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. Additional detail will be provided in the SMS.	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 distances	Where feasible, a minimum advisory safe passing distance for cable laying vessels will be implemented.	Protects Project vessels from passing third party vessels, minimizing collision risk.

Mitigation Measure	Details	How Mitigation Measure Manages Risk
Minimum blade clearance	The minimum blade clearance for WTG blades will be 89 ft (27 m) above HAT.	Minimizes powered and drifting allision risk for recreational vessels with a mast.
Monitoring of cable burial and protection measures	Cable burial and protection measures will be periodically monitored to ensure they remain effective, with monitoring of protection in the vicinity of any areas of existing anchoring as identified within the CBRA.	Minimizes anchor snagging and contact risk.
Pollution Response Plan	Appropriate marine pollution contingency planning will be undertaken, such as the creation of an Oil Spill Response Plan to manage discharges from Project facilities.	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.
Operational SAR procedures	Operational SAR procedures will be put in place to detail how the Company will cooperate with the USCG in the event of an emergency situation.	Minimizes drifting allision risk and assists emergency responders to undertake SAR operations as efficiently as possible.
Project vessel AIS carriage	The Project will require operational AIS on all vessels associated with the construction, operations, and decommissioning of the Project, pursuant to USCG and AIS carriage requirements. AIS will be required to monitor the number of vessels and traffic patterns for analysis and compliance with vessel speed requirements.	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.

Mitigation Measure	Details	How Mitigation Measure Manages Risk
Promulgation of information	Information relating to the Project and 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/WTG based resources or facilities relating to the Project may be able to assist. However at this point it is too early within the process to confirm what these self-help capabilities will consist of.	Minimizes drifting allision risk and assists in limiting the effects of the Project on emergency response capability.
Risk assessment for foundation transportation	Risk assessments associated with the transportation of foundations to the Wind Development Area will be undertaken prior to construction once the foundation type to be used is finalized.	Minimizes collision risk for Project vessels. Ensures disruption is minimized, including access to ports used for operations relating to the Project.
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.
USCG SAR trials	The ability for the USCG to undertake SAR trials within and in proximity to the Wind Development Area will be facilitated.	Assists emergency responders to undertake SAR operations as efficiently as possible.
Use of a safety vessel	A safety vessel will be deployed during the construction and decommissioning phases (where deemed appropriate by 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 PATONs	PATONs may be deployed during the construction, operation and maintenance, and decommissioning phases to mark the working area or Wind Development 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	The Company will shut down individual turbine(s) as directed including blade position and access requirements.	Assists emergency responders to undertake SAR operations as efficiently as possible.

22 Conclusion

This NSRA has assessed the impact of the major hazards associated with the development of the Kitty Hawk North Wind Project based on 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 facilities, and collision, allision, and grounding risk modelling.

Table 22.1 summarizes the potential impacts identified for shipping and navigation which were assessed in the NSRA. Other impacts, such as those relating to navigation and communication position fixing equipment, tropical cyclones, ice, and anchoring activity displacement which were not deemed significant enough to be considered fully in the impact assessment have not been included in Table 22.1.

It can be seen that with embedded mitigation measures in place, all impacts have been considered to be within at most **Tolerable with Mitigation**. As per the definitions given in Section 2.1.3, each impact is therefore within ALARP parameters.

Table 22.1 Summary of potential impacts identified for shipping and navigation and ALARP risk levels

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
Commercial vessels	Deviations	Broadly Acceptable	▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Monitoring of third party vessels; and ▪ Promulgation of information (including Notice to Mariners).	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; ▪ Lighting and marking; ▪ Marine coordination for Project vessels; ▪ Minimum advisory safe passing distances; ▪ Pollution Response Plan; ▪ Project vessel AIS carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of information (including Notice to Mariners); and ▪ Risk assessment for foundation transportation.	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 of up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Lighting and marking; ▪ Pollution Response Plan; ▪ Promulgation of information (including Notice to Mariners); ▪ Use of a safety vessel; and ▪ Use of PATONs.	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
	Drifting vessel to structure allision risk	Broadly Acceptable	▪ Pollution Response Plan; ▪ Operational SAR procedures; ▪ Provision of self-help capability; and ▪ Use of a safety vessel.	Risk level has been reduced to ALARP and no further mitigation is required.
Military vessels	Deviations	Broadly Acceptable	▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Monitoring of third party vessels; ▪ Ongoing engagement with stakeholders; and ▪ Promulgation of information (including Notice to Mariners).	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; ▪ Lighting and marking; ▪ Marine coordination for Project vessels; ▪ Minimum advisory safe passing distances; ▪ Pollution Response Plan; ▪ Project vessel AIS carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of information (including Notice to Mariners); and ▪ Risk assessment for foundation transportation.	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; ▪ Construction vessel and schedule notification system; ▪ Lighting and marking; ▪ Marine pollution contingency planning; ▪ Pollution 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
			▪ Promulgation of information (including Notice to Mariners); ▪ Use of a safety vessel; and ▪ Use of PATONs.	
	Drifting vessel to structure allision risk	Broadly Acceptable	▪ Pollution Response Plan; ▪ Operational SAR procedures; ▪ Provision of self-help capability; and ▪ Use of a safety vessel.	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; and ▪ Promulgation of information (including Notice to Mariners).	Risk level has been reduced to ALARP and no further mitigation is required.
	Adverse weather deviations	Broadly Acceptable	▪ Charting of infrastructure; and ▪ Promulgation of information (including Notice to Mariners).	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 for Project vessels; ▪ Minimum advisory safe passing distances; ▪ Pollution Response Plan; ▪ Project vessel AIS carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of information (including Notice to Mariners); and ▪ Risk assessment for foundation transportation.	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; ▪ Construction vessel and schedule notification system; ▪ Lighting and marking;	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			▪ Minimum blade clearance; ▪ Pollution Response Plan; ▪ Promulgation of information (including Notice to Mariners); ▪ Use of a safety vessel; and ▪ Use of PATONs.	
	Drifting vessel to structure allision risk	Broadly Acceptable	▪ Minimum blade clearance; ▪ Pollution Response Plan; ▪ Operational SAR procedures; ▪ Provision of self-help capability; and ▪ Use of a safety vessel.	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; and ▪ Promulgation of information (including Notice to Mariners).	Risk level has been reduced to ALARP and no further mitigation is required, noting that fishing vessel displacement from a commercial perspective is considered separately in the commercial fisheries assessment (see Section 7.2, Commercial and Recreational Fishing).
	Adverse weather deviations	Broadly Acceptable	▪ Charting of infrastructure; and ▪ Promulgation of information (including Notice to Mariners).	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; ▪ Lighting and marking; ▪ Marine coordination for Project vessels; ▪ Minimum advisory safe passing distances; ▪ Pollution Response Plan; ▪ Project vessel AIS carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of information (including Notice to Mariners); 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
			▪ Risk assessment for foundation transportation.	
	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; ▪ Construction vessel and schedule notification system; ▪ Lighting and marking; ▪ Pollution Response Plan; ▪ Ongoing engagement with stakeholders; ▪ Promulgation of information (including Notice to Mariners); ▪ Use of a safety vessel; and ▪ Use of PATONs.	Risk level has been reduced to ALARP and no further mitigation is required.
	Drifting vessel to structure allision risk	Broadly Acceptable	▪ Pollution Response Plan; ▪ Operational SAR procedures; ▪ Provision of self-help capability; and ▪ Use of a safety vessel.	Risk level has been reduced to ALARP and no further mitigation is required.
Anchored vessels	Underwater snagging or contact risk	Broadly Acceptable	▪ CBRA; ▪ Charting of infrastructure; and ▪ Monitoring of cable burial and protection measures.	Risk level has been reduced to ALARP and no further mitigation is required.
Emergency responders	Emergency response capability	Broadly Acceptable	▪ Lighting and marking; ▪ Marine coordination for Project vessels; ▪ Pollution Response Plan; ▪ Operational SAR procedures; ▪ Provision of self-help capability; ▪ SMS; and ▪ USCG SAR trials.	Risk level has been reduced to ALARP and no further mitigation is required.
Ports and services	Restricted access at ports	Broadly Acceptable	▪ Cable Installation Plan; ▪ Marine coordination for Project vessels; ▪ Ongoing engagement with stakeholders; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of information (including Notice to Mariners); 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
			▪ Risk assessment for foundation transportation.	
All users (cumulative)	Deviations	Tolerable with Mitigation	▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; and ▪ Promulgation of information (including Notice to Mariners).	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; ▪ Lighting and marking; ▪ Marine coordination for project vessels; ▪ Minimum advisory safe passing distances; ▪ Pollution Response Plan; ▪ Project vessel AIS carriage; ▪ Project vessel compliance with international and flag state regulations; ▪ Project vessel operational procedures; ▪ Promulgation of information (including Notice to Mariners); and ▪ Risk assessment for foundation transportation.	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 of up to 1,640 ft (500 m) radius during construction and decommissioning; ▪ Charting of infrastructure; ▪ Construction vessel and schedule notification system; ▪ Lighting and marking; ▪ Pollution Response Plan; ▪ Operational SAR procedures; ▪ Promulgation of information (including Notice to Mariners); ▪ Provision of self-help capability; ▪ Use of a safety vessel; and ▪ Use of PATONs.	Risk level has been reduced to ALARP and no further mitigation is required.

23 References

Anatec (2016). *Influence of UK Offshore Wind Farm Installation on Commercial Vessel Navigation: A Review of Evidence*. Aberdeen, UK: Anatec.

Atlantic Array (2012). *Atlantic Array Offshore Wind Farm Draft Environmental Statement – Annex 18.3: Noise and Vibration (Anthropogenic Receptors): Predictions of Operational Wind Turbine Noise Affecting Fishing Vessel Crews*. Swindon, UK: Channel Energy Limited.

BOEM (2021). *Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development*. Washington, D.C.: BOEM.

BOEM (2021). *VMS Polar Histogram Data (Jan 2014 to Aug 2019).* Washington, D.C.: BOEM.

BOEM (2020). *Guidelines for Information Requirements for a Renewable Energy Construction and Operations Plan*. Washington, D.C.: BOEM.

BOEM (2015.). Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore North Carolina Revised Environmental Assessment. Available online: https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/NC/NC-EA-Camera-FONSI.pdf.

BTS (2019). *Petroleum Oil Spills Impacting Navigable U.S. Waterways*. Washington, D.C., USA: BTS.

British Wind Energy Association (2007). *Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind Farm*. British Wind Energy Association (now RenewableUK), BEIS, MCA and Port of London Authority.

Convention for the Protection of the Marine Environment of the North-East Atlantic (2008). *Background Document on Potential Problems Associated with Power Cables Other Than Those for Oil and Gas Activities*. Paris, France: Convention for the Protection of the Marine Environment of the North-East Atlantic.

Department for Transport (2001). *Identification of Marine Environmental High Risk Areas (MEHRAs) in the UK.* Southampton, UK: Department for Transport.

Dominion Energy (2020). *Coastal Virginia Offshore Wind (CVOW) Pilot Project Update – July/August 2020*. https://cdn-dominionenergy-prd-001.azureedge.net/-/media/pdfs/global/wind/071620-cvow-pilot-july-construciton-update.pdf (accessed August 2020).

ElizCity.com (2020). U.S. *Coast Guard Air Station Elizabeth City*. https://www.elizcity.com/uscg-elizabeth-city.html (accessed August 2020).

Energinet.dk (2014). *Horns Rev 3 Offshore Wind Farm Technical Report no. 12 – Radio Communication and Radars*. Fredericia, Denmark: Energinet.dk.

GVSU (2014). *West Michigan Wind Assessment Issue Brief No.9*. Michigan: GVSU.

Hudecz, A., Hansen, M.O.L., Battisti, L. & Villumsen, A. (2014). *Icing Problems of Wind Turbines in Cold Climates*. Copenhagen, Denmark: Technical University of Denmark.

IMO (1972/77). *Convention on International Regulations for Preventing Collisions at Sea (COLREGs) Annex III – Technical Details of Sound Signal Appliances*. London, UK: IMO.

IMO (2000). *Maritime Safety Committee 72nd Session Agenda Item 16*. Norway: IMO.

IMO (2002). SOLAS Chapter V – Safety of Navigation. London, UK: IMO.

IMO (2018). *Revised Guidelines for Formal Safety Assessment for Use in the Rule-Making Process*. Maritime Safety Committee-MEPC.2/Circ.12/Rev.2. London, UK: IMO.

Kitty Hawk Wind, LLC (2020). *New Buoy Active Near Triple Zeros*. Kitty Hawk Wind, LLC. https://static1.squarespace.com/static/511cdc7fe4b00307a2628ac6/t/5ef5032ba12f001c40959be7/1593115436382/Kitty+Hawk+-+Buoy+Data+Notice_June_2020.pdf (accessed July 2020).

Maritime Executive (2018). *Maersk Shanghai: Container Containing Acid Yet to be Found*. https://www.maritime-executive.com/article/maersk-shanghai-container-containing-acid-yet-to-be-found (accessed September 2020).

The Martha's Vineyard Times (2019). *Coast Guard Suspends Search for Missing Fishermen*. Martha's Vineyard, MA: The Martha's Vineyard Times. https://www.mvtimes.com/2019/01/01/station-menemsha-searches-survivors-fishing-boat-sinks/ (accessed August 2020).

MCA (2005). *Offshore Wind Farm Helicopter Search and Rescue – Trials Undertaken at the North Hoyle Wind Farm Report of Helicopter SAR Trials Undertaken with Royal Air Force (RAF) Valley "C" Flight 22 Squadron on March 22 2005*. Southampton, UK: MCA.

MCA (2008). *Marine Guidance Note 372 (Merchant and Fishing) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs*. Southampton: MCA.

MCA (2013). *Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI)*. Southampton, UK: MCA.

MCA (2016). *MGN 543 (Merchant & Fishing) Safety of Navigation: OREIs – Guidance on UK Navigational Practice, Safety and Emergency Responses*. Southampton, UK: MCA.

MCA (2016). *Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response*. Southampton, UK: MCA.

MCA (2017). *Merchant Shipping Notice (MSN) 1781 Navigation Safety: The Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996 – COLREGs*. Amendment 2. Southampton: MCA.

MCA (2021). *MGN 654 (Merchant & Fishing) Safety of Navigation: OREIs – Guidance on UK Navigational Practice, Safety and Emergency Responses*. Southampton, UK: MCA.

NEODP (2018). Northeast Ocean Data Portal Data Explorer Commercial Fishing Vessel Activity layers. https://www.northeastoceandata.org/data-explorer/ (accessed September 2021).

NOAA (2016). *Automated Wreck and Obstruction Information System (AWOIS)*. Office of Coast Survey. https://nauticalcharts.noaa.gov/data/wrecks-and-obstructions.html (accessed July 2020).

NOAA (2018). *Military Operating Area Boundaries: Atlantic/Gulf of Mexico*. https://catalog.data.gov/dataset/military-operating-area-boundaries (accessed August 2021).

NOAA (2019). *United States Coastal Pilot 4 Atlantic Coast: Cape Henry, Virginia to Key West, Florida*. 51st Edition. Washington, D.C.: NOAA.

NOAA (2019). *Military Submarine Transit Lanes: Atlantic/Gulf of Mexico*. https://catalog.data.gov/dataset/military-submarine-transit-lanes-atlantic-gulf-of-mexico (accessed August 2021).

NOAA (2021). *United States Coastal Pilot 3 Atlantic Coast: Sandy Hook, New Jersey to Cape Henry, Virginia*. 53rd Edition. Washington, D.C.: NOAA.

NOAA (2020). *Historical Hurricane Tracks*. https://www.ncdc.noaa.gov/ibtracs/index.php?name=ib-v4-access (accessed August 2021).

Office of the Federal Register (2016). *Federal Register Vol. 81, No. 98*. Washington, D.C.: Office of the Federal Register.

Office of the Federal Register (2019). *Federal Register Vol. 84, No. 229*. Washington, D.C.: Office of the Federal Register.

Office of the Federal Register (2020). *Code of Federal Regulations Title 30 – Mineral Resources*. Washington, D.C: Office of the Federal Register.

Office of the Federal Register (2020). *Code of Federal Regulations Title 33 – Navigation and Navigable Waters*. Washington, D.C: Office of the Federal Register.

Office of the Federal Register (2020). *Code of Federal Regulations Title 46 – Shipping*. Washington, D.C: Office of the Federal Register.

Office of the Federal Register (2020). *Code of Federal Regulations Title 50 – Wildlife and Fisheries*. Washington, D.C: Office of the Federal Register.

Office of the Federal Register (2020). *Federal Register Vol. 85, No. 119*. Washington, D.C.: Office of the Federal Register.

Organization for Economic Cooperation and Development and International Transport Forum (2015). *The Impact of Mega-Ships: Case Specific Policy Analysis*. Paris, France: Organization for Economic Cooperation and Development and International Transport Forum.

Port of London Authority (2005). *Interference to Radar Imagery from Offshore Wind Farms*. London: Port of London Authority.

Qinetiq and MCA (2004). *Results of the Electromagnetic Investigations and Assessments of Marine Radar, Communications and Positioning Systems Undertaken at the North Hoyle Wind Farm*. Southampton, UK: Qinetiq and MCA.

Renewables UK (2014). *Guidelines for Health and Safety in the Wind Energy Industry*. Issue 2. London, UK: Renewables UK.

Schmidt Etkin (2006). *Oil Spill Probability Analysis for the Cape Wind Energy Project in Nantucket Sound*. Cortlandt Manor, NY: Environmental Research Consulting.

The Crown Estate and Anatec (2012). *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 REZ*. London: The Crown Estate.

UKHO. *Admiralty Sailing Directions East Coast of the United States Pilot Volume 2*. NP69. 14th Edition. Taunton, UK: UKHO.

USACE (2019). *Federal Register Vol. 84, No. 136*. Washington, D.C.: U.S. Government Publishing Office.

USCG (2007*). NVIC No. 02-07 Guidance on the Coast Guard's Roles and Responsibilities for Offshore Renewable Energy Installations (OREI)*. Washington, D.C.: USCG.

USCG (2008). *Report of the Effect on Radar Performance of the Proposed Cape Wind Project and Advance Copy of USCG Findings and Mitigation*. Washington, D.C.: USCG.

USCG (2013). *COMDTINST M16130.2F Addendum to the United States National Search and Rescue Supplement (NSS) to the International Aeronautical and Maritime Search and Rescue Manual (IAMSAR)*. Washington, D.C.: USCG.

USCG (2015). *COMDTINST M16500.7A Aids to Navigation Manual*. Washington, D.C.: USCG.

USCG (2015). *AIS Encoding Guide*. Version 25. Washington, D.C.: USCG.

USCG (2016). *Atlantic Coast Port Access Route Study (ACPARS) Final Report*. USCG-2011-0351. Washington, D.C.: USCG.

USCG (2016). *Coast Guard MH-60 Jayhawk Helicopter*. Washington, D.C.: USCG.

USCG (2018). *MH-60T Medium Range Recovery Helicopter*. https://www.dcms.uscg.mil/Portals/10/CG-9/Acquisition%20PDFs/Factsheets/MH-60T.pdf (accessed August 2021).

USCG (2019). *NVIC No. 01-19 Guidance on the Coast Guard's Roles and Responsibilities for Offshore Renewable Energy Installations (OREI)*. Washington, D.C.: USCG.

USCG (2019). *COMDTINST 16003.2B Marine Planning to Operate and Maintain the Marine Transportation System (MTS) and Implement National Policy*. Washington, D.C.: USCG.

USCG (2019). *Light List Volume II: Atlantic Coast (Shrewsbury River, NJ to Little River, SC)*. Washington, D.C.: USCG.

USCG (2020). *NC, VA, MD, DE, NJ-Atlantic Ocean-Offshore Structure PATON Marking Guidance*. Washington, D.C.: USCG.

WindEurope (2020). *Offshore Wind in Europe Key Trends and Statistics 2019*. Brussels, Belgium: WindEurope.

Appendix A Navigation and Vessel Inspection Circular 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 Wind Development 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 Wind Development Area were provided to USCG on 24 Jun 2020.
2. Traffic survey		
Was the traffic survey conducted within 12 months of the NSRA?	Yes	The main vessel traffic dataset covers January to December 2019 as noted in 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 6.2.3.
Is the time period of the survey at least 28 days duration?	Yes	The main vessel traffic dataset covers January to December 2019 as noted in Section 6.1.
Does the survey include consultation with recreational vessel organizations?	Yes	Consultation has been undertaken with recreational representatives with key points summarized in Section 7.2 of the COP.
Does the survey include consultation with fishing vessel organizations?	Yes	Consultation has been undertaken with commercial fishing representatives with key points summarized in Section 7.2 of the COP.
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.

Issue	Yes/ No	Comments
Does the survey include consultation with commercial vessel organizations?	Yes	Consultation has been undertaken with the AWO, VMA, WSC, and Chamber of Shipping of America with key points summarized in Section 3.1. Consultation has been undertaken with regular operators, including a meeting with VMA members, as noted in 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	All figures throughout Section 6 depicting vessel traffic include the Wind Development Area and/or export cable corridor.
Does the survey include numbers, types, sizes and other characteristics of vessels presently using such areas?	Yes	The main vessel traffic dataset has been analyzed in terms of vessel count (Section 6.2.1), size (Section 6.2.2) and type (Section 6.2.3).
Does the survey include types of cargo carried by vessels presently using such areas?	Yes	Types of cargo vessel have been identified as noted in Section 6.2.3.1. Tankers have been considered as a separate vessel type in Section 6.2.3.3.
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 (Section 6.2.3.6) and fishing vessels (Section 6.2.3.7) have been identified. 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 7.2 of the COP), as noted in Section 6.7.2.
Does the survey include whether these areas contain transit routes used by coastal or deep-draft vessels, ferry routes, and fishing vessel routes?	Yes	The main vessel traffic dataset has been analyzed in terms of vessel draft (Section 6.6.2) and routing (Section 6.7.4).
Does the survey include alignment and proximity of the site relative to adjacent shipping routes?	Yes	The main vessel traffic dataset has been analyzed in terms of vessel routing in Section 6.7.4.
Does the survey include whether the nearby area contains prescribed or recommended routing measures or precautionary areas?	Yes	IMO routing measures have been considered in Section 5.1.1. The location of the proposed ACPARS fairways relative to the Wind Development Area has been considered in Section 6.7.4.
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	IMO routing measures have been considered in Section 5.1.1.

Issue	Yes/ No	Comments
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	Pilotage areas (Section 0) and ports (Section 5.1.11) have been considered. No anchorage areas were identified.
Does the survey include the feasibility of allowing vessels to anchor within the vicinity of the structure field?	Yes	The main vessel traffic dataset has been analyzed in terms of vessel anchoring in Section 6.2.3.8.
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 vessels have been identified in Section 6.2.3.7.
Does the survey include whether the site lies within the limits of jurisdiction of a port and/or navigation authority?	Yes	The Wind Development Area does not fall under the jurisdiction of any port as noted in Section 5.1.11.
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 and transit routes have been considered in Section 5.1.7.
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 10. No marine aggregate dredging areas were identified.
Does the survey include the proximity of the site to existing or proposed structure developments?	Yes	Existing surface infrastructure (Section 5.1.8) and proposed surface infrastructure (Section 10) have been considered.
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	Dump sites including dredged materials and explosives have been considered (Section 5.1.5).
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 have been considered in Section 5.1.4. The Wind Development Area does not fall under the jurisdiction of any port as noted in Section 5.1.11.
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 facility routing based on the main vessel traffic dataset (and therefore considering multiple vessel types) is provided in Section 11.3.1. Changes in traffic density and vessel to vessel collision risk including choke points have been assessed in Section 1.1.1.
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	It is not anticipated that any changes to vessel emission requirements will result in variations to routing patterns as noted in Section 6.7.4.
Does the survey include seasonal variations in traffic?	Yes	The main vessel traffic dataset covers January to December 2019 to ensure any

Issue	Yes/ No	Comments
		seasonal variation in traffic levels or behaviors are accounted for as noted in Section 6.1.2.
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 offshore wind structures (allision risk) (Section 13.3) and cables (underwater snagging or contact risk) (Section 17) have been assessed. The WTG blade clearance has been considered in the assessment of allision risk to recreational vessels in Section 15.4. The burial depth of cables has been considered in the assessment of underwater snagging or contact risk in Section 17. Floating foundations are not under consideration as noted in Section 4.2.2.
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 15.4. No characteristics of individual structures have been identified as potentially affecting navigational safety in relation to USCG missions.
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 18.
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	Shut down procedures for the WTGs have been described in Section 4.2.3.
Does the NSRA denote whether any noise or vibrations generated by a structure above and below the water column would impact navigation safety or affect other Coast Guard missions?	Yes	Impacts due to surface and underwater noise have been assessed in Section 8.11. It is noted that a separate underwater noise assessment (Section 4.5 of the COP and Appendix P to the COP) is being undertaken.
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	The consequences of an allision incident for different vessel types/sizes and speeds has been assessed in Section 11.5.2.

Issue	Yes/ No	Comments
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	The only materials which may reduce navigable water depth are additional external protection for subsea cables and there is not expected to be any significant reduction as assessed in Section 17.
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 11.3.7.
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 11.3.7.
5. Assessment of access to and navigation within, or close to, a structure. Has the developer determined the extent to which navigation would be feasible within the structure site itself by assessing whether:		
Navigation within the site would be safe? ▪ By all vessels or ▪ By specified vessel types, operations and/or sizes? ▪ In all directions or areas; or ▪ In specified directions or areas? ▪ In specified tidal, weather or other conditions; and ▪ At any time, day or night?	Yes	Internal vessel to structure allision risk has been assessed for relevant vessel types (noting that commercial vessels are not expected to navigate internally within the array) in Section 15.4. Weather and tidal conditions have been accounted for in drifting allision risk modelling in Section 11.3.5. The above assessments have been qualified with facility 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 facility routing based on the main vessel traffic dataset (Section 11.3.1) assumes commercial vessels will avoid navigating internally within the array (Section 6.7.4) and has been used as input to the collision and allision risk modelling and impact assessment.

Issue	Yes/ No	Comments
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 (Section 5.3.4) with traffic flows primarily dictated by the IMO routing measure at the entrance to Chesapeake Bay (Section 6.2).
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	Drifting vessel to structure allision risk modelling has taken into consideration the speed and direction of the tide as noted in Section 11.3.5.
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.
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	Drifting vessel to structure allision risk modelling has taken into consideration the likelihood of propulsion on a vessel failing as noted in Section 11.3.5.
Structures in the tidal stream could produce siltation, deposition of sediment or scouring, any other suction or discharge aspects, which could affect navigable water depths in the structure area or adjacent to the area?	Yes	Based on the available data and distance offshore no impacts relating to tidal streams are anticipated as noted in Section 5.3.4.
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 7.6 of the COP, Aviation and Radar and Appendix CC to the COP, Obstruction Evaluation & Airspace Analysis, and Appendix DD to the COP Air Flow Traffic Analysis. Impacts to the seabed and water column have been addressed in Section 5.4 of the COP, Benthic Resources and Finfish, Invertebrates, and Essential Fish Habitat, and Section 4.2 of the COP, Water Quality.

Issue	Yes/ No	Comments
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	The allision risk modelling has taken visibility (Section 11.3.4), sea state (Sections 11.3.4 and 11.3.5) and wind (Section 11.3.5) into account with such inputs based on localized meteorological ocean data (Section 5.3). Adverse weather deviations have been assessed for commercial fishing vessels (Section 16.2) but not commercial vessels since no adverse weather routing was detected in proximity to the Wind Development Area (Section 6.3.1.1).
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 15.4.
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 allision risk modelling includes consideration for an NUC vessel including the likelihood of the vessel experiencing propulsion failure and tidal drift scenarios as described in Section 11.3.5.
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.

Issue	Yes/ No	Comments
8. Configuration and collision avoidance		
The Coast Guard will provide SAR services in and around OREIs in U.S. 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 18.
Each OREI layout design will be assessed on a case-by-case basis.	Yes	The array layout assessed is indicative but is considered the maximum design scenario for shipping and navigation and the outcome of the subsequent impact assessment for shipping and navigation is not anticipated to result in any greater impact significance than that concluded in this NSRA as noted in Section 4.2.1.
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 has been applied ensuring that any refinement to the PDE will not increase the significance of the impacts identified as noted in Section 4.7. The risk assessment uses an RBDM approach (Section 2.1) with the ALARP principle applied (Section 2.1.3) 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) (Section 12).
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	Yes	The array layout includes two main lines of orientation which are consistent across all offshore wind structures as discussed in Section 4.2.1.

Issue	Yes/ No	Comments
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.		
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 indicative array layout assessed in this NSRA does not include a packed boundary.
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 13.2.
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 (both offshore and onshore) has been assessed in Section 8.12.
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 13.2.
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 that may arise from the offshore wind infrastructure relating to VHF (Section 8.1 and Section 8.2), AIS (Section 8.3), 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 that may arise from the offshore wind infrastructure relating to marine Radar have been assessed in Section 8.9.
Structures, in general, would comply with current recommendations concerning electromagnetic interference?	Yes	Impacts that may arise from the offshore wind infrastructure relating to electromagnetic interference have been assessed in Section 8.8.

Issue	Yes/ No	Comments
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, noting that a robust underwater noise assessment (Section 4.5 of the COP and Appendix P to the COP) is being undertaken.
Structures, generators, and the seabed cabling within the site and onshore might produce electromagnetic fields affecting compasses and other navigation systems?	Yes	Impacts that may arise from the offshore wind infrastructure 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, noting that a robust underwater noise assessment (Section 4.5 of the COP and Appendix P to the COP) is being undertaken.
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 including consideration of the frequency, consequences and location has been assessed (Sections 1.1.1 and 13.2) for multiple vessel types. Allision risk including frequency, consequences and location has been assessed (Sections 11.3.4, 11.3.5, 1.1.1, 13.3, and 13.4) for multiple vessel types. Grounding risk including frequency, consequences and location has been assessed (Section 11.3.7) for multiple vessel types.
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?		
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.	Yes	SAR data provided by the USCG has been assessed in Section 9. The change in the number of SAR incidents due to the presence of the Project and consideration for the offshore wind structures as a place of refuge has been given in Section 18.

Issue	Yes/ No	Comments
▪ 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?		
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	Pollution data provided by the USCG has been assessed in Section 9. The change in the number of pollution incidents due to the presence of the Project has been considered in Section 18.
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:		
Note: the Company looks forward to continued dialog with the USCG as the engineering design matures.		
Marine navigation marking?	Yes	The process for defining lighting and marking has been outlined in Section 7.
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	The process for defining lighting and marking has been outlined in Section 7.
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 of the offshore wind structures including in both day and night conditions has been outlined in Section 7.
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	The process for defining lighting and marking has been outlined in Section 7. Specifically, AIS will be used to mark structures within the Wind Development Area, pending additional guidance from USCG.
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	The process for defining lighting and marking has been outlined in Section 7.

Issue	Yes/ No	Comments
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	The process for defining lighting and marking has been outlined in Section 7.
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	The process for defining lighting and marking has been outlined 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	The process for defining lighting and marking has been outlined in Section 7.
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	The process for defining lighting and marking has been outlined in Section 7.
How will the marking of the structure 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?		
Note: the Company looks forward to continued dialog with the USCG as the engineering design matures.		
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	The process for defining lighting and marking has been outlined in Section 7.

Issue	Yes/ No	Comments
All generators and transmission systems should be equipped with control mechanisms that can be operated from an operations center of the installation.	Yes	It will be possible to shut down WTGs from the Project's operation and maintenance base as outlined in Section 4.2.3. Further details regarding shut down procedures will be provided in the SMS prior to construction.
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 4.2.3. Further details regarding shut down procedures will be provided in the SMS prior to construction.
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	WTG shut down procedures have been outlined in Section 4.2.3. Further details regarding shut down procedures will be provided in the SMS prior to construction.
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	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:		
Note: the Company looks forward to continued dialog with the USCG as the engineering design matures.		
The operations center should be manned 24 hours a day?	Yes	The operation and maintenance facilities 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 the operation and maintenance facilities will be equipped with charts indicating the position and unique identification number of each offshore wind structure as noted in 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	The contact number for the operation and maintenance facilities will be provided to the USCG as noted in Section 4.5.

Issue	Yes/ No	Comments
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 offshore farm structure 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 shutdown procedure for those structures as requested by the SMC, and maintain the structure in the appropriate shutdown position, again as requested by the SMC, until receiving notification from the SMC that it is safe to restart the structure.	Yes	WTG shut down procedures have been outlined in Section 4.2.3. Further details regarding shut down procedures will be provided in the SMS prior to construction.
Communication and shutdown procedures should be tested satisfactorily at least twice each year.	Yes	WTG shut down procedures have been outlined in Section 4.2.3. Further details regarding shut down procedures will be provided in the SMS prior to construction.
After an allision, the applicant should submit documentation that verifies the structural integrity of the structure.	Yes	Checks of the integrity of offshore wind structures will be standard as part of operation and maintenance activity.

Appendix B Consequences Assessment

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 offshore wind structures.

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 offshore wind structures. 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 offshore wind structures 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 offshore wind structures 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.

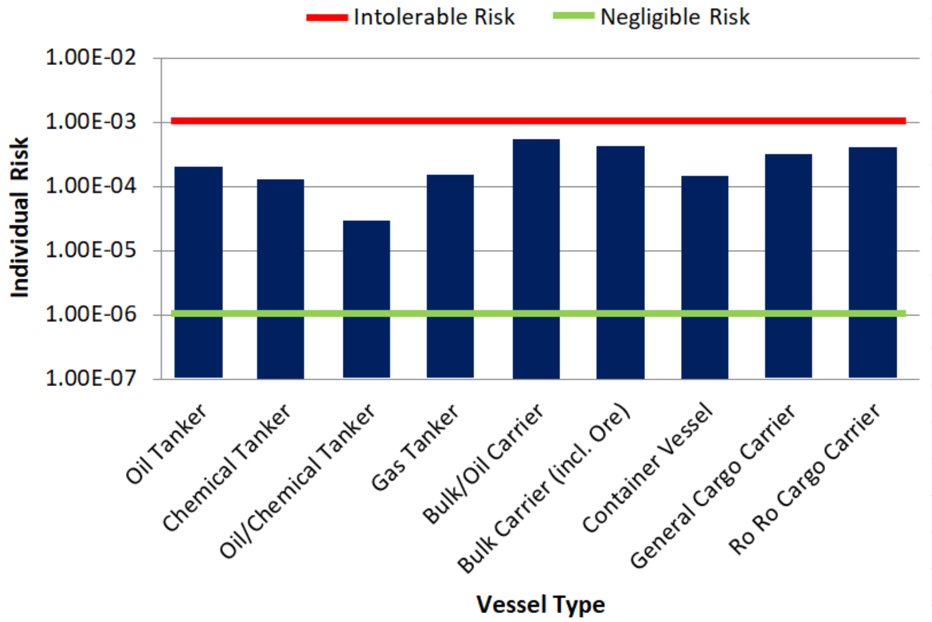

Figure B.1 Individual risk levels and acceptance criteria per vessel type (IMO, 2000)

Typical bounds defining the ALARP regions for RBDM within shipping are presented in Table B.1.

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 offshore wind structures. 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 development is assessed to have the potential to affect the following incidents:

- Vessel to vessel collision;
- Powered vessel to structure allision; and
- Drifting 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 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 12,093 accidents, injuries and hazardous incidents were reported to the MAIB between 2000 and 2019 involving approximately 13,965 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.

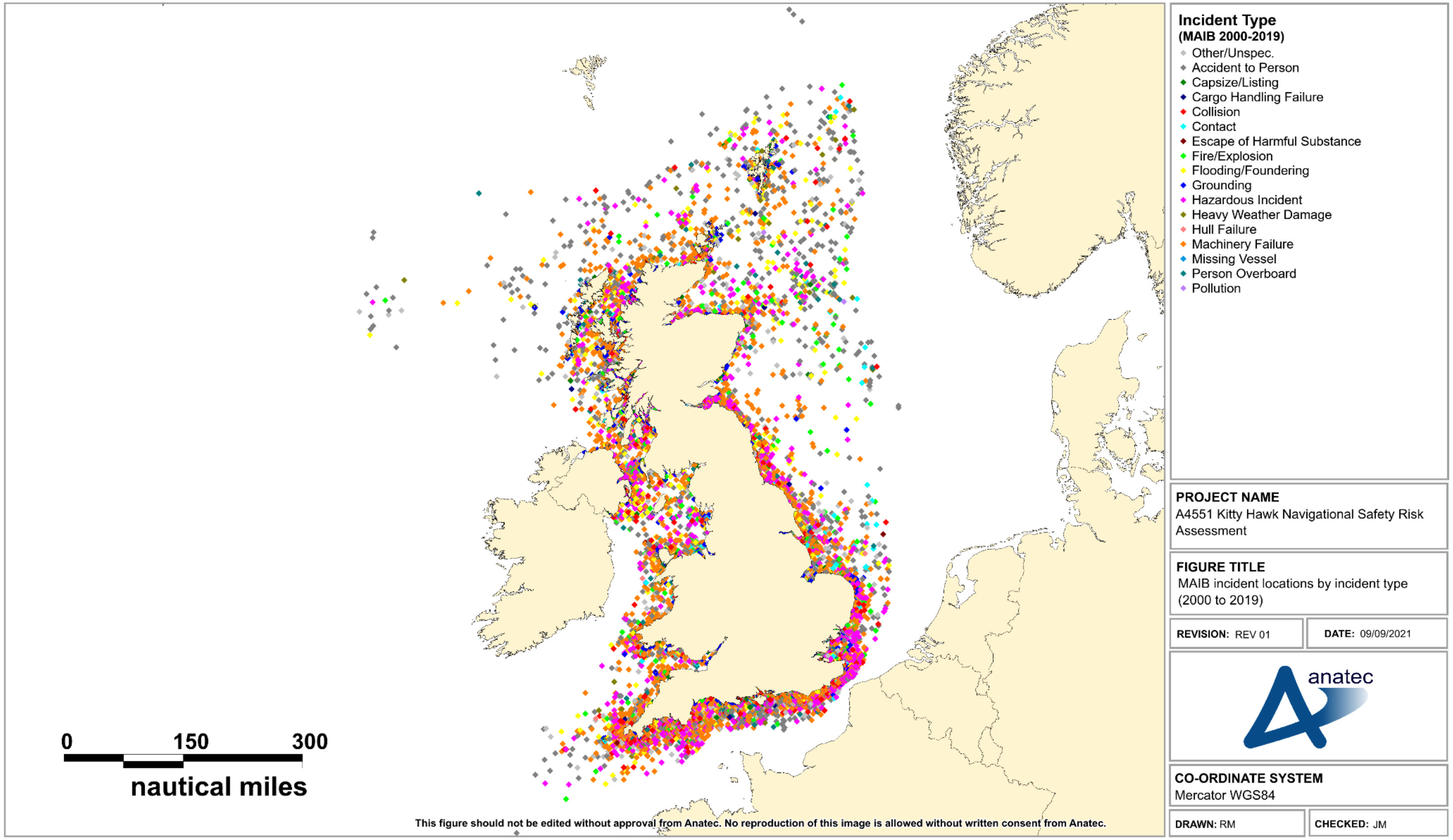

Figure B.2 MAIB incident locations by incident type (2000 to 2019)

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 probabilities have been computed. 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[24]

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability
Commercial	Dry cargo, passenger, tanker, etc.	1	9,847	1.0×10^{-4}
Fishing	Trawler, potter, dredger, etc.	1	115	1.5×10^{-2}
Pleasure craft	Yacht, small commercial motor vessel, etc.	2	571	5.3×10^{-3}

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 1.

Table B.3 Summary of annual collision and allision frequency results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Facility	Post Wind Facility	Change
Vessel to vessel collision	Base case	4.66×10^{-3} (215 years)	7.39×10^{-3} (135 years)	2.73×10^{-3} (79 years)
	Future case (10%)	5.64×10^{-3} (177 years)	8.94×10^{-3} (112 years)	3.31×10^{-3} (66 years)
	Future case (20%)	6.71×10^{-3} (149 years)	1.06×10^{-2} (94 years)	3.89×10^{-3} (55 years)

[24] 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.

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Facility	Post Wind Facility	Change
Powered vessel to structure allision	Base case	N/A	3.40×10^{-3} (294 years)	3.40×10^{-3} (294 years)
	Future case (10%)	N/A	3.74×10^{-3} (268 years)	3.74×10^{-3} (268 years)
	Future case (20%)	N/A	4.08×10^{-3} (245 years)	4.08×10^{-3} (245 years)
Drifting vessel to structure allision	Base case	N/A	5.72×10^{-4} (1,749 years)	5.72×10^{-4} (1,749 years)
	Future case (10%)	N/A	6.29×10^{-4} (1,590 years)	6.29×10^{-4} (1,590 years)
	Future case (20%)	N/A	6.86×10^{-4} (1,457 years)	6.86×10^{-4} (1,457 years)
Fishing vessel to structure allision	Base case	N/A	6.95×10^{-4} (1,440 years)	6.95×10^{-4} (1,440 years)
	Future case (10%)	N/A	7.51×10^{-4} (1,332 years)	7.51×10^{-4} (21,332 years)
	Future case (20%)	N/A	8.07×10^{-4} (1,239 years)	8.07×10^{-4} (1,239 years)
Total	**Base case**	**4.66×10^{-3} (215 years)**	**1.21×10^{-2} (83 years)**	**7.39×10^{-3} (132 years)**
	Future case (10%)	**5.64×10^{-3} (177 years)**	**1.41×10^{-2} (71 years)**	**8.43×10^{-3} (106 years)**
	Future case (20%)	**6.71×10^{-3} (149 years)**	**1.62×10^{-2} (62 years)**	**9.46×10^{-3} (87 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		21
Passenger vessel		2,520
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% increase in traffic), future case (10% increase in traffic), and future case (20% increase in traffic) are presented in Figure B.3.

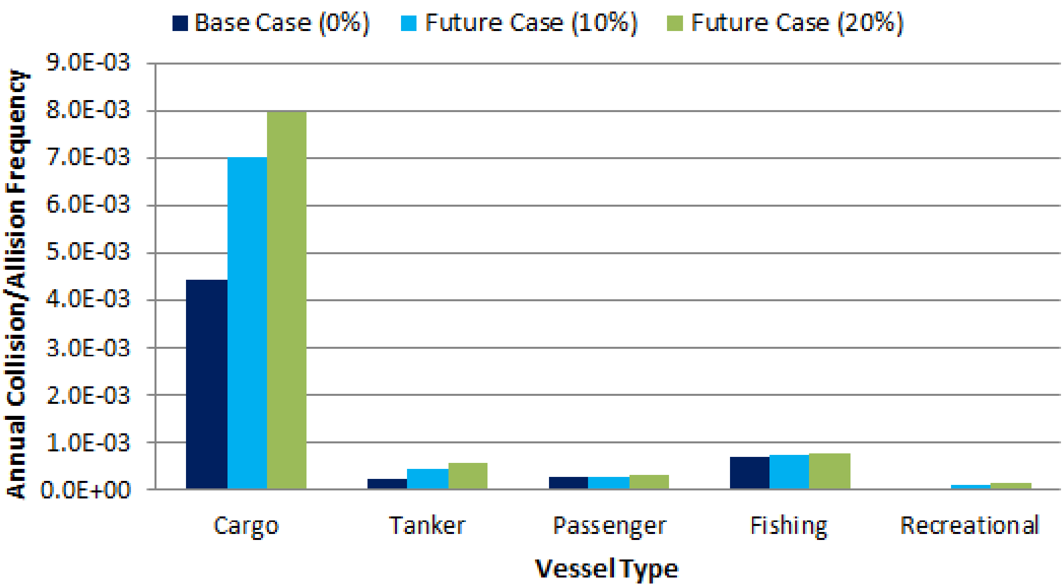

Figure B.3 Change in annual collision and allision frequency by vessel type

The majority of change in allision and collision risk is associated with cargo vessels owing to the volume of these types of vessels in the area.

Combining the annual collision and allision frequency (Table B.3), estimated POB 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 1.18×10^{-4}, which equates to one additional fatality in approximately 8,495 years. The annual increase in PLL due to the impact of the development for the future case (10% increase in traffic) is estimated to be approximately 1.41×10^{-4}, which equates to one additional fatality in approximately 7,103 years. The annual increase in PLL due to the impact of the development for the future case (20% increase in traffic) is estimated to be 1.57×10^{-4}, which equates to one additional fatality in approximately 6,354 years.

The estimated incremental changes in PLL due to the development, distributed by vessel type for the base and future cases, are presented in Figure B.4.

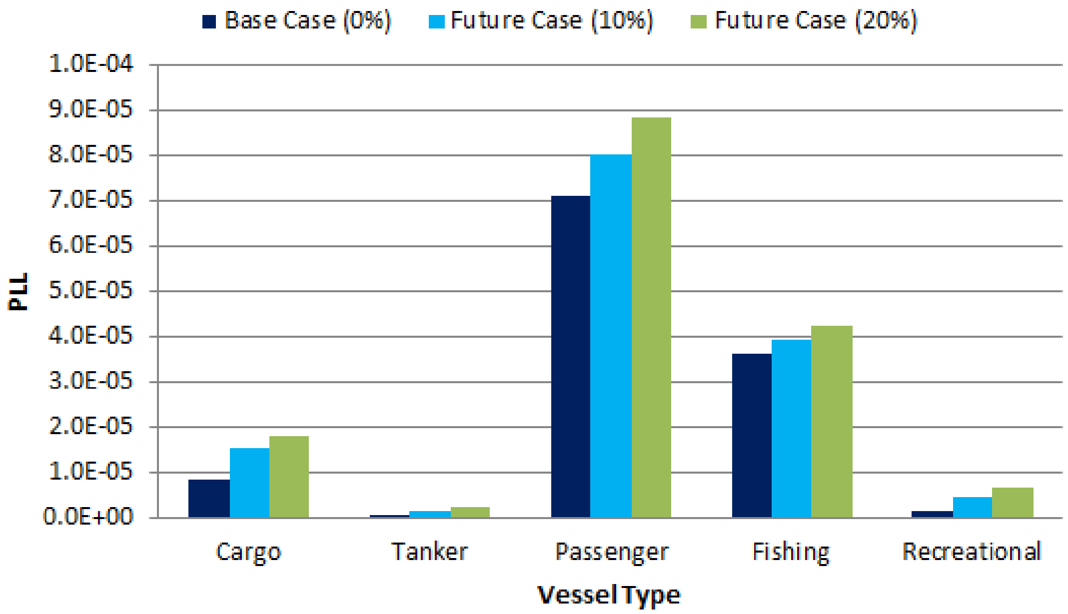

Figure B.4 Estimated change in annual PLL by vessel type

The majority of increase in PLL was observed to be associated with passenger vessels due to the high average number of POB. Cargo vessels were the other significant contributor due to the high volume of such traffic in the area.

Converting the PLL to individual risk per annum (IRPA) based upon the average number of people exposed by vessel type per year, the results are presented 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.

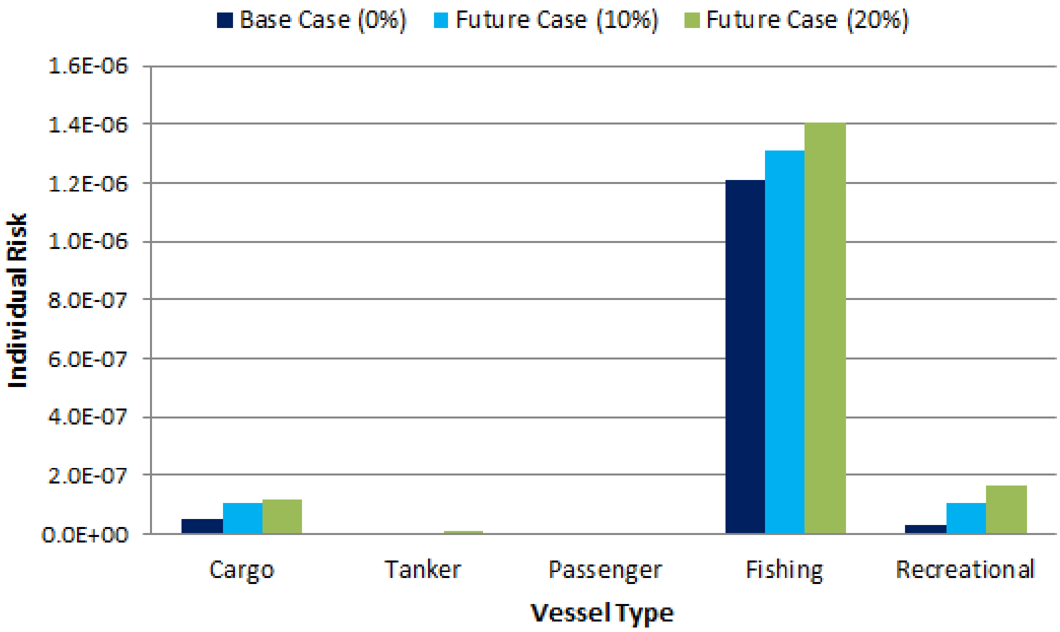

Figure B.5 Estimated change in individual risk by vessel type

IRPA was observed to be greatest to fishing vessels owing to the higher probability of fatality per incident compared to other vessel types. 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 was relatively higher owing to the low average number of POB therefore distributing the risk among fewer individuals. The main factor in individual risk for cargo vessels is the high volume of traffic in comparison to other vessel types.

B.2.4 Significance of Increase in Fatality Risk

The overall increase in PLL and individual risk post offshore wind project is 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. The changes in frequency are presented for the base case, 10% future case and 20% future case scenarios.

Table B.5 Summary of fatality risk for future cases

Fatality Risk	Change in Frequency		
	Base Case	10% Increase	20% Increase
PLL	1.18×10^{-4} (0.00012)	1.41×10^{-4} (0.00014)	1.57×10^{-4} (0.00016)
IRPA	1.30×10^{-6} (0.0000013)	1.53×10^{-6} (0.0000015)	1.70×10^{-6} (0.0000017)

Each of these changes in frequency is considered very low and indicates that the increase in fatality risk resulting from the development is negligible.

B.3 Pollution Risk

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 Department for Transport's Marine Environmental High Risk Areas project (Department for Transport, 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.

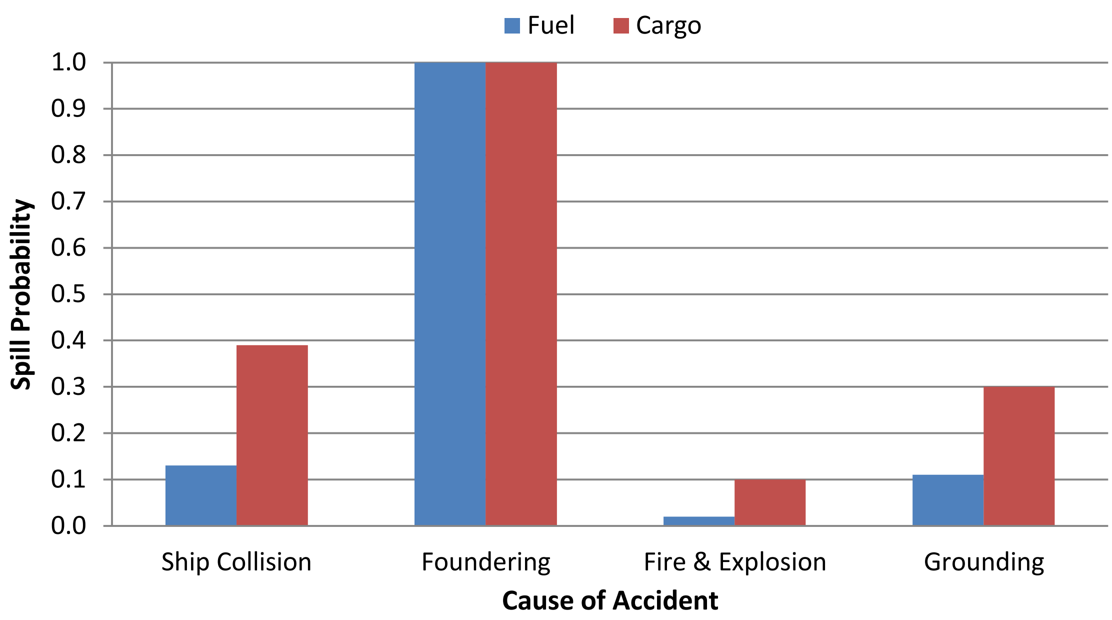

Figure B.6 Probability of an oil spill resulting from an accident

Based on this data, it was estimated that 13% of vessel collisions result in a fuel oil spill and 39% 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% 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 report the following spill size distribution for tanker collisions between 1974 and 2004:

- 31% of spills below seven tons (2,100 gallons);
- 52% of spills between seven and 700 tons (2,100 and 213,000 gallons); and
- 17% 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% 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% 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 seven gallons per year for the base case, approximately 26 gallons per year for the future case (10% increase in traffic), and approximately 34 gallons per year for the future case (20% increase in traffic).

The estimated increase in gallons of oil spilled distributed by vessel type for the base case, future case (10% increase in traffic), and future case (20% increase in traffic) are presented in Figure B.7.

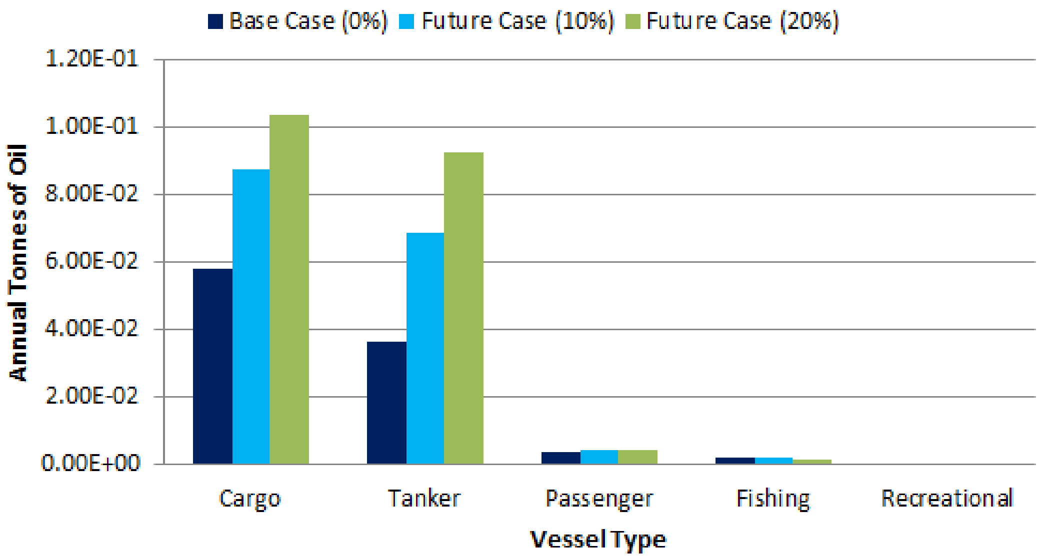

Figure B.7 Estimated change in pollution by vessel type

The majority of increase in oil spilled was observed to be associated with tankers and cargo vessels, owing to the volume of these types of vessels in the area and the much higher quantity of oil spilled by these types of vessels in the event of an incident.

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 U.S. 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 U.S. waterways was 2,790.

The overall change in pollution estimated due to the Project (approximately seven gallons per year for the base case) represents a negligible increase (0.005%) in the total annual average gallons of oil spilled which impact navigable U.S. waterways. This indicates that the increase in pollution risk resulting from the development is negligible.

Appendix C Regular Operator Letter

The letter issued to regular operators (as introduced in Section 3.2), with information redacted as appropriate, is shown below.

Anatec Ltd.
Cain House
10 Exchange Street
Aberdeen AB11 6PH
Tel: 01224 253700
Email: aberdeen@anatec.com
Web: www.anatec.com

Date: 11th August 2020

Opportunity to Participate in Consultation for Kitty Hawk Offshore Wind Project

Dear Sir/Madam,

You may be aware that Kitty Hawk Wind, LLC are intending to construct and operate the Kitty Hawk Offshore Wind Project (the 'Project') located approximately 24 nautical miles (nm) east of Corolla, North Carolina. The commercial lease for the Project was awarded in March 2017 and went into effect in November 2017, with the start of operations for the Project anticipated at the end of Q4 2026. At present, Kitty Hawk Wind, LLC is in the pre-application stage of the Project, and are preparing the formal application for submission to the Bureau of Ocean Energy Management (BOEM).

The location of the Wind Development 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 62 wind turbine generators (WTGs; 60 WTG with two alternate locations are under evaluation) installed within the Wind Development Area, and one Electrical Service Platform (ESP). The Export Cable Corridor will include two export cables which make landfall at Sandbridge Beach in Virginia Beach, Virginia.

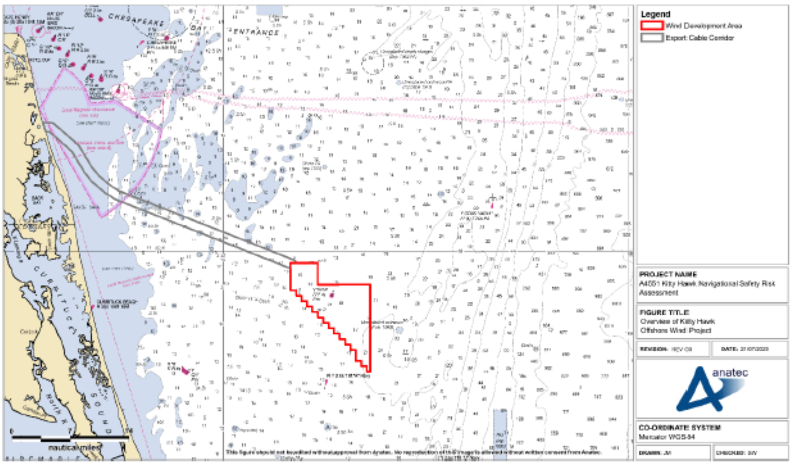

Figure 1 Overview of Kitty Hawk Offshore Wind Project

Page 1

Anatec Ltd have been contracted by Kitty Hawk Wind, LLC to offer you an opportunity to provide input into the Project at this stage, should you seek to do so. Your organization has been identified as a potential stakeholder on the basis that a study of vessel traffic data has indicated that multiple vessels you operate transit within a 10 nm buffer of the Wind Development Area, and hence may be affected by the presence of the Project. Should you require any further information on these vessel traffic studies undertaken, please get in touch.

We are particularly interested in how the Project may impact vessel routing in the area, noting the location of the Wind Development Area approximately 30 nm southeast of the International Maritime Organization (IMO) routing measure at the entrance to Chesapeake Bay and in the vicinity of a proposed deep draft route from the Atlantic Coast Port Access Study (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 on your vessels currently routing in the area, would anything change about the way you operate?
2. Are you familiar with the ACPARS? If so, what impact might that have on your operations in the area including in combination with the presence of Kitty Hawk Offshore Wind Project?
3. What mitigation measures would you like to see in place for the operational wind farm?
4. Do vessels you operate regularly transit past operational or constructing offshore wind farm projects in other areas (for example, within European Waters)? If so, do you have any comments from these offshore wind farms that would be of interest to Kitty Hawk Wind, LLC?
5. Do you intend to publicly comment on the Project during the National Environmental Policy Act (NEPA) process?

Please note that consultation input is not limited to the above questions, and we would welcome any additional feedback you may have. Consultation responses and any queries should be sent to [redacted]. To aid the timeframe within which the NSRA must be completed, I would be grateful if all responses are received prior to 8th September 2020. Finally, we would also appreciate a response to confirm if you have no comments or concerns.

Should you require any further information on the Project, or have any queries on the NSRA process, please feel free to get in touch with myself at any point.

Yours sincerely,

[redacted]

Anatec Ltd.
On behalf of Avangrid Renewables, LLC

Page 2

Appendix D Individual Post Wind Facility Main Route Deviations

This appendix presents a comparison of the pre and post wind facility mean positions for each individual main route which is anticipated to require a deviation following the installation of the Project. These deviations follow the methodology outlined in Section 6.7.4, including the mean position of routes being set to a minimum of 1 nm (1.9 km) from the Wind Development Area and utilization of the ACPARS fairways where appropriate. Where the ACPARS fairways have been utilized they have been included in the accompanying figure for clarity.

D.1 Route 1

Figure D.1 presents a comparison of Route 1 prior to and following installation of the Project.

The deviation associated with this route is wholly associated with the presence of the ACPARS fairway, i.e., the Project in isolation has no impact but the future baseline does have an impact.

The route is anticipated to utilize the deep draft route out of Chesapeake Bay and therefore pass closer to the Wind Development Area than in the pre wind facility scenario (approximately 3.0 nm [5.6 nm] at the closest point of approach). Given the location of Navy Tower Light A in the center of the deep draft route, the route is required to split to pass safely around the structure.

The deviation associated with this route represents an 8.2 nm (15 km) increase in the route length compared with the pre wind facility scenario.

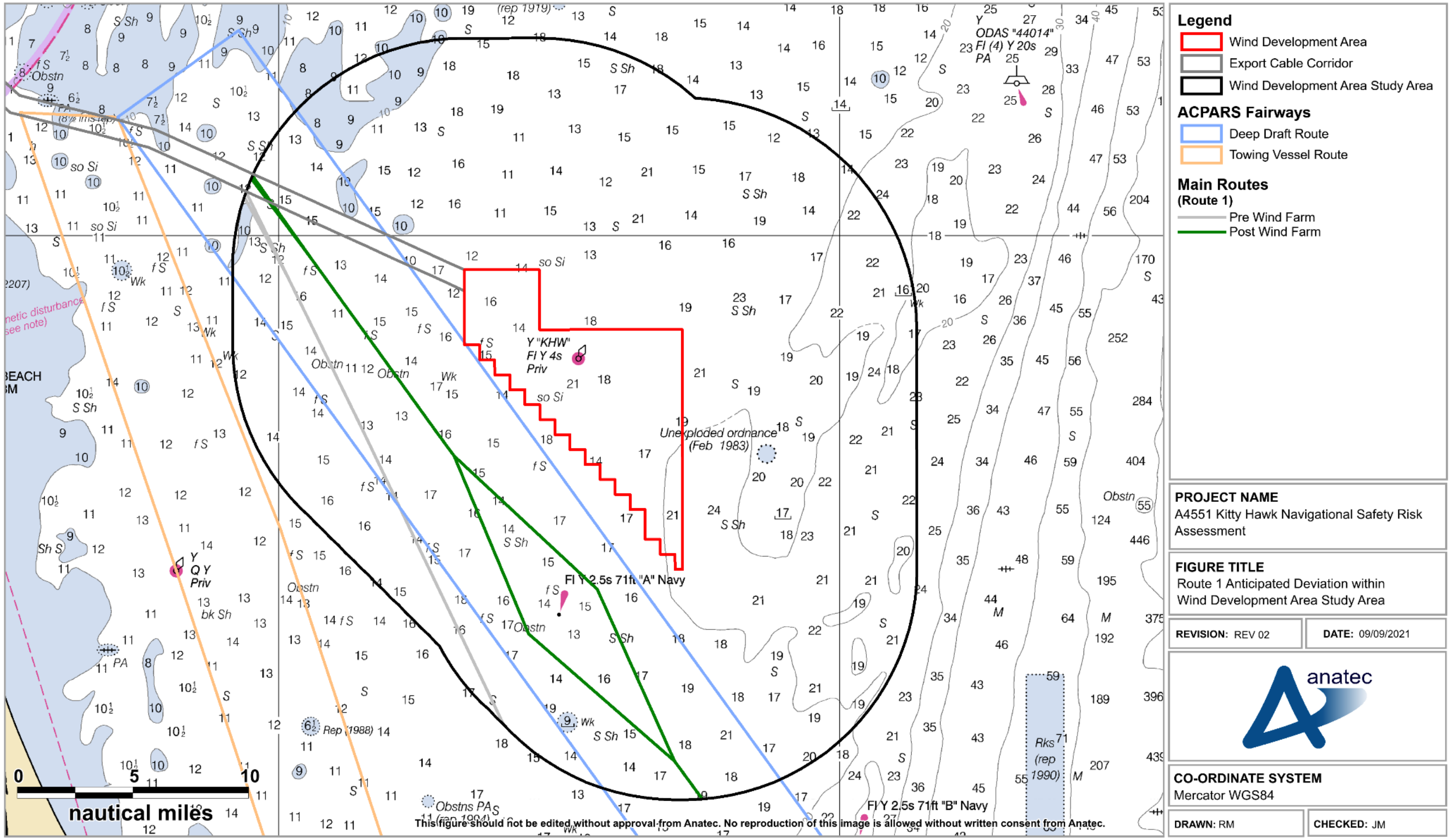

Figure D.1 Route 1 anticipated deviation within Wind Development Area study area

D.2 Route 2

Figure D.2 presents a comparison of Route 2 prior to and following installation of the Project.

The deviation associated with this route is partially associated with the presence of the ACPARS fairways, i.e., both the Project in isolation and future baseline have an impact.

The route is anticipated to utilize the deep draft route out of Chesapeake Bay and therefore pass further from the Wind Development Area than in the pre wind facility scenario (approximately 3.0 nm [5.6 km] at the closest point of approach). It is noted that this closest point of approach is greater than the minimum 1 nm (1.9 km) considered in the re-routing methodology owing to the need for this route to utilize the deep draft route. Given the location of Navy Tower Light A in the center of the deep draft route, the route is required to split to pass safely around the structure.

The deviation associated with this route represents a 0.9 nm (1.7 km) decrease in the route length compared with the pre wind facility scenario.

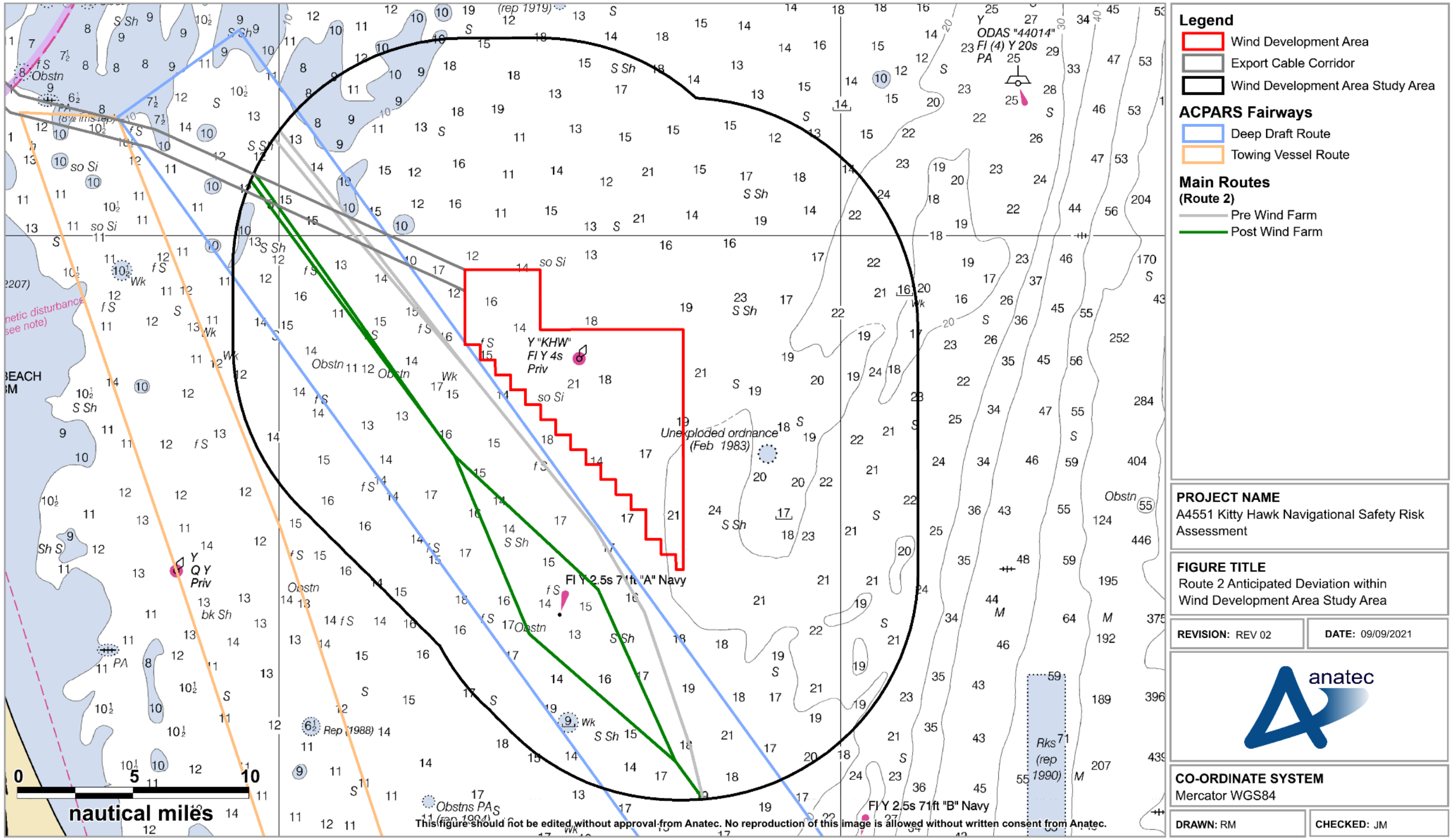

Figure D.2 Route 2 anticipated deviation within Wind Development Area study area

D.3 Route 4

Figure D.3 presents a comparison of Route 4 prior to and following installation of the Project.

The route is anticipated to pass seaward of the Wind Development Area both in order to preserve the approach in and out of the Chesapeake Bay IMO routing measure and since the route tends to avoid shallower waters in comparison to other main routes following the U.S. Atlantic coast (e.g., Routes 1 and 2). Furthermore, there is a minority of the vessel traffic utilizing this route which is headed for international ports including Brazil and Columbia for which use of the ACPARS fairways would be less likely.

The deviation associated with this route represents a 3.9 nm (7.2 km) increase in the route length compared with the pre wind facility scenario.

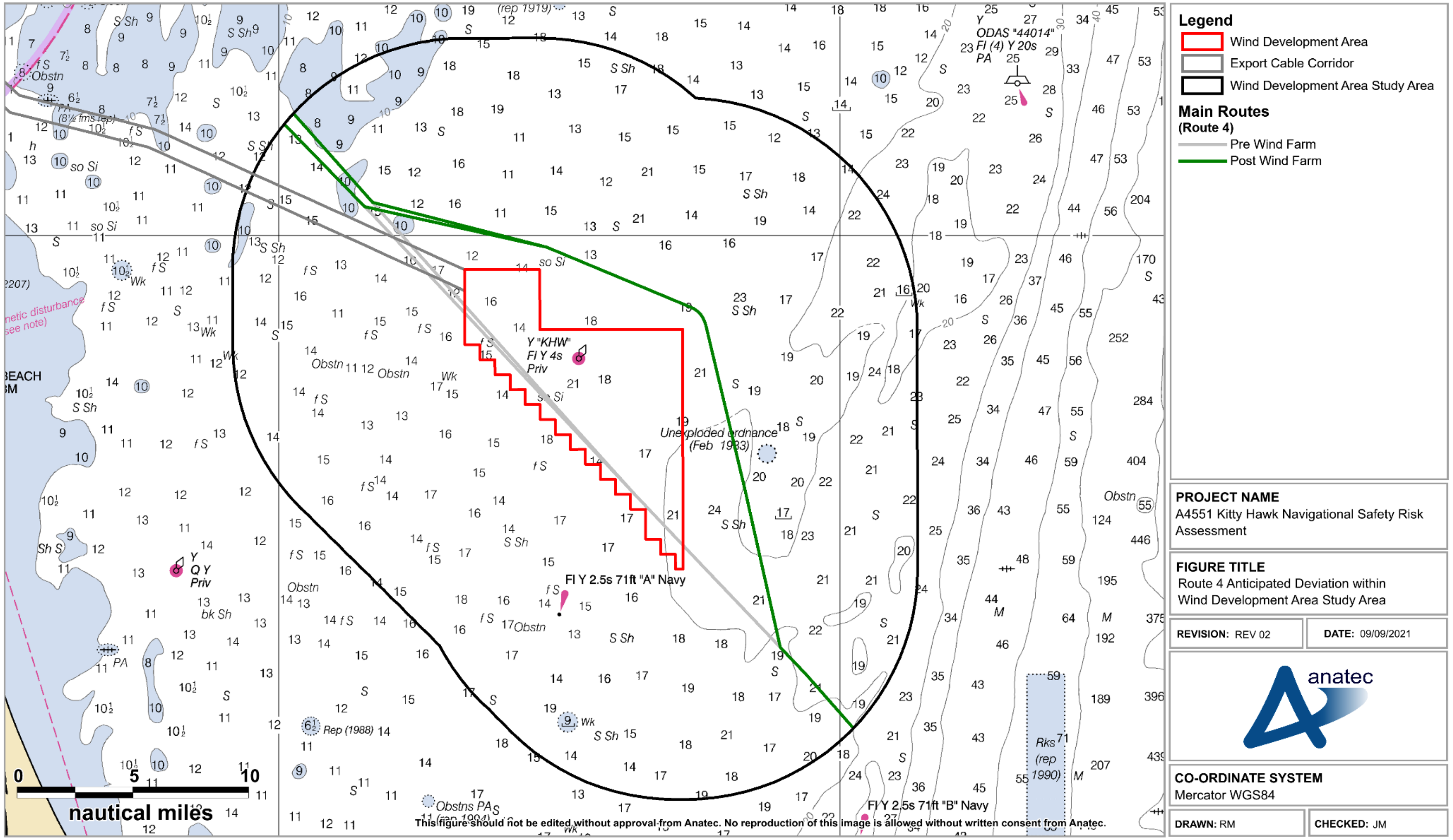

Figure D.3 Route 4 anticipated deviation within Wind Development Area study area

D.4 Route 6

Figure D.4 presents a comparison of Route 6 prior to and following installation of the Project.

The route is anticipated to pass seaward of the Wind Development Area in order to preserve the approach in and out of the Chesapeake Bay IMO routing measure, with the route later joining the ACPARS deep draft route for its north-south component (out with the Wind Development Area study area).

The deviation associated with this route represents a 3.9nm (7.2 km) increase in the route length compared with the pre wind facility scenario.

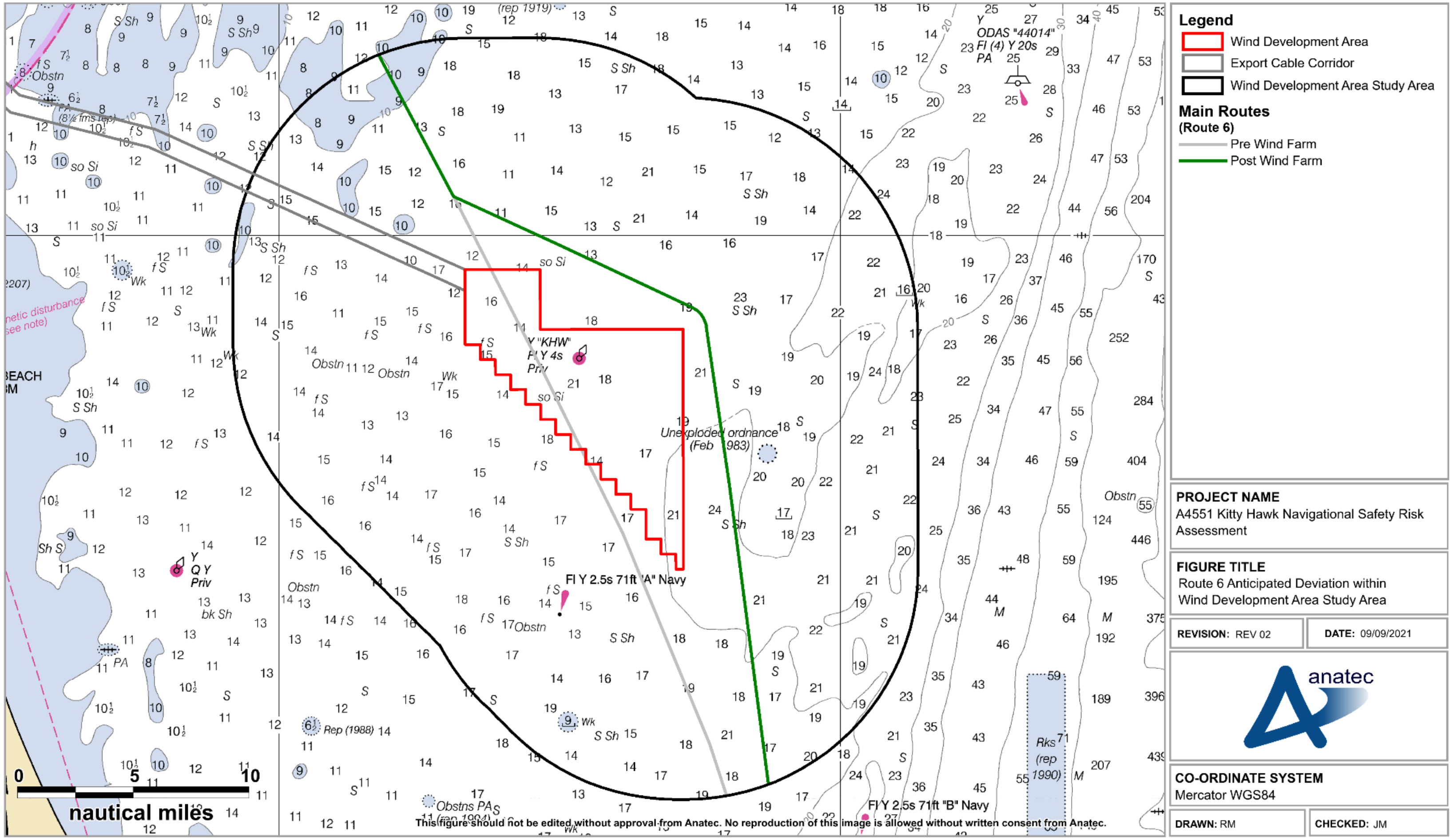

Figure D.4 Route 6 anticipated deviation within Wind Development Area study area

D.5 Route 8

Figure D.5 presents a comparison of Route 8 prior to and following installation of the Project.

The route is anticipated to pass seaward of the Wind Development Area in order to preserve the approach in and out of the Chesapeake Bay IMO routing measure.

The deviation associated with this route represents a 2.2 nm (4.1 km) increase in the route length compared with the pre wind facility scenario.

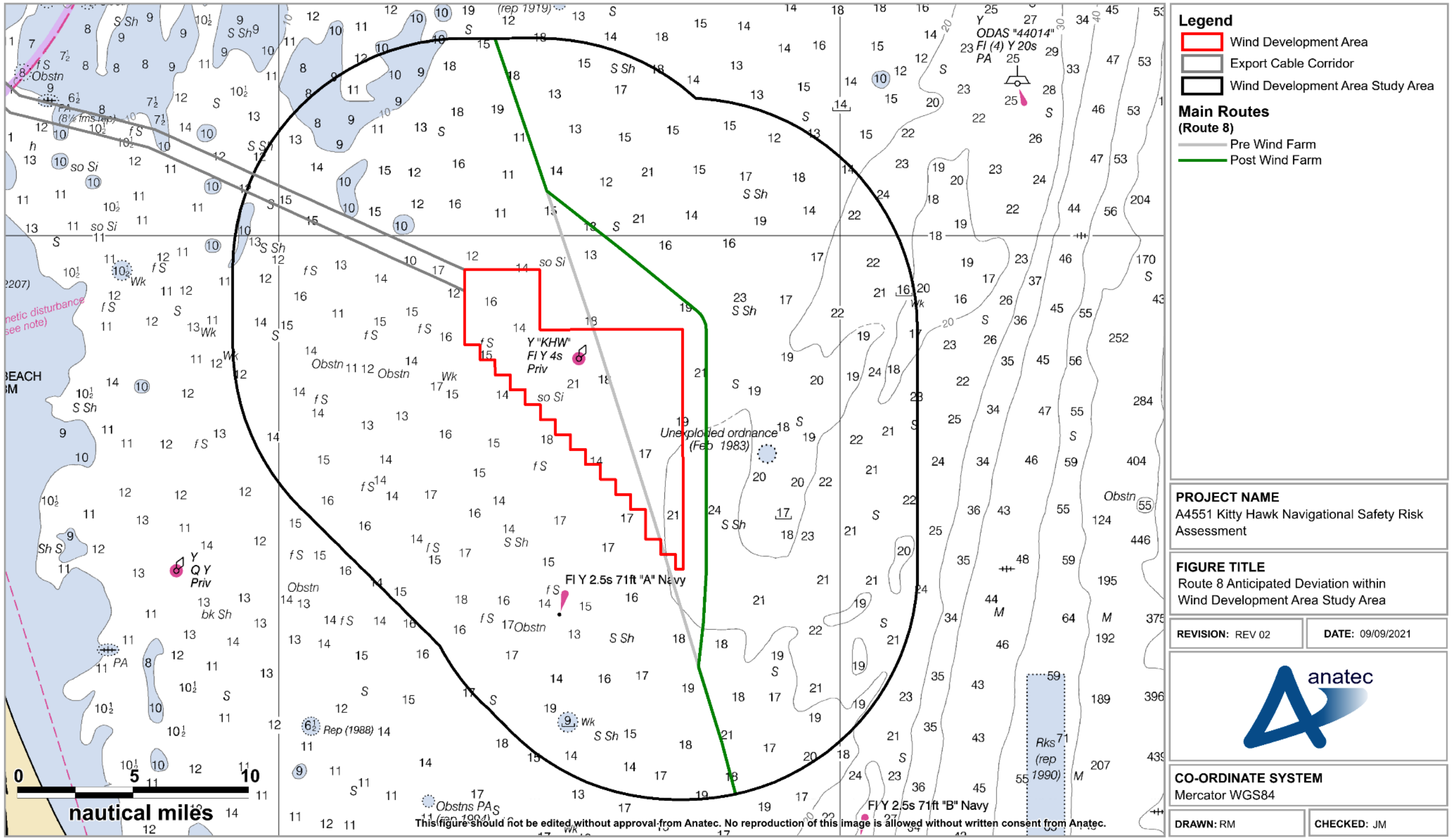

Figure D.5 Route 8 anticipated deviation within Wind Development Area study area

D.6 Route 9

Figure D.6 presents a comparison of Route 9 prior to and following installation of the Project.

The route is anticipated to deviate marginally to ensure a minimum 1 nm (1.9 km) mean distance from the eastern boundary of the Wind Development Area is maintained.

The deviation associated with this route represents a less than 0.1 nm (0.19 km) increase in the route length compared with the pre wind facility scenario.

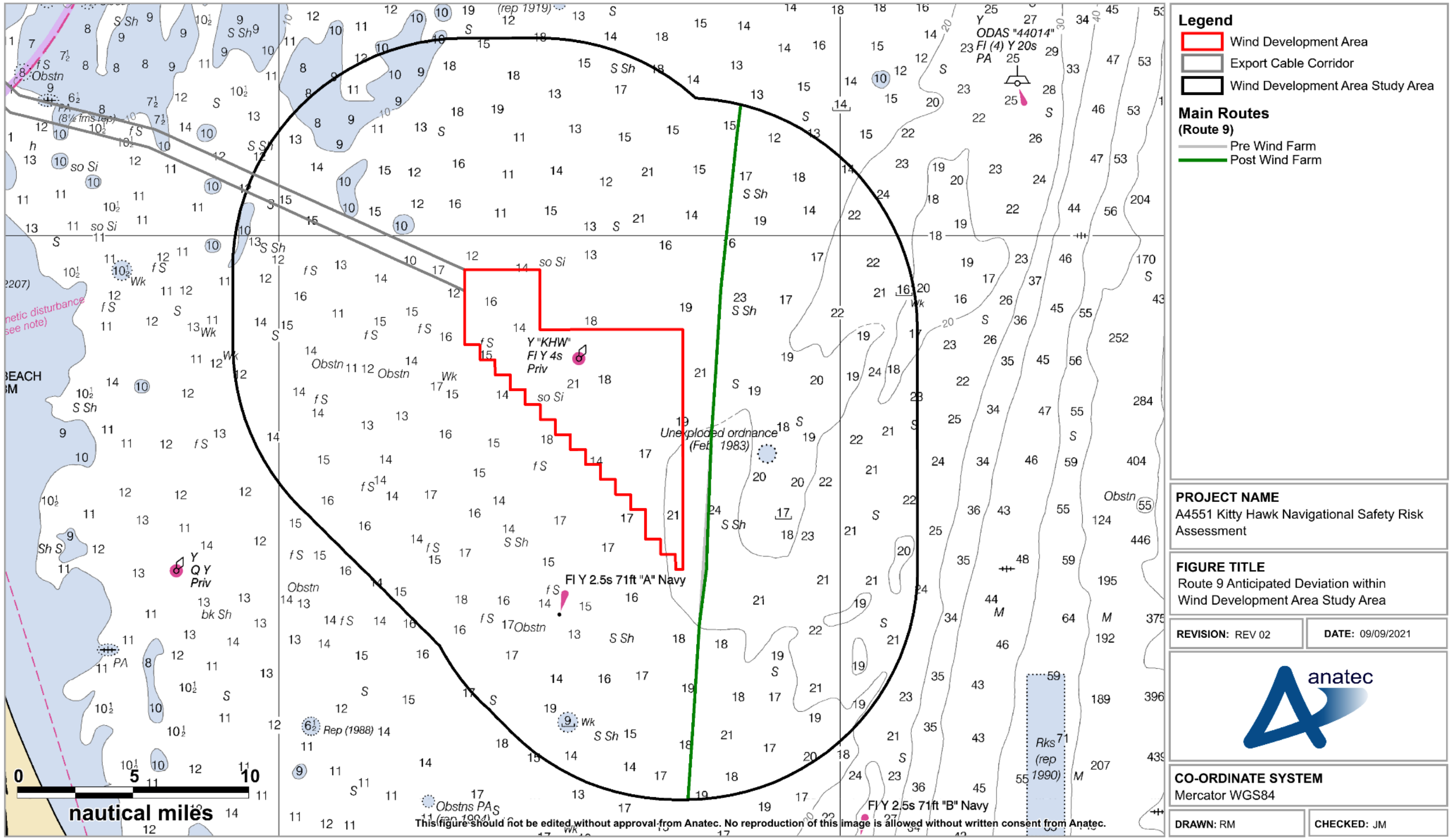

Figure D.6 Route 9 anticipated deviation within Wind Development Area study area

D.7 Route 10

Figure D.7 presents a comparison of Route 10 prior to and following installation of the Project.

The route is anticipated to deviate marginally to pass around the north eastern corner of the Wind Development Area.

The deviation associated with this route represents a 0.3 nm (0.6 km) increase in the route length compared with the pre wind facility scenario.

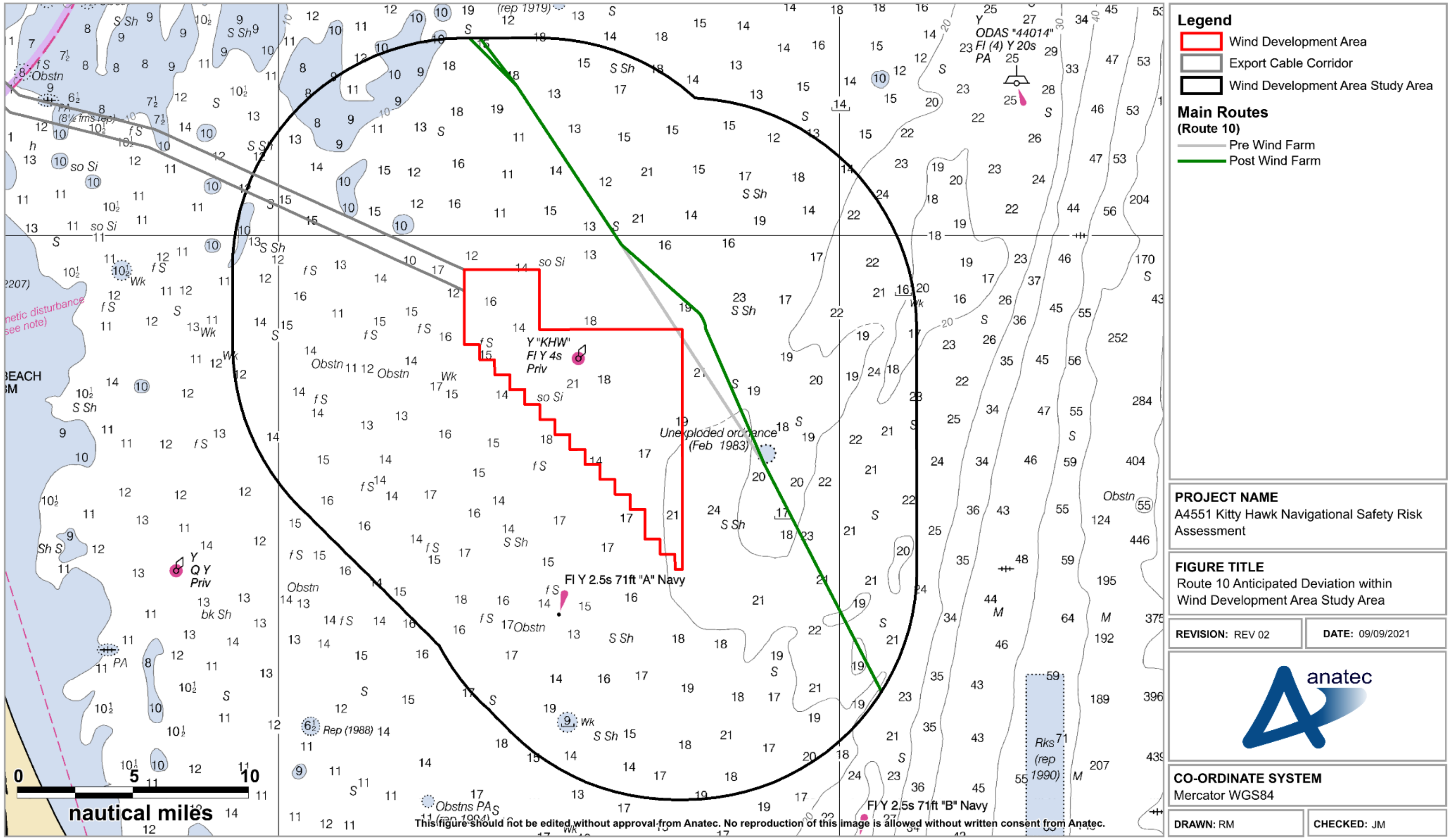

Figure D.7 Route 10 anticipated deviation within Wind Development Area study area

D.8 Route 11

Figure D.8 presents a comparison of Route 11 prior to and following installation of the Project.

The route is anticipated to deviate marginally to ensure a minimum 1 nm mean distance from the western boundary of the Wind Development Area is maintained.

The deviation associated with this route represents a less than 0.1 nm (0.19 km) increase in the route length compared with the pre wind facility scenario.

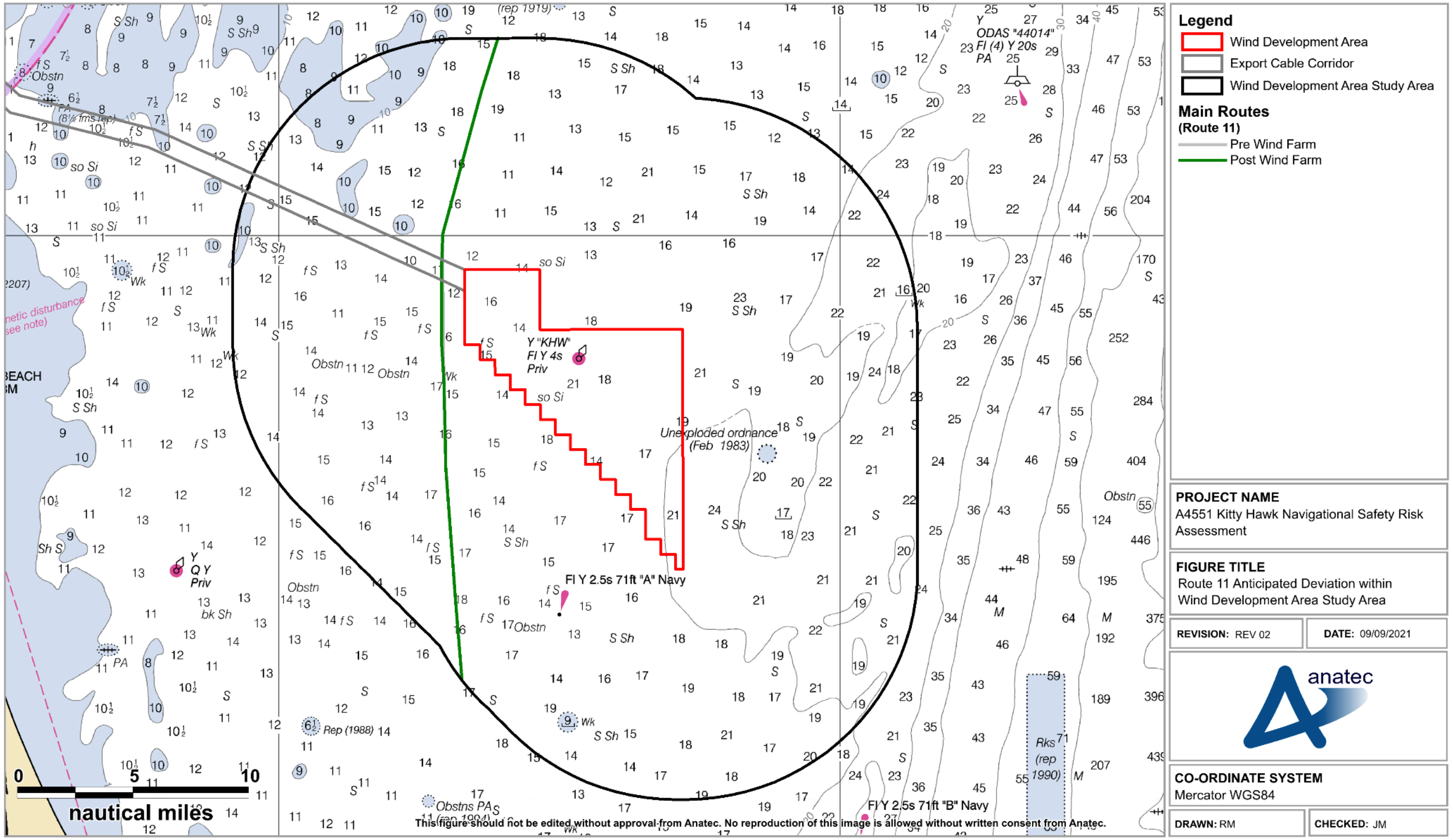

Figure D.8 Route 11 anticipated deviation within Wind Development Area study area