DOGGER BANK D WIND FARM

Preliminary Environmental Information Report

Volume 2
Appendix 15.2 Navigational Risk Assessment

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Glossary of Terms

Term	Definition
Allision	The act of striking or collision of a moving vessel against a stationary object.
Array Area	The area within which the wind turbines, inter-array cables and offshore platform(s) will be located.
Automatic Identification System (AIS)	A system by which vessels automatically broadcast their identity and key statistics including location, destination, length, speed and current status. Most commercial vessels and United Kingdom / European Union fishing vessels over 15m in length are required to carry AIS.
Baseline	The existing conditions as represented by the latest available survey and other data which is used as a benchmark for making comparisons to assess the impact of the Project.
Collision	The act or process of colliding (crashing) between two moving objects.
Development Consent Order (DCO)	A consent required under Section 37 of the Planning Act 2008 to authorise the development of a Nationally Significant Infrastructure Project, which is granted by the relevant Secretary of State following an application to the Planning Inspectorate.
Embedded Mitigation Measure	Embedded mitigation includes: ▪ Measures that form an inherent part of the project design evolution such as modifications to the location or design of the development made during the pre-application phase (also known as primary (inherent) mitigation); and ▪ Measures that will occur regardless of the EIA process as they are imposed by other existing legislative requirements or are considered as standard or best practice to manage commonly occurring environmental impacts (also known as tertiary (inexorable) mitigation). All embedded mitigation measures adopted by the Project are provided in the Commitments Register.
Environmental Impact Assessment (EIA)	A process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information and includes the publication of an Environmental Statement.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity.
Future Case	The assessment of risk based on the predicted growth in future shipping densities and traffic types as well as foreseeable changes in the marine environment.
Inter-Array Cables	Cables which link the wind turbines to the offshore platform(s).
Landfall	The area on the coastline, south-east of Skipsea, at which the offshore export cables are brought ashore, connecting to the onshore export cables at the transition joint bay above Mean High Water Springs.
Main Commercial Route	Defined transit route (mean position) of commercial vessels identified within each Study Area.
Marine Guidance Note (MGN)	A system of guidance notes issued by the Maritime and Coastguard Agency (MCA) which provide significant advice relating to the improvement of the safety of shipping at sea, and to prevent or minimise pollution from shipping.

Term	Definition
Navigational Risk Assessment (NRA)	A document which assesses the hazards to Shipping and Navigation of a proposed Offshore Renewable Energy Installation (OREI) based upon FSA
Offshore Export Cable	Cables which bring electricity from the offshore platform(s) to the transition joint bay at landfall.
Offshore Export Cable Corridor (offshore ECC)	The area within which the offshore export cables will be located, extending from the DBD Array Area to Mean High Water Springs at the landfall.
Offshore ECC Study Area	A buffer of 2 nautical miles (nm) (3.7 kilometres (km) applied around the offshore ECC.
Offshore Platform(s)	Fixed structures located within the DBD Array Area that contain electrical equipment to aggregate and, where required, convert the power from the wind turbines, into a more suitable voltage for transmission through the export cables to the Onshore Converter Station. Such structures could include (but are not limited to): Offshore Converter Station(s) and an Offshore Switching Station.
Offshore Renewable Energy Installation (OREI)	As defined by MGN 654 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on United Kingdom (UK) Navigational Practice, Safety and Emergency Response (MCA, 2021). For the purposes of this report and in keeping with the consistency of the EIA, OREI can mean offshore wind turbines and the associated electrical infrastructure such as offshore substations.
Project Design Envelope	A range of design parameters defined where appropriate to enable the identification and assessment of likely significant effects arising from a project's worst-case scenario. The Project Design Envelope incorporates flexibility and addresses uncertainty in the DCO application and will be further refined during the EIA process.
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.
Safety Zone	A statutory, temporary marine zone demarcated for safety purposes around a possibly hazardous offshore installation or works / construction area.
Scoping Opinion	A written opinion issued by the Planning Inspectorate on behalf of the Secretary of State regarding the scope and level of detail of the information to be provided in the Applicant's Environmental Statement. The Scoping Opinion for the Project was adopted by the Secretary of State on 02 August 2024.
Scoping Report	A request by the Applicant made to the Planning Inspectorate for a Scoping Opinion on behalf of the Secretary of State. The Scoping Report for the Project was submitted to the Secretary of State on 24 June 2024.
Section 36 Consent	Consent to construct and operate an offshore generating station, under Section 36 (S.36) of the Electricity Act 1989. This includes deemed planning permission for onshore works.
Study Area	A buffer of 10nm (19km) applied around the Array Area.

Term	Definition
The Applicant	SSE Renewables and Equinor acting through 'Doggerbank Offshore Wind Farm Project 4 Projco Limited'.
The Project	Dogger Bank D (DBD) Offshore Wind Farm Project, also referred to as DBD in this NRA.
Unique Vessel	An individual vessel identified on any particular calendar day, irrespective of how many tracks were recorded for that vessel on that day. This prevents vessels being over counted. Individual vessels are identified using their Maritime Mobile Service Identity (MMSI).
Wind Turbines	Power generating devices located within the DBD Array Area that convert kinetic energy from wind into electricity.

Abbreviations Table

Abbreviation	Definition
µT	Microtesla
AC	Alternating Current
ACE	ARUP Concept Elevator
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ALB	All-Weather Lifeboats
ARPA	Automatic Radar Plotting Aid
ATBA	Area to be Avoided
AtoN	Aid to Navigation
BBC	British Broadcasting Corporation
BWEA	British Wind Energy Association
CAA	Civil Aviation Authority
CBA	Cost Benefit Analysis
CBRA	Cable Burial Risk Assessment
CCTV	Closed Circuit Television
CD	Chart Datum
CHIRP	Confidential Human Factors Incident Reporting Programme
COLREGs	International Regulations for Preventing Collisions at Sea 1972
CTV	Crew Transfer Vessel
DBA	Dogger Bank A
DBB	Dogger Bank B
DBC	Dogger Bank C
DBD	Dogger Bank D
DBS	Dogger Bank South
DC	Direct Current
DCO	Development Consent Order
DECC	Department of Energy & Climate Change
DESNZ	Department for Energy Security and Net Zero
DF	Direction Finding
DfT	Department for Transport
DML	Deemed Marine License
DSC	Digital Selective Calling

Abbreviation	Definition
DW	Deep Water
E	East
ECC	Export Cable Corridor
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ERCoP	Emergency Response Cooperation Plan
ERRV	Emergency Response and Rescue Vessels
ES	Environmental Statement
ESRI	Environmental Systems Research Institute
ETRS89	European Terrestrial Reference System 1989
FLO	Fisheries Liaison Officer
FLOWW	Fishing Liaison with Offshore Wind and Wet Renewables Group
FSA	Formal Safety Assessment
GIS	Geographical Information System
GLA	General Lighthouse Authority
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
GT	Gross Tonnage
HAT	Highest Astronomical Tide
HF	High Frequency
HM	His Majesty
HMCG	His Majesty's Coastguard
HRA	Helicopter Refuge Areas
HSE	Health and Safety Executive
HVDC	High Voltage Direct Current
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ILB	Inshore Lifeboats
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
IPS	Intermediate Peripheral Structures
JRCC	Joint Rescue Coordination Centre
kHz	Kilohertz

Abbreviation	Definition
km	Kilometre
km^2	Square Kilometre
LAT	Lowest Astronomical Tide
LOA	Length Overall
LPG	Liquid Petroleum Gas
m	Metre
MAIB	Marine Accident Investigation Branch
MARPOL	International Convention for the Prevention of Pollution from Ships
MCA	Maritime and Coastguard Agency
MEHRA	Marine Environmental High Risk Areas
MEPC	Marine Environment Protection Committee
MF	Medium Frequency
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MMSI	Maritime Mobile Service Identity
MOD	Ministry of Defense
MPCP	Marine Pollution Contingency Plan
MRCC	Maritime Rescue Coordination Centre
NAVTEX	Navigational Telex
nm	Nautical Mile
nm^2	Square Nautical Mile
NPS	National Policy Statement
NRA	Navigational Risk Assessment
NSIP	Nationally Significant Infrastructure Projects
NUC	Not Under Command
O&M	Operation and& Maintenance
oANS	Offshore Artificial Nesting Structure
OREI	Offshore Renewable Energy Installations
OSP	Offshore Substation Platform
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PDS	Project Design Statement

Abbreviation	Definition
PEIR	Preliminary Environmental Information Report
PEMP	Pollution Environmental Management Plan
PEXA	Practice and Exercise Area
PLL	Potential Loss of Life
PNT	Positioning, Navigation and Timing
POB	Persons on Board
QHSE	Quality, Health, Safety and Environment
Radar	Radio Detection and Ranging
RAM	Restricted in Ability to Maneuver
REZ	Renewable Energy Zones
RIB	Rigid-hulled Inflatable Boat
RNLI	Royal National Lifeboat Institution
RoPax	Roll-On / Roll-Off Passenger
RoRo	Roll-On / Roll-Off Cargo
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SEAL	Shearwater Elgin Area Line
SLoO	Single Line of Orientation
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea
SONAR	Sound Navigation Ranging
SOV	Service Operation Vessel
SPS	Significant Peripheral Structure
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
VHF	Very High Frequency
VTS	Vessel Traffic Service
WGS84	World Geodetic System 1984

1 Introduction

1.1 Background

1. Anatec Ltd was commissioned by SSE Renewables and Equinor, hereafter referred to as 'the Applicant', to undertake a Navigational Risk Assessment (NRA) for the proposed Dogger Bank D (DBD) Offshore Wind Farm Project (hereafter 'the Project'). The NRA has been undertaken with respect to the offshore components of the Project comprising the Array Area and the offshore export cable corridor (ECC). It is noted there may be a potential for an Offshore Artificial Nesting Structure (oANS) to be installed and if so, a separate assessment will be carried out and submitted at the Environmental Statement (ES) Stage. This NRA presents information on the Project relative to the existing and estimated future navigational activity and forms the technical appendix to **Volume 1, Chapter 15 Shipping and Navigation**.

1.2 Navigational Risk Assessment

2. An Environmental Impact Assessment (EIA) is a process which identifies the environmental risks of a Project, both negative and positive. An important element / requirement of the EIA for offshore projects is the NRA. Following the relevant Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 564 (MCA, 2021) including the methodology document (Annex 1), the NRA includes:

- Outline of methodology applied in the NRA;
- Summary of consultation undertaken with Shipping and Navigation stakeholders to date;
- Lessons learnt from previous offshore wind farm developments;
- Summary of the Project description relevant to Shipping and Navigation;
- Baseline characterisation of the baseline environment;
- Discussions of potential risks on navigation, communication and position fixing equipment;
- Cumulative and transboundary overview;
- Future case vessel traffic characterisation;
- Collision and allision risk modelling;
- Assessment of navigational risk (applying the Formal Safety Assessment (FSA) process);
- Outline of embedded and additional mitigation measures as necessary;
- Outline of through life safety management features; and
- Completion of the MGN 654 checklist.

3. Potential hazards are considered for each phase of the Project as appropriate:

- Construction;
- Operation and maintenance (O&M); and
- Decommissioning.

4. The assessment of the Projects is based on a parameter-based design envelope approach, which is recognised in:

- *Overarching National Policy Statement (NPS) for Energy (EN-1)* (Department for Energy Security and Net Zero (Department for Energy Security and Net Zero (DESNZ)), 2023b);
- *NPS for Renewable Energy Infrastructure (EN-3)* (DESNZ, 2023a); and
- *Planning Inspectorate Advice Note Nine: Rochdale Envelope* (The Planning Inspectorate, 2018).

5. The shipping and navigation baseline has been developed and risk assessment undertaken based upon the information available and responses received at the time of preparation, including the worst-case scenario which has been defined for the NRA based on the information detailed in **Volume 1, Chapter 4 Project Description**.

2 Guidance and Legislation

2.1 Legislation

6. Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIP) specific to Shipping and Navigation is contained in the NPS for Renewable Energy Infrastructure (EN-3) (DESNZ, 2023). Additionally, planning policy on NSIPs for ports is contained in the NPS for Ports (Department for Transport (DfT), 2012). **Volume 1, Chapter 15 Shipping and Navigation** summarises the relevant matters within NPS EN-3 and the NPS for Ports, and where they are considered in the ES.

2.2 Primary Guidance

7. The primary guidance documents used during the assessment are the following:

- *Marine Guidance Note (MGN) 654 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on United Kingdom (UK) Navigational Practice, Safety and Emergency Response (MCA, 2021);* and
- *Revised Guidelines for FSA for Use in the Rule-Making Process (International Maritime Organization (IMO), 2018).*

8. MGN 654 highlights issues that shall be considered when assessing the risk to navigational safety from offshore renewable energy developments proposed in United Kingdom (UK) internal waters, territorial seas, UK Exclusive Economic Zone (EEZ), or Renewable Energy Zones (REZ).

9. The MCA require that their methodology (Annex 1 to MGN 654) is used as a template for preparing NRAs. It is centred on risk management and requires a submission that shows that sufficient controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with mitigation (**Section 3.2**). Across **Volume 1, Chapter 15 Shipping and Navigation** and the NRA, both base and future case levels of risk have been identified, in addition to the measures required to ensure that both the base and future cases remain broadly acceptable or tolerable with mitigation (As Low as Reasonably Practicable (ALARP)).

2.2 Other Guidance

10. Other guidance documents used during the assessment include:

- *MGN 372 Amendment 1 (Merchant and Fishing) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs* (MCA, 2022);
- *International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures* (IALA, 2021a);

- *IALA Guideline G1162 The Marking of Offshore Man-Made Structures* (IALA, 2021b);
- *The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy* (RYA, 2019);
- *Standard Marking Schedule for Offshore Installations* (Department of Energy & Climate Change (DECC)), 2011); and
- *UK Marine Policy Statement* (His Majesty's (HM) Government, 2011).

2.3 Lessons Learnt

11. There is considerable benefit for the Applicant in the sharing of lessons learnt within the offshore industry. The NRA, and in particular the risk assessment undertaken in **Section 18** and **Volume 1, Chapter 15 Shipping and Navigation**, includes general consideration for lessons learnt and expert opinion from previous offshore wind farm developments and other sea users, capitalising upon the UK's position as a leading generator of offshore wind power. This includes the shipping and navigation chapters of the ES for the Round 3 Dogger Bank offshore wind farm developments.

3 Navigational Risk Assessment Methodology

3.1 Formal Safety Assessment Methodology

12. A Shipping and Navigation user can only be exposed to a risk caused by a hazard if there is a pathway through which a risk can be transmitted between the source activity and the user. In cases where a user is exposed to a risk, the overall significance of risk to the user is determined. This process incorporates a degree of subjectivity and is reliant upon data, defined risk assessment criteria and expert judgement. The assessments presented herein for Shipping and Navigation users have considered the following criteria:

- Baseline data and assessment;
- Expert opinion;
- Level of stakeholder concern;
- Time and / or distance of any deviation;
- Number of transits of specific vessels and / or vessel types; and
- Lessons learnt from existing offshore developments.

13. It is noted that, with regards to commercial fishing vessels, the methodology and assessment has been applied to hazards considering commercial fishing vessels in transit (i.e. where gear is not deployed). A separate methodology and assessment have been applied in **Volume 1, Chapter 14 Commercial Fisheries** to consider hazards which are directly related to commercial fishing activity (as opposed to commercial fishing vessels in transit) including hazards of a commercial nature.

3.2 Formal Safety Assessment Process

14. In line with the standard approach to marine risk assessment, the IMO FSA process (IMO, 2018) as approved by the IMO in 2018 under Maritime Safety Committee – Marine Environment Protection Committee (MECP).2/circ.12/Rev.2 has been applied to the risk assessment within this NRA and informs **Volume 1, Chapter 15 Shipping and Navigation**.

15. The FSA process is a structured and systematic methodology based upon risk analysis and Cost Benefit Analysis (CBA) (if applicable) to reduce risks to ALARP. There are five basic steps within this process as illustrated by **Figure 3-1** and summarised in the following list:

- **Step 1** – Identification of hazards (a list is produced of hazards prioritised by risk level specific to the problem under review);
- **Step 2** – Risk analysis (investigation of the causes and initiating events and consequences of the more important hazards identified in Step 1);
- **Step 3** – Risk control options (identification of measures to control and reduce the identified hazards);

- **Step 4** – CBA (identification and comparison of the benefit and costs associated with the risk control options identified in Step 3; and
- **Step 5** – Recommendations for decision-making (defining of recommendations based upon Steps 1 to 4).

Figure 3-1 Flow Chart of the FSA Methodology

3.3 Hazard Workshop Methodology

16. A key tool used in the NRA process is the Hazard Workshop which ensures that all hazards are identified, and the corresponding risks qualified in discussion with relevant stakeholders. **Table 3-1** and **Table 3-2** define the severity of consequence and the frequency of occurrence rankings that have been used to assess risks within **Section 18** and will also be used in the creation of the Hazard Log at the ES stage.

Table 3-1 Severity of Consequences Ranking Definitions

Rank	Description	Definition			
		People	Property	Environment	Business
1	Negligible	No perceptible impact	No perceptible impact	No perceptible impact	No perceptible impact
2	Minor	Slight injury(s)	Minor damage to property i.e. superficial damage	Tier 1 local assistance required	Minor reputational risks – limited to users
3	Moderate	Multiple minor or single serious injury	Damage not critical to operations	Tier 2 limited external assistance required	Local reputational risks
4	Serious	Multiple serious injuries or single fatality	Damage resulting in critical impact on operations	Tier 2 regional assistance required	National reputational risks
5	Major	More than one fatality	Total loss of property	Tier 3 national assistance required	International reputational risks

Table 3-2 Frequency of Occurrence Ranking Definitions

Rank	Description	Definition
1	Negligible	Less than 1 occurrence per 10,000 years
2	Extremely unlikely	1 per 100 to 10,000 years
3	Remote	1 per 10 to 100 years
4	Reasonably probable	1 per 1 to 10 years
5	Frequent	Yearly

17. The severity of consequence and frequency of occurrence are then used to define the significance of risk via a tolerability matrix approach as shown in **Table 3-3**. Thresholds for significance of risk are defined throughout the IMO FSA process (IMO, 2018) under Maritime Safety Committee – Marine Environment Protection Committee (MECP).2/circ.12/Rev.2 and is defined as either **Broadly Acceptable** (low risk), **Tolerable with Mitigation** (intermediate risk), or **Unacceptable** (high risk).

Table 3-3 Tolerability Matrix and Risk Rankings

Severity of Consequence	5					
	4					
	3					
	2					
	1					
		1	2	3	4	5
		Frequency of Occurrence				

	Unacceptable (high risk)
	Tolerable with Mitigation (intermediate risk)
	Broadly Acceptable (low risk)

18. Once identified, the significance of risk will be assessed with the inclusion of risk control measures (mitigations) to ensure it is ALARP. Further risk control measures may be required to further mitigate a hazard in accordance with the ALARP principles. Broadly Acceptable and Tolerable with Mitigation risks are ALARP, whilst Unacceptable and Tolerable risks are not considered to be ALARP.

3.4 Cumulative Risk Assessment Methodology

19. The hazards identified in the FSA are also assessed for cumulative risks with the inclusion of other projects. Given the varying type, status and location of developments, a tiered approach to cumulative risk assessment has been undertaken, which splits developments into tiers depending upon project status, proximity to the Project and the level to which they are anticipated to cumulatively impact relevant users. It also considers data confidence, most notably in terms of the level of certainty over the location and timescales for a development.

20. The tiers are summarised in **Table 3-4**, with the level of assessment undertaken for each tier included. It is noted that an aggregate of the criterion is used to determine the tier of each development. For example, if a development is located within 25 nautical miles (nm) (46 kilometres (km)) of the Project and may impact a main commercial route within 1nm (1.9km) of the Array Area but the development is only scoped, it may still be allocated to Tier 1.

21. The cumulative screening is provided in **Section 13**.

Table 3-4 Cumulative Development Screening Summary

Tier	Minimum Development Status	Criterion	Data Confidence Level	Level of Cumulative Risk Assessment
1	Consent application submitted	▪ May impact a main commercial route passing within 1nm (1.9km) of the Array Area and / or interacts with traffic which may be directly displaced by the Array Area. ▪ Raised as having possible cumulative effect during consultation. ▪ Offshore wind farms up to 25nm (46km). ▪ Oil and gas infrastructure up to 5nm (9.3km). ▪ Marine aggregate dredging areas up to 15nm (28km).	High or medium	Quantitative cumulative re-routeing of main commercial routes
2	Consent application submitted	▪ May impact a main commercial route passing within 1nm (1.9km) of the Array Area and / or interacts with traffic which may be directly displaced by the Array Area. ▪ Offshore wind farms between 25 and 50nm (46 and 93km). ▪ Oil and gas infrastructure between 5 and 10nm (9.3 and 19km). ▪ Marine aggregate dredging areas between 15 and 30nm (28 and 56km).	High or medium	Quantitative cumulative re-routeing of main commercial routes
3	Scoped	▪ Does not impact a main commercial route passing within 1nm (1.9km) of the Array Area and does not interact with traffic which may be directly displaced by the Array Area. ▪ Offshore wind farms up to 50nm (93km). ▪ Oil and gas infrastructure up to 10nm (19km). ▪ Marine aggregate dredging areas up to 30nm (56km).	Low	Qualitative assumptions of routeing only

3.5 Study Areas

22. A buffer of 10nm (19km) has been applied around the Array Area (hereafter referred to as the 'Study Area'), as shown on **Figure 3-2**. This is a standard size of Study Area for a Shipping and Navigation assessment and was presented to relevant Shipping and Navigation stakeholders during consultation. The 10nm (19km) radius ensures that relevant routeing which may be affected is captured while still remaining specific to the area being studied.

23. An additional Study Area for the offshore ECC, hereafter referred to as the 'offshore ECC Study Area', has been defined as a 2nm (3.7km) offshore buffer of the offshore

ECC. This Study Area omits the portion of the offshore ECC funnelling out to the western boundary of the Array Area noting that this area is fully captured by the Array Area Study Area. This buffer has again been chosen to capture relevant routeing while still remaining specific to the offshore ECC.

24. The DBD Study Areas are shown on **Figure 3-2**.

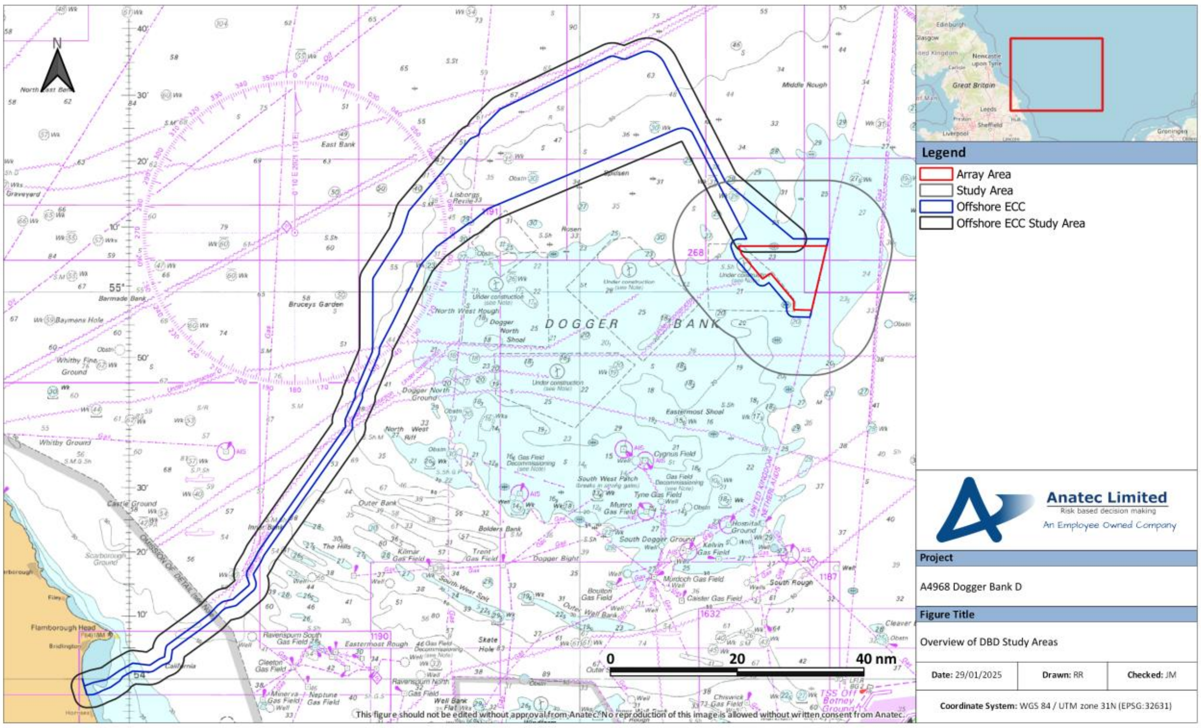


Figure 3-2 Overview of DBD Study Areas

4 Consultation

4.1 Stakeholders Consulted in the Navigational Risk Assessment Process

25. Key Shipping and Navigation stakeholders have been consulted in the NRA process. The following stakeholders have been consulted via dedicated meetings (other than the Hazard Workshop – see **Section 4.2**):

- MCA;
- Trinity House; and
- Chamber of Shipping.

26. As well as consulting with the organisations outlined above, 14 Regular Operators identified from the summer vessel traffic data and the supplementary Automatic Identification System (AIS) data (see **Section 5**) were provided with an overview of the Project and offered the opportunity to provide comment (the full Regular Operator letter is presented in **Annex C**). The full list of Regular Operators identified is provided below:

- Aasen Shipping
- DFDS Seaways[1]
- Döhle Group
- F.Laeisz Reederei
- Fednav
- Glomar Offshore
- Intrada Ships Management (ScotLine)
- KESS ("K" Line)
- DFDS Seaways
- Myklebusthaug Rederi AS
- Pot Scheepvaart
- Rederi AB Swedish Bulk
- Sentinel Marine Ltd
- Utkilen AS
- Wagenborg Shipping BV
- Wilson ASA

27. The key issues raised including via dedicated meetings and the Scoping Opinion (PINS, 2023), and where they are addressed within the NRA or **Volume 1, Chapter 15 Shipping and Navigation** have been included within **Appendix 15.1 Consultation Responses on Shipping and Navigation**.

28. It is noted that only DFDS Seaways and Sentinel Marine Ltd responded to the Regular Operator outreach and noted no impact of the Project on their operations.

4.2 Hazard Workshop

29. A key element of the consultation phase is the Hazard Workshop, a meeting of local and national marine stakeholders to identify and discuss potential Shipping and

[1] DFDS Seaways were not identified as Regular Operators in the analysis if vessel traffic data but the Project is aware of a frequent Roll-On/Roll-Off Cargo (RoRo) route situated just beyond the Study Area.

Navigation hazards. The Hazard Workshop will be undertaken post-Preliminary Environmental Information Report (PEIR) and the information gathered from the Hazard Workshop will aid in the development of a Hazard Log as introduced in **Section 3.3** which will be incorporated into the NRA at the ES stage. The decision to carry out the Hazard Workshop post-PEIR was agreed with relevant stakeholders during consultation on the fact that the winter survey is yet to be undertaken and so not all baseline data has been collected at PEIR. The baseline is also still evolving in proximity to the Array Area due to the progression of the neighbouring Dogger Bank C (DBC) project.

5 Data Sources

30. This section summarises the main data sources used to characterise the Shipping and Navigation baseline relative to the Project.

5.1 Summary of Data Sources

31. The main data sources used to characterise the Shipping and Navigation baseline relative to the Array Area and Offshore ECC are outlined in **Table 5-1**.

Table 5-1 Data Sources Used to Inform Shipping and Navigation Baseline

Data	Source(s)	Purpose
Vessel traffic	Vessel traffic survey data consisting of AIS, Radio Detection and Ranging (Radar) and visual observations for the Study Area (14 days, 18 July to 1 August 2023).	Characterising vessel traffic movements within and in proximity to the boundary of the Array Area in agreement with MCA and Trinity House.
	Vessel traffic data consisting of AIS data only covering the Study Area (40 days, 2024), provided by Vissim and recorded via the Dogger Bank A (DBA) offshore substation platforms (OSP).	
	Vessel traffic data consisting of AIS data only covering the offshore ECC Study Area (40 days, 2024), provided by Vissim and recorded via the DBA OSP.	Characterising vessel traffic movements within and in proximity to the offshore ECC.
	Anatec's ShipRoutes database (2024).	Secondary source for characterising vessel traffic movements including cumulatively within and in proximity to the boundary of the Array Area.
Maritime incidents	Marine Accident Investigation Branch (MAIB) marine accidents database (2003 to 2022).	Review of maritime incidents within and in proximity to the boundary of the Array Area and offshore ECC.
	Royal National Lifeboat Institution (RNLI) incident data (2008 to 2023).	
	DfT UK civilian Search and Rescue (SAR) helicopter taskings (April 2015 to March 2024).	
Marine aggregate dredging	Marine aggregate dredging areas (licenced and active) (The Crown Estate, 2024).	Characterising marine aggregate dredging areas within and in proximity to the Projects.
Other navigational features	Admiralty Charts 105, 107, 121, 129, 266, 267, 268, 1187, 1191, 1192, and 2182 (United Kingdom Hydrographic Office (UKHO), 2024).	Characterising other navigational features in proximity to the boundary of the Array Area and Offshore ECC.
	Admiralty Sailing Directions North Sea (West) Pilot NP54 (UKHO, 2021).	

Data	Source(s)	Purpose
Weather	Wind direction data provided by Health and Safety Executive (HSE) from two locations between 31 and 35nm (57 and 65km) from the Array Area.	Characterising weather conditions in proximity to Array Area for use as input in the collision and allision risk modelling.
	Significant wave height data provided by HSE from two locations between 31 and 35nm (57 and 65km) from the Array Area.	
	Tidal data provided by Admiralty Chart 266 (UKHO, 2024).	
	Visibility data provided in *Admiralty Sailing Directions North Sea (West) Pilot NP54* (UKHO, 2021).	
	Case Studies of Past Weather Events (Met Office, 2024).	Identifying periods of adverse weather in proximity to the Array Area.

5.2 Vessel Traffic Data

5.2.1 Vessel Traffic Survey

32. A vessel traffic survey was undertaken by the survey vessel *Karima* (IMO number 7,427,403) from 18 July to 1 August 2023. The vessel undertook the survey in agreement with the MCA and Trinity House and consisted of 14 full days of vessel traffic data collection via AIS, Radar, and visual observation which combined comply with MGN 654 requirements. This vessel traffic survey was undertaken prior to the start of offshore construction works for DBC and will have been undertaken more than 24 months prior to the time of the Application (ES). Therefore, this survey will be considered as a secondary source only, and two further dedicated surveys will be undertaken totalling 28 days of dedicated survey data serving as the MGN 654 compliant vessel traffic data.

33. The two surveys yet to be undertaken, will each comprise of 14 full days of AIS, Radar, and visual observation data recorded via a site-specific survey vessel during a period in both winter and summer 2025. As these surveys are yet to occur, the findings are not presented in this NRA but will be incorporated at ES. This methodology was agreed with the MCA and Trinity House.

5.2.2 Vissim Data

34. For PEIR, an additional data set comprising of AIS provided by Vissim has been acquired by the Applicant to supplement the initial 2023 summer survey data detailed above. This data covers the same area as the summer survey for the Study Area over 40 full days recorded across July to September 2024. The dates included in this data set were selected as provided the greatest coverage of the Study Area. The 40 days include:

- 18 consecutive days from 19th July to 5th August;
- 29th August;
- 11 consecutive days from 31st August to 10th September;
- 5 consecutive days from 12th September to 16th September; and
- 5 consecutive days from 18th September to 22nd September.

35. The same data provided by Vissim was also used to characterise vessel traffic data in the offshore ECC Study Area over the same 40-day data period. The data was recorded via the DBA OSP and ensures optimal coverage of the Study Areas given the distance offshore of the Project where coastal and satellite receivers may not have provided as conclusive of a dataset.

36. These AIS only datasets covering the Array Area will be replaced by the vessel traffic surveys anticipated to be undertaken in 2025 at ES stage. However, it may still be incorporated into the NRA for data validation depending on coverage and traffic volumes.

5.2.3 Temporary Traffic

37. It is standard practice for temporary traffic (non-routine) to be removed from the analysis which ensures the focus is on routine traffic and activities within the area only and is representative of the vessel traffic movements which may be expected at the time of the Project being constructed.

38. A number of vessel tracks recorded during the survey period were classified as temporary. The tracks of two guard vessels attending the Viking Link Cable which was under construction at the time of the survey, and a fishery research vessel which was undertaking activity within the Study Area (based on their track behaviour and information broadcast on AIS) were removed from the dataset. As for the Vissim data recorded within the Study Area, temporary traffic removed included a multitude of vessels attending the under-construction Dogger Bank and Sofia developments to the west of the Array Area. Vessels included survey vessels, offshore support vessels, a jack-up rig, cable layers, and guard vessels.

39. For the offshore ECC Study Area, several vessel tracks were again deemed temporary and removed and these included the same vessels highlighted above for the Array Area, as well as further construction, survey, and crew transfer vessels which were again associated with the under-construction Dogger Bank and Sofia developments. Survey vessels for the Eastern Green Link 3 sub-sea cable which was in the early development phase, as well as several oil and gas vessels which were attending temporary jack-up rigs.

5.3 Data Limitations

5.3.1 Automatic Identification System Data

40. The carriage of AIS is required on board all vessels of greater than 300 Gross Tonnage (GT) engaged on international voyages, cargo vessels of more than 500 GT not engaged on international voyages, passenger vessels irrespective of size built on or after 1 July 2002, and fishing vessels over 15 metre (m) length overall (LOA).

41. Therefore, for the vessel traffic surveys larger vessels were recorded on AIS, while smaller vessels without AIS installed (including fishing vessels under 15m LOA and recreational craft) were recorded, where possible, on the Automatic Radar Plotting Aid (ARPA) on board the *Karima*. A proportion of smaller vessels also carry AIS voluntarily, typically utilising a Class B AIS device.

42. Due to the distance offshore and the location of the Array Area, it is expected that smaller craft (those not carrying AIS) would be limited. This was confirmed during the summer 2023 survey data analysed in Section 10.1 as well as noting that no vessels were recorded via Radar that were not also broadcasting on AIS. Recorded Radar tracks were reviewed but, in each instance, the AIS receiver tracked the vessel over a greater range than the corresponding Radar track and provided more accurate information on position and vessel characteristics. Therefore, the AIS track has been prioritised and used alone where the vessel was recorded by both systems.

5.3.2 Historical Incident Data

43. Although all UK commercial vessels are required to report accidents to the MAIB, non-UK vessels do not have to report unless they are in a UK port or within 12nm (22km) territorial waters (noting that the Study Area is not located entirely within 12nm (22km) territorial waters) or carrying passengers to a UK port. There are also no requirements for non-commercial recreational craft to report accidents to the MAIB.

44. The RNLI incident data cannot be considered comprehensive of all incidents in the Study Areas as not all incidents require assistance from a RNLI resource. Although hoaxes and false alarms are excluded, any incident to which an RNLI resource was not mobilised has not been accounted for in this dataset. The distance offshore of the Array Area is also out with the RNLI operational limit and is discussed further in Section 9.2. United Kingdom Hydrographic Office Admiralty Charts

45. The UKHO Admiralty Charts are updated periodically and therefore the information shown may not reflect the real time features within the region with total accuracy. For aids to navigation, only those charted and considered key to establishing the Shipping and Navigation baseline are shown. During consultation input has been sought from relevant stakeholders regarding the navigational features baseline.

Navigational features are based upon the most recently available UKHO Admiralty Charts and Sailing Directions at the time of writing.

6 Project Design Relevant to Shipping and Navigation

46. The NRA reflects the Project Design Statement (PDS), which is detailed in full in **Volume 1, Chapter 4 Project Description**. The following subsections outline the maximum extent of the Project for which any Shipping and Navigation hazards are assessed.

6.1 Project Area

47. The Array Area is located approximately 114nm (211km) east of the east Yorkshire coast of England with the closest point at Flamborough Head. The total area covered by the Array Area is approximately 76 square nautical miles (nm^2) (262 square kilometre (km^2)) with depths ranging between 21.2 and 34.6m below Chart Datum (CD). Excluding the Array Area, the total area covered by the offshore ECC is approximately 1,937nm^2 (6,644 km^2) with landfall north of Hornsea, on the Yorkshire coast. Charted water depths within the offshore ECC range from zero (nearshore) and 118m below CD.

48. All surface piercing structures (wind turbines and Offshore Platforms) will be located entirely within the Array Area, inclusive of blade overfly. The key coordinates defining the boundary of the Array Area are illustrated on **Figure 6-1** and provided in **Table 6-1** using World Geodetic System 1984 (WGS84).

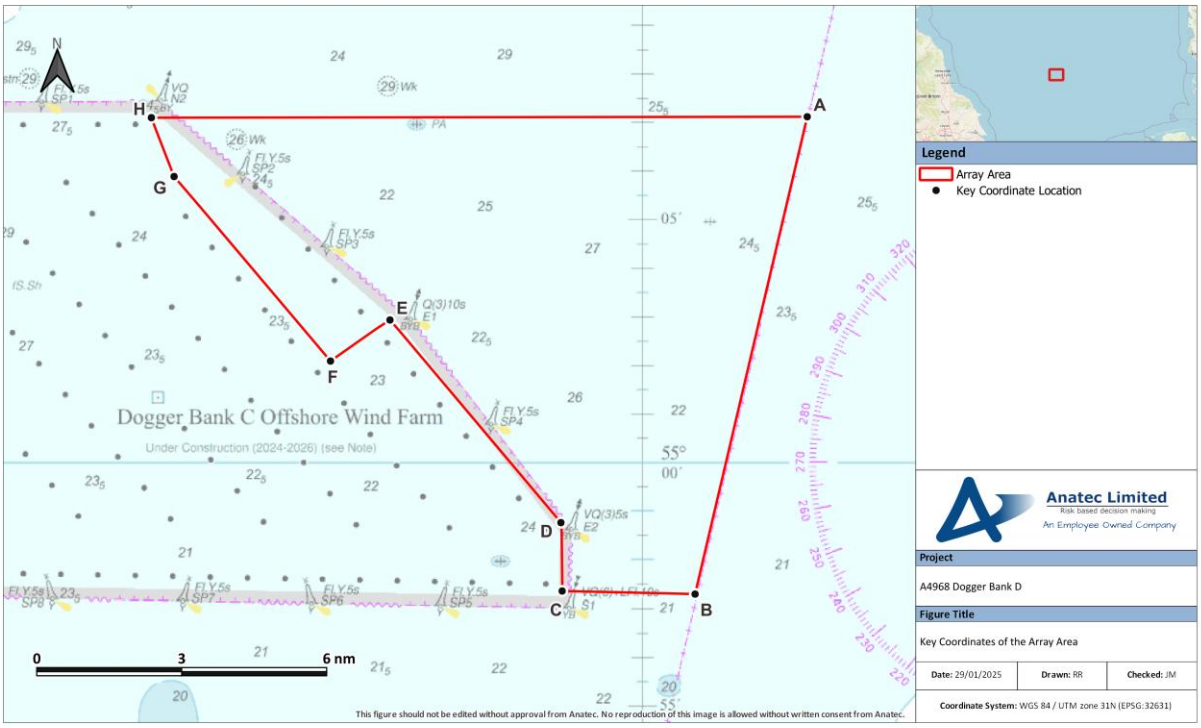


Figure 6-1 Key Coordinates of the Array Area

Table 6-1 Key Coordinates of the Array Area (WGS84)

Point	Latitude	Longitude
A	55°07'06.95" North (N)	003°05'56.03" East (E)
B	54°57'17.44" N	003°01'54.72" E
C	54°57'21.24" N	002°57'08.76" E
D	54°58'45.85" N	002°57'06.10" E
E	55°02'56.26" N	002°50'58.33" E
F	55°02'05.54" N	002°48'50.36" E
G	55°05'53.27" N	002°43'13.80" E
H	55°07'05.83" N	002°42'24.99" E

6.2 Surface Infrastructure

6.2.1 Indicative Worst-Case Layout

49. Up to 115 surface structures will be installed consisting of 113 wind turbines and two Offshore Platforms. An additional five spare locations are also being considered and although the final locations of infrastructure have not yet been defined, an indicative worst-case layout has been determined for Shipping and Navigation and is presented on **Figure 6-2**, inclusive of spare locations. Only 113 wind turbines and the two Offshore Platform locations have been used throughout the modelling process in **Section 16**, with internal locations considered to be less exposed to passing vessel traffic designated as the five spare locations.

50. Following this, **Figure 6-3** illustrates the worst-case layout alongside the under construction DBC layout as DBC shares its eastern border with the western boundary of the Array Area and is due to begin operation in 2026. Spare locations associated with DBC coincide with locations selected for the indicative worst-case layout – these will not be utilised unless a planned DBC location is found to be unfeasible during installation. Should any spare locations be utilised for DBC then they will be accounted for when determining the final array layout for the Project post consent.

51. The worst-case assumptions are for the purposes of modelling / risk assessment only and the final array layout will need to be agreed with the MCA and Trinity House post consent.

52. The minimum spacing between wind turbines (measured centre-to-centre) is 826m and two lines of orientation have been maintained throughout the indicative worst-case layout. Should the Applicant consider a Single Line of Orientation (SLoO) layout post consent then a safety justification would be undertaken in line with MGN 654 requirements.

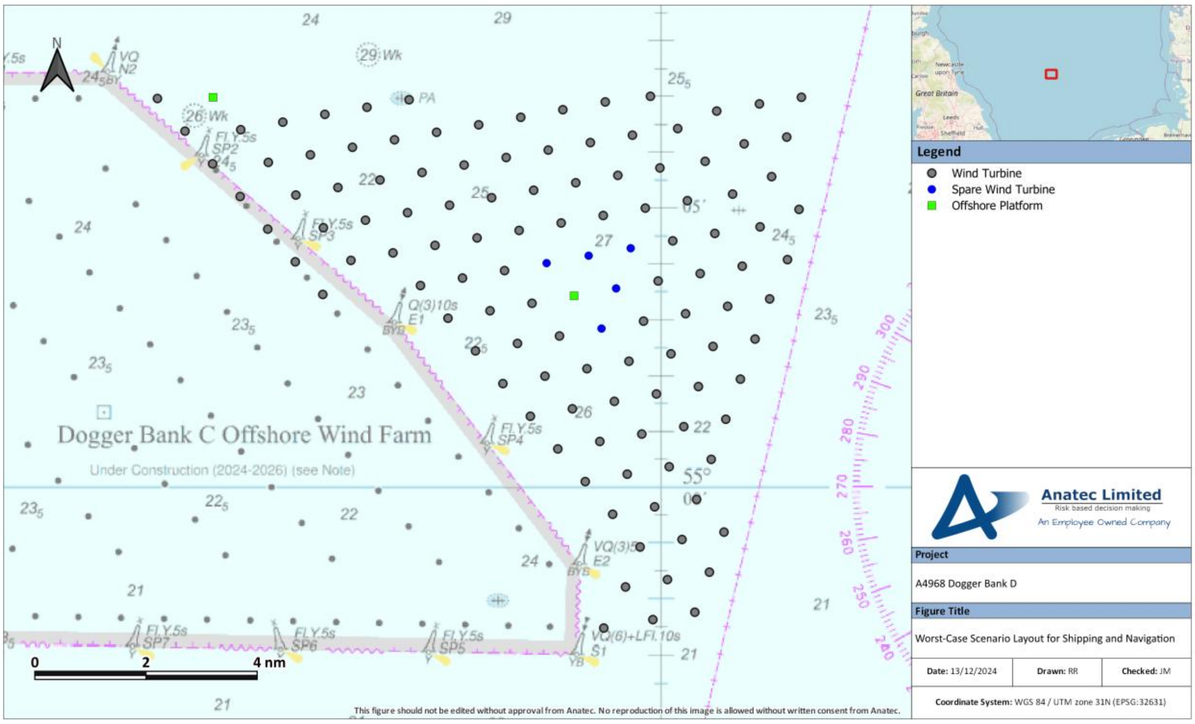


Figure 6-2 Worst-Case Layout for Shipping and Navigation

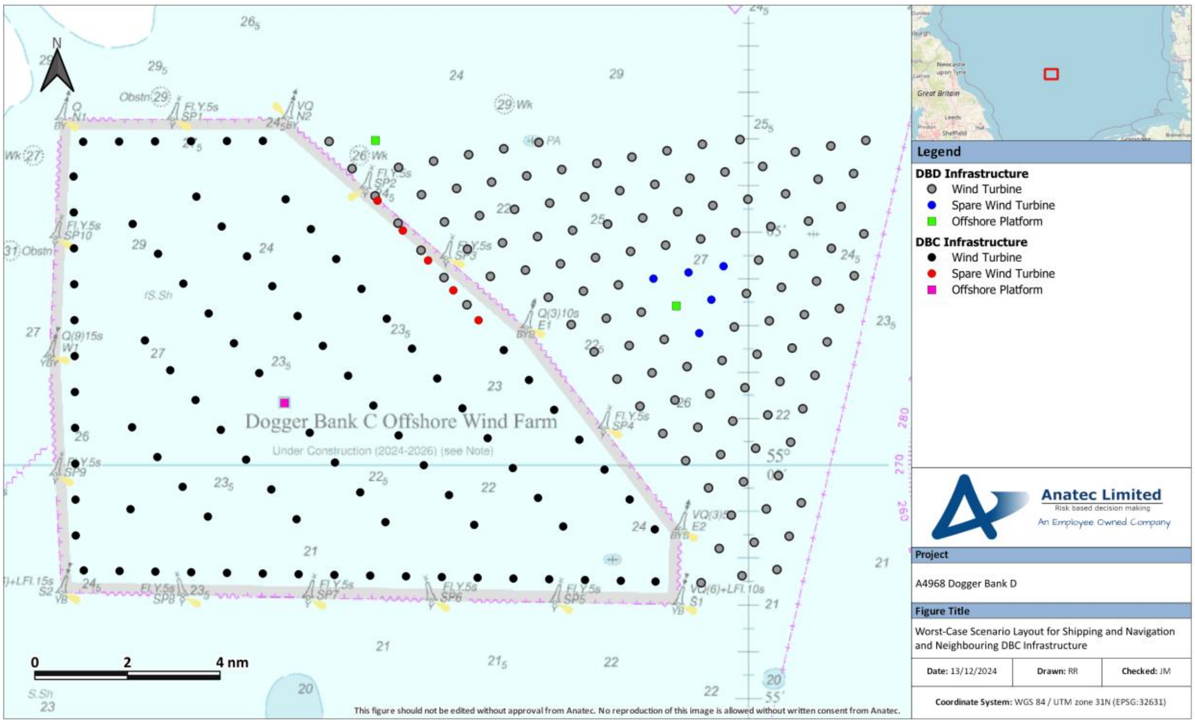


Figure 6-3 Worst-Case Scenario Layout for Shipping and Navigation and Neighbouring DBC Infrastructure

6.2.2 Wind Turbines

53. The wind turbines within the indicative worst-case layout each have a maximum rotor diameter of 337m, maximum blade tip height (above Highest Astronomical Tide (HAT)) of 370m, and a minimum air gap of 26.37m above Mean High Water Springs (MHWS), noting that these values represent a worst-case for Shipping and Navigation rather than the Project as a whole but fall within the scope of the PDS.

54. The worst-case scenario wind turbines measurements are provided in **Table 6-2**, noting that the values provided are specific to the worst-case selected for Shipping and Navigation and do not necessarily represent the maximum within the PDS overall.

Table 6-2 Worst-Case Scenario – Wind Turbines

Parameter	Worst-Case Scenario for Shipping and Navigation
Maximum blade tip height (above HAT)	370m
Minimum air gap (above (MHWS)	26.37m
Maximum rotor diameter	337m
Minimum spacing between turbines (centre to centre)	826m

6.2.3 Foundations

55. Fixed four-legged (piled or suction bucket) jacket foundations for each wind turbine has been considered within the worst-case scenario for Shipping and Navigation as this foundation type provides the maximum structure dimensions at sea surface level. The worst-case scenario for the wind turbine foundations is provided in **Table 6-3**.

56. It is noted that in addition to these foundations, monopiles are also being considered in the PDS. Descriptions of each foundation type under consideration is provided in **Volume 1, Chapter 4 Project Description**.

Table 6-3 Worst-Case Scenario – Wind Turbine Foundations

Parameter	Worst-Case Scenario for Shipping and Navigation
Foundation type	Four-legged jackets
Dimensions at sea surface	39×39m

6.2.4 Offshore Platform

57. Up to two High Voltage Direct Current (HVDC) Offshore Platforms will be installed within the Array Area.

58. The Offshore Platforms will be installed on fixed foundations of either monopiles, piled jackets, suction buckets, gravity based foundations, or via an Arup Concept Elevator (ACE) platform. The maximum topside dimensions for the Offshore Platform at the sea surface will be 60×75m.

6.3 Subsea Cables

59. Various types of sub-sea cables will be installed and can be categorised as follows: inter-array cables and offshore export cables. Each of these cable types are summarised in the following subsections.

6.3.1.1 Inter-Array Cables

60. The inter-array cables will connect individual wind turbines to the Offshore Platforms. Up to 216nm (400km) of inter-array cable will be required with the final length dependent on the final array layout. All inter-array cables will be situated within the Array Area.

61. Up to five cable crossings between DBD assets are being considered, inclusive of inter-array cables. There will be no pipeline crossings for the inter-array cables.

6.3.1.2 Offshore Export Cables

62. The offshore export cables will carry the energy generated from the wind turbines from the Array Area to landfall on the Yorkshire coast, north of Hornsea. Up to two HVDC offshore export cables are being considered, with a combined total length of 432nm (800km) (216nm per cable (400km)) and will be installed within the offshore ECC in up to two trenches.

63. If the offshore export cables are unbundled, the maximum spacing between each offshore export cable will be 1,000m. A maximum of 16 cable crossings are anticipated for the offshore export cables with three pipeline crossings also being considered.

6.3.1.3 Cable Burial

64. Where available, the primary means of cable protection will be by seabed burial. The extent and method by which the sub-sea cables will be buried will depend on the results of a detailed seabed survey of the final cables routes and associated cable burial risk assessment, but the most likely method will be a combination of jetting, ploughing, and trenching. The inter-array cables and offshore export cables will have a minimum burial depth of 0.2m, with this depth varying depending on the

conclusions of the cable burial risk assessment. However, a target burial depth of 3.5m is being considered.

65. Where cable burial is not possible, rock placement over exposed section of cables on the seabed may be necessary. As a worst-case, it is assumed 10% (22nm (40km)) of inter-array cables will require cable protection and 20% (86nm (160km)) of offshore export cables. The maximum height of any additional cable protection will be 1.5m for both the inter-array and offshore export cables and will be in the form of rock placement or mattressing.

66. Cable burial and protection is captured in the embedded mitigation measures (**Section 21**).

6.4 Construction Phase

67. The offshore construction phase will last for up to approximately five years. **Figure 6 - 4** outlines an indicative construction programme for the Project which indicates the maximum duration of construction for each element.

Figure 6-4 Indicative Construction Programme

6.5 Indicative Vessel and Helicopter Numbers

6.5.1 Construction Vessels

68. Up 7,527 return trips by up to 159 construction vessels may be made throughout the construction phase, however, a peak of 90 vessels on site at any given time is expected throughout the construction periods. A breakdown of vessel numbers is summarised in **Table 6-4**.

69. During the construction phase, ports up to 297nm (550 kilometres (km)) from the centre of the Array Area are being considered for construction bases. Components could also be transported directly from a fabrication site to the Project site.

Table 6-4 Maximum Vessel Numbers per Construction Activity

Construction Activity	Maximum Number of Vessels	Maximum Number of Return Trips
Site Preparation	18	243
Wind Turbine Foundation Installation	27	1,808
Transition Piece Installation	3	113
Wind Turbine Installation	20	1,695
Wind Turbine Commissioning	4	452
Offshore Platform Foundation Installation	12	60
Offshore Platform Topside Installation	24	48
Offshore Platform Commissioning	2	38
Scour, Cable Protection & Grout Installation	9	678
Inter-Array Cable Installation & Commissioning	13	1,884
Offshore Export Cable and Landfall Installation	23	376
Miscellaneous	4	132
Total	**159**	**7,527**

70. Additionally, 2,730 round trips by medium sized offshore transport helicopters are anticipated to be utilised during the construction phase. Any heliport on the east coast of England or Scotland, or the north coast of mainland Europe up to 1,000km from the centre of the Array Area will be considered.

6.5.2 Operation and Maintenance Phase

71. Up to 96 return trips per year by up to a peak of 16 O&M vessels at any one time may be made throughout a maximum 35-year operational lifetime O&M phase, breaking down as summarised in **Table 6-5**.

Table 6-5 Maximum Vessel Numbers per O&M Activity

O&M Activity	Maximum Number of Vessels	Maximum Number of Return Trips per Year
General O&M Service Operation Vessel (SOV)	3	39
General O&M Platform / Offshore Supply Vessels	1	12
Various Survey / Research*	2	7
Seabed Survey (Unmanned Vessels)*	6	12
Corrective Maintenance – Major Components	1	23
Corrective Maintenance – Foundations	1	4
Corrective Maintenance – Cables	3	2
Corrective Maintenance – Cable Protection	1	4
Total	**16**	**96**

* Alternative options with only one taken forward at a time and presence would never overlap.

72. During both the construction and O&M phases, logistics will be managed by a marine coordination team with an integrated Quality, Health, Safety and Environment (QHSE) management system in place to ensure control of all vessels and their respective works. The Project will be operational 24 / 7 / 365.

73. During the O&M phase, it is likely that the routine SOVs will be provisionally operated from Port of Tyne, where the existing Dogger Bank O&M Facility is located. If not feasible, a suitable location on the north-east of England will be selected. All other vessels are unlikely to be operated from the Port of Tyne and more so from ports in the North Sea basin, again up to 297nm (550km) from the centre of the Array Area.

74. The maximum number of major component replacement events for wind turbines and Offshore Platforms requiring jack-up operations over the lifetime of the Project is anticipated at seven per wind turbine and 10 per Offshore Platform. The maximum number of inter-array cable repairs over the lifetime of the Project is anticipated at 15 and at 35 for the offshore export cables. Both types of cable are anticipated to have a lifetime number of 35 cable reburial events.

75. Additionally, up to 24 round trips by helicopters during the O&M phase are possible. It is likely that the helicopter provision will be from Humberside, with the potential for Norwich airports to also be considered. This will be subject to review and progression.

6.5.3 Decommissioning Phase

76. The decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels. The decommissioning duration of the offshore infrastructure is anticipated to take 3.5 years, and it is assumed as a worst-case that all subsea cables would be left in situ. However, legislation at the time of decommissioning and the best environmental option would be considered at the time.

6.6 Worst-Case Scenario

77. The worst-case scenario for each Shipping and Navigation hazard is provided in **Table 6-6** and is based on the parameters described in the previous subsections.

Table 6-6 Worst-Case Scenario for Shipping and Navigation by Hazard

Potential Hazard	Phase(s)	Worst-Case Scenario for Shipping and Navigation	Justification
Vessel to vessel collision risk between a third-party vessel and a project vessel	Construction	■ Maximum extent of buoyed construction area; ■ Use of 500m construction Safety zones and 50m pre-commissioning Safety Zones; ■ Maximum of two offshore export cables with a combined length of 432nm (800km); ■ Peak of 90 construction vessels offshore; and ■ Single phase offshore construction of approximately five years.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel.
	O&M	■ Full buildout of Array Area; ■ Up to 113 fixed wind turbines; ■ Surface dimensions of fixed four-legged jacket foundations of up to 39×39m; ■ Up to two fixed Offshore Platforms; ■ Offshore Platform topside dimensions of up to 75×60m; ■ Up to 216nm (400km) of inter-array cables; ■ Use of 500m major maintenance Safety Zones; and ■ Operational life of 35 years.	
	Decommissioning	■ Maximum extent of buoyed decommissioning area; ■ Use of 500m decommissioning Safety Zones and 50m pre-commissioning Safety Zones; ■ Maximum of two offshore export cables with a combined length of 432nm (800km); ■ Peak of 90 decommissioning vessels offshore; and ■ Single phase offshore decommissioning of approximately three and a half years.	
Vessel to vessel collision risk between a third-party vessel and a project vessel	Construction	■ Maximum extent of buoyed construction area; ■ Use of 500m construction Safety Zones and 50m pre-commissioning Safety Zones; ■ Maximum of two offshore export cables with a combined length of 432nm (800km); ■ Peak of 90 construction vessels offshore; and ■ Single phase offshore construction of approximately five years.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum

Potential Hazard	Phase(s)	Worst-Case Scenario for Shipping and Navigation	Justification
	O&M	▪ Full buildout of Array Area; ▪ Use of 500m major maintenance Safety Zones; ▪ Peak of 16 maintenance vessels with up to 96 round trips per year; and ▪ Operational life of 35 years.	spatial and temporal effect on vessel to vessel collision risk involving a third-party vessel and a project vessel.
	Decommissioning	▪ Maximum extent of buoyed decommissioning area; ▪ Use of 500m decommissioning Safety Zones and 50m pre-commissioning Safety Zones; ▪ Maximum of two offshore export cables with a combined length of 432nm (800km); ▪ Peak of 90 decommissioning vessels offshore; and ▪ Single phase offshore decommissioning of approximately three and a half years.	
Vessel to structure allision risk for third-party vessels due to the presence of project structures (including powered, drifting and internal)	O&M	▪ Full build out of Array Area; ▪ Up to 113 fixed wind turbines; ▪ Surface dimensions of fixed four-legged jacket foundations of up to 39×39m; ▪ Up to two fixed Offshore Platforms; ▪ Offshore Platform topside dimensions of up to 75×60m; ▪ Indicative worst-case array layout as per **Figure 6-2**; ▪ Use of 500m major maintenance Safety Zones; ▪ Minimum spacing of 826m between wind turbines; ▪ Operational life of 35 years.	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk.
Reduction of under keel clearance as a result of cable protection or cable crossings	O&M	▪ Full buildout of Array Area; ▪ Up to 216nm (400km) of inter-array cables with a potential of five cable crossings considered; ▪ Maximum of two offshore export cables with a combined length of 432nm (800km) with a potential of 16 cable crossings and three pipeline crossings considered; ▪ Minimum burial depth of 0.2m for inter-array cables and offshore export cables;	Largest possible extent of sub-sea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on under keel clearance.

Potential Hazard	Phase(s)	Worst-Case Scenario for Shipping and Navigation	Justification
		▪ External protection where needed for up to 10% of inter-array cables and up to 20% for offshore export cables, with a height of up to 1.5m; and ▪ Operational life of 35 years.	
Vessel interaction with sub-sea cables	O&M	▪ Full buildout of Array Area; ▪ Up to 216nm (400km) of inter-array cables with a potential of five cable crossings considered; ▪ Maximum of two offshore export cables with a combined length of 432nm (800km) with a potential of 16 cable crossings and three pipeline crossings considered; ▪ Minimum burial depth of 0.2m for inter-array cables and offshore export cables; ▪ External protection where needed for up to 10% of inter-array cables and up to 20% for offshore export cables, with a height of up to 1.5m; and ▪ Operational life of 35 years.	Largest possible extent of sub-sea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on anchor interaction with sub-sea cables.
Reduction of emergency response capability due to increased incident rates and / or reduced access for SAR responders	O&M	▪ Full build out of Array Area; ▪ Up to 113 fixed wind turbines; ▪ Up to two fixed Offshore Platforms; ▪ Peak of 16 maintenance vessels with up to 96 round trips per year; and ▪ Operational life of 35 years.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability.

7 Navigational Features

78. An overview of navigational features within and in proximity to the Project is presented on **Figure 7-1**. Each of the features shown are discussed in the following subsections and have been identified using the most detailed UKHO Admiralty Charts available as well as information from *Admiralty Sailing Directions North Sea (West) Pilot NP54* (UKHO, 2021).

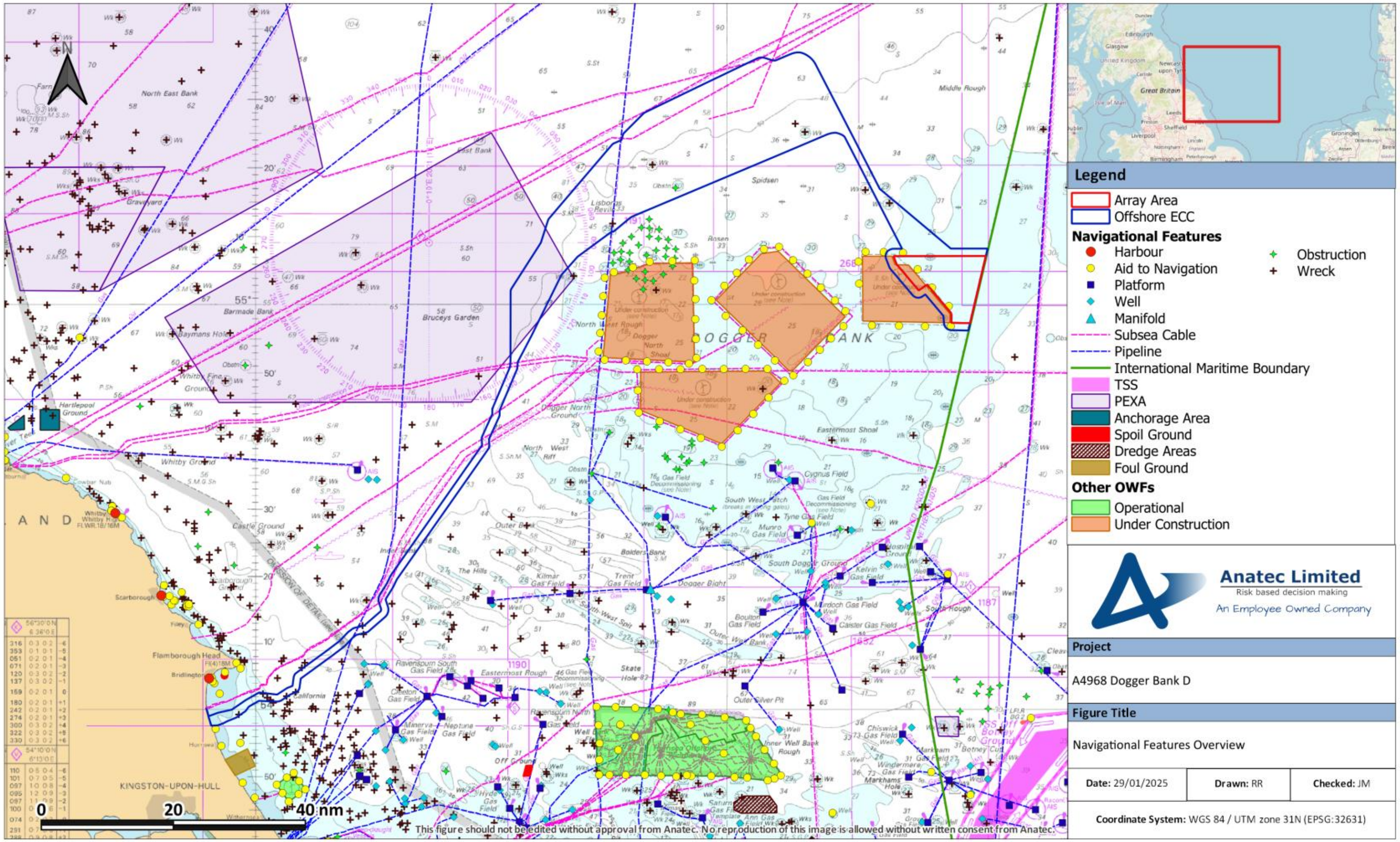


Figure 7-1 Navigational Features Overview

7.1 Other Offshore Wind Farm Developments

79. Other offshore wind farm developments in proximity to the Project are presented on **Figure 7-2**. Only developments deemed so be part of the baseline assessment (either under construction or already operational) are illustrated, with cumulative proposed developments assessed in **Section 13**.

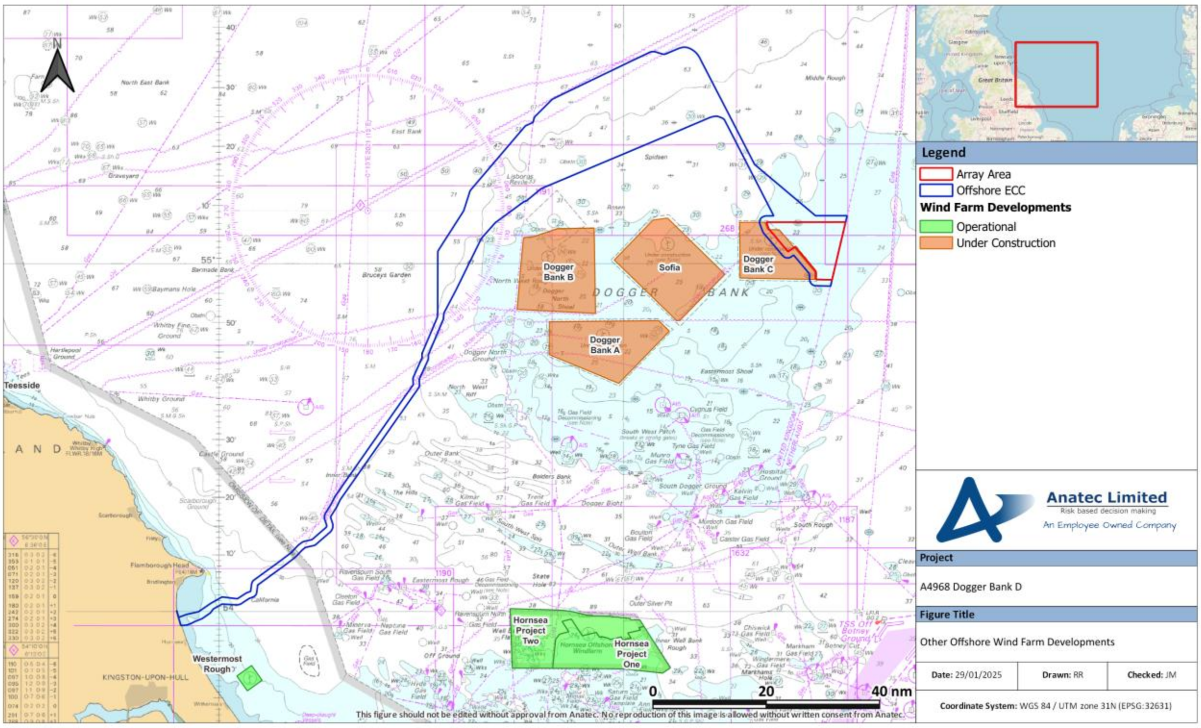


Figure 7-2 Other Offshore Wind Farm Developments

80. In terms of operational wind farm developments, Hornsea Project Two is the closest to the Array Area at approximately 66nm (122km) south-west. Hornsea Project Two became operational as of August 2022 while the neighbouring Hornsea Project One has been operational since early 2020. Westermost Rough is located approximately 11nm (20km) south of the offshore ECC, close to the landfall location, and became operational in May 2015.

81. Although not operational, at the time of writing, Dogger Bank A (DBA), Dogger Bank B (DBB), DBC and Sofia are all under construction and so part of the surrounding baseline environment.

7.2 Aids to Navigation

82. Currently, the closest aid to navigation (AtoN) to the Array Area is the construction buoyage for DBC including three buoys located within the Array Area and two on the perimeter, each of which is within the offshore ECC also. This construction buoyage will be removed following the completion of installation activities for DBC.

83. The closest AtoN to the offshore ECC is located approximately 0.5nm (0.9km) to the south near the landfall location and is located at the 5m contour line, close to the end of a coastal outflow pipeline.

84. Apart from the construction buoyage associated with DBC, no AtoNs are located within the Array Area or offshore ECC.

7.3 Oil and Gas Infrastructure

85. Oil and gas infrastructure is present within the surrounding sea area, especially to the south, with many surface piercing platforms as well as wells, manifolds, and associated pipelines. There are several platforms located to the east of the Array Area located in Dutch waters, with the closest to the Array Area approximately 25nm (46km). The closest platform to the Array Area within the UK EEZ is the active Cygnus Alpha within the Cygnus gas field, located approximately 33nm (61km) to the south-west.

86. No oil and gas infrastructure are located within the Array Area or within the offshore ECC.

7.4 Subsea Cables and Pipeline

87. Several offshore pipelines and sub-sea cables are present within the vicinity of the Project with several existing intersecting the offshore ECC. Eight sub-sea cables including those offshore export cables under construction for DBA, DBB and Sofia, the VSLN Northern Europe interconnector telecommunications cable between Hunmanby Bay (UK) and Eemshaven (the Netherlands), the Pangea cable system linking Redcar (UK) and Fanø (Denmark), and part of the Havhingsten cable route between Seaton Sleuice (UK) and Houstrup (Denmark).

88. Two pipelines intersect the offshore ECC and are the Langeled (Britpipe) pipeline connecting Norway to the UK making landfall in Easington (UK) and the Shearwater Elgin Area Line (SEAL) pipeline between oil and gas fields in the Northern North Sea and the Bacton Gas Terminal on the Norfolk (UK) coast.

89. No subsea cables or pipelines intersect the Array Area.

7.5 International Maritime Boundary

90. Running parallel in close proximity to the eastern boundary of the Array Area is the International Maritime Boundary between the UK and the Netherlands. This border separates the North Sea into UK and Dutch international waters and delineates the edge of the UK EEZ / REZ.

7.6 Other Navigational Features

91. The closest harbour to the Project is Bridlington Harbour, located approximately 5nm (9km) north of the offshore ECC, near landfall, and approximately 117nm (217km) south-west of the Array Area. The closest large-scale commercial ports are the Humber ports located approximately 30nm (56km) south of the offshore ECC.

92. A spoil ground is located to the east of Bridlington Harbour and approximately 4nm (7km) north of the offshore ECC. A foul ground is located on the Hornsea coastline, approximately 5nm (9km) south of the offshore ECC.

93. There are no IMO routeing measures in proximity to the Project with the closest to the Array Area being the Off Botney Ground Traffic Separation Scheme (TSS) approximately 60nm (111km) to the south.

94. The closest charted anchorage area to the Project is approximately 25nm (46km) south of the offshore ECC and is the Humber Deep Water (DW) Anchorage (not illustrated in the extent of **Figure 7-1**).

95. No charted wrecks or obstructions which pose a safety to navigation are located within the Array Area with 11 such wrecks and one obstruction located within the offshore ECC. Additional wrecks which are not considered a danger to safe navigation, are considered in **Volume 1, Chapter 17 Offshore Archaeology and Cultural Heritage**.

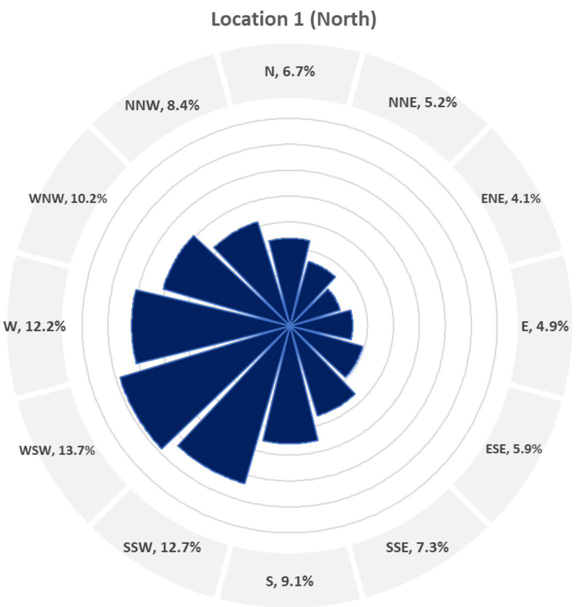
96. The closest charted military practice and exercise area (PEXA) is located approximately 46nm (85km) to the west of the Array Area, this PEXA is the D412 Saxton Firing Practice Area and overlaps the offshore ECC to the west of DBB. As noted on the UKHO Admiralty Charts, there are no restrictions in place on the right to transit within the firing practice areas at any given time. These areas are operated using a clear range procedure with operations only taking place when the areas are considered clear of all shipping.

8 Meteorological Ocean Data

8.1 Wind Distribution

97. Based on wind direction data from two locations in the region, provided by HSE, the distribution of wind direction data within each 30-degree interval is presented on **Figure 8-1**, in the form of a wind rose.

98. Location 1 was situated approximately 31nm (57km) to the north-west of the Array Area, located within the most northernly area of the offshore ECC. Location 2 was situated approximately 35nm (65km) south-west of the Array Area near the Tyne Gas Field.



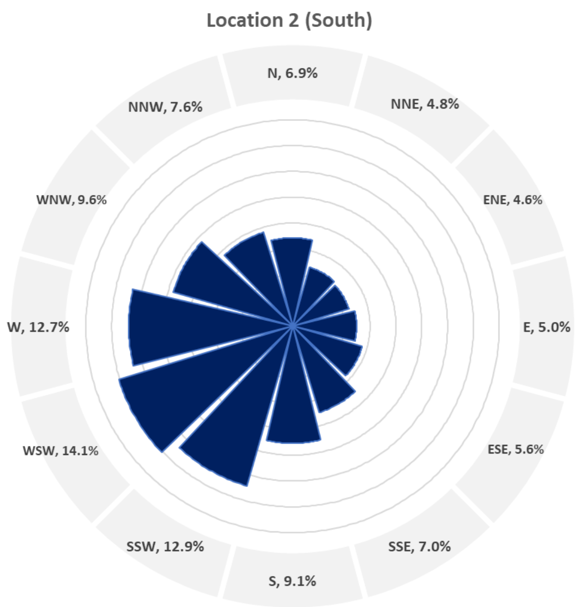


Figure 8-1 Wind Direction Distribution in Proximity to the Array Area

99. Winds are predominantly from the west-south-west (13.7% and 14.1% for locations 1 and 2, respectively). Winds from westerly through southerly directions accounted for nearly half of the total wind distribution in both locations; 48% for Location 1 and 49% for Location 2.

8.2 Significant Wave Height

100. Significant wave height data was provided by HSE from the same two locations introduced for the wind direction data in **Section 8.1**. **Table 8-1** presents the proportion of the significant wave height within each of three defined ranges which are categorised as calm, moderate and severe sea states.

Table 8-1 Sea State Distribution in Proximity to Array Area

Sea State	Proportion (%)	
	Location 1 (North)	Location 2 (South)
Calm (Less than 1m)	25	36
Moderate (1m to 5m)	73	64
Severe (More than or equal to 5m)	2	0

8.3 Visibility

101. The annual average incidence of poor visibility (defined as the proportion of a year where the visibility can be expected to be less than 1km) is 2%. This is based upon information available within the UKHO Admiralty Sailing Directions North Sea (West) Pilot, NP54 12th Edition (UKHO, 2021).

8.4 Tidal Speed and Direction

102. **Table 8-2** presents the peak flood and ebb direction and speed values obtained from UKHO Admiralty Charts local to the Array Area. The tidal diamond detailed in **Table 8-2** is located approximately 2.8nm (5km) north of the Array Area.

Table 8-2 Peak Flood and Ebb Speed and Direction Data

UKHO Admiralty Chart	Tidal Diamond	Flood		Ebb	
		Direction (°)	Speed (knot)	Direction (°)	Speed (knot)
266	K	083	0.6	255	0.7

103. Based upon the available data, no impacts are expected at high water that would not also be expected at low water, and vice versa. The wind farm structures are not expected to have any additional impact on the existing tidal streams in relation to their effect on existing Shipping and Navigation users.

9 Emergency Response and Incident Overview

104. This section summarises the existing emergency response resources (including SAR) and reviews historical maritime incident data to assess baseline incident rates in proximity to the Project.

9.1 Search and Rescue Helicopters

105. In July 2022, the Bristow Group were awarded a new ten-year contract by the MCA (as an executive agency of the DfT) beginning in September 2024 to provide helicopter SAR operations in the UK. Bristow have been operating the service since April 2015.

106. The SAR helicopter service is currently operated out of ten base locations around the UK, with the closest to the Project, Humberside, located approximately 142nm (263km) to the south-west of the Array Area. This base operates two Sikorsky S92 helicopters.

107. The DfT has produced data on civilian SAR helicopter activity in the UK by the Bristow Group on behalf of the MCA between April 2015 and March 2024.

108. No SAR helicopter taskings have occurred within the Array Area or surrounding Study Area. The locations of SAR helicopter taskings within the offshore ECC Study Area are presented on **Figure 9-1**, colour-coded by tasking type.

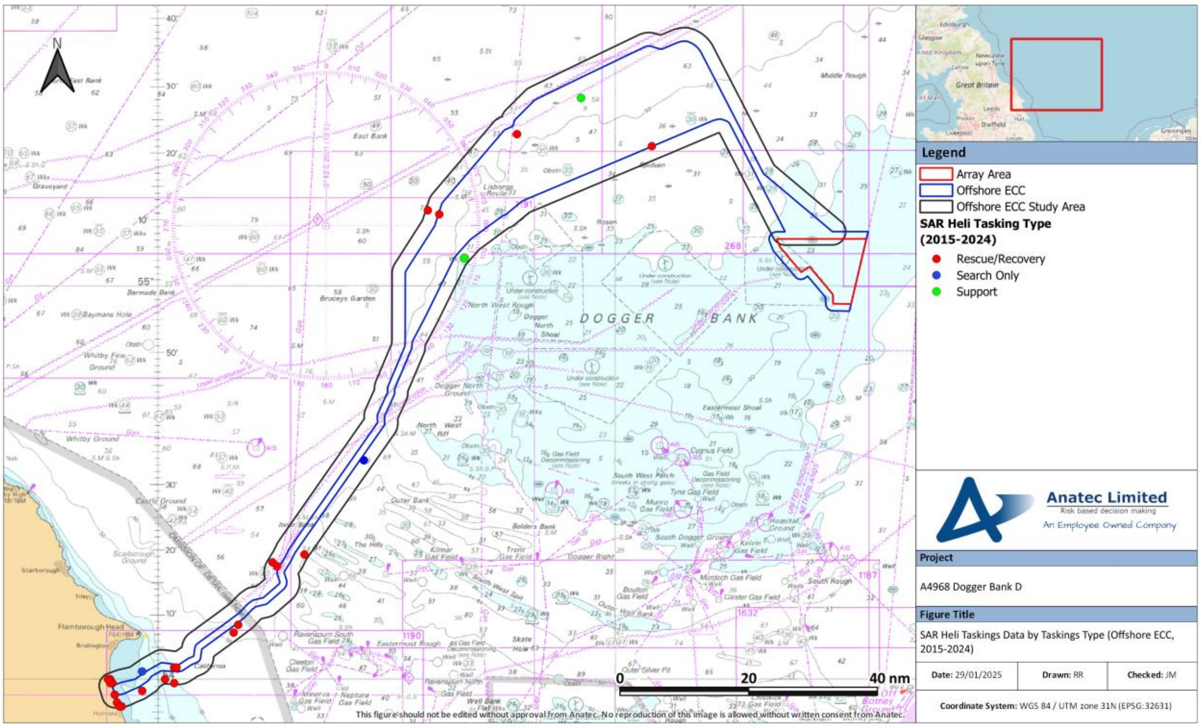


Figure 9-1 SAR Heli Tasking Data by Tasking Type (Offshore ECC, 2015-2024)

109. Over the nine-year period, a total of 28 helicopter taskings were recorded within the offshore ECC Study Area, equating to an average of three incidents per year. Of the incidents recorded within the offshore ECC Study Area, 78% were '*Rescue / Recovery*'. Both '*Search Only*' and '*Support*' accounted for 11% each. Only 21% of these recorded incidents occurred within the offshore ECC itself.

110. A total of 57% of these incidents were within 10nm (19km) of the coast with 75% being within 30nm (56km) of the coast.

111. All incidents were responded to by the Humberside base.

9.2 Royal National Lifeboat Institution

112. The RNLI is organised into six divisions, with the relevant region for the Project being the 'North and East' division. Based out of more than 230 stations, there are over 400 active lifeboats across the RNLI fleet, including both All-Weather Lifeboats (ALB) and Inshore Lifeboats (ILB). There are a number of RNLI stations in proximity to the Project, as illustrated on **Figure 9-2**.

113. The closest RNLI station to the Array Area is Flamborough (151nm (280km) south-west of the Array Area) where an ILB is in use. Flamborough RNLI station is located less than 6nm (11km) to the north of the offshore ECC, with the Bridlington station also at the same distance north.

114. Given that the RNLI have an operational limit of 100nm (185km), it is anticipated that an incident occurring in proximity to the Array Area would be unlikely to result in a response from an RNLI asset which is reflected within the data as no incidents were recorded between 2014 and 2023 within the Array Area or surrounding Study Area.

115. The incidents recorded within the RNLI dataset between 2014 and 2023 occurring within the offshore ECC Study Area are presented on **Figure 9-2**, colour-coded by incident type. Following this, **Figure 9-3** shows the same data colour-coded by casualty type.

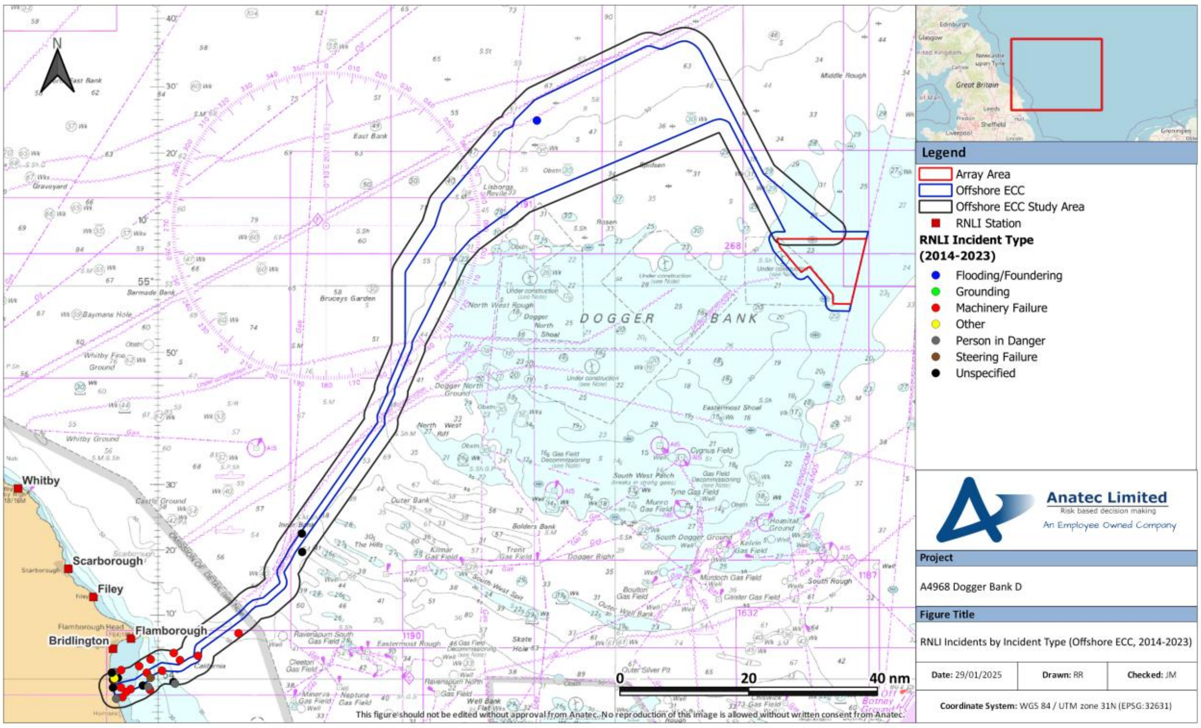


Figure 9-2 RNLI Stations and Incidents by Incident Type (Offshore ECC, 2014-2023)

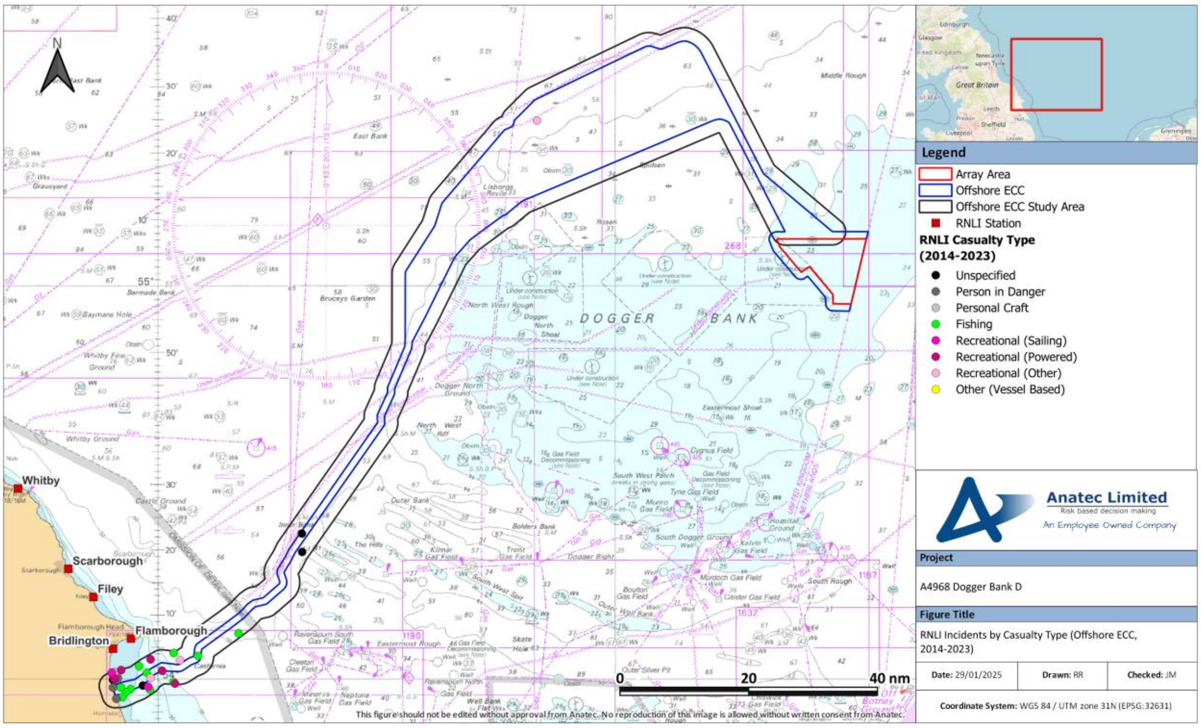


Figure 9-3 RNLI Stations and Incidents by Casualty Type (Offshore ECC, 2014-2023)

116. There were six hoaxes or false alarms recorded within the offshore ECC Study Area during the 10-year period. Excluding these cases, a total of 34 RNLI lifeboat responses

to 34 unique incidents were recorded within the offshore ECC Study Area during the 10-year period, equating to three to four unique incidents per year. Of these incidents, the most common incident type recorded was '*Machinery Failure*' (44%). '*Unspecified*' (26%) and '*Person in Danger'* (18%) incidents were also commonly recorded. A total of 26% of these incidents occurred within the offshore ECC itself, or one incident per year.

117. As for casualty types, fishing vessels (32%) and powered recreational vessels (18%) were the most commonly recorded. With '*Unspecified*' (15%) and '*Person in Danger'* (12%) also recorded.

118. A total of 88% of all RNLI incidents were recorded within 10nm (19km) of the coast, with only one incident exceeding 30nm (56km) offshore. This incident was recorded 95nm (176km) offshore and was a recreational angling vessel which had taken on water.

119. Bridlington RNLI station responded to 88% of all incidents, with Flamborough only 6%. Both Tynemouth and Scarborough also responded to one incident each.

120. A review of older RNLI incident data spanning a six-year period between 2008 and 2013 was also analysed and indicated that the number of incidents has decreased, with 38 unique incidents recorded in the previous six-year period within the offshore ECC Study Area, corresponding to an average of six to seven incidents per year. Of the recorded incidents, Bridlington responded to 89% of the incidents. The most common incident type was '*Machinery Failure*' (56%) and the most common casualty type was powered recreational vessels (38%). Again, within this dataset, no incidents were recorded within the Array Area or surrounding Study Area.

9.3 Maritime Rescue Coordination Centres and Joint Rescue Coordination Centres

121. His Majesty's Coastguard (HMCG), a division of the MCA, is responsible for requesting and tasking SAR resources made available to other authorities and for coordinating the subsequent SAR operations (unless they fall within military jurisdiction).

122. The HMCG coordinates SAR operations through a network of 11 Maritime Rescue Coordination Centres (MRCC), including a Joint Rescue Coordination Centre (JRCC) based in Hampshire.

123. All of the MCA's operations, including SAR, are divided into 18 geographical regions. Area 6 – '*East of England (Yorkshire, Humberside & Lincolnshire)*' – covers the east coast of England between Yorkshire and The Wash and therefore covers the area encompassing the Offshore Development Area. The Humber MRCC is located within Area 6 approximately 118nm (219km) south-west of the Array Area, as illustrated on **Figure 9-4**, and coordinates the SAR response for maritime and coastal emergencies within the district boundary.

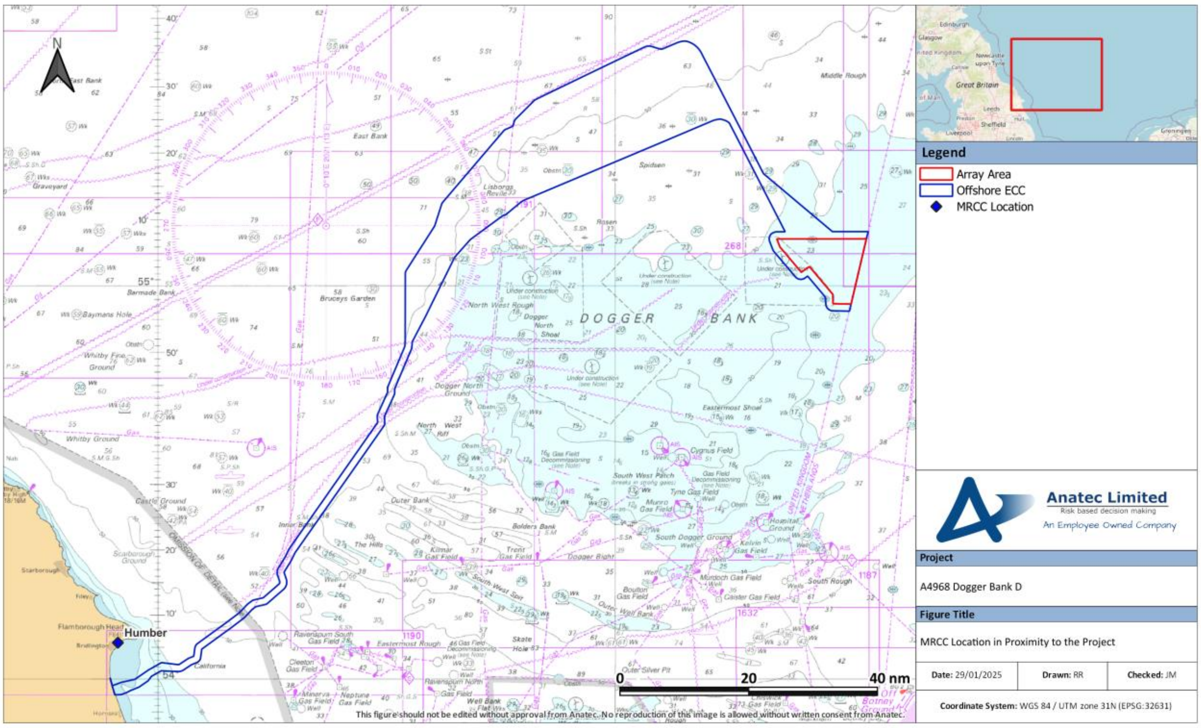


Figure 9-4 MRCC Location in Proximity to the Project

9.4 Global Maritime Distress and Safety System

124. The Global Maritime Distress and Safety System (GMDSS) is a maritime communications system used for emergency and distress messages, vessel to vessel routeing communications and vessel to shore routine communications. It is implemented globally, and vessels engaged in international voyages are obliged to carry GMDSS certified communication equipment.

125. There are four GMDSS sea areas, with the areas applicable in proximity to the UK shown on **Figure 9-5**. Vessels in proximity to the Array Area would be located within sea area A2.

126. In the event of an emergency involving a vessel located further offshore within sea area A2, vessels are able to contact coastal stations using High Frequency (HF) or Medium Frequency (MF) radio or otherwise contact other offshore resources.

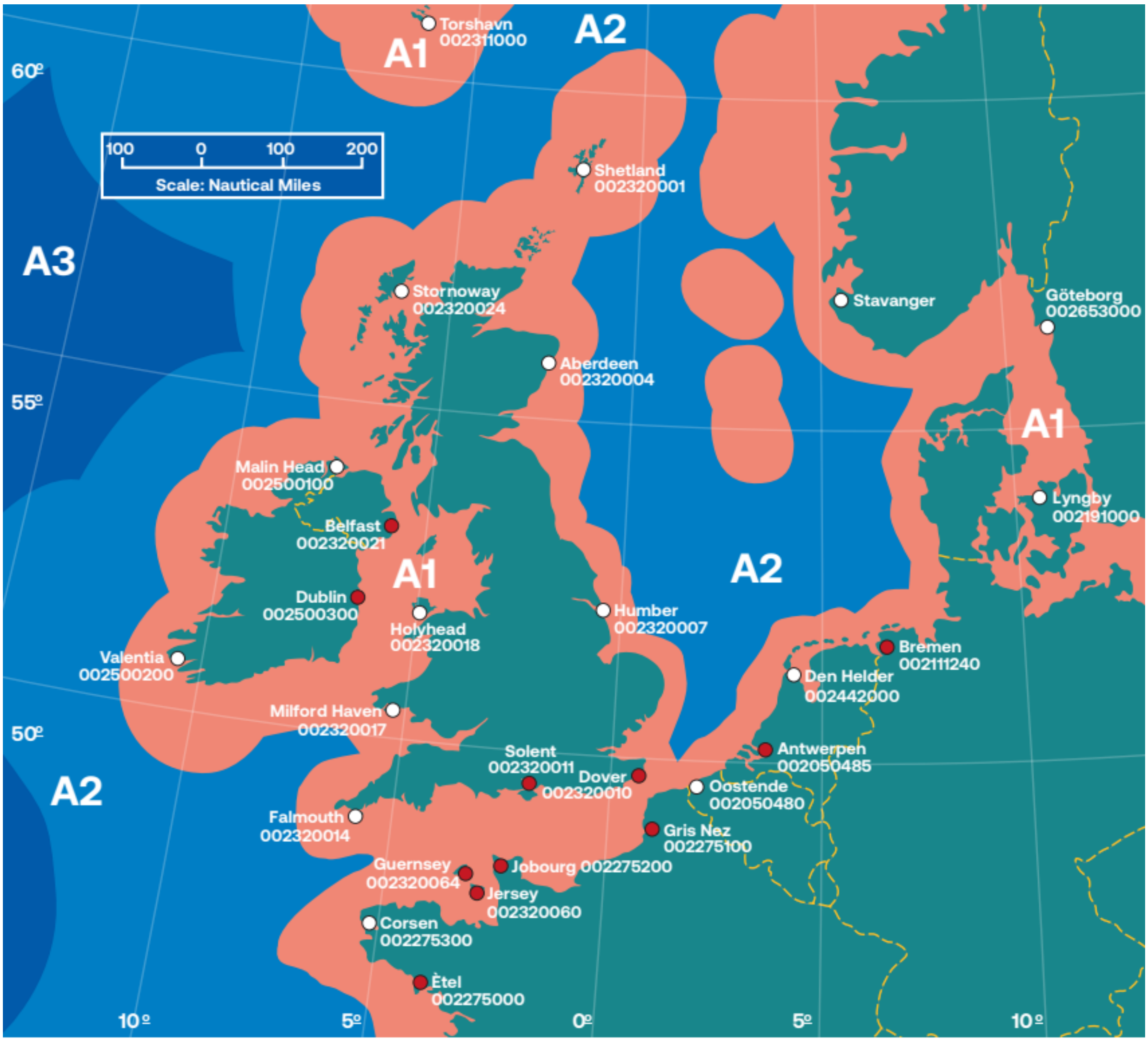


Figure 9-5 GMDSS Sea Areas (MCA, 2021).

9.5 Marine Accident Investigation Branch

127. All UK flagged vessels and non-UK flagged vessels in UK territorial waters (12nm (22km)), a UK port or carrying passengers to a UK port are required to report incidents to the MAIB. Data arising from these reports are assessed within this section, primarily covering the ten-year period between 2013 and 2022.

128. The incidents recorded within the MAIB dataset between 2013 and 2022 occurring within the combined Study Areas are presented on **Figure 9-6**, colour-coded by incident type. Following this, **Figure 9-7** shows the same data colour-coded by the type of vessel(s) involved in each incident.

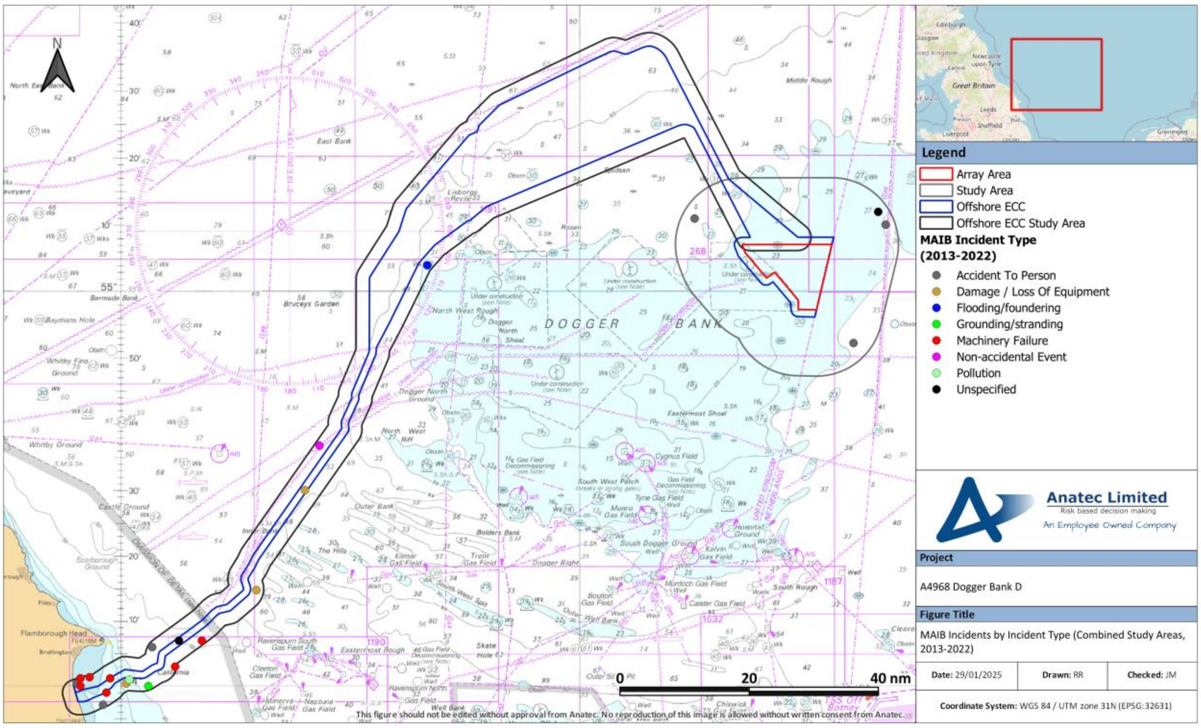


Figure 9-6 MAIB Incident Data by Incident Type (Combined Study Areas, 2013-2022)

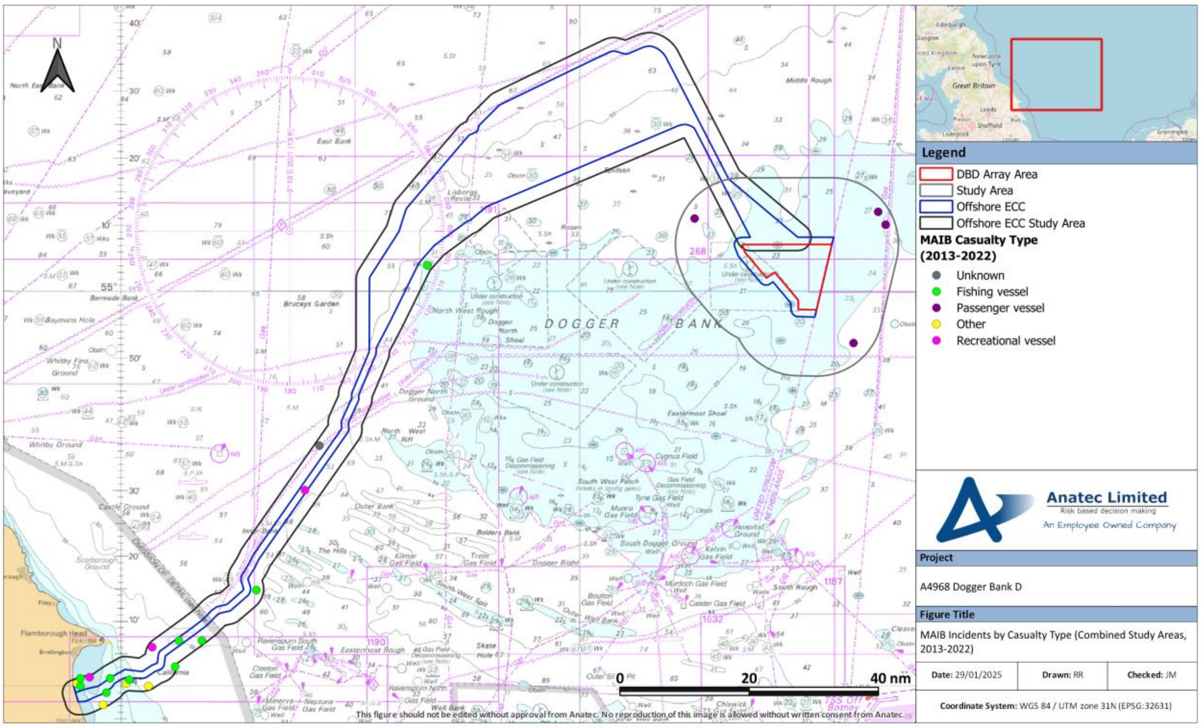


Figure 9-7 MAIB Incident Data by Casualty Type (Combined Study Areas, 2013-2022)

129. A total of four incidents were reported to the MAIB across the 10-year period within the Study Area, equivalent to one incident every two to three years. No incidents

were reported within the Array Area. These four incidents all consisted of passenger vessels with three incidents being an '*Accident to Person'* and one was '*Unspecified'*. The three '*Accident to Person'* incidents occurred in 2018 and were all reported from cruise liners. Two reported an injury to a passenger while another reported an injury to a crew member.

130. Within the offshore ECC Study Area, a total of 18 incidents were reported across the 10-year period, equivalent to two incidents per year, with only three of these incidents occurring within the offshore ECC itself (17%). The main incident type recorded was '*Machinery Failure*' (39%), with *'Accident to Person'* and '*Damage / Loss of Equipment'* (accounting for 17% each) also recorded. As for casualty type, fishing vessels accounted for 56%. '*Other´* vessels (22%) and recreational vessels (17%) were also recorded.

131. A review of older MAIB incident data across a 10-year period between 2003 and 2012 was also analysed and indicated that that the number of incidents has increased within the Study Area as no incidents were recorded during this 10-year period within the Array Area or surrounding Study Area. Incidents have slightly reduced with 22 unique incidents being recorded within the offshore ECC Study Area across this 10-year period. The main incident types recorded were '*Machinery Failure'* (41%) and *'Hazardous Incident'* (36%). As for casualty type, fishing vessels were the most common (59%).

9.6 Historical Offshore Wind Farm Incidents

9.6.1 Incidents Involving UK Offshore wind farm Developments

132. As of December 2024, there are 42 operational offshore wind farms in the UK, ranging from the North Hoyle offshore wind farm (fully commissioned in 2003) to the Hornsea Project Two offshore wind farm (fully commissioned in 2022). Between them these developments encompass approximately 24,724 fully operational wind turbine years.

133. MAIB incident data has been used to collate a list of reported historical collision and allision incidents involving UK offshore wind farm developments[2], which is summarised in **Table 9-1**. Other sources have also been used to produce this list including the UK Confidential Human Factors Incident Reporting Programme (CHIRP) for Aviation and Maritime, International Marine Contractors Association (IMCA) and basic web searches.

[2] Includes only incidents reported to an accident investigation branch or an anonymous reporting service.

Table 9-1 Summary of Historical Collision and Allision Incidents Involving UK Offshore Wind Farm Developments

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Allision	7 August 2005	Wind turbine installation vessel allision with wind turbine base whilst manoeuvring alongside it. Minor damage sustained to a gangway on the vessel, the wind turbine tower and a wind turbine blade.	Minor damage to gangway on the vessel	None	MAIB
Project	Allision	29 September 2006	Offshore services vessel allision with rotating wind turbine blade.	None	None	MAIB
Project	Allision	8 February 2010	Work boat allision with disused pile following human error with throttle controls whilst in proximity. Passenger later diagnosed with injuries and no serious damage sustained by vessel.	Minor	Injury	MAIB
Project / third-party	Collision	23 April 2011	Third-party catamaran collision with project guard vessel within harbour.	Moderate	None	MAIB
Project	Allision	18 November 2011	Cable-laying vessel allision with wind turbine foundation following watchkeeping failure. Two hull breaches to vessel.	Major	None	MAIB
Project / project	Collision	2 June 2012	Crew Transfer Vessel (CTV) allision with flotel. Nine persons safely evacuated and transferred to nearby vessel before being brought back into port.	Moderate	None	UK CHIRP

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Allision	20 October 2012	Project vessel allision with wind turbine monopile following human error (misjudgement of distance). Minor damage sustained by vessel.	Minor	None	MAIB
Project	Allision	21 November 2012	Passenger transfer catamaran allision with buoy following navigational error. Vessel abandoned by crew of 12 having been holed, causing extensive flooding but no injuries sustained.	Major	None	MAIB
Project	Allision	21 November 2012	Work boat allision with unlit wind turbine transition piece at moderate speed following navigational error. Vessel able to proceed to port unassisted with no water ingress but some structural damage sustained.	Moderate	None	MAIB
Project	Allision	1 July 2013	Service vessel allision with wind turbine foundation following machinery failure. Minor damage sustained by vessel.	Minor	None	IMCA Safety Flash
Project	Allision	14 August 2014	Standby safety vessel allision with wind turbine pile. Oil leaked by vessel which moved away from environmentally sensitive areas until leak was stopped.	Minor with pollution	None	UK CHIRP
Third-party	Allision	26 May 2016	Third-party fishing vessel allision with wind turbine following human error (autopilot). Lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Allision	14 February 2019	Survey vessels rubbing stake made contact with a wind turbine jacket while autopilot was engaged.	Minor	None	MAIB
Project	Allision	17 January 2020	Project vessel allision with wind turbine. Injury sustained by crew member but vessel able to proceed to port unassisted.	None	Injury	Web search (Vessel Tracker, 2020)
Project	Allision	27 January 2020	Project vessel allision with wind turbine. Minor damage to vessel and wind turbine sustained, with no personal injuries.	Minor	None	Marine Safety Forum
Project	Allision	February 2021	The deckhand engineer fell asleep whilst supposed to be on watch, resulting in a CTV making contact with a wind turbine at low speed.	None	None	MAIB
Project	Allision	12 April 2021	An allision occurred with a wind turbine resulting in a passenger suffering a chest injury and was attended to by paramedics upon the vessel's return to port.	None	Injury	MAIB
Project	Allision	May 2021	A CTV was drifting towards the wind turbine it was tied off to. The Master started the engines but was with insufficient time to avoid contact. Upon returning to port the vessel began listing due to substantial water ingress.	Moderate	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Third-party	Allision	9 June 2022	Fishing vessel allision with wind turbine resulting in damage to vessel and two minor injuries for crew members. RNLI lifeboat escorted vessel under its own power to port.	Minor	Injury	Web search (RNLI, 2022)
Project	Allision	October 2022	A project vessel allided with the boat landing for a wind turbine causing a deformation to the port side midship area.	Minor	None	MAIB
Project	Allision	November 2022	A high speed craft allided with a wind turbine whilst the vessel propulsion was in neutral resulting in damage to the starboard jet platform and bucket.	Minor	None	MAIB
Project	Allision	19 September 2024	SOV allided with a wind turbine in daylight conditions. The contact caused damage to vessel above the waterline and the helideck. There was also some damage to the base of the turbine.	Minor	None	Web search (Maritime Executive, 2024)

* As per incident reports.

134. The worst consequences reported for vessels involved in a collision or allision incident involving a UK offshore wind farm development has been flooding, with no life-threatening injuries to persons reported.

135. As of December 2024, there have been no third-party collisions directly as a result of the presence of an offshore wind farm in the UK. The only reported collision incident in relation to a UK offshore wind farm involved a project vessel hitting a third-party vessel whilst in harbour.

136. As of December 2024, there have been 19 reported cases of an allision between a vessel and a wind turbine (under construction, operational or disused) in the UK, with all but two involving a support vessel for the development and the errant vessel in each case under power rather than drifting. Therefore, there has been an average of 1,310 years per wind turbine allision incident in the UK, noting that this is a conservative calculation given that only operational wind turbine hours have been included (whereas allision incidents counted include non-operational wind turbines).

9.6.2 Incidents Involving Non-UK Offshore Wind Farms

137. There have also been collision and allision incidents involving non-UK offshore wind farm developments. However, it is impractical to maintain a comprehensive list of such incidents and the associated operational hours.

138. One high profile non-UK incident of relevance involved a bulk carrier in January 2022 which broke its anchor chain during a storm in Dutch waters and collided with a nearby anchored vessel. The vessel began to take on water, leading to all crew members being evacuated by helicopter. The vessel then continued to drift towards shore including through an under construction offshore wind farm where it allided with a wind turbine foundation and a platform foundation before being taken under tow (Marine Safety Investigation Unit, 2024).

139. Another non-UK incident involved a general cargo vessel which collided with a wind turbine at the Gode Wind 1 in the German North Sea in April 2023. No injuries were reported and the vessel was able to return to port with damage to its starboard side resulting in water ingress. The affected wind turbine was taken out of service for around 24 hours (Offshore WIND, 2023).

9.6.3 Incidents Responded to by Vessels Associated with UK Offshore Wind Farms

140. Although the presence of offshore wind farms and associated activities does increase the likelihood of an incident requiring emergency response it is also acknowledged that the presence of project vessels can aid with emergency response efforts, particularly for offshore wind farms located further offshore where a project vessel is more likely to be able to serve as the first responder to an incident.

141. From news reports, web searches and experience working with existing offshore wind farm developments, a list has been collated of historical incidents responded to by vessels associated with UK offshore wind farm developments, which is summarised in **Table 9-2**. The initial cause of these incidents is not related to the offshore wind farm in question.

142. Additional incidents associated with the construction or operation of offshore wind farms are also known to have occurred. These incidents typically involve an accident to person which requires medical attention (including emergency response) but does not affect the operation of the vessel involved. It is noted that these incidents do increase the workload on SAR resources.

Table 9-2 Historical Incidents Responded to By Vessels Associated with UK Offshore Wind Farm Developments

Incident Type	Date	Related Development	Description of Incident	Source
Capsize	21 June 2018	Walney	HM Coastguard issued mayday relay broadcast following trimaran capsize. Support vessel for Walney arrived and recovered two persons from the water who were then winched onboard a Coastguard helicopter.	Web search (4C Offshore, 2018)
Capsize	5 November 2018	Race Bank	Fishing vessel capsized resulting in two persons in the water. Vessel operating at the nearby Race Bank reported to have assisted with the rescue which also involved a Belgian military helicopter and the RNLI.	Web search (British Broadcasting Corporation (BBC), 2018)
Vessel in distress	15 May 2019	London Array	Yacht in difficulty sought shelter by tying up to a wind turbine but suffered damage and a person in the water. Support vessel for London Array identified and secured the casualty vessel and recovered the person in the water. The support vessel raised the alarm to the Coastguard. The Coastguard later instructed the support vessel to return to port and seek medical assistance for the casualty vessel's occupant.	Web search (The Isle of Thanet News, 2019)
Drifting	7 July 2019	Gwynt y Môr	Speedboat suffered mechanical failure stranding four persons. Support vessel for Gwynt y Môr responded to an 'all-ships' broadcast from the Coastguard and prevented the casualty vessel drifting into the Gwynt y Môr array. The support vessel later towed the casualty vessel back towards port.	Web search (Renews, 2019)

Incident Type	Date	Related Development	Description of Incident	Source
Machinery failure	28 September 2019	Race Bank	Fishing vessel suffered mechanical failure and launched flares. Guard vessel and SOV for Race Bank both immediately offered assistance until the MCA's arrival on-scene.	Internal daily progress report received by Anatec
Vessel in distress	13 December 2019	Race Bank	Passing vessel got into difficulty and guard vessel for Race Bank was requested to assist. The Coastguard later requested that the guard vessel tow the casualty vessel into port.	Internal daily progress report received by Anatec
Search	21 May 2020	Walney	Coastguard contacted guard vessel for Walney reporting red flare sighting at the wind farm. Guard vessel proceeded to undertake search but did not find anything to report.	Internal daily progress report received by Anatec
Aircraft crash	15 June 2020	Hornsea Project One	United States jet crashed into sea during routine flight. CTVs and SOVs for Hornsea Project One joined the search for the missing pilot.	Web search (4C Offshore, 2020)
Fire / explosion	15 December 2020	Dudgeon	Fishing vessel experienced explosions on board with crew injured. SOV for Dudgeon deployed its Fast Rescue Boat and evacuated the casualty vessel.	Web search (Offshore WIND, 2020)
Person in danger	10 July 2021	Unknown (East Irish Sea)	Two swimmers were in difficulty against a rising tide near to Talacre beach. A RNLI lifeboat was launched but a commercial wind farm vessel recovered the swimmers from the water. They were then transferred to the lifeboat.	Web search (RNLI, 2021)
Drifting	17 July 2021	Neart na Gaoithe	Small dinghy with two children aboard drifted offshore due to strong winds. A guard vessel associated with Neart na Gaoithe was able to retrieve the children.	Web search (Edinburgh Evening News, 2021)
Vessel in distress	1 September 2022	Rampion	A recreational motorboat experienced power failure and anchored near Rampion. The anchor could then not be recovered and Coastguard assistance was requested. A CTV for Rampion responded and towed the vessel back to port.	MAIB
Machinery Failure	1 December 2022	Unknown	A survey vessel suffered an engine failure and was towed back to port by a wind farm RIB.	MAIB

10 Vessel Traffic Movements

10.1 Dogger Bank D Array Area

143. This section presents an overview of vessel traffic movements within the Study Area, primarily based upon the findings of the summer vessel traffic survey undertaken in July / August 2023 as well as supplementary Vissim data provided by the Applicant (**Section 5.2**). AIS vessel traffic recorded within the offshore ECC Study Area is analysed separately in **Section 10.2**.

144. A plot of the vessel tracks recorded during the 14-day summer survey period within the Study Area, colour-coded by vessel type and excluding temporary traffic, is presented on **Figure 10-1**. Following this, **Figure 10-2** presents the same data converted to a density heat map.

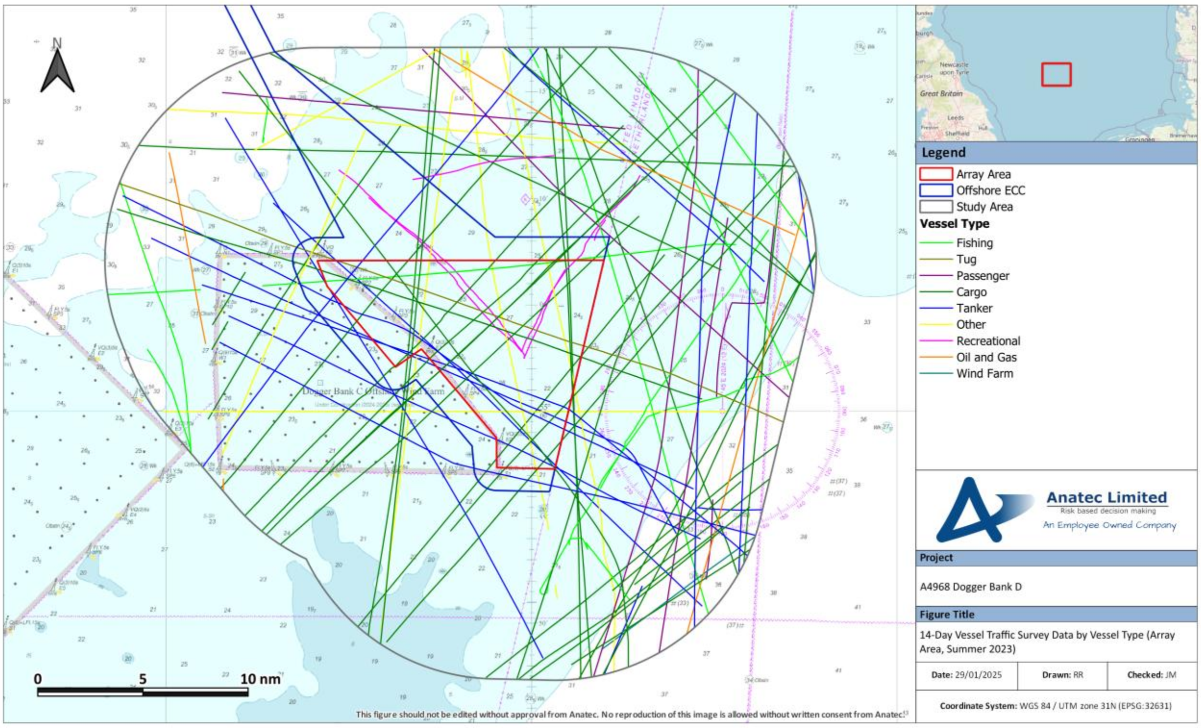


Figure 10-1 14-Day Vessel Traffic Survey Data by Vessel Type (Array Area, Summer 2023)

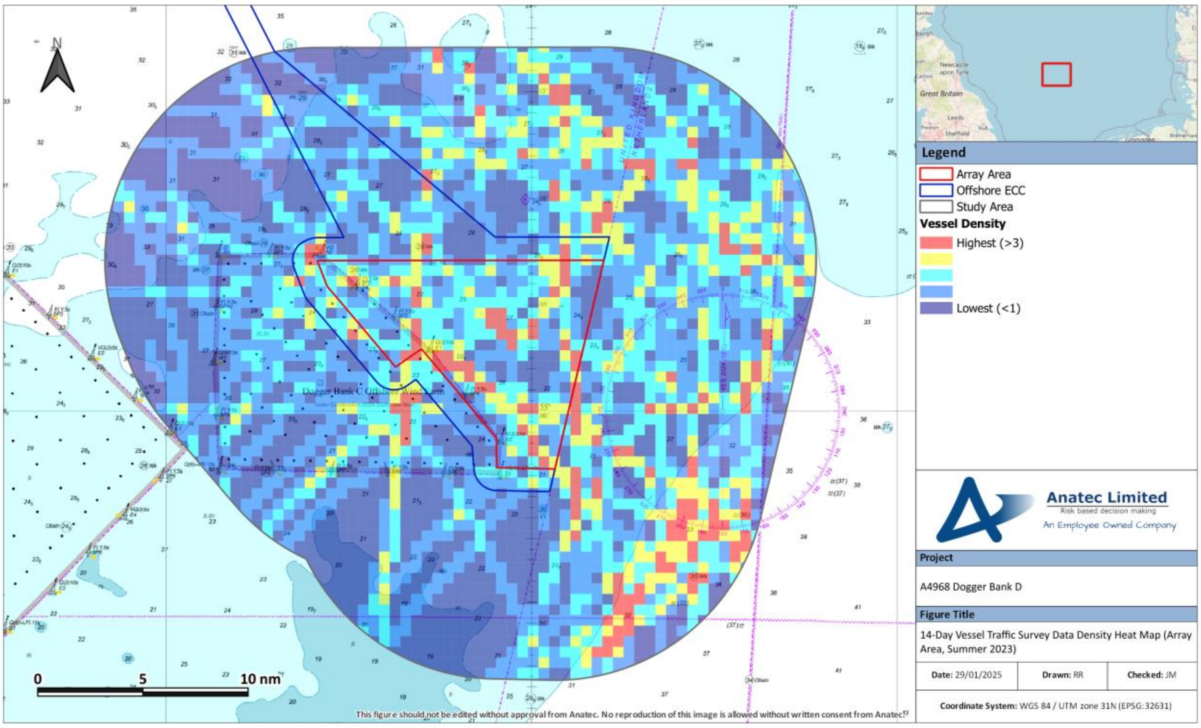


Figure 10-2 14-Day Vessel Traffic Survey Data Density Heat Map (Array Area, Summer 2023)

145. A plot of the vessel tracks recorded during the 40-day Vissim data period within the Study Area, colour-coded by vessel type and excluding temporary traffic, is presented on **Figure 10-3**. Following this, **Figure 10-4** presents the same data converted to a density heat map.

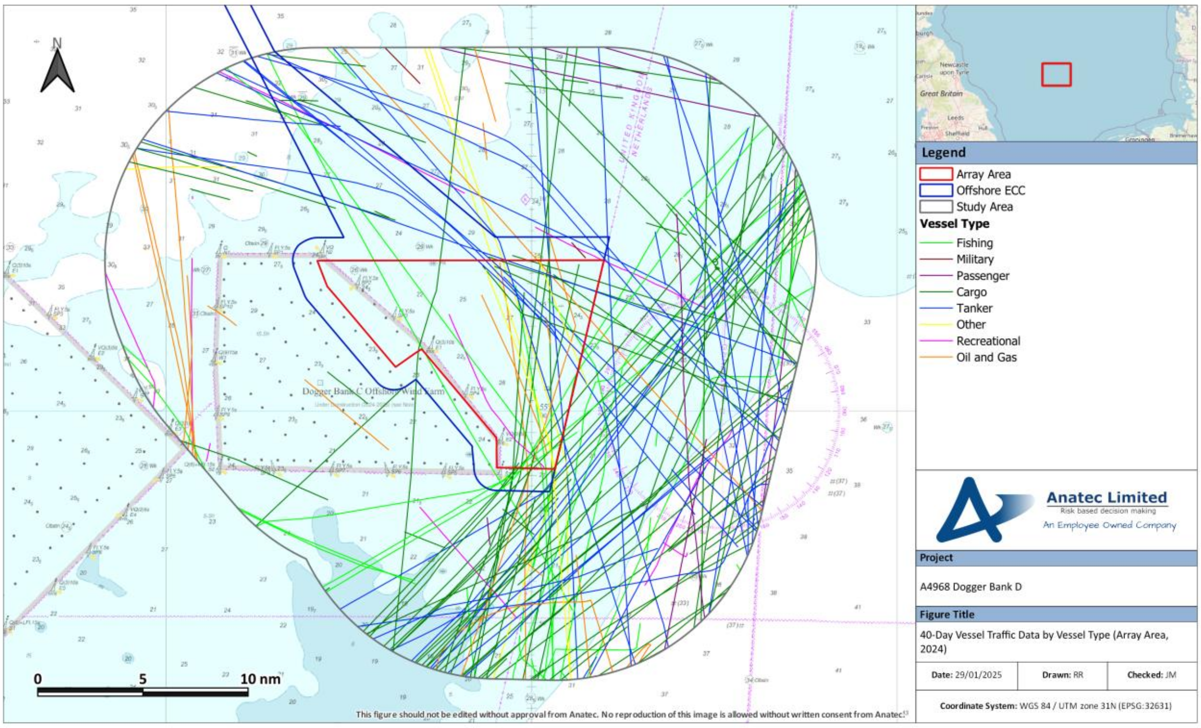


Figure 10-3 40-Day Vessel Traffic Data by Vessel Type (Array Area, 2024)

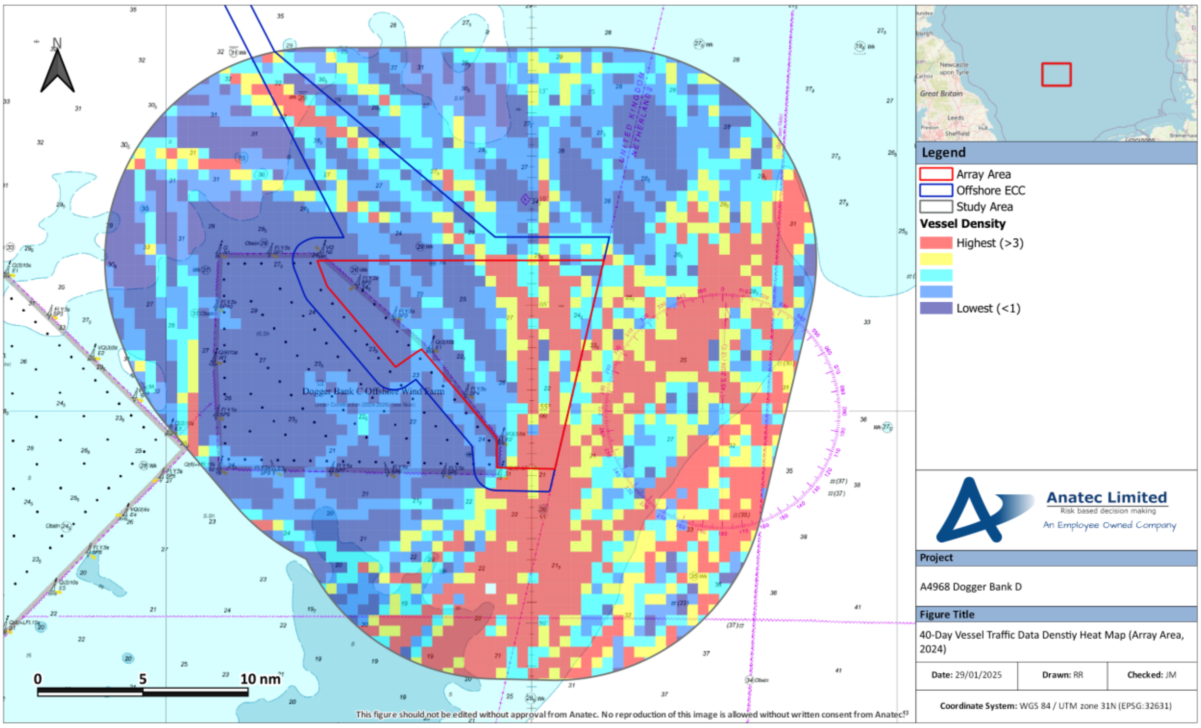


Figure 10-4 40-Day Vessel Traffic Data Density Heat Map (Array Area, 2024)

10.1.1 Vessel Counts

146. For the 14 days survey data analysed in summer 2023, there was an average of six unique vessels per day recorded within the Study Area. An average of two unique vessels per day were recorded intersecting the Array Area, or 37% of all vessel traffic recorded during the summer survey period.

147. **Figure 10-5** illustrates the daily number of unique vessels recorded within the Study Area as well as intersecting the Array Area during the summer survey period. It is noted that partial survey days are represented by hatched colouring and have been taken into consideration where relevant during the analysis.

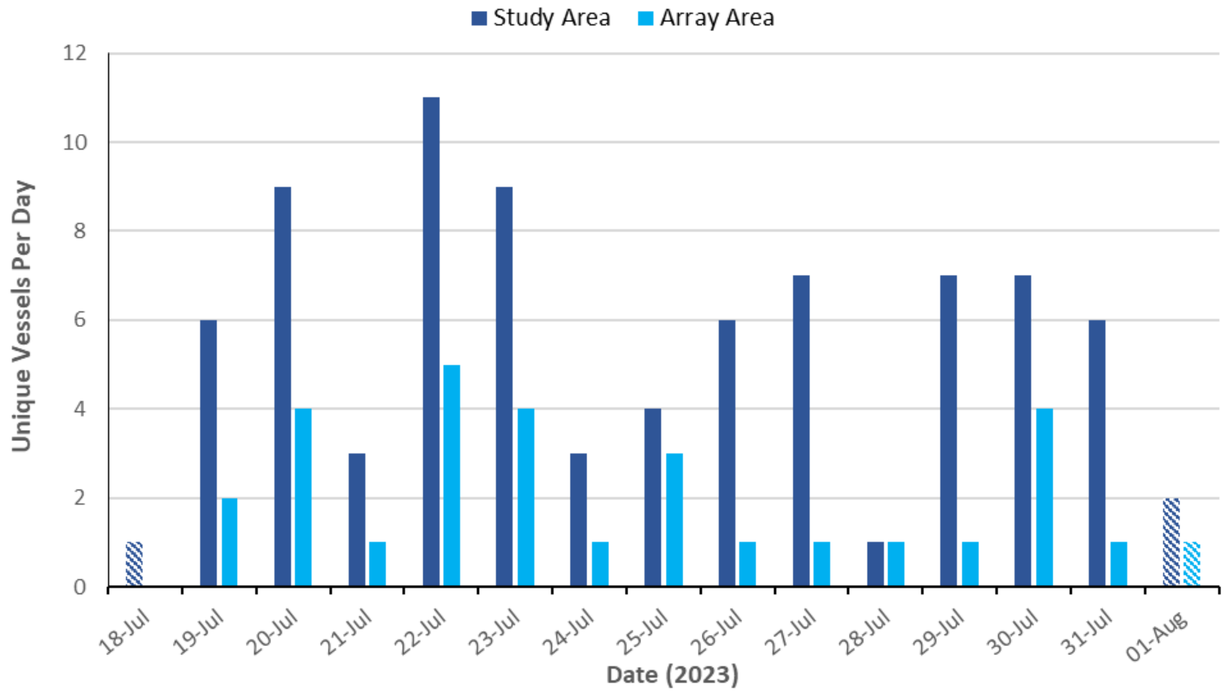


Figure 10-5 Daily Unique Vessel Counts within Study Area and Array Area (Summer 2023)

148. The busiest full day recorded within the Study Area throughout the summer survey period was 22nd July, when 11 unique vessels were recorded. The busiest full day recorded during the summer survey period within the Array Area was also 22nd July, when five unique vessels were recorded.

149. The quietest full day recorded within the Study Area throughout the summer survey period was 28th July when one unique vessel was recorded. The quietest full days recorded during the summer survey period within the Array Area recorded only one unique vessel; this occurred on six separate days.

150. For the 40 days vessel traffic data analysed in 2024, there was an average of four unique vessels per day recorded within the Study Area. An average of one unique vessel per day was recorded intersecting the Array Area, or 26% of all vessel traffic recorded during the data period.

151. **Figure 10-6** illustrates the daily number of unique vessels recorded within the Study Area as well as intersecting the Array Area during the data period.

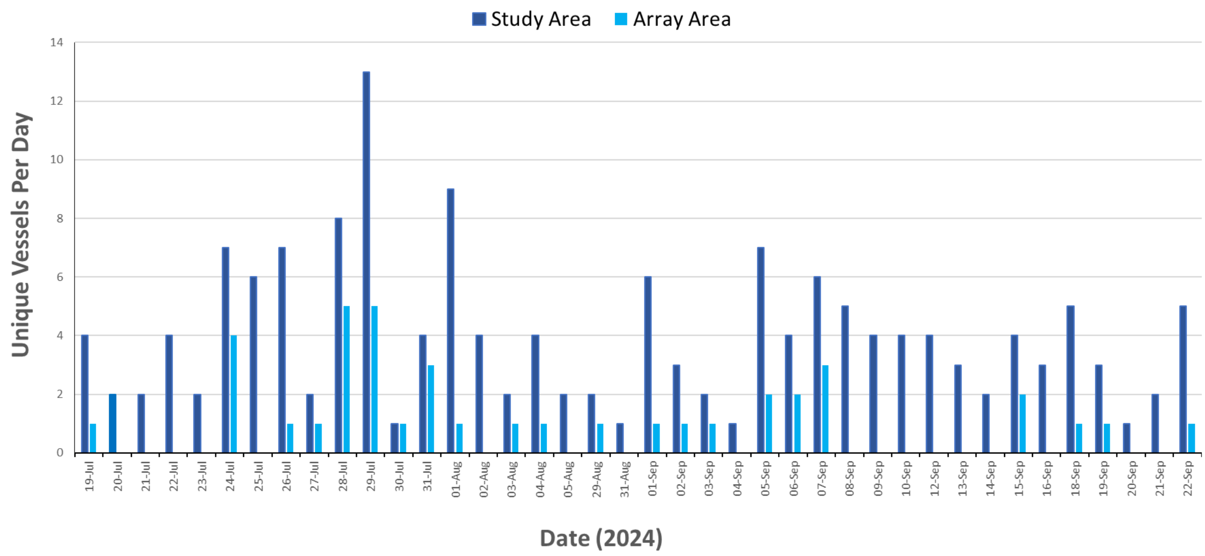


Figure 10-6 Daily Unique Vessel Counts within Study Area and Array Area (40-Days, 2024)

152. The busiest full day recorded within the Study Area throughout the data period was the 29th July, when 13 unique vessels were recorded. The busiest full day recorded during the data period within the Array Area was 28th and 29th July, when five unique vessels were recorded each day.

153. The quietest full days within the Study Area throughout the data period recorded one unique vessel each day; this occurred on four separate days. The quietest full days within the Array Area recorded no vessels; this occurred on 18 separate days.

10.1.2 Vessel Type

154. The percentage distribution of the main vessel types recorded passing within the Study Area as well as intersecting the Array Area during the summer survey period is presented on **Figure 10-7**.

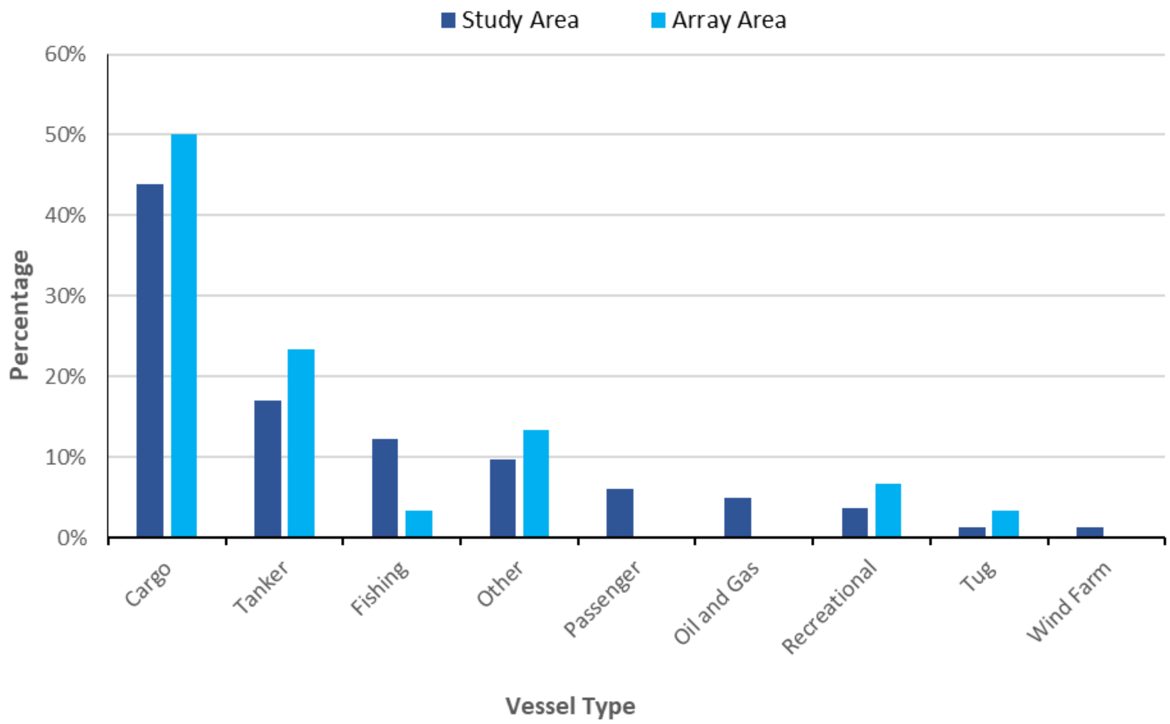


Figure 10-7 Vessel Type Distribution within Study Area and Array Area (Summer 2023)

155. Throughout the summer survey period, the main vessel type recorded within the Study Area was cargo vessels which accounted for 44% of all vessels recorded. Tankers (17%) and fishing vessels (12%) were also recorded. No other vessel type accounted for more than 10% of all vessels recorded. There is a similar trend in vessel types intersecting the Array Area with cargo vessels (45% of all intersecting vessel traffic) and tankers (21%) being the most commonly recorded vessel types.

156. It is noted that only three unique recreational vessels were recorded during the summer survey period. This is expected given the distance offshore (approximately 114nm (211km)) and unfavourable sea conditions which can are known to occur in the Dogger Bank region. Recreational vessels are detailed more in **Section 10.1.2.5**.

157. The percentage distribution of the main vessel types recorded passing within the Study Area as well as intersecting the Array Area during the 40-day data period is presented on **Figure 10-8**.

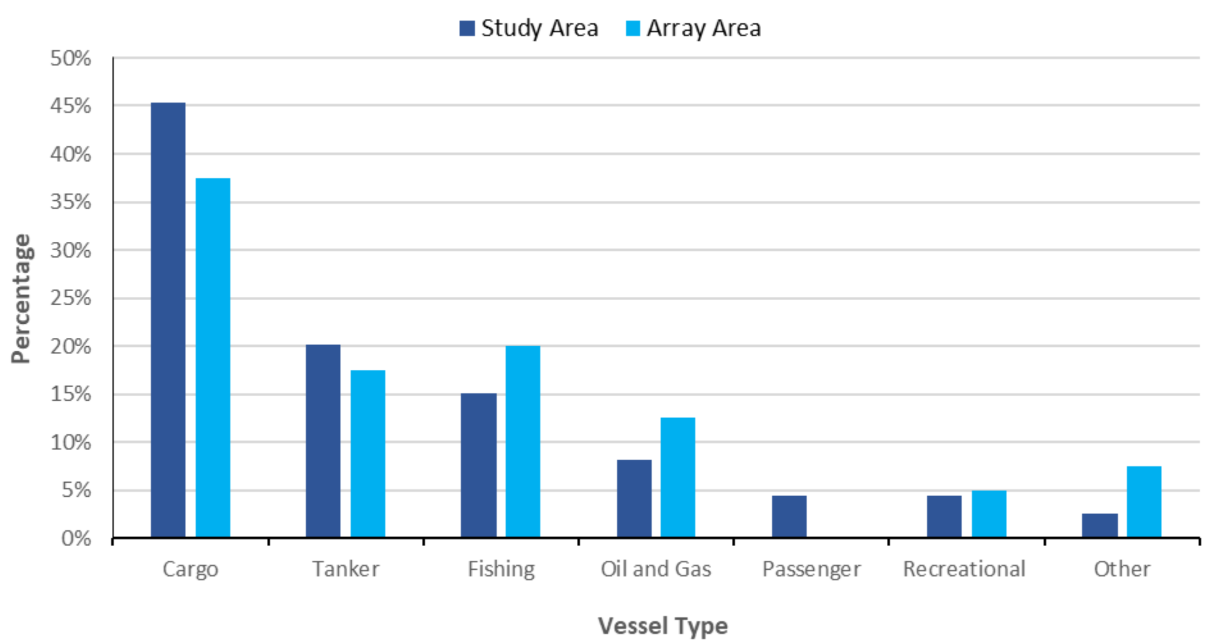


Figure 10-8 Vessel Type Distribution within Study Area and Array Area (40-Days, 2024)

158. Throughout the data period, the main vessel type recorded within the Study Area was cargo vessels which accounted for 45% of all vessels recorded. Tankers (20%) and fishing vessels (15%) were also recorded. No other vessel type accounted for more than 10% of all vessels recorded. There is a similar trend in vessel types intersecting the Array Area with cargo vessels (38% of all intersecting vessel traffic) and tankers (18%) being the most commonly recorded vessel types.

159. The following subsections consider each of the main vessel types individually with the summer survey data and the supplementary AIS data in a combined dataset.

10.1.2.1 Cargo Vessels

160. Cargo vessels recorded during the 54-day combined data period are presented on **Figure 10-9**.

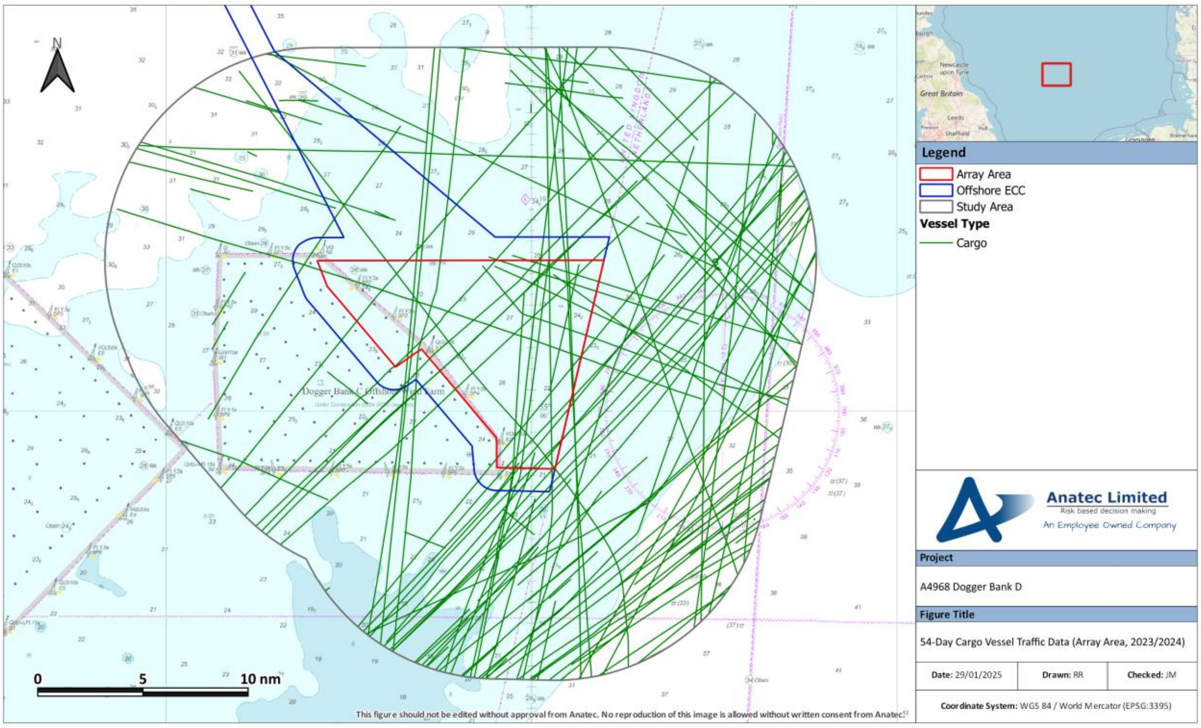


Figure 10-9 54-Day Cargo Vessel Traffic Data (Array Area, 2023/2024)

161. An average of two unique cargo vessels were recorded within the Study Area per day during the combined data period with an average of one cargo vessel intersecting the Array Area every one to two days; or 28% of all cargo vessels recorded.

162. The majority of cargo vessels were routeing north-east south-west across the Study Area, including through the Array Area. Vessels on this route were mainly heading south-west to ports within the River Humber with those vessels routeing north to ports in the Baltic Sea. Several vessels were also noted routeing north south through the Array Area. Main commercial routes identified from commercial vessels during the survey period are outlined in **Section 11**.

163. As for cargo sub type, the main sub types recorded were general cargo (43%), part containerised (28%), and bulk carriers (12%). No commercial ferries (RoRo) were identified within the Study Area during the combined data period.

10.1.2.2 Tankers

164. Tankers recorded during the 54-day combined data period are presented on **Figure 10-10**.

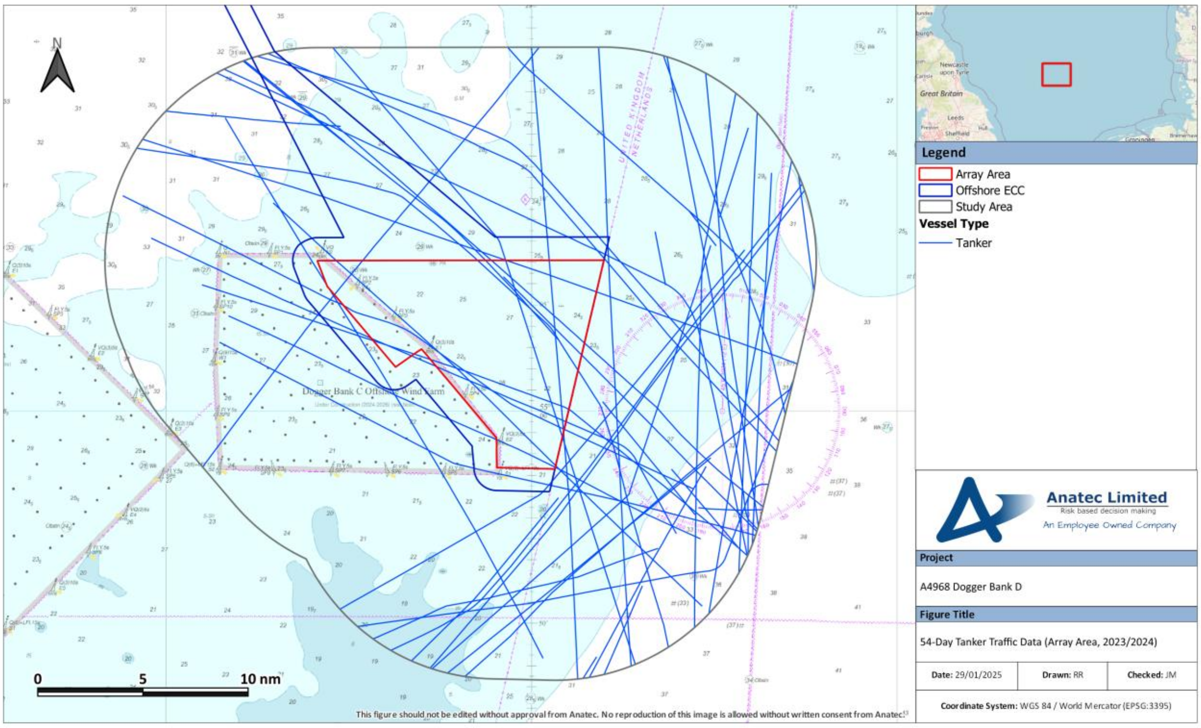


Figure 10-10 54-Day Tankers Traffic Data (Array Area, 2023/2024)

165. An average of one tanker was recorded per day within the Study Area during the combined data period with an average of two unique tankers intersecting the Array Area every week; or 30% of all tankers recorded.

166. Tankers were noted routeing north-west south-east through the south of the Array Area and were primarily routeing to / from mainland Europe.

167. The main tanker sub types recorded were chemical (28%), crude oil (24%), combined oil / chemical (17%), and Liquid Petroleum Gas (LPG) (13%).

10.1.2.3 Fishing Vessels

168. Fishing vessels recorded during the 54-day combined data period are presented on **Figure 10-11**.

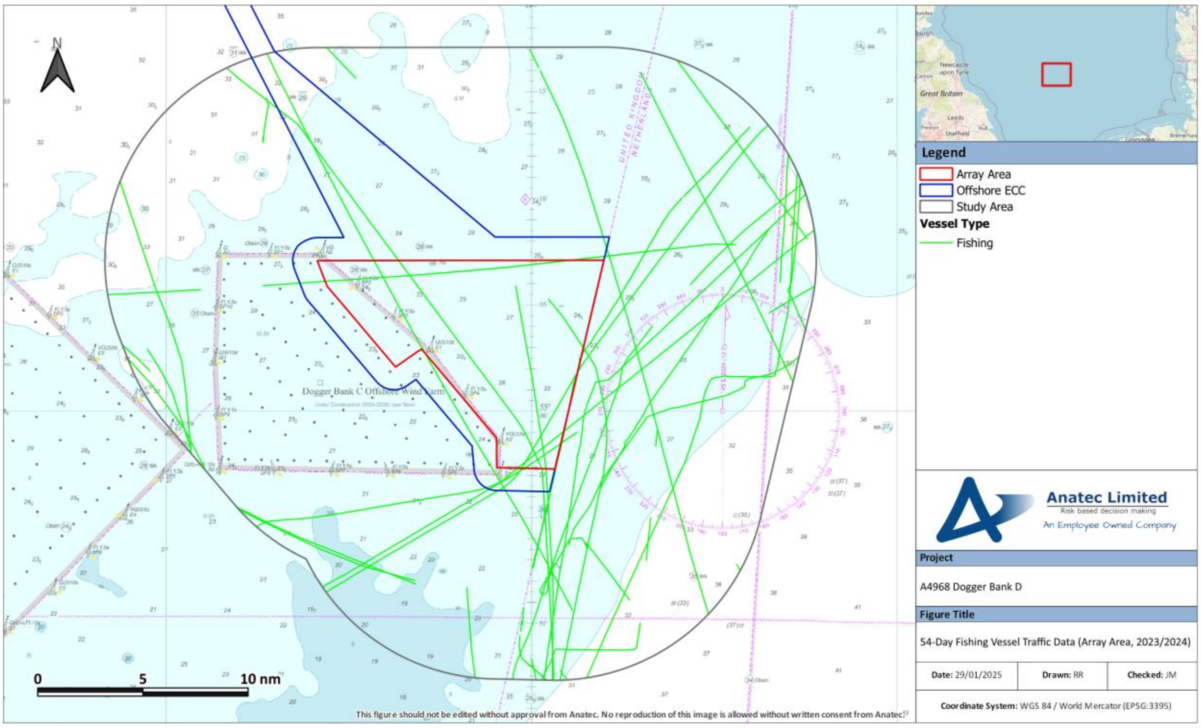


Figure 10-11 54-Day Fishing Vessel Traffic Data (Array Area, 2023/2024)

169. An average of one unique fishing vessel was recorded on transit every one to two days within the Study Area during the combined data period with an average of one unique fishing vessel intersecting the Array Area per week; or 26% of all fishing vessels recorded.

170. No fishing vessels were deemed to be engaged in any active fishing activities within the Study Area during the summer survey period. Fishing activity is identified through vessel behaviour, track speed and navigational status (for those commercial fishing vessels broadcasting via AIS) but all vessels were on transit. Fishing vessels engaged in active fishing are discussed further in **Volume 1, Chapter 14 Commercial Fisheries**.

171. It is noted that the Array Area and associated Study Area are within the Dogger Bank Special Area of Conservation (SAC) which prohibits bottom-trawling fishing gear and has been in operation since June 2022[3].

10.1.2.4 Passenger Vessels

172. Passenger vessels recorded during the 54-day combined data period are presented on **Figure 10-12**.

[3] The Dogger Bank SAC will be assessed every five years to identify if it remains fit for purpose.

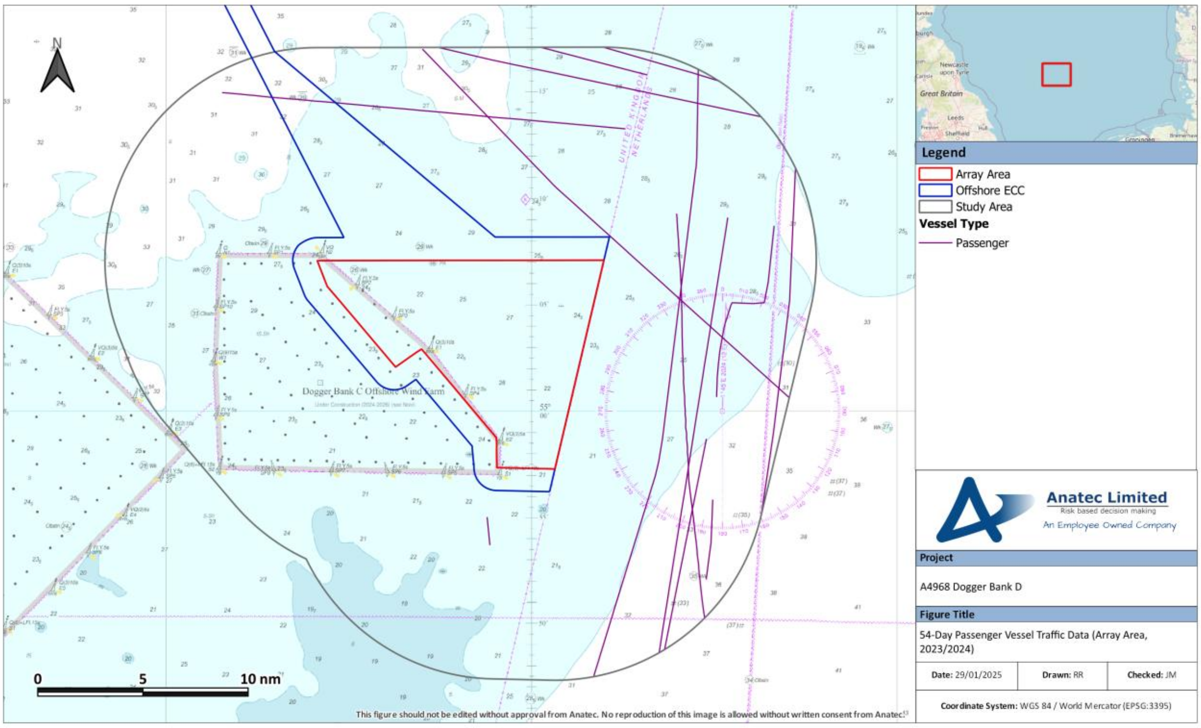


Figure 10-12 54 -Day Passenger Vessel Traffic Data (Array Area, 2023/2024)

173. An average of two unique passenger vessel were recorded on transit within the Study Area per week during the combined data period with no passenger vessels intersecting the Array Area.

174. The majority of passenger vessels were routeing north-south to the east of the Study Area with only several vessels routing east-west to the north of the Study Area.

175. Recorded passenger vessels included both cruise liners (66%) and larger yachts (33%). No Roll-on / Roll-Off Passenger (RoPax) vessels were recorded during the combined data period.

10.1.2.5 Recreational Vessels

176. Recreational vessels recorded during the 14-day summer survey period are presented on **Figure 10-14**.

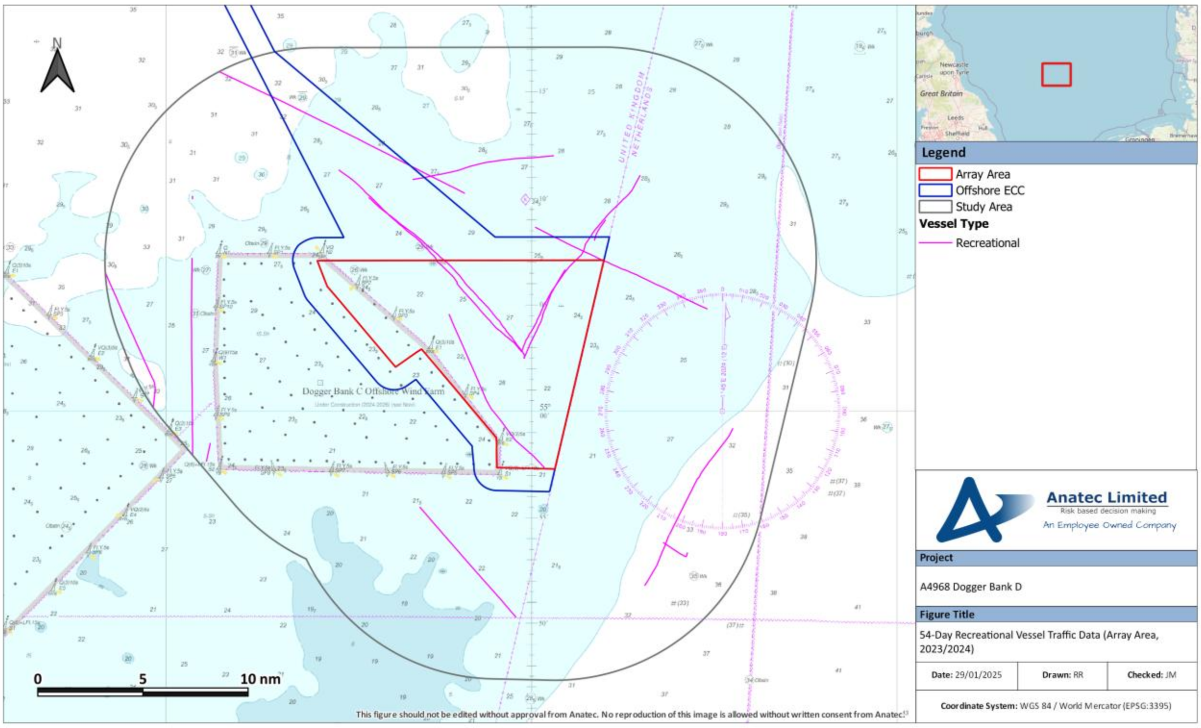


Figure 10-13 54-Day Recreational Vessels (Array Area, 2023/2024)

177. An average of one unique recreational vessel was recorded on transit within the Study Area per week during the combined data period with one unique recreational vessel recorded within the Array Area every two weeks; or 40% of all recreational vessels recorded.

178. Two of these vessels which intersected the Array Area during the summer survey period were sailing vessels recorded transiting on an identical course simultaneously. These vessels were likely tacking, an action where small craft (typically sailing vessels) align into the direction of the wind and transit in a zig-zag pattern to enable sailing upwind.

179. Although summer periods tend to provide more attractive sailing conditions, the distance offshore is likely a key factor in the infrequency of recreational vessels present within the Study Area.

10.1.2.6 Anchored Vessels

180. Anchored vessels can be identified based upon the AIS navigational status which is programmed on the AIS transmitter on board a vessel. However, information is manually entered into the AIS and therefore it is common for vessels not to update their navigational status if only at anchor for a short period of time. For this reason, vessels which travelled at a speed of less than 1 knot for more than 30 minutes are assumed to potentially be at anchor. Such cases have therefore been identified and

checked for likely anchoring activity along with vessel track behaviour and AIS broadcasted navigational status.

181. After applying the criteria, no vessels were deemed to be at anchor within the Study Area across the combined data period.

10.1.3 Vessel Size

10.1.3.1 Vessel Length

182. Vessel LOA was available for all vessels recorded throughout the combined data period. The vessel traffic data is presented on **Figure 10-16**, colour-coded by LOA. Following this, a distribution of these vessel lengths is presented on **Figure 10-17**.

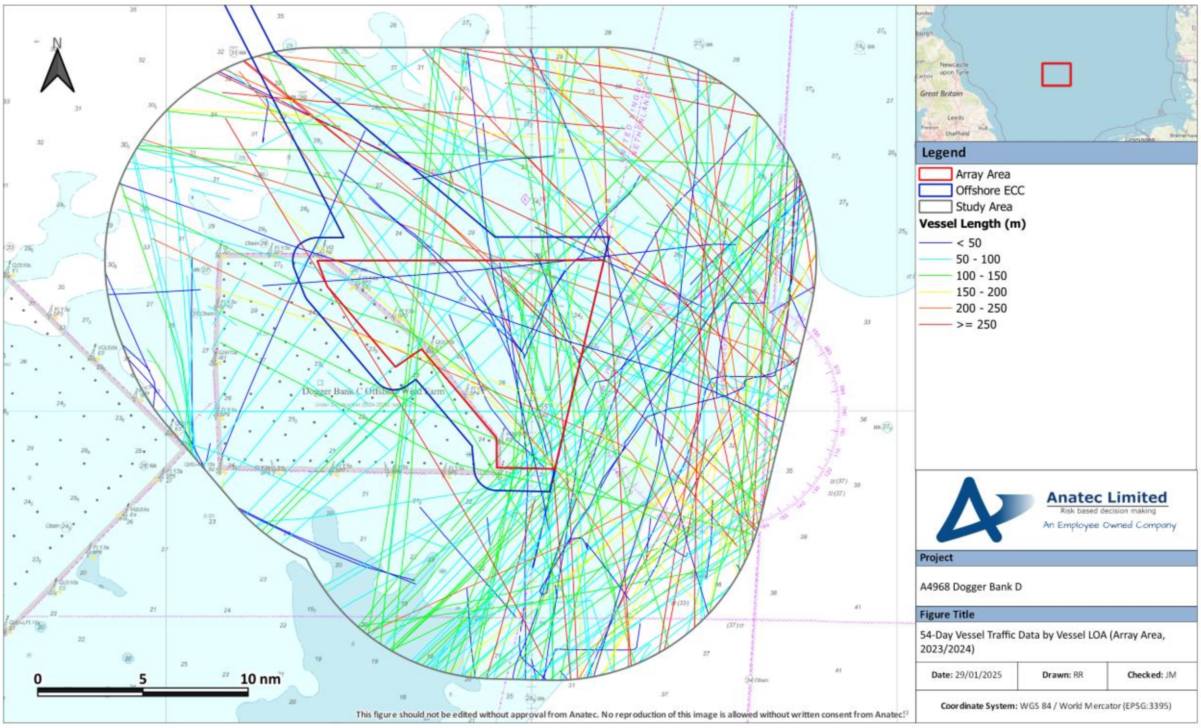


Figure 10-14 54-Day Vessel Traffic Data by Vessel LOA (Array Area, 2023/2024)

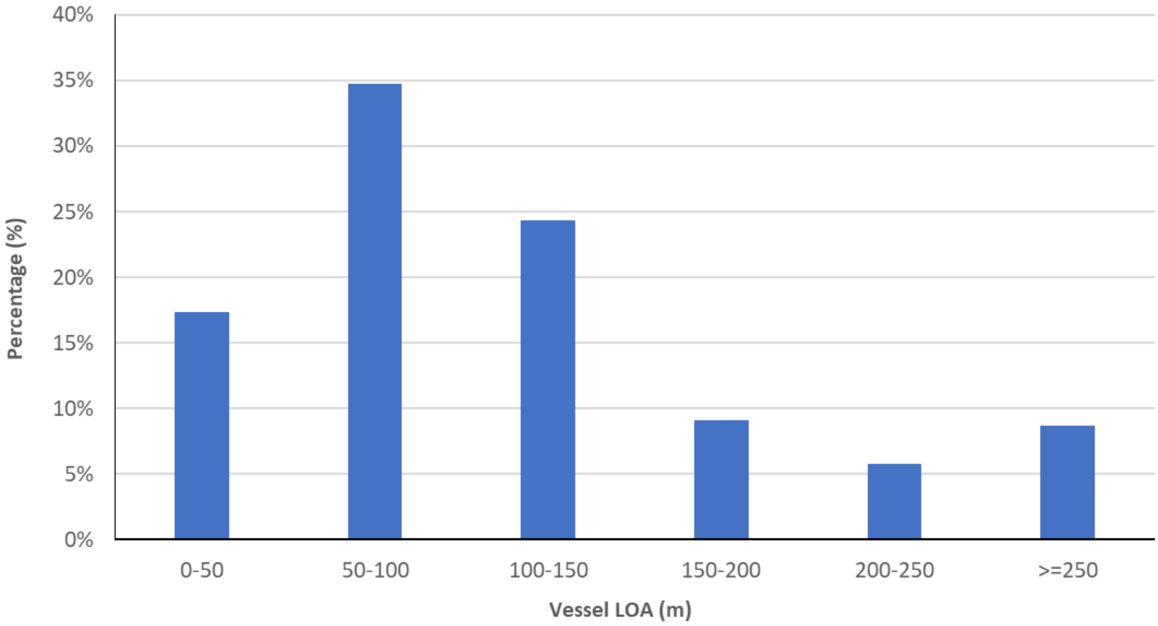


Figure 10-15 Vessel LOA Distribution (Array Area, 2023/2024)

183. The average vessel length recorded across all vessels within the combined data period was 116m. Vessel length ranged from a 9m sailing vessel to a 382m crane vessel. The greatest range of vessel lengths were between 50-100m (35% of all vessels). Only 21 unique vessels (9%) had a length equal to or greater than 250m; 5 unique vessels (2%) equal to or greater than 300m; these were two cruise liners, one crude oil tanker, one bulk carrier, and the crane vessel aforementioned.

10.1.3.2 Vessel Draught

184. Vessel draught was available for approximately 82% of off vessels recorded throughout the combined data period. The vessel traffic data is presented on **Figure 10-16**, colour-coded by vessel draught. Following this, a distribution of these vessel draughts is presented on **Figure 10-17**.

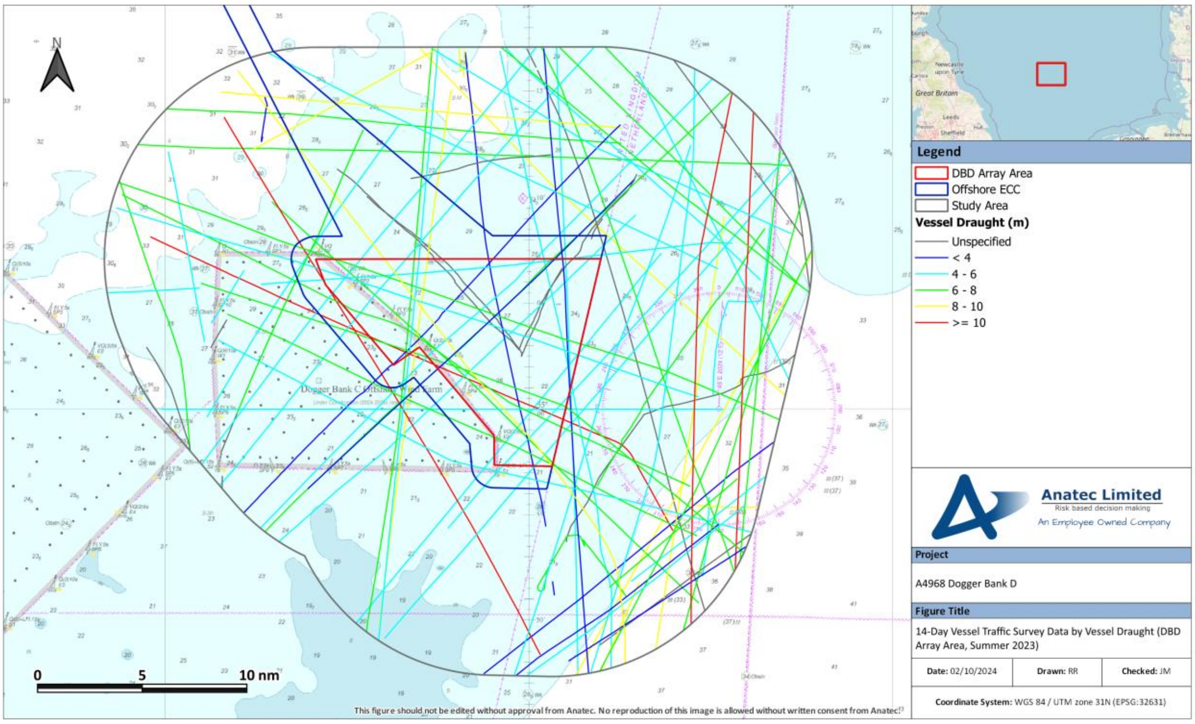


Figure 10-16 54-Day Vessel Traffic Data by Vessel Draught (Array Area, Summer 2023/2024)

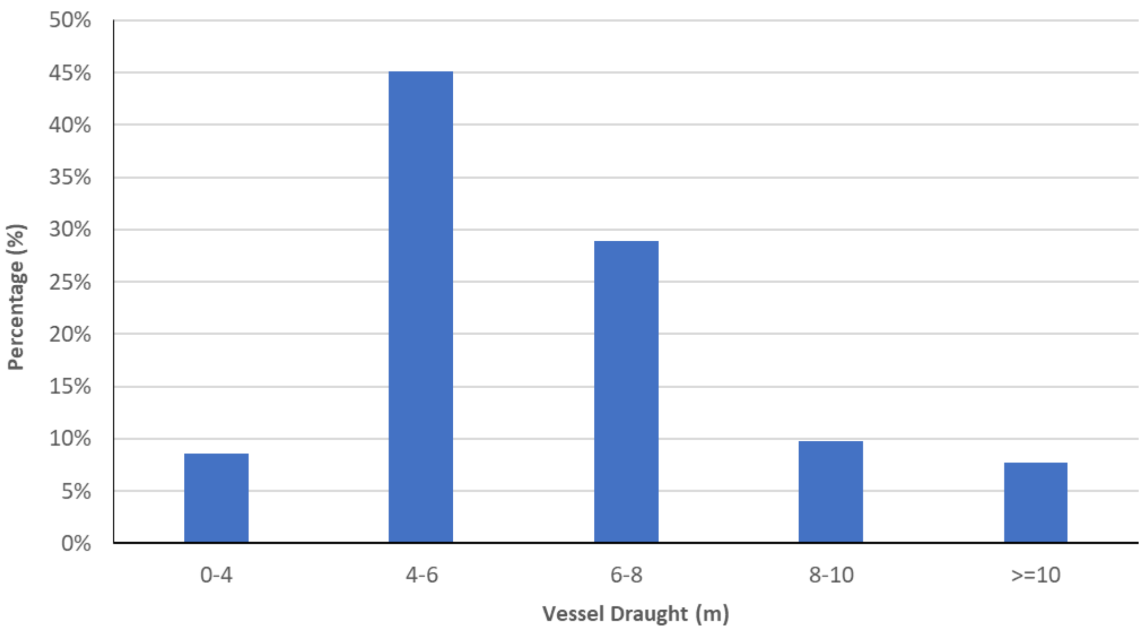


Figure 10-17 Vessel Draught Distribution (Array Area, 2023/2024)

185. Of vessels which broadcast a valid vessel draught, the average draught recorded was 6.3m. Vessel draught ranged from 2.5m for an emergency response and rescue vessel (ERRV) to 20.2m for an crude oil tanker. The greatest range of vessel draughts were

between 4-6m (45% of all vessels). Only 19 unique vessels (8%) had a draught greater than or equal to 10m; the majority of these tankers with bulk carrier cargo vessels and a crane vessel. Of these 19 vessels, only one (the crude oil tanker aforementioned) had a vessel draught greater than 14m.

10.2 Offshore Export Cable Corridor

186. This section presents an overview of vessel traffic movements within the Offshore ECC Study Area, based upon the 40 days of AIS data (**Section 5.2**). As noted in **Section 5.2**, this data is AIS only and any vessels not broadcasting on AIS (typically smaller craft; recreational and fishing) may be underrepresented.

187. A plot of the vessel tracks recorded during the 40-day data period within the offshore ECC Study Area, colour-coded by vessel type and excluding temporary traffic, is presented on **Figure 10-1**. Following this, **Figure 10-2** presents the same data converted to a density heat map[4].

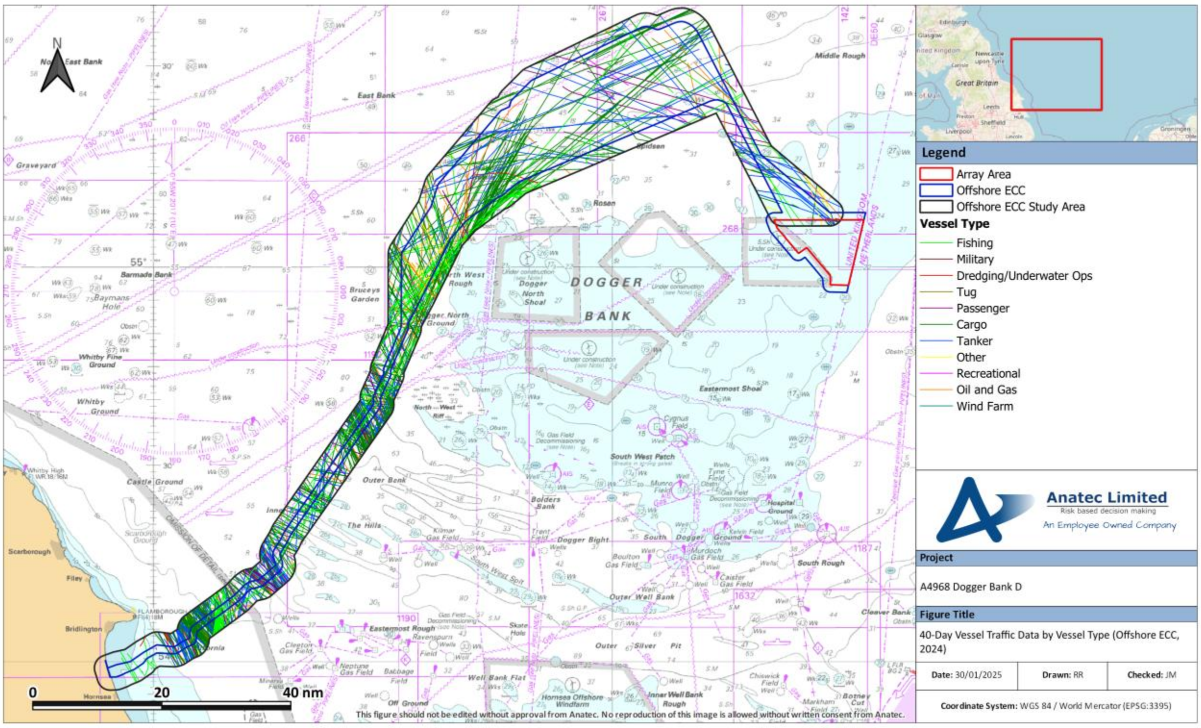


Figure 10-18 40-Day Vessel Traffic Data by Vessel Type (Offshore ECC, 2024)

[4] To ensure contrasts in vessel density are suitably illustrated, the scale used for the vessel density heat map of the offshore ECC Study Area is specific to the vessel traffic data and does not match that used for the vessel density heat maps associated with the Array Area.

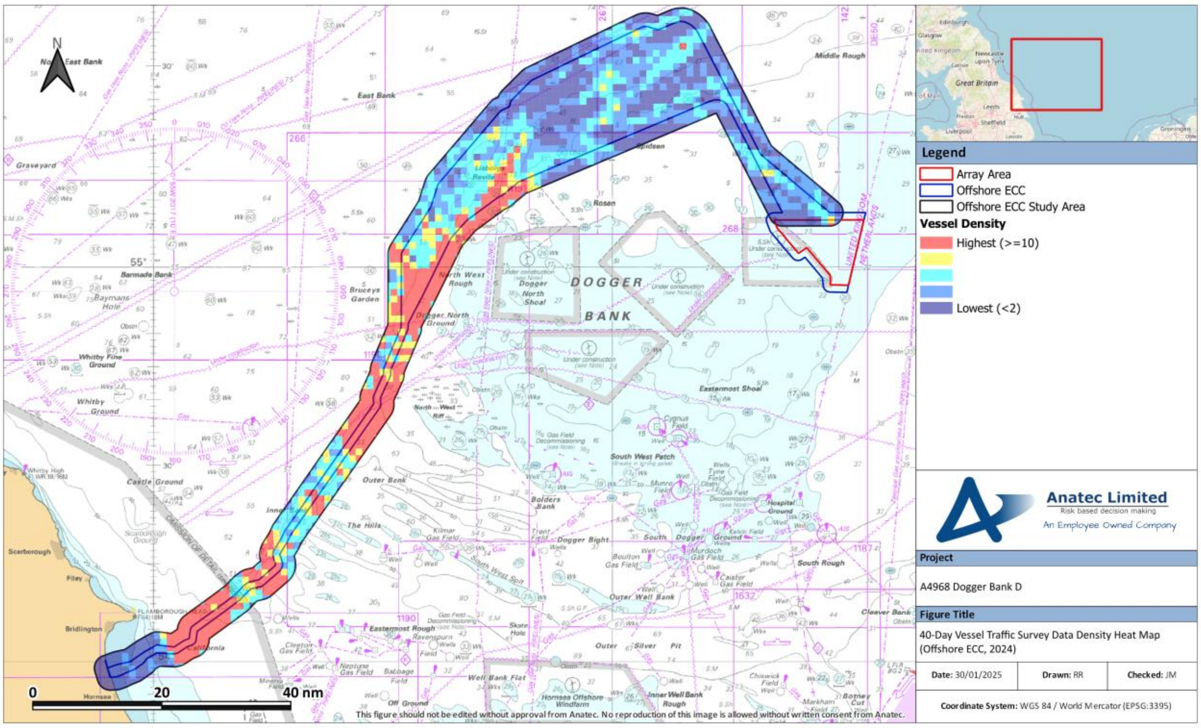


Figure 10-19 40-Day Vessel Traffic Data Density Heat Map (Offshore ECC, 2024)

10.2.1 Vessel Counts

188. Across the data period, there was an average of 21 unique vessels per day recorded within the offshore ECC Study Area. An average of 19 unique vessels per day were recorded crossing the offshore ECC, or 88% of all vessel traffic recorded during the data period.

189. **Figure 10-20** illustrates the daily number of unique vessels recorded within the offshore ECC Study Area as well as crossing the offshore ECC during the data period.

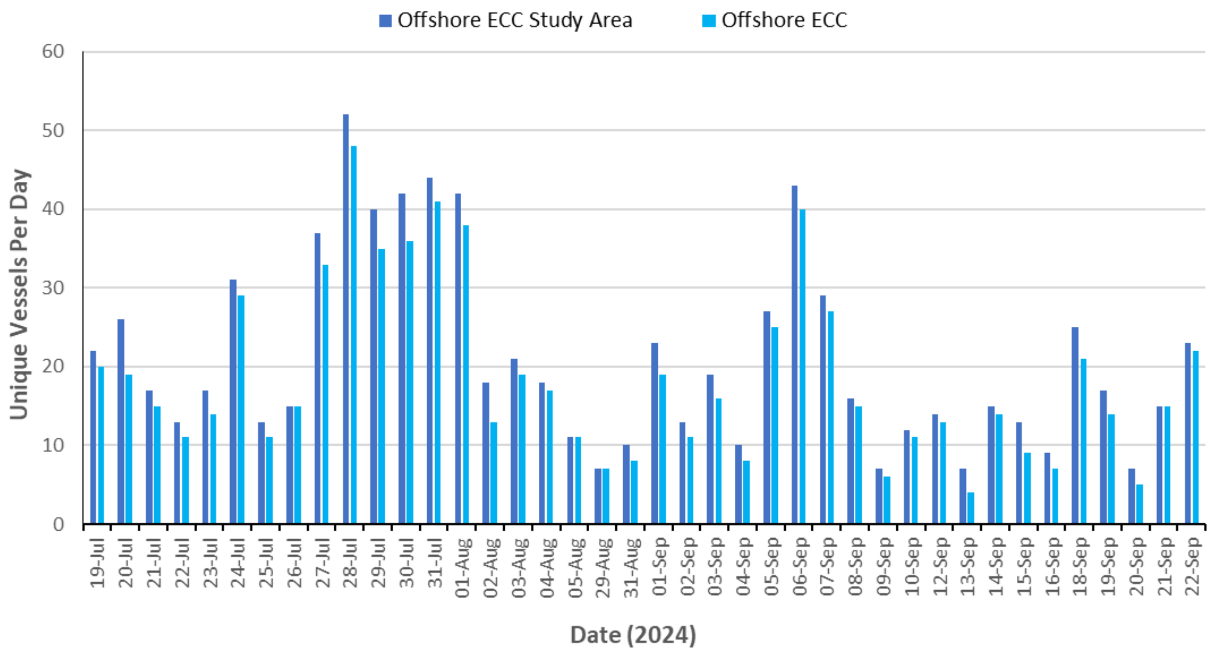


Figure 10-20 Daily Unique Vessel Counts within Offshore ECC Study Area and Offshore ECC (40-Days, 2024)

190. The busiest day recorded within the offshore ECC Study Area throughout the data period was 28th July 2024, when 52 unique vessels were recorded. The busiest day recorded within the offshore ECC was also 28th July 2024, when 48 unique vessels were recorded crossing.

191. The quietest day recorded within the offshore ECC Study Area throughout the data period recorded seven unique vessels per day which occurred over four separate days. The quietest day recorded during the data period within the offshore ECC was 13th September 2024 when four unique vessels were recorded crossing.

10.2.2 Vessel Type

192. The percentage distribution of the main vessel types recorded within the Offshore ECC Study Area as well as crossing the offshore ECC during the data period is presented on **Figure 10-21**.

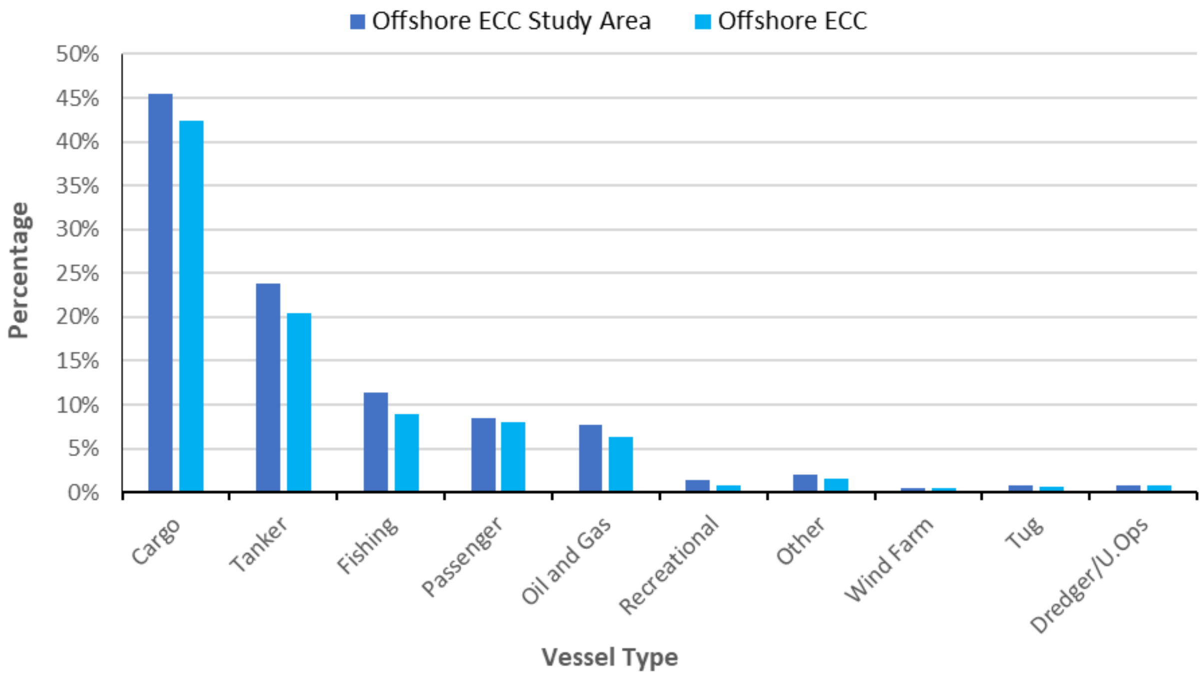


Figure 10-21 Vessel Type Distribution within Offshore ECC Study Area and Offshore ECC (40-Days 2024)

193. Across the data period, the main vessel types within the offshore ECC Study Area were cargo vessels which accounted for 45% of all vessels recorded. Tankers (24%), fishing vessels (11%), passenger vessels (9%), and oil and gas vessels (8%) were also recorded. No other vessel type accounted for more than 5% of all vessels recorded. As aforementioned, the majority of vessels intersected the offshore ECC (88%), and the same trend in common vessel types were also recorded with those vessels intersecting the Offshore ECC; cargo vessels (42%), tankers (20%), fishing vessels (9%), passenger vessels (8%), and oil and gas vessels (6%).

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

10.2.2.1 Cargo Vessels

195. Cargo vessels recorded during the data period are presented on **Figure 10-22**.

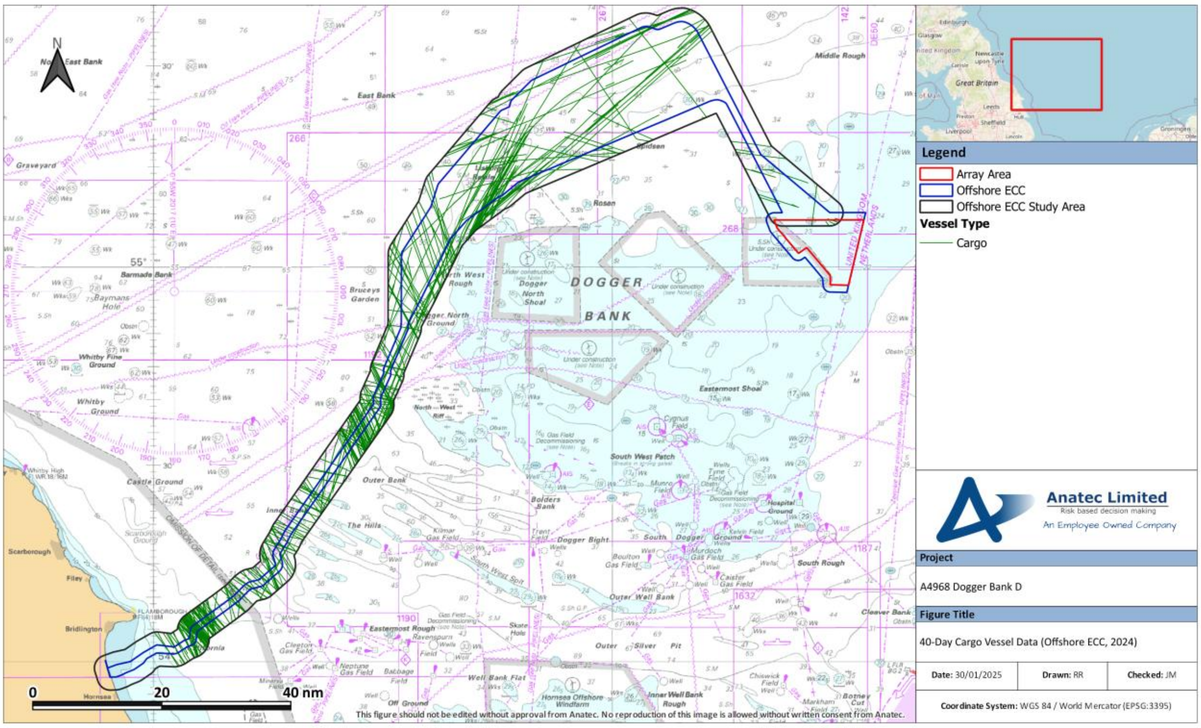


Figure 10-22 40-Day Cargo Vessels (Offshore ECC, 2024)

196. An average of nine unique cargo vessels were recorded within the offshore ECC Study Area per day during the data period, with 93% of these vessels recorded crossing the offshore ECC itself.

197. The main cargo sub types recorded were part containerised (21%), general cargo (21%), containerised (20%), and bulk carriers (15%). Several RoRo vessels were also recorded within the offshore ECC Study Area and these accounted for only 9% of all cargo vessels. These vessels were on distinct routes and location of each annotated on **Figure 10-23**. These routes include:

- **Route A:** A Smyril Line operated RoRo routeing north-west south-east on a weekly return between Rotterdam (the Netherlands) and Tórshavn (Faroe Islands); this vessel routes approximately 32nm (59km) offshore when routeing south and approximately 42nm (78km) offshore when routeing north – both crossing the offshore ECC;
- **Route B:** Two RoRo vessels operating a weekly return sailing routeing north-west south-east between Tees Port (UK) and Zeebrugge (Belgium) approximately 7nm (13km) from the coast. One vessel operated by Bore Ltd and the other by Wallenius Sol;
- **Route C:** Bore Ltd operated RoRo routeing north-east south-west between Immingham (UK) and Risavika (Norway). This route is further offshore, routeing west of the currently under construction Dogger Bank sites; and

- **Route D:** Sea-Cargo operated RoRo routeing south-west to Immingham once weekly. This vessel is on a circular route between the Immingham, Esbjerg (Denmark), and multiple ports in Norway but only the route leg between Risavika (Norway) and Immingham intersects the offshore ECC to the north-west of the currently under construction Dogger Bank Sites.

198. Several other cargo vessels were also routeing between ports in the Netherlands and ports in the UK, Iceland, and the Faroe Islands across the western portion of the offshore ECC Study Area. These vessels were routeing north-west south-east and were on well-defined routes.

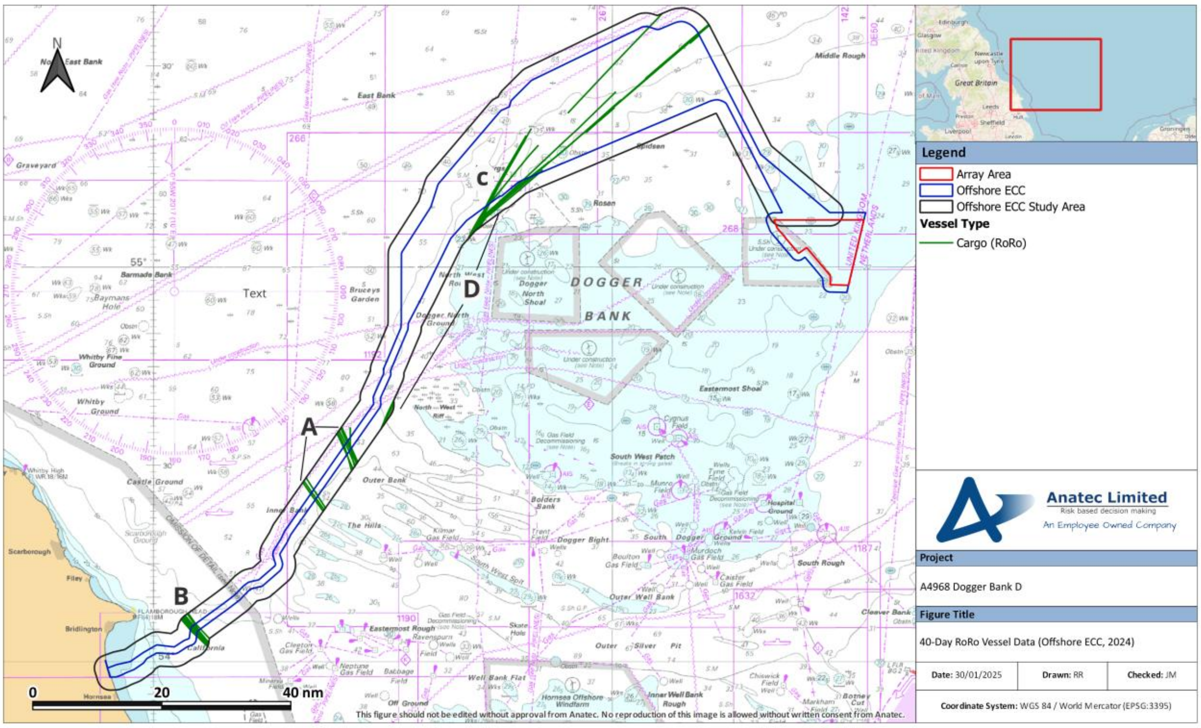


Figure 10-23 40-Day RoRo Vessel Data (Offshore ECC, 2024)

10.2.2.2 Tankers

199. Tankers recorded during the data period are presented on **Figure 10-24**.

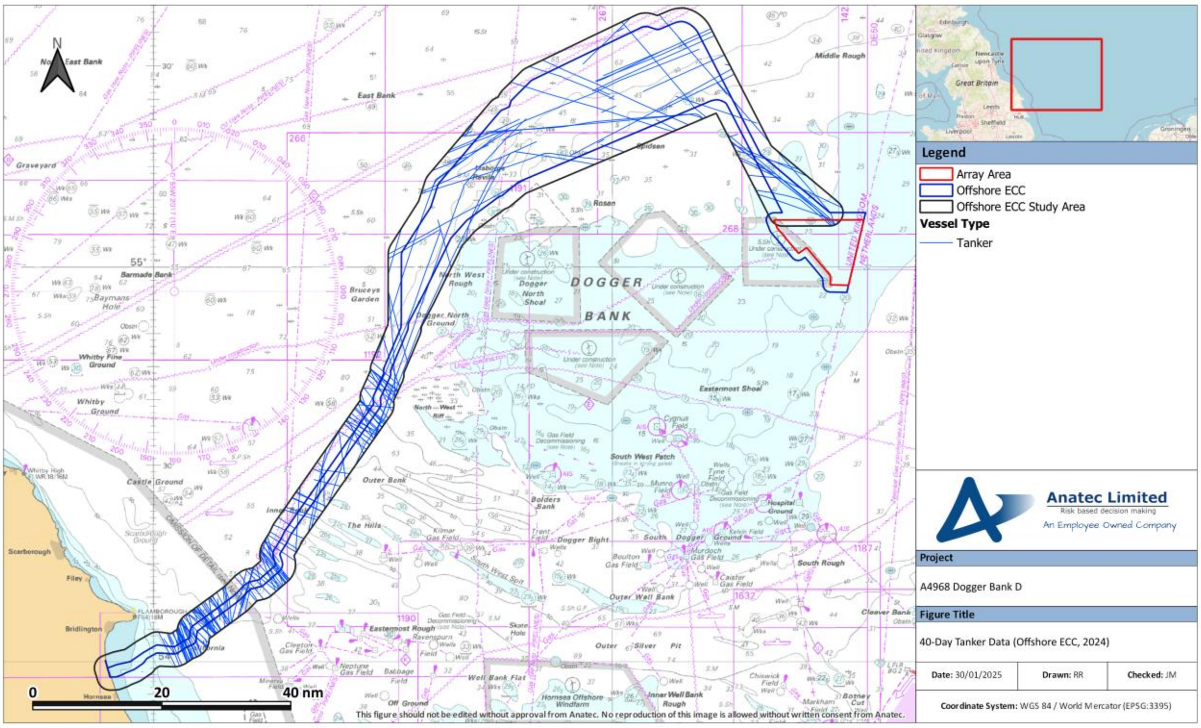


Figure 10-24 40-Day Tankers (Offshore ECC, 2024)

200. An average of five unique tankers were recorded within the Offshore ECC per day during the data period, with 86% of these vessels recorded crossing the Offshore ECC itself.

201. The main tanker sub types recorded were combined oil / chemical (31%), LPG (18%), crude oil (17%), and chemical (17%).

202. The majority of tankers were routeing north-west south-east across the Offshore ECC with only occasional vessels routeing parallel, which was recorded further offshore. Several routes were identified from tankers including those further inshore between Humber Ports and Aberdeen (UK) as well as Tees (UK) and routes between Belgium and the Netherland to ports on the Scottish east coast. Several vessels on these latter routes were also recorded further offshore. At the east of the Offshore ECC and north of the Array Area, tankers were recorded routeing to Forth Ports and ports in the north of Scotland.

10.2.2.3 Fishing Vessels

203. Fishing vessels recorded during the data period are presented on **Figure 10-25**.

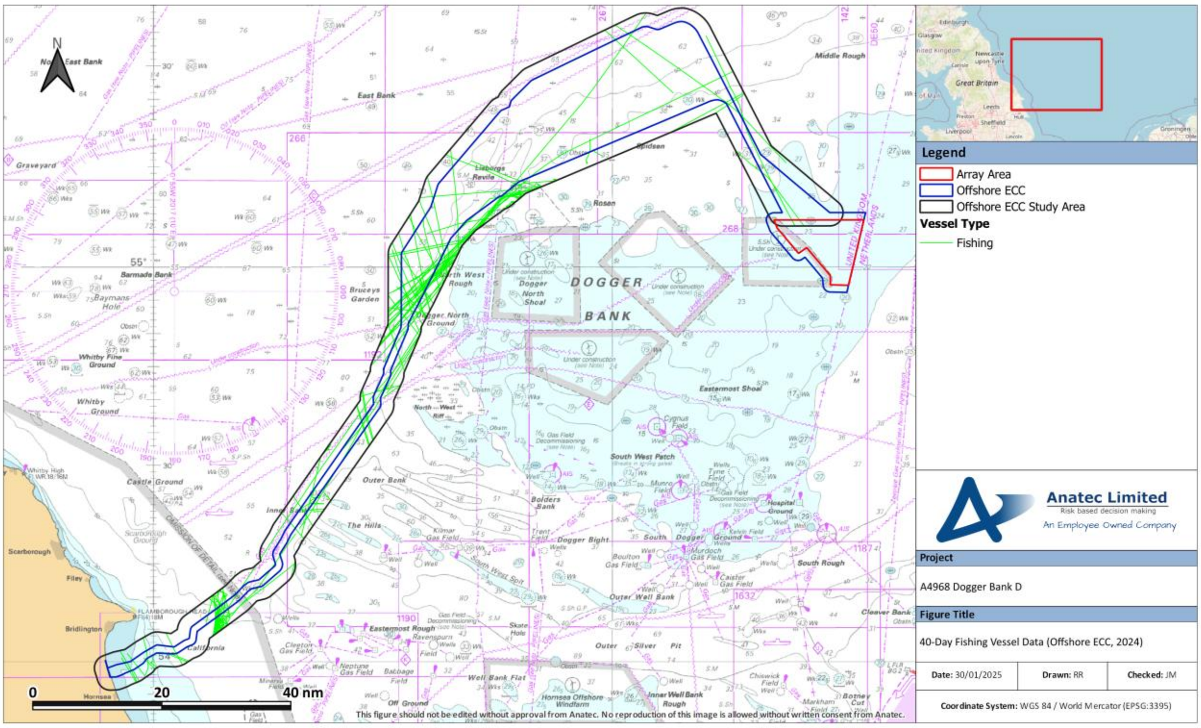


Figure 10-25 40 -Day Fishing Vessel Traffic Data (Offshore ECC, 2024)

204. An average of two to three fishing vessels per day were recorded within the offshore ECC Study Area during the data period, with 78% of these vessels crossing the offshore ECC itself.

205. The majority of fishing vessels were recorded in proximity to the currently under construction Dogger Bank developments, where vessels were transiting around the sites and based on information broadcast by AIS, were on route to crab fishing grounds further offshore. Several transits were also recorded inshore from fishing vessels on transits to / from Bridlington.

206. Similar to the Array Area analysis in **Section 10.1.2.3**, vessels were analysed based on behaviour, track speed and navigational status to identify any periods of fishing activity but all vessels within the offshore ECC Study Area were in transit as opposed to being engaged in active fishing.

10.2.2.4 Passenger Vessels

207. Passenger vessels recorded during the data period are presented on **Figure 10-26**.

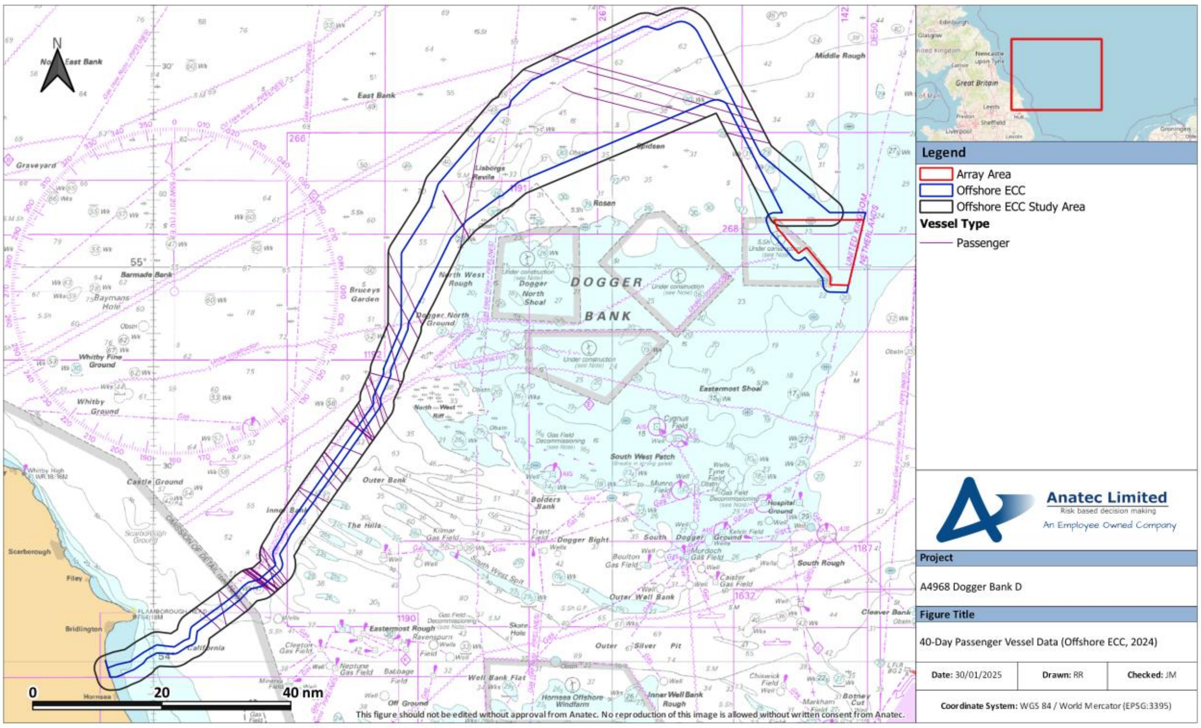


Figure 10-26 40 -Day Passenger Vessel Traffic Data (Offshore ECC, 2024)

208. An average of two passenger vessels per day were recorded within the offshore ECC Study Area during the data period, with 94% of these vessels crossing the offshore ECC itself.

209. Passenger vessel sub types recorded included cruise liners (57%), RoPax (41%), and one larger yacht (1%). A RoPax route was recorded within the offshore ECC Study Area operated by DFDS Seaways between Newcastle and Amsterdam (the Netherlands), at approximately 18nm (33km) from the coast. This route is operated by sister vessels which each route once daily in opposite directions. Several cruise liners were also recorded routeing to Hamburg (Germany) towards the eastern extent of the offshore ECC, north of the Array Area.

10.2.2.5 Oil and Gas Vessels

210. Oil and gas vessels recorded during the data period are presented on **Figure 10-27**.

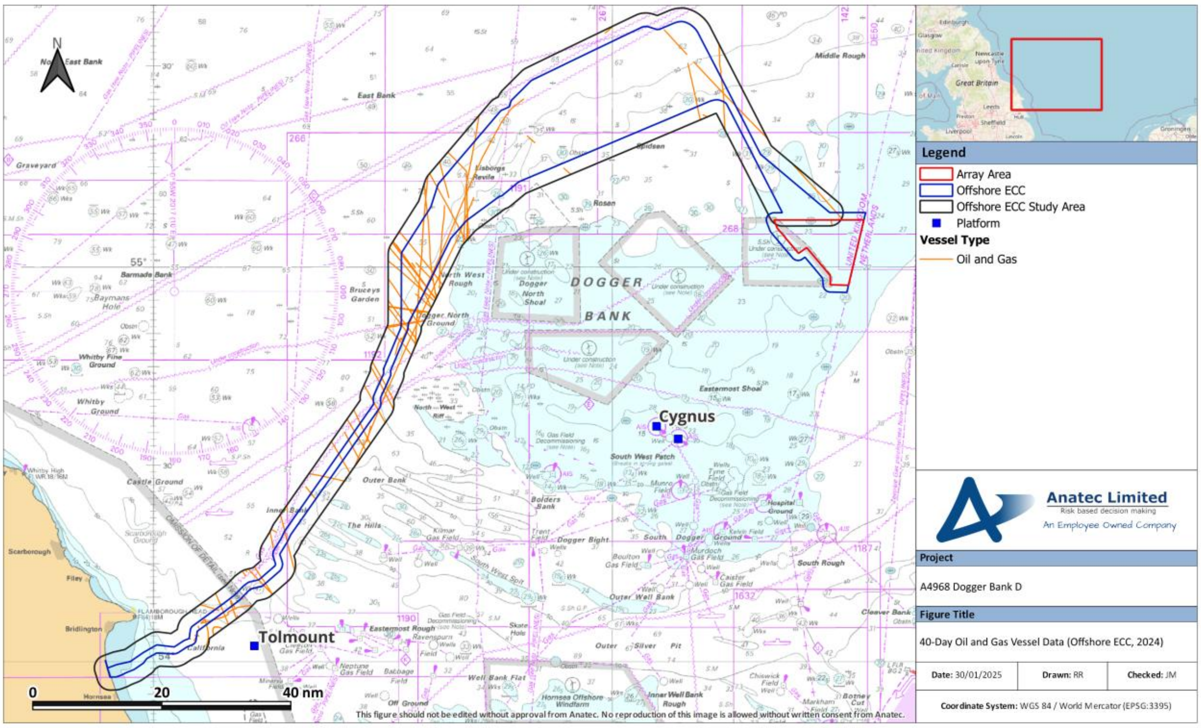


Figure 10-27 40-Day Oil and Gas Vessel Traffic Data (Offshore ECC, 2024)

211. An average of one to two oil and gas vessels per day were recorded within the offshore ECC Study Area during the data period, with 83% of these vessels crossing the offshore ECC itself.

212. The main proportion of oil and gas vessels were routeing to the west of the currently under construction Dogger Bank developments and were mainly routeing between Aberdeen and Montrose to offshore oil and gas fields, including the Cygnus Field to the south-east of DBA. Oil and gas vessels recorded further inshore were routeing to / from the Tolmount Field, which is situated south of the offshore ECC Study Area, and the Hewett Field, located further south off the Norfolk coast. The former two fields are illustrated on **Figure 10-27** for context.

10.2.2.6 Anchored Vessels

213. The same criteria for determining anchored vessels outlined in **Section 10.1.2.6** was again applied to the vessel traffic data within the offshore ECC Study Area. After applying the criteria, no vessels were deemed to be at anchor within the offshore ECC Study Area across the data period.

10.2.3 Vessel Size

10.2.3.1 Vessel Length

214. Vessel LOA was available for all vessels recorded throughout the data period. The vessel traffic data, colour-coded by LOA, is presented on **Figure 10-28**. Following this, a distribution of these vessel LOA is presented on **Figure 10-29**.

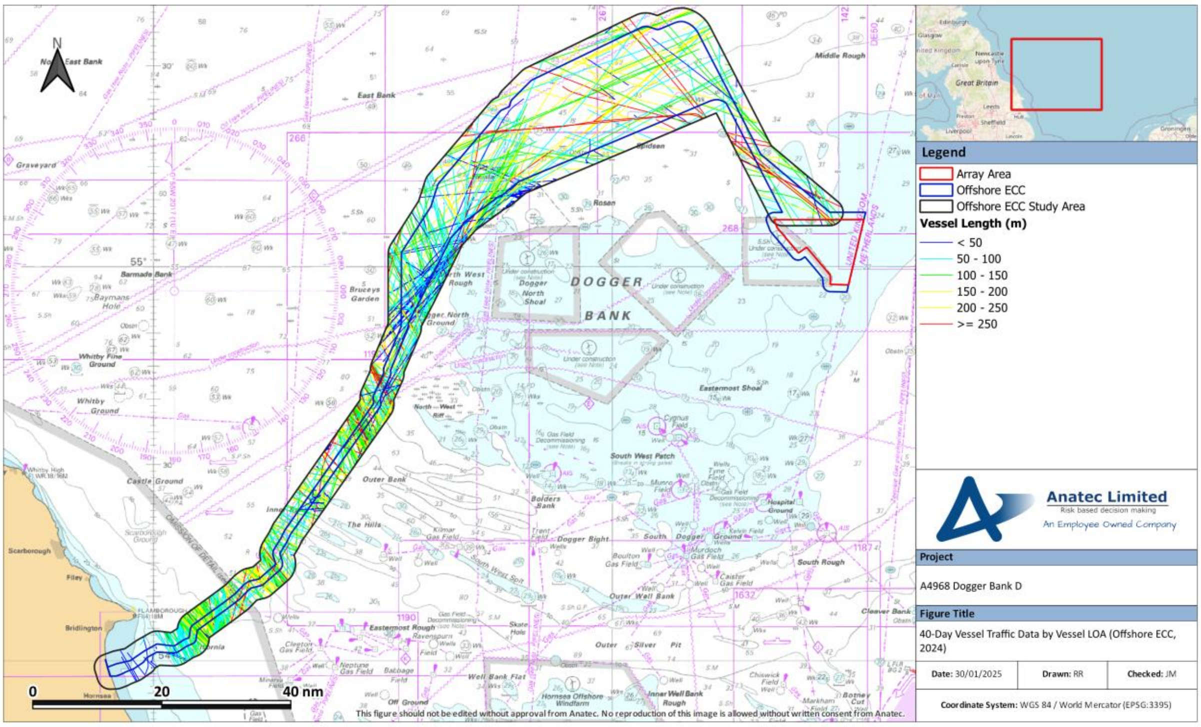


Figure 10-28 40-Day Vessel Traffic Survey Data by Vessel Length (Offshore ECC, 2024)

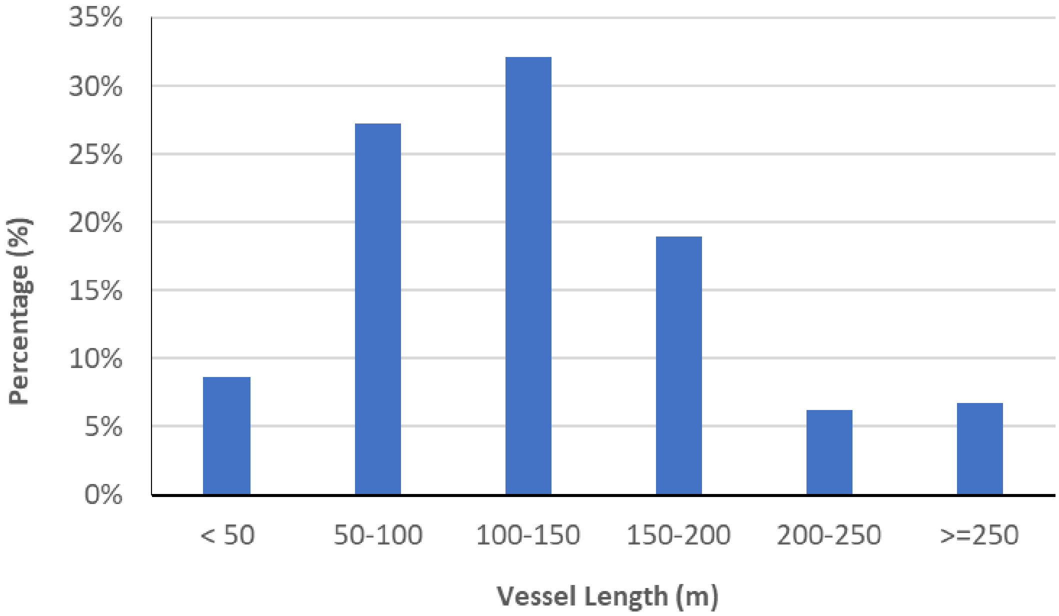


Figure 10-29 Vessel LOA Distribution (Offshore ECC, 2024)

215. The average LOA recorded was 129m. Vessel LOA ranged from an 8m fishing vessel to a 382m crane vessel, the same identified during the analysis of the Array Area (**Section 10.1.3.1**). The greatest range of vessel LOA was between 100 to 150m (32%). Vessels with greater LOA were primarily cruise liners and tankers with no vessels greater than 257m recorded inshore of the 50m contour water depth, situated approximately 9nm (17km) offshore. Vessels of smaller LOA were recreational and fishing vessels.

10.2.3.2 Vessel Draught

216. Vessel draught was available for approximately 89% of vessels recorded throughout the data period. Vessels with unspecified draughts have been removed from the analysis where relevant.

217. The vessel traffic data, colour-coded by vessel draught, is presented on **Figure 10-30**. Following this, a distribution of these vessel draughts is presented on **Figure 10-31**.

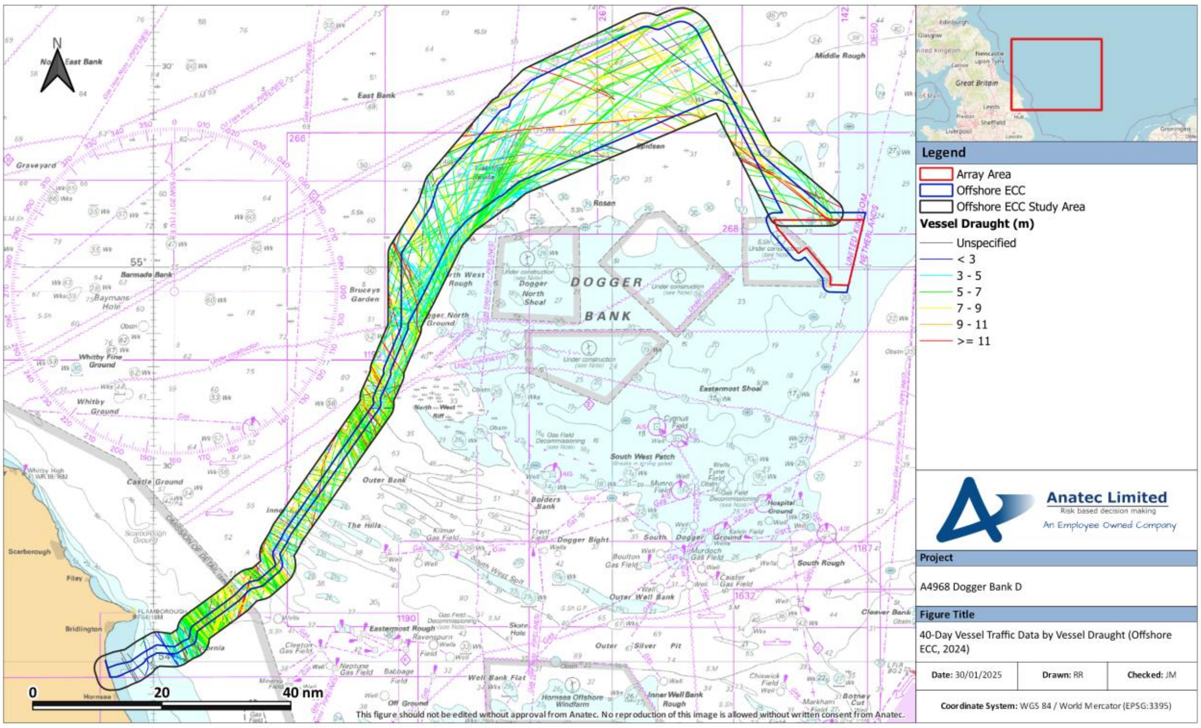


Figure 10-30 40-Day Vessel Traffic Data by Vessel Draught (Offshore ECC, 2024)

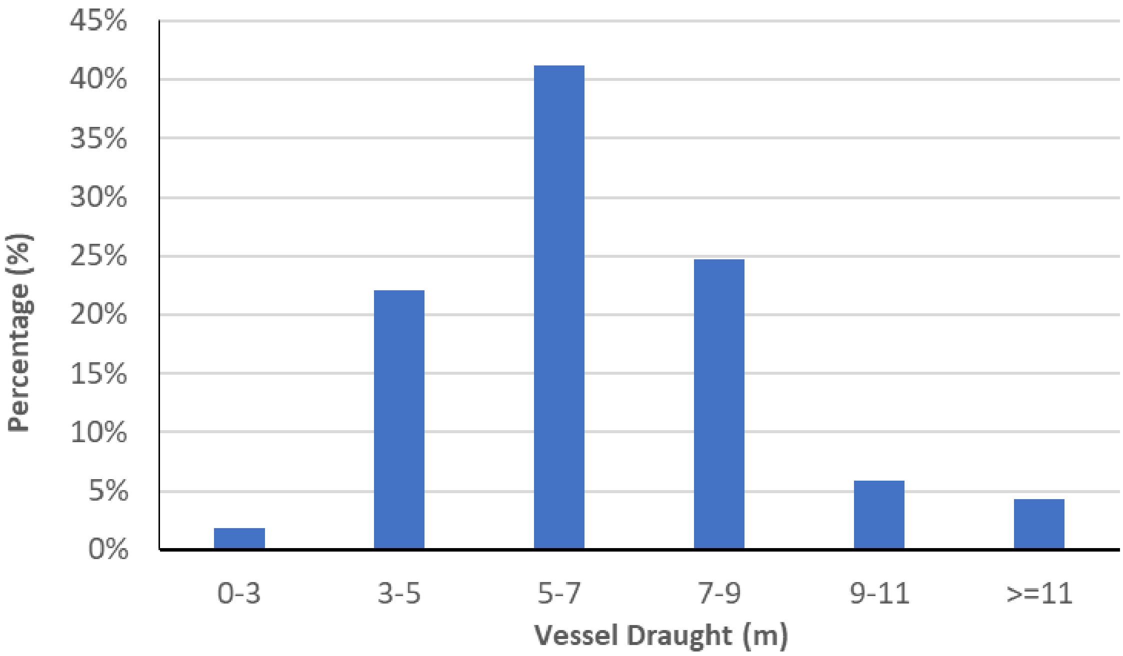


Figure 10-31 Vessel Draught Distribution (Offshore ECC, 2024)

218. Of vessels with a valid broadcast vessel draught, the average draught recorded was 6.6m. Vessel draught ranged from 1.8m for a wind farm support vessel to 20.4m for a crude oil tanker. The greatest range of vessels draught was between 5 to 7m (41%) and mainly comprised of commercial vessels.

219. Less than 5% of vessels had a vessel draught greater than 11m and mainly consisted of crude oil tankers and bulk cargo vessels. The crude oil tanker with the greatest draught was the one of the two vessel recorded with a draught greater than 14m.

11 Base Case Vessel Routeing

11.1 Definition of a Main Commercial Route

220. Main commercial routes have been identified using the principles set out in MGN 654 (MCA, 2021). Vessel traffic data are assessed and vessels transiting at similar headings and locations are identified as a main route. To help identify main routes, vessel traffic data can also be interrogated to show vessels (by name and / or operator) that frequently transit those routes. The route width is then calculated using the 90th percentile rule from the median line of the potential shipping route as shown on **Figure 11-1**. It is noted that the presence of DBC has been accounted for when defining mean positions of routes as the construction buoyage was not implemented at the time of the dedicated survey data collection. The mean route positions have therefore been based on Anatec's experience and professional judgement, with weight given to the 2024 AIS data (which was recorded after DBC construction buoyage deployment) where necessary.

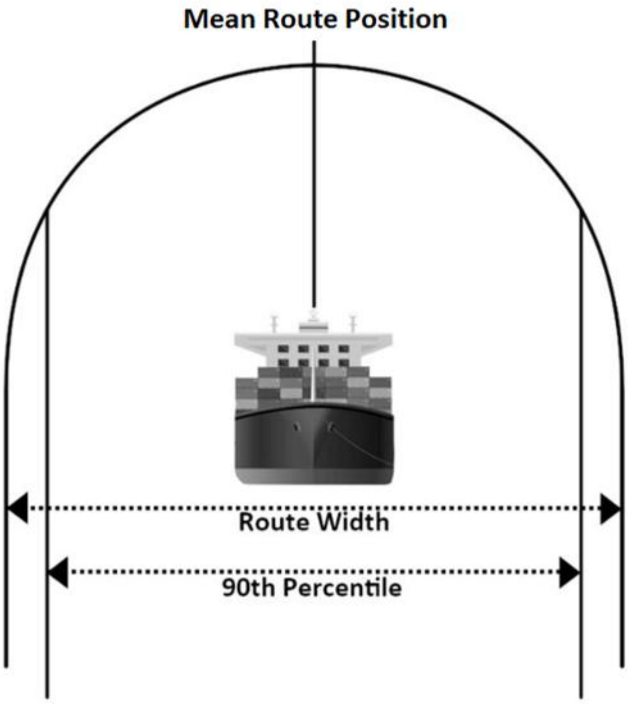


Figure 11-1 Illustration of a Main Route Calculation

11.2 Pre-Wind Farm Main Commercial Routes

221. A total of seven main commercial routes were identified within the Study Area from the vessel traffic data i.e. the pre-wind farm scenario. These main commercial routes and corresponding 90th percentiles within the Study Area are shown relative to the Array Area on **Figure 11-2**. Following this, a description of each route is provided in

Table 11-1, including the average number of vessels per week, start and end locations and main vessel types. Again, no commercial ferries were present on any routes.

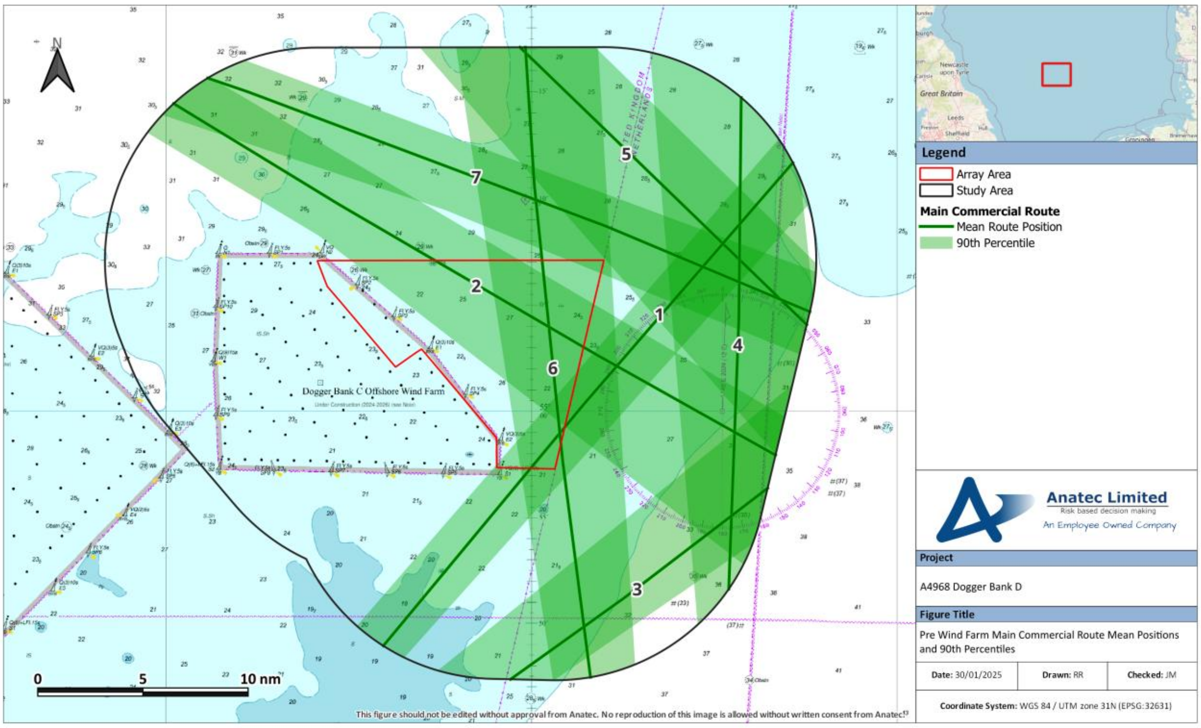


Figure 11-2 Pre-Wind Farm Main Commercial Route Mean Positions and 90th Percentiles

Table 11-1 Main Commercial Route Details

Route Number	Vessels per Week	Route Details
1	5	**Between Humber ports and ports in Norway.** Mainly consists of cargo vessels (69%) and tankers (21%).
2	4	**Between Forth ports and ports in Germany.** Mainly consists of tankers (41%), cargo vessels (32%).
3	3	**Between Humber ports and ports in Denmark.** Mainly consists of cargo vessels (95%).
4	2 to 3	**Between Rotterdam and ports in Norway.** Consists of tankers (72%) and cargo vessels (28%).
5	2 to 3	**Between German ports and the Pentland Firth.** Consists of tankers (50%), cargo vessels (43%).
6	2	**North Sea oil and gas locations to ports in the Netherlands and Belgium.** Mainly consist of cargo vessels (54%) and oil and gas vessels (36%); only operating one way.
7	1	**Between Forth ports and ports in Germany.** Mainly consists of cargo vessels (57%) and tankers (30%).

12 Adverse Weather Routeing

222. Some vessels and vessel operators may operate alternative routes during periods of adverse weather. This section focuses on vessel movements in adverse weather. This takes into consideration the implications of a scenario when a commercial vessel is unable to make passage, or a small craft is unable to access safe havens in adverse weather due to the presence of the Project or activities associated with the Project.

223. Adverse weather includes wind, wave, and tidal conditions as well as reduced visibility due to fog that may hinder a vessel's standard route, speed of navigation and / or ability to enter the destination port. Adverse weather routes are assessed to be significant course adjustments to mitigate vessel motion in adverse weather conditions. When transiting in adverse weather conditions, a vessel is likely to encounter various types of weather and tidal phenomena, which may lead to severe roll motions, potentially causing damage to cargo, equipment and / or discomfort and danger to persons on board. The sensitivity of a vessel to these phenomena depends upon the actual stability parameters, hull geometry, vessel type, vessel size, and speed.

12.1 Identification of Periods of Adverse Weather

224. The vessel traffic survey data has been checked for instances of adverse weather. Based on the weather log maintained by the on-site survey vessel, the sea state was rough from 24 to 25 July and from 30 to 31 July, but the vessel was able to remain on site. The sea state was also recorded to be rough while the survey vessel was leaving site at the end of the 14-day period.

225. Historical weather information provided by the Met Office (Met Office, 2024) has been analysed to identify periods of adverse weather during the 14-day survey period in July / August 2023 as well as the AIS only 2024 data. By investigating such identified periods, cases where routes may have been altered or cancelled can then be identified. However, no key weather events were identified which overlap with the datasets.

12.2 Adverse Weather Effects of Vessel Traffic

226. The vessel traffic data was assessed for any vessel movements which could be associated with periods of adverse weather. This analysis along with consultation has been used to identify potential commercial routeing activity related to adverse weather conditions in proximity to the Project. A focus is usually on periods of key weather events and commercial ferries (which can be seen to make similar transits on a very regular basis) studied most closely. However, no commercial ferries were recorded within the Study Area and no key weather events were identified. Additionally, as part of the Regular Operator consultation, Regular Operators identified from the long-term vessel traffic data were asked "*Whether the presence*

of the Project poses any safety concerns to your vessels, including in relation to adverse weather routeing" (**Annex C**) and no Regular Operator provided any feedback in relation to adverse weather effects on their operations.

13 Cumulative Overview

227. Cumulative effects have been considered for activities in combination and cumulatively with the Project. This section provides an overview of cumulative developments screened into the cumulative risk assessment based on the criteria outlined in **Section 3.4**.

228. The outputs of the cumulative risk assessment are then provided in **Section 19**.

13.1 Offshore Wind Farm Developments

229. In addition to the Project, there are several other proposed offshore wind farm projects located in the North Sea.

230. Operational or under construction offshore wind farms in proximity to the Project are part of the baseline assessment. These include DBA, DBB, DBC, and Sofia.

231. The closest, and only, screened in development to the Project is the Dogger Bank South (DBS) Project, located approximately 39nm (72km) south-west of the Array Area. Relevant developments within 50nm (93km) of the Array Area are detailed in **Table 13-1** along with their associated tier based on the criteria outlined in **Section 3.4**. Following this, these developments are illustrated on **Figure 13-1**.

Table 13-1 Cumulative Screening Summary for Offshore Wind Farm Developments

Project	Status (as of December 2024)	Distance to Array Area (nm)	Distance to Offshore ECC (nm)	Data Confidence	Tier
Dogger Bank South	Consent Application Submitted	39.2	0	High	2
Dogger Bank C	Under Construction	0	0	High	Baseline
Sofia	Under Construction	10.7	0	High	Baseline
Dogger Bank B	Under Construction	24.4	0	High	Baseline
Dogger Bank A	Under Construction	29.4	0	High	Baseline

* Distances are measured between the appropriate element of the Project and all offshore elements of the potential cumulative developments (inclusive of export cables).

232. For completeness, non-baseline offshore wind farm developments located in the region but beyond the limit of 50nm (93km) (and therefore beyond the Tier 2 and 3 buffer distance) from the Array Area include the two consented Hornsea Offshore Wind Farm projects with the closest point approximately 58nm (107km) to the south.

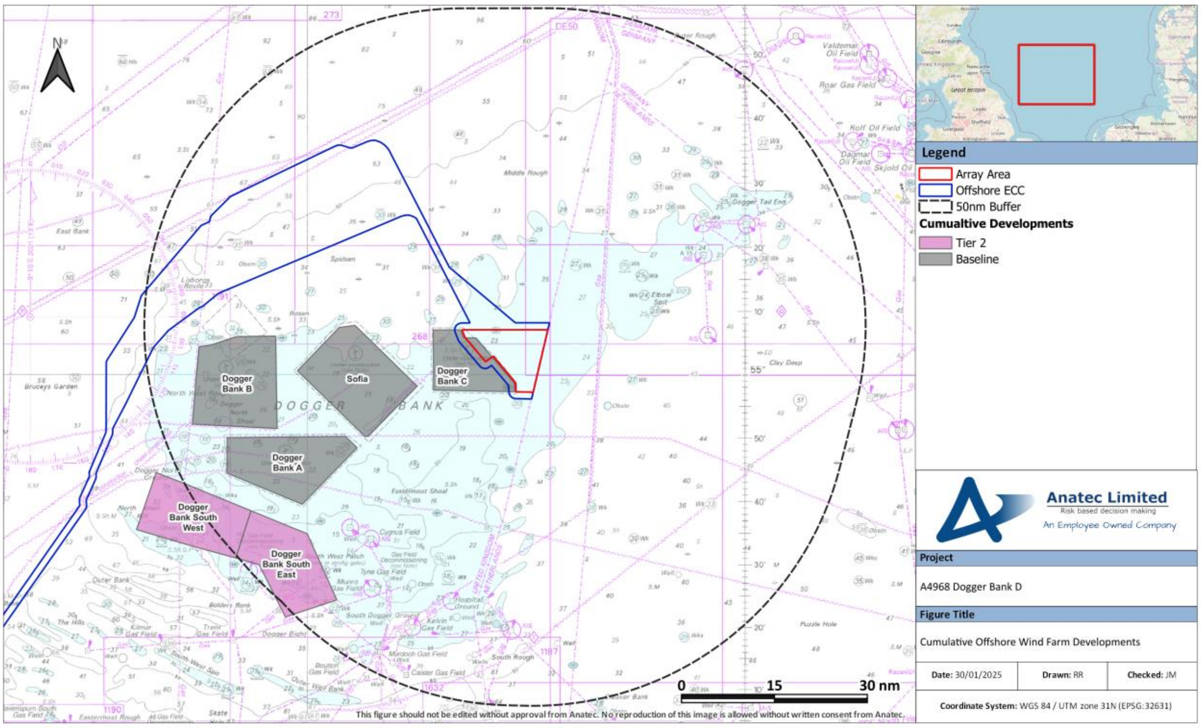


Figure 13-1 Cumulative Offshore Wind Farm Developments

13.2 Other Cumulative Developments

233. It is noted that no sub-sea pipelines or cables, oil and gas infrastructure, marine aggregate dredging areas, port developments, or wave / tidal developments have been screened into the cumulative assessment. This is due either to any identified projects already being operational or active (and thus part of the baseline assessment) or no clear pathway through which a potentially significant hazard relating to Shipping and Navigation may arise.

234. This includes Eastern Greenlink 3 and 4 which are anticipated to cross the Offshore ECC but are assumed to be subject to the same cable burial risk assessment mitigation which is applicable to the Project (Section 21). Therefore, there is no clear pathway in this instance.

14 Future Case Vessel Traffic

235. The vessel traffic baseline established in **Section 10** is used as input into the risk assessment (**Section 18**). However, it is also necessary to consider potential future case vessel traffic in terms of general volume and size changes, port developments which may influence movements, and changes to movements associated with the presence of the Project (the post-wind farm scenario).

236. The following subsections outline the future case scenarios which have been used to inform the risk assessment, and which has also been applied to the collision and allision risk modelling in **Section 16**.

14.1 Increases in Commercial Vessel Activity

237. Given future commercial traffic trends are dependent on various factors, and are hence difficult to predict, the NRA has assumed potential increases of 10% and 20% within the commercial traffic collision and allision modelling. The consideration of a range of conservative values is considered as covering potential increases over the course of the Project's operational lifespan.

238. These values also consider that oil and gas vessels may decrease over time due to the decommissioning of oil and gas structures in the North Sea.

14.2 Increases in Commercial Fishing Activity

239. Indicative 10% and 20% increases in commercial fishing vessel transits have been considered in the modelling undertaken within the NRA. These values are used due to there being limited reliable information on future activity levels upon which any firm assumption can be made. Should the Dogger Bank SAC be revoked in the future then increases may be greater but at the time of writing there is no firm bass for considering this scenario. It is noted that additional information on commercial fishing trends is contained within **Volume 1, Chapter 14 Commercial Fisheries**.

14.3 Increases in Recreational Activity

240. There are no known developments which will increase the activity of recreational vessels within the area. Therefore, as with commercial fishing activity, given the lack of reliable information relating to future trends, 10% and 20% increases are considered conservative, and therefore been applied.

14.4 Increase Associated with Project Activities

241. The anticipated number of vessels associated with the Project during the construction and O&M phases are presented in **Section 6.5**. Base ports have not yet been determined for any phase of the Project and therefore it is not possible to provide any detailed overview of the likely pattern of project vessel movements. The

presence of vessels associated with O&M for the neighbouring developments is assumed for the future case, noting that the Dogger Bank O&M Facility is located at the Port of Tyne (see **Section 6.5.2**).

14.5 Commercial Traffic Routeing (Project in Isolation)

14.5.1 Methodology

242. It is not possible to consider all potential alternative routeing options for commercial traffic and therefore alternatives have been based upon worst-case assumptions to ensure exposure to wind farm structures is maximised.

243. Assumptions for re-routeing include:

- All alternative routes maintain a minimum mean distance of 1nm (1.9km) from offshore installations and existing offshore wind farm boundaries in line with industry experience. This distance is considered for Shipping and Navigation from a safety perspective as explained below; and
- All mean routes take into account known routeing preferences including consideration of banks / shallows and AtoNs.

244. Annex 1 of MGN 654 defines a methodology for assessing passing distance from offshore wind farm boundaries, noting that it also states that the methodology is "*not a prescriptive tool but needs intelligent application"* (MCA, 2021).

245. To date, internal and external studies undertaken by Anatec on behalf of the UK Government and individual clients show that vessels do pass consistently and safely within 1nm (1.9km) of established offshore wind farms (including between distinct developments) and these distances vary depending upon the sea room available as well as the prevailing conditions. This evidence also demonstrates that the mariner defines their own safe passing distance based upon the conditions and nature of the traffic at the time, but they are shown to frequently pass 1nm (1.9km) off established developments.

246. The NRA also aims to establish the worst-case scenario based on navigational safety parameters. On this basis the most conservative realistic scenario for vessel routeing is considered to be mean route positions passing 1nm (1.9km) off developments. Evidence collected during numerous assessments at an industry level confirms that it is a safe and reasonable distance for vessels to pass; however, it is likely that a large number of vessels would instead choose to pass at a greater distance depending upon their own passage plan and the current conditions.

14.5.2 Main Commercial Route Deviations

247. The methodology detailed in **Section 14.5.1** has been applied to potential deviations that may arise to the base case routes identified and discussed in **Section 11.2**.

248. An illustration of the anticipated worst-case scenario shift in the mean route positions of the main commercial routes within the Study Area following the development of the Project is presented on **Figure 14-1**.

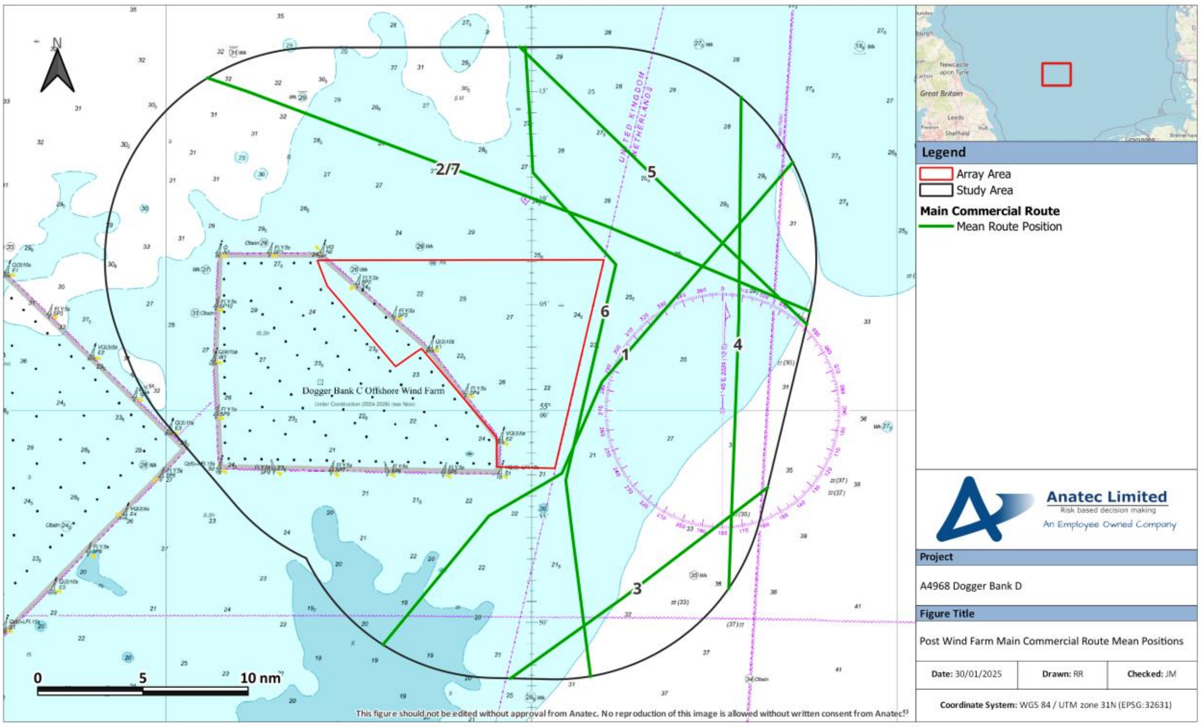


Figure 14-1 Post-Wind Farm Main Commercial Route Mean Positions

249. Deviations of main commercial routes from the pre-wind farm scenario would be required for three of the seven main commercial routes identified, with the greatest deviation required for Route 6; a 0.4% increase in overall route length.

250. Deviated routes are detailed further in **Table 14-1**.

Table 14-1 Summary of Post-Wind Farm Deviated Main Commercial Routes

Route Number	Route Information	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)	Nature of Deviation
1	Humber – Norway	0.4	0.1	Deviated slightly south-east of DBD.
2	Forth ports - Germany	0.6	0.2	Deviated across the north and to the east of DBD to match Route 7 (which shares the same main port destinations).

Route Number	Route Information	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)	Nature of Deviation
6	North Sea Oil and Gas – Netherlands / Belgium	1.7	0.4	Deviated to the east of DBD.

14.6 Commercial Traffic Routeing (Cumulative)

251. An illustration of the anticipated worst-case shift in the mean positions of the main commercial routes within the 50nm (93km) buffer following the development of the Project and the only Tier 1 or Tier 2 cumulative project (**Section 13.1**) is presented on **Figure 14-2**. Again, these deviations are based on Anatec's assessment of the worst-case scenario and follow the same methodology outlined for deviations due to the Project in isolation (**Section 14.5.1**).

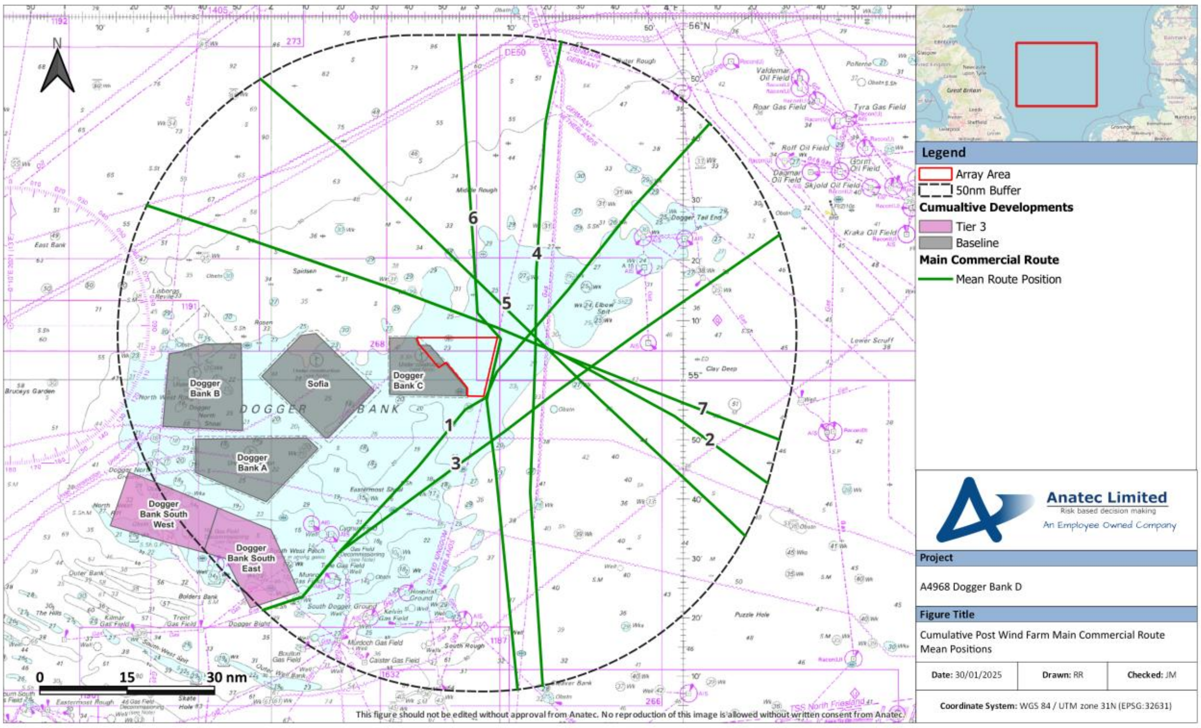


Figure 14-2 Cumulative Post-Wind Farm Main Commercial Route Mean Positions

252. At a cumulative level, deviations would be required for four of the seven main commercial routes identified in the pre-wind farm scenario.

253. Of these four deviations, two are identical to the post-wind farm in isolation scenario, i.e. the presence of DBS does not further increase the deviation (Route 2 and Route 6). One of these route deviations (Route 3) is also not affected by the Project in isolation and a deviation is only required with the presence of DBS. Route 1 is already

deviated in isolation but would require further deviation due to the presence of DBS. This increases the route deviation by a further 0.6nm (1km), taking the total increase in route length to 0.3%.

254. **Table 14-2** provides a summary of the cumulative effect on the deviations of main commercial routes.

Table 14-2 Summary of Post-Wind Farm Cumulative Deviated Main Commercial Routes

Route Number	Route Information	Increase in Route Length (nm)	Percentage Change in Total Route Length (%)	Nature of Deviation
1	Humber –Norway	1.1	0.3	Deviated slightly south-east of DBD and south of DBS.
2	Forth ports – Germany	0.6	0.2	As per isolation: Deviated across the north and to the east of DBD to match Route 7 (which shares the same main port destinations).
3	Humber –Denmark	0.6	0.2	Deviated slightly south of DBS but unaffected by DBD.
6	North Sea Oil and Gas – Netherlands / Belgium	1.7	0.4	As per isolation: Deviated to the east of DBD.

15 Navigation, Communication, and Position Fixing Equipment

255. This section discusses the potential effects on the use of navigation, communication and position fixing equipment of vessels that may arise due to the infrastructure associated with the Project.

15.1 Very High Frequency Communications (including Digital Selective Calling)

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

257. The wind turbines had no noticeable effect on voice communications within the array 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 wind turbines, then it is reasonable to assume that larger vessels with higher powered and more efficient systems would also be unaffected.

258. During this trial, a number of telephone calls were made from ashore, both within and offshore of the array. No effects were recorded using any system provider (MCA and QinetiQ, 2004).

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

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

261. Following consideration of these reports and noting that since the trials detailed above there have been no significant issues with regards to VHF observed or reported, the presence of the Project is anticipated to have no significant impact upon VHF communications.

15.2 Very High Frequency Direction Finding

262. During the North Hoyle trials in 2004, the VHF Direction Finding (DF) equipment carried in the trial boats did not function correctly when very close to wind turbines (within approximately 50m). This is deemed to be a relatively small-scale impact due

to the limited use of VHF direction finding equipment and will not impact operational or SAR activities (MCA and QinetiQ, 2004).

263. Throughout the 2005 SAR trials carried out at North Hoyle, the Sea King radio homer system was tested. The Sea King radio homer system utilises 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 1nm (1.9km), the homer system operated as expected with no apparent degradation.

264. Since the trials detailed above, no significant issues with regards to VHF DF have been observed or reported, and therefore the presence of the Project is anticipated to have no significant impact upon VHF DF equipment.

15.3 Automatic Identification System

265. No significant issues with interference to AIS transmission from operational offshore wind farms have been observed or reported to date. Such interference was also absent in the trials carried out at North Hoyle (MCA and QinetiQ, 2004).

266. In theory there could be interference when there is a structure located between the transmitting and receiving antennas (i.e. blocking line of sight) of the AIS. However, given no issues have been reported to date at operational developments or during trials, no significant impact is anticipated due to the presence of the Project.

15.4 Navigational Telex System

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

268. There are two NAVTEX frequencies. All transmissions on NAVTEX 518 Kilohertz (kHz), the international channel, are in English. NAVTEX 518 kHz 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.

269. The 490 kHz national NAVTEX service may be transmitted in the local language. In the UK full use is made of this secondary frequency including useful information for smaller craft, such as the inshore waters forecast and actual weather observations from weather stations around the coast.

270. Although no specific trials have been undertaken, no significant effect on NAVTEX has been reported to date at operational developments, and therefore no significant impact is anticipated due to the presence of the Project.

15.5 Global Positioning Service

271. 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*".

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

273. Therefore, there are not expected to be any significant impacts associated with the use of GPS systems within or in proximity to the Project, noting that there have been no reported issues relating to GPS within or in proximity to any operational offshore wind farms to date.

15.6 Electromagnetic Interference

274. 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 magnetised 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.

275. 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 as a secondary source, it is important that potential impacts from electromagnetic fields (EMF) are minimised to ensure continued safe navigation.

276. The vast majority of commercial traffic uses non-magnetic gyrocompasses as the primary means of navigation, which are unaffected by EMF. Therefore, it is considered highly unlikely that any interference from EMF as a result of the presence the Project will have a significant impact on vessel navigation. However, some smaller craft (fishing or leisure) may rely on it as their sole means of navigation but there was only a limited number of small craft recorded within proximity to the Array Area as illustrated in **Section 10.1**.

15.6.1 Subsea Cables

277. The subsea cables for the Project will be Alternating Current (AC) or Direct Current (DC), with studies indicating that AC does not emit an EMF significant enough to impact marine magnetic compasses (Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), 2008). Therefore, electromagnetic interference due to cables associated with the Project are not considered any further.

278. For DC cables, the Moray Offshore Renewables Environmental Statement (Moray Offshore Renewables, 2012) notes that for both buried and protected DC cables the magnetic field would decrease exponentially with vertical distance from the seabed and with horizontal distance from the cables (within a few metres), irrespective of whether cables are buried or protected. It states that "*in all cases, where cables are buried to 1m depth, the predicted magnetic field is expected to be below the earth's magnetic field (assumed to be 50 microtesla (µT)). Where DC cables cannot be buried and are instead protected, the magnetic field is expected to be below the earth's magnetic field within 5m from the seabed*".

279. The following are therefore considered to be important factors affecting the likelihood of EMF to affect compass deviation as a result of the presence of cables:

- Water depth;
- Burial depth (or protection);
- Type of current (alternating or direct) running through the cables; and / or
- Spacing or separation of the cables.

280. **Table 15-1** details assumed EMF mitigation relating to offshore export cables, noting that such an analysis is not provided for inter-array or interconnector cables since these will be entirely contained within the Array Area and therefore are not expected to be subject to regular navigation by third-party vessels.

Table 15-1 EMF Mitigation

Mitigation	Reasoning	Percentage of Offshore ECC Applied To
Cables are installed in close proximity / bundled	Industry experiences in cable installation and offshore renewables show that bundled cables or cables closely installed mitigate the effects of EMF (NorthConnect, 2018).	100%
Water depth greater than 10m	Increased water depth (vertical distance) mitigates the effects of EMF.	Approximately 99.5% is within depths greater than 10m below CD.
Water depth greater than 20m	Increased water depth (vertical distance) mitigates the effects of EMF.	Approximately 98.7% is within depths greater than 20m below CD.
Cable burial	Burial depth also increases vertical distance.	At least 80% of offshore export cables will be buried.
Cable route alignment relative to passing traffic	Vessel movements crossing the cables rather than transiting along the cables minimises the temporal effect of EMF.	There are limited instances of vessels navigating along the route of the Offshore ECC. Cases of transits following the route of the Offshore ECC are primarily associated with cargo vessels and tankers further offshore where the Offshore ECC widens, but transits were spatially limited

Mitigation	Reasoning	Percentage of Offshore ECC Applied To
		as only occurred over a small area when passing across the offshore ECC.
Width of cables	DC cables produce static magnetic fields, which decrease with (horizontal) distance from the offshore ECC. Therefore, assuming 200m indicative width between two DC cables buried side by side, compass interference would potentially only be experienced directly above or in direct proximity to the cables, noting again effects decrease quickly with horizontal distance.	100% given the effects will only be present when vessels are directly over the cables or in very close proximity (within metres).
Compass deviation study undertaken preconstruction	MCA request a maximum three-degree deviation for 95% of the route and no more than five-degrees for the remaining 5% is acceptable.	100%

281. Given that all offshore export cables will be buried and more than 99% will be located in water depths of greater than 10m, there are not anticipated to be any effects on compass deviation for the majority of the offshore ECC. This will be verified by the compass deviation study to comply with any MCA requirements post-consent.

15.6.2 Wind Turbines

282. MGN 654 (MCA, 2021) notes that small vessels with simple magnetic steering and hand bearing compasses should be wary of using these close to wind turbines as with any structure in which there is a large amount of ferrous material (MCA and QinetiQ, 2004). Potential effects are deemed to be within acceptable levels when considered alongside other mitigation such as the mariner being able to make visual observations (not wholly reliant on the magnetic compass), lighting, sound signals and identification marking in line with MGN 654.

15.6.3 Experience at Operation Offshore wind farms

283. No issues with respect to magnetic compasses have been reported to date in any of the trials (MCA and QinetiQ, 2004) undertaken (inclusive of SAR helicopters) nor in any published reports from operational offshore wind farms.

15.7 Marine Radar

284. This section summarises the results of trials and studies undertaken in relation to Radar effects from offshore wind farms in the UK. It is important to note that since the time of the trials and studies discussed, wind turbine technology has advanced significantly, most notably in terms of the size of wind turbine available to be installed

and utilised. The use of these larger wind turbines allows for a greater spacing between wind turbines than was achievable at the time of the studies being undertaken, which is beneficial in terms of Radar interference effects (and surface navigation in general) as detailed below.

15.7.1 Trials

285. During the early years of offshore renewables within the UK, maritime regulators undertook a number of trials (both shore-based and vessel-based) into the effects of wind turbines on the use and effectiveness of marine Radar.

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

287. 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 1.5nm (2.8km)) 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 on **Figure 15-1**.

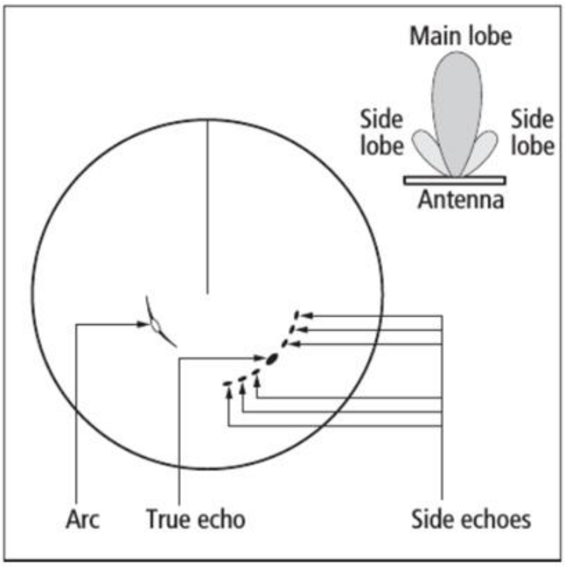


Figure 15-1 Illustration of Side Lobes on Radar Screen

288. 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 on **Figure 15-2**.

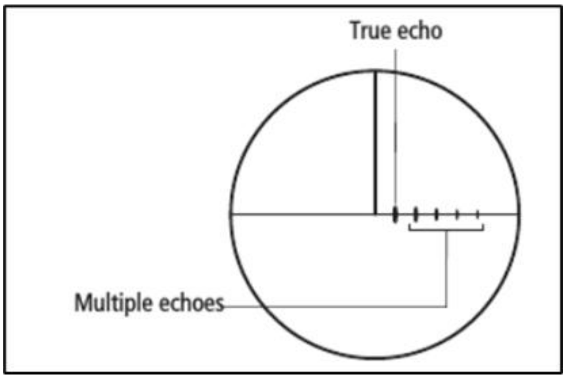


Figure 15-2 Illustration of Multiple Reflected Echoes on Radar Screen

289. Based on 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 established between shipping routes and offshore wind farms. However, as experience of effects associated with use of marine Radar in proximity to offshore wind farms grew, the MCA refined their guidance, offering more flexibility within the most recent Shipping Route Template contained within MGN 654 (MCA, 2021).

290. A second set of trials conducted at Kentish Flats offshore wind farm in 2006 on behalf of the British Wind Energy Association (BWEA) – now called RenewableUK (BWEA, 2007) – also found that Radar antennas which are sited unfavourably with respect to components of the vessel's structure can exacerbate 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 (GRP) constructed craft; therefore, due care should be taken in making such adjustments.

291. 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, on marine Radar systems was undertaken by the Atlantic Array project (Atlantic Array, 2012) and considered a wider spacing of wind turbines than that considered within the early trials. The main outcomes of the modelling were the following:

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

- Overall, it was concluded that the amount of shadowing observed was very little (noting that the model considered lattice-type foundations which are sufficiently sparse to allow Radar energy to pass through);
- The lower the density of wind turbines the easier it is to interpret the Radar returns and fewer multipath ambiguities are present;
- In dense, target rich environments S-Band Radar scanners suffer more severely from multipath effects in comparison to X-Band Radar scanners;
- It is important for passing vessels to keep a reasonable separation distance between the wind turbines in order to minimise the effect of multipath and other ambiguities;
- The Atlantic Array study undertaken in 2012 noted that the potential for 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 proximity (those without AIS installed which are usually fishing and recreational craft). It is noted that this situation would arise with or without wind turbines in place; and
- There is potential for the performance of a vessel's ARPA to be affected when tracking targets in or near the array. Although greater vigilance is required, during the Kentish Flats trials it was shown that false targets were quickly identified as such by the mariners and then by the equipment itself.

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

293. The MCA has also produced guidance to mariners operating in proximity to OREIs in the UK which highlights Radar issues amongst others to be taken into account when planning and undertaking voyages in proximity to OREIs (MCA, 2008a). The interference buffers presented in **Table 15-2** are based on MGN 654 (MCA, 2021), MGN 371 (MCA, 2008a), MGN 543 (MCA, 2016) and MGN 372 (MCA, 2008b).

Table 15-2 Distance at which Impacts of Marine Radar Occur

Distance at which effect occurs (nm)	Identified effects
0.5	▪ Intolerable impacts can be experienced. ▪ X-Band Radar interference is intolerable under 0.25nm (0.5km). ▪ Vessels may generate multiple echoes on shore-based Radars under 0.45nm (0.8km).

Distance at which effect occurs (nm)	Identified effects
1.5	▪ Under MGN 654, impacts on Radar are considered to be tolerable with mitigation between 0.5 and 3.5nm (0.9 to 5km). ▪ S-band Radar interference starts at 1.5nm (2.8km). ▪ Echoes develop at approximately 1.5nm (2.8km), 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 wind turbines. ▪ The wind turbines produce strong Radar echoes giving early warning of their presence. ▪ Target size of the wind turbine echo increases close to the wind turbine with a consequent degradation on both X and S-Band Radars.

294. As noted in **Table 15-2**, the onset range from the wind turbines of false returns is approximately 1.5nm (2.8km), with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of the International Regulations for Preventing Collisions at Sea 1972 (COLREGs) Rule 6 Safe Speed are particularly applicable and must be observed with due regard to the prevailing circumstances (IMO, 1972 / 77). 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 Look-out to take into account information from other sources which may include sound signals and VHF information, for example from a VTS or AIS (MCA, 2016).

15.7.2 Experience from Operational Developments

295. The evidence from mariners operating in proximity to existing offshore wind farms is that they quickly learn to adapt to any effects. **Figure 15-3** presents the example of the Galloper and Greater Gabbard Offshore Wind Farms, which are located in proximity to IMO routeing measures. Despite this proximity to heavily trafficked TSS lanes, there have been no reported incidents or issues raised by mariners who operate within the vicinity. The interference buffers presented on **Figure 15-3** are as per **Table 15-2**.

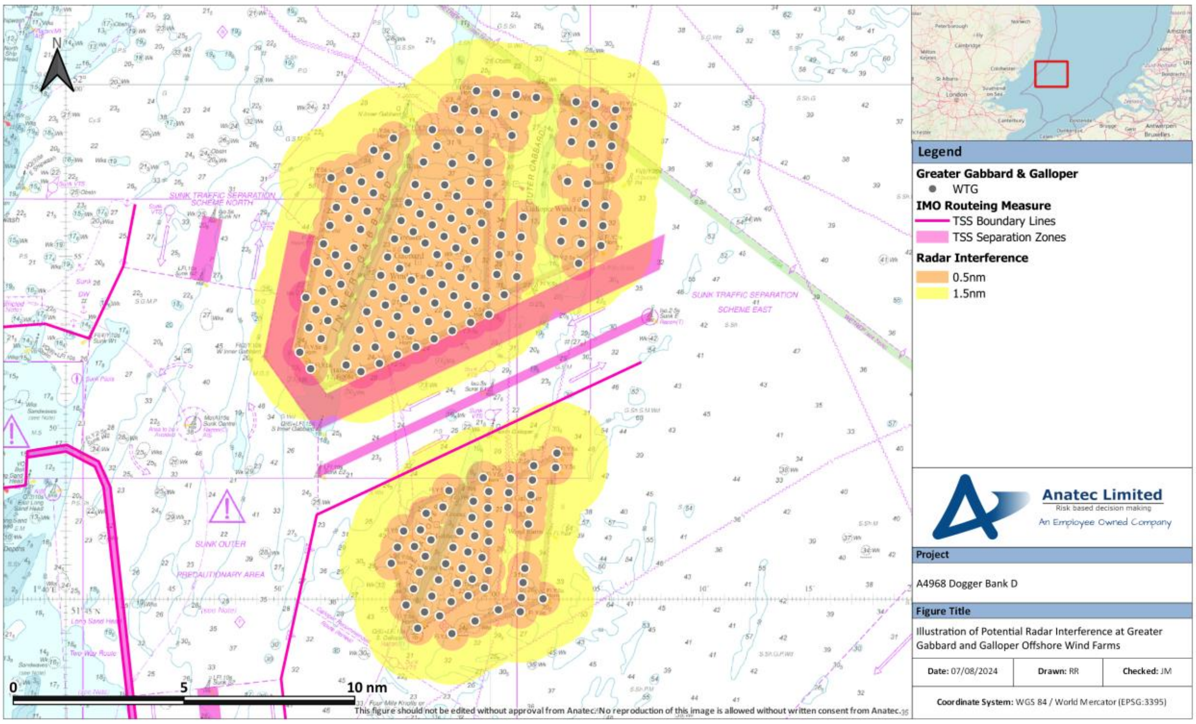


Figure 15-3 Illustration of Potential Radar Interference at Greater Gabbard and Galloper Offshore Wind Farms

296. As indicated by **Figure 15-3**, vessels utilising the TSS lanes will experience some Radar interference based on the available guidance. Both developments are operational, and each of the lanes is used by a minimum of eight 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.

297. AIS information can also be used to verify the targets of larger vessels (generally vessels over 15m LOA – the minimum threshold for fishing vessel AIS carriage requirements). Approximately 4% of the vessel traffic data recorded within the Shipping and Navigation Study Area was under 15m LOA.

298. For any smaller vessels, particularly fishing vessels and recreational vessels, AIS Class B devices are becoming increasingly popular and allow the position of these small craft to be verified when in proximity to an offshore wind farm.

299. **Figure 15-4** presents an illustration of potential Radar interference due to the Project relative to the post-wind farm routeing illustrated in **Section 13**. The Radar effects have been applied to the indicative array layout introduced in **Section 6.2.1**.

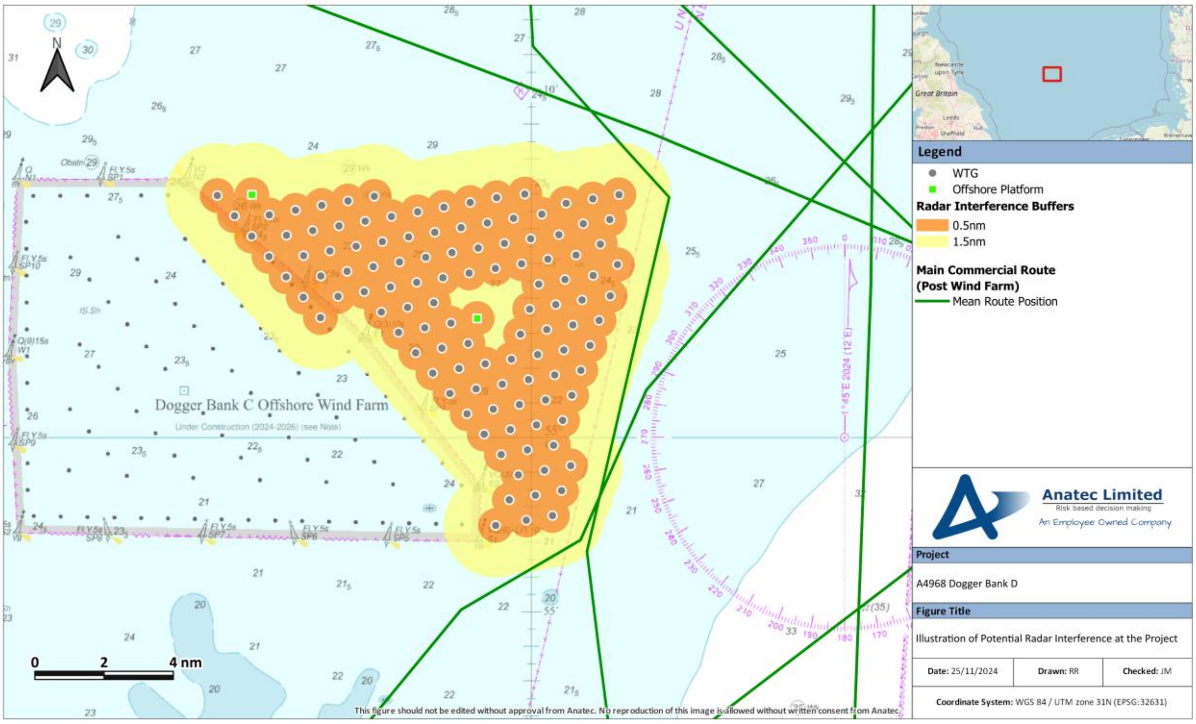


Figure 15-4 Illustration of Potential Radar Interference at the Project

300. Vessels passing within the Array Area will be subject to a greater level of interference with impacts becoming more substantial in close proximity to wind turbines. This will require additional mitigation by any vessels including consideration of the navigational conditions (visibility) when passage planning and compliance with the COLREGs (IMO, 1972 / 77) will be essential.

301. Overall, the impact on marine Radar is expected to be low and no further impact upon navigational safety is anticipated outside the parameters which can be mitigated by operational controls.

15.8 Sound Navigation and Ranging System

302. No evidence has been found to date with regard to existing offshore wind farms to suggest that Sound Navigation Ranging (SONAR) systems 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 presence of the Project.

15.9 Noise

303. No evidence has been found to date with regard to existing offshore wind farms to suggest that prescribed sound signals are in any way impacted by acoustic noise produced by the wind farm.

15.10 Summary of Potential Effects on Use

304. Based on the detailed technical assessment of the effects due to the presence of the Project on navigation, communication and position fixing equipment in the previous subsections, **Table 15-3** summarises the assessment of frequency and consequence and the resulting risk for each component of this hazard.

Table 15-3 Summary of Risk to Navigation, Communication, and Position Fixing Equipment

Topic	Frequency of Occurrence	Severity of Consequence	Significance of Risk
VHF	Negligible	Minor	Broadly Acceptable
VHF direction finding	Extremely Unlikely	Minor	Broadly Acceptable
AIS	Negligible	Minor	Broadly Acceptable
NAVTEX	Negligible	Minor	Broadly Acceptable
GPS	Negligible	Minor	Broadly Acceptable
EMF	Extremely Unlikely	Negligible	Broadly Acceptable
Marine Radar	Remote	Minor	Broadly Acceptable
SONAR	Negligible	Minor	Broadly Acceptable
Noise	Negligible	Minor	Broadly Acceptable

305. On the basis of these findings, associated risks are screened out of the detailed risk assessment undertaken in **Section 18**.

16 Collision and Allision Risk Modelling

306. To inform the risk assessment, a quantitative assessment of some of the major hazards associated with the Project has been undertaken. The following subsections outline the inputs and methodology used for the collision and allision risk modelling.

16.1 Hazards Under Consideration

307. Hazards considered in the quantitative assessment are as follows:

- Increased vessel to vessel collision risk;
- Increased powered vessel to structure allision risk;
- Increased drifting vessel to structure allision risk; and
- Increased fishing vessel to structure allision risk.

308. The pre-wind farm assessment has been informed by the vessel traffic survey data (**Section 10**) and other baseline data sources (such as Anatec's ShipRoutes database). Conservative assumptions have been made with regard to route deviations and future shipping growth over the lifetime of the Project.

309. The methodology for determining the post-wind farm routeing is outlined in **Section 14.5.1** with the subsequent route deviations used throughout this section for post-wind farm modelling.

16.2 Scenarios Under Consideration

310. For each element of the quantitative assessment both a pre and post-wind farm scenario with base and future case vessel traffic levels have been considered. As a result, four distinct scenarios have been modelled:

- Pre-wind farm with base case traffic levels;
- Pre-wind farm with future case traffic levels defined by a:
  - 10% increase in traffic; and
  - 20% increase in traffic.
- Post-wind farm with base case traffic levels; and
- Post-wind farm with future case traffic levels defined by a:
  - 10% increase in traffic; and
  - 20% increase in traffic.

311. The results of the base case scenarios are detailed in full in the following subsections with the equivalent results for the future case scenarios provided in **Section 16.5**.

16.3 Pre-Wind Farm Modelling

16.3.1 Vessel to Vessel Encounters

312. An assessment of current vessel to vessel encounters has been undertaken by replaying at high speed the vessel traffic data collected as part of the vessel traffic survey (**Section 5.2**). The model defines an encounter as two vessels passing within 1nm (1.9km) of each other within the same minute. This helps to illustrate where existing shipping congestion is highest and therefore where offshore developments, such as an offshore wind farm, could potentially increase congestion and therefore also increase the risk of encounters and collision. No account of whether encounters are head on or stern on are given; only close proximity is accounted for.

313. The identified encounters were manually checked to determine whether there were any clear cases of non-genuine encounters (e.g. towing operations). Any such instances have been removed and the final encounters are illustrated on **Figure 16-1**, colour-coded by vessel type.

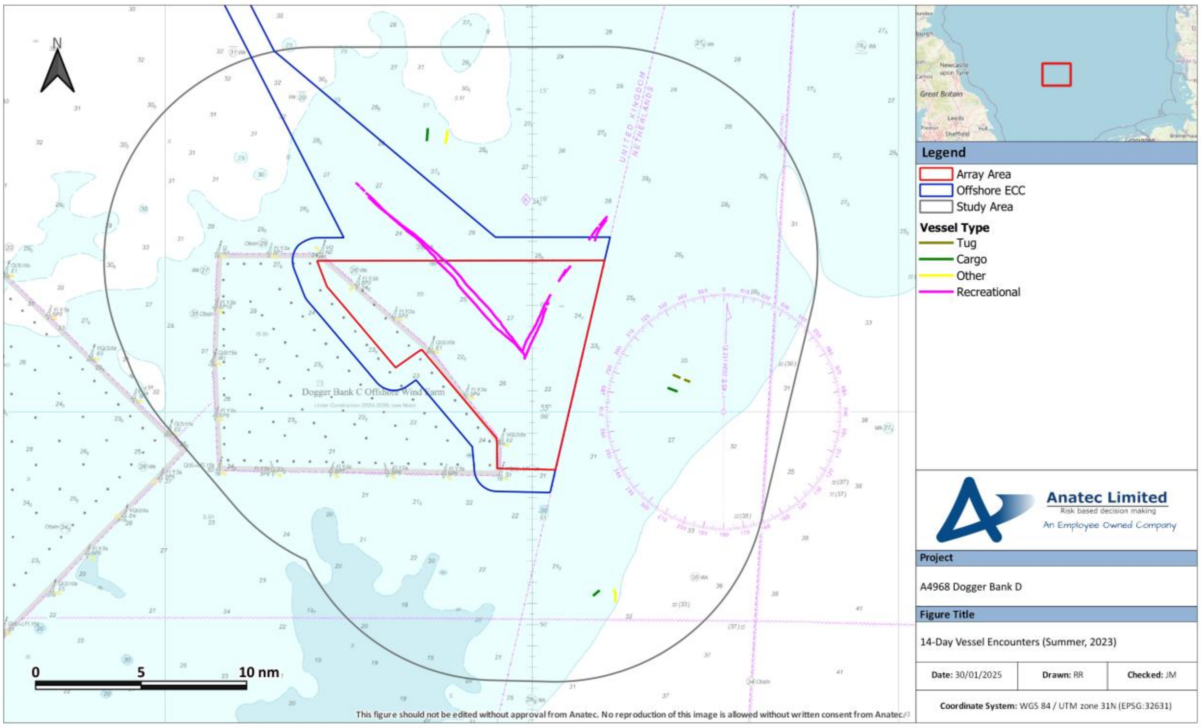


Figure 16-1 14-Day Vessel Encounters (Summer, 2023)

314. A total of five encounters were recorded during the 14-day summer survey period resulting in an average of one encounter every three days within the Study Area.

315. Two of these encounters were related to the two recreational vessels likely tacking through the Array Area as first discussed in **Section 10.1.2.5**. Although still

encountering each other, if these vessels were tacking, the encounters were a result of these vessels purposefully aligning.

316. As for the other three encounters, each instance involved a cargo vessel with the other encountering vessel cable layer, a research vessel and a tug. All three of these encounters were out with the Array Area.

16.3.2 Vessel to Vessel Collisions

317. Using the pre-wind farm vessel routeing as input, Anatec's COLLRISK model has been run to estimate the existing vessel to vessel collision risk in proximity to the Project.

318. A heat map based upon the geographical distribution of collision risk within a 0.5×0.5nm (0.9×0.9km) grid for the base case is presented on **Figure 16-2**.

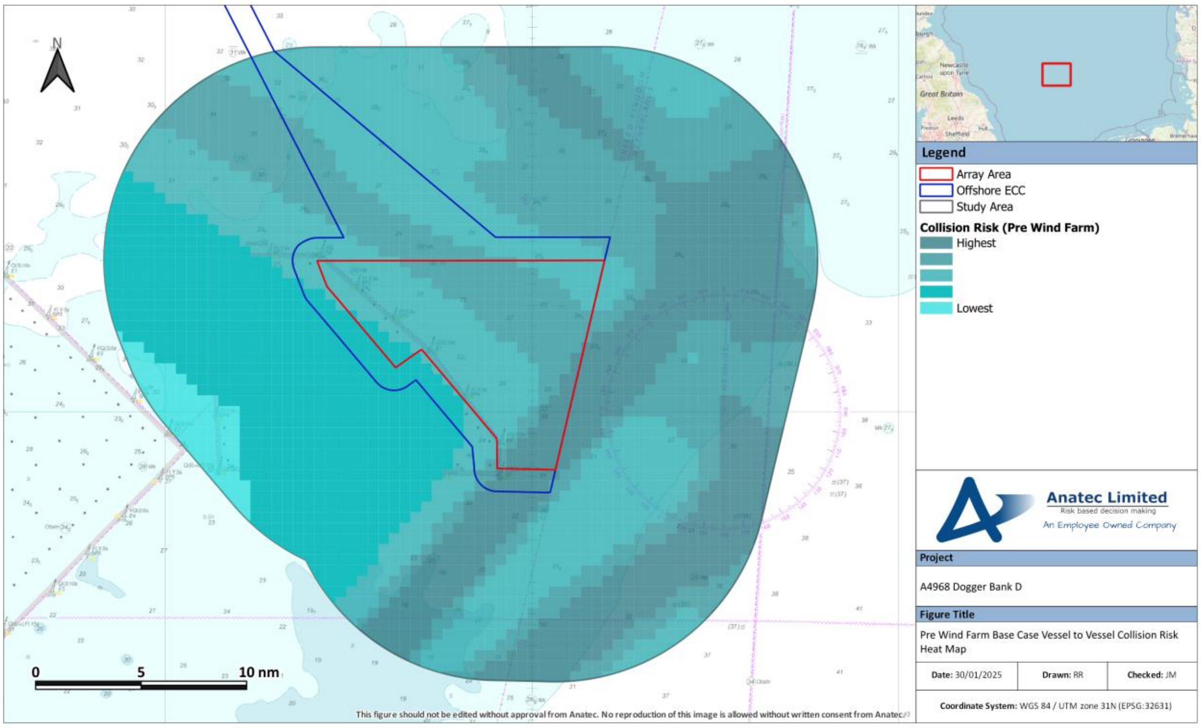


Figure 16-2 Pre-Wind Farm Base Case Vessel to Vessel Collision Risk Heat Map

319. Assuming base case vessel traffic levels, the annual collision frequency pre-wind farm was estimated to be 1.78×10^{-5}, corresponding to a return period of approximately one in 56,177 years. This return period is low compared with other UK offshore wind farm developments and is reflective of the low volume of vessel traffic in the area.

320. It is noted that the model is calibrated based upon major incident data at sea which allows for benchmarking but does not cover all incidents. Other incident data, which includes minor incidents, is presented in **Section 9**.

16.4 Post-Wind Farm Modelling

16.4.1 Simulated Automatic Identification System

321. Anatec's AIS Simulator software was used to gain an insight into the potential re-routed commercial traffic following the installation of the wind farm structures within the Array Area. The AIS Simulator uses the mean positions of identified main commercial routes within the Study Area and the anticipated shift post-wind farm, together with the standard deviations and average number of vessels on each main commercial route to simulate tracks.

322. A plot of 28 days of simulated AIS within the Study Area based on the deviated main commercial routes is presented on **Figure 16-3**.

323. It is noted that the simulated AIS represents a worst-cast scenario based on a mean 1nm (1.9km) passing distance from the Array Area for post-wind farm routes.

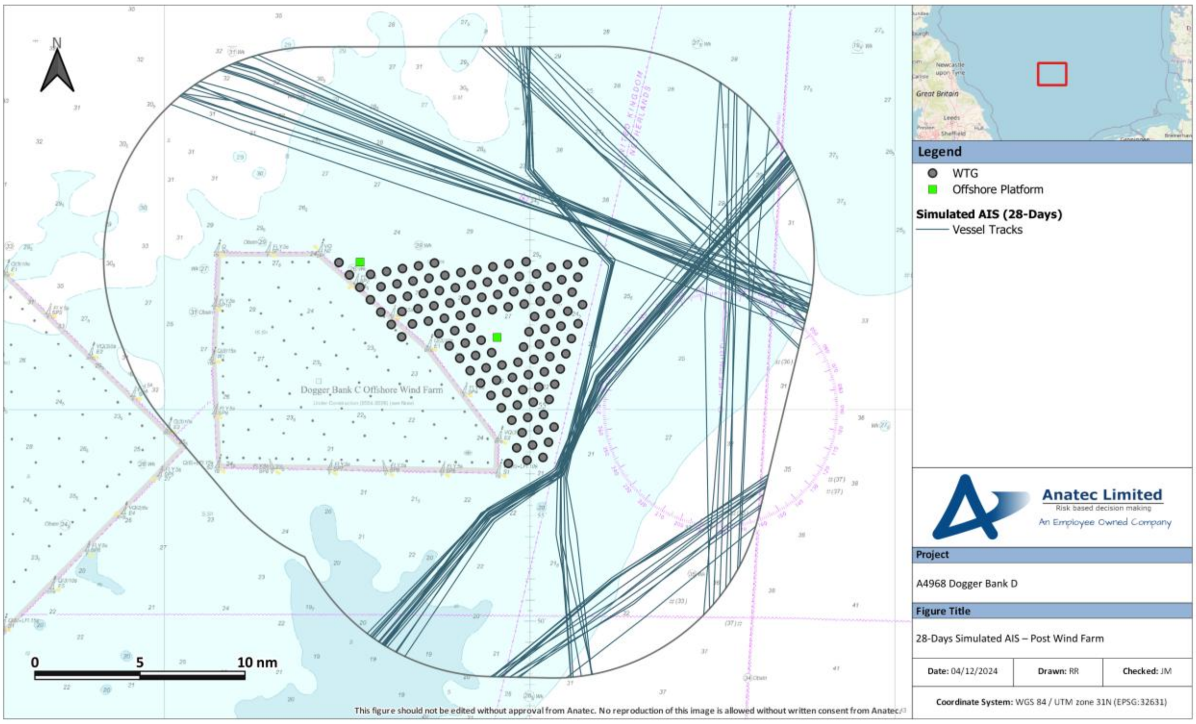


Figure 16-3 28-Days Simulated AIS – Post-Wind Farm

16.4.2 Vessel to Vessel Collisions

324. Using the post-wind farm routeing as input, Anatec's COLLRISK model has been run to estimate the anticipated vessel to vessel collision risk in proximity to the Project.

325. A heat map based upon the geographical distribution of collision risk within a 0.5×0.5nm (0.9×0.9km) grid for the base case is presented on **Figure 16-4**.

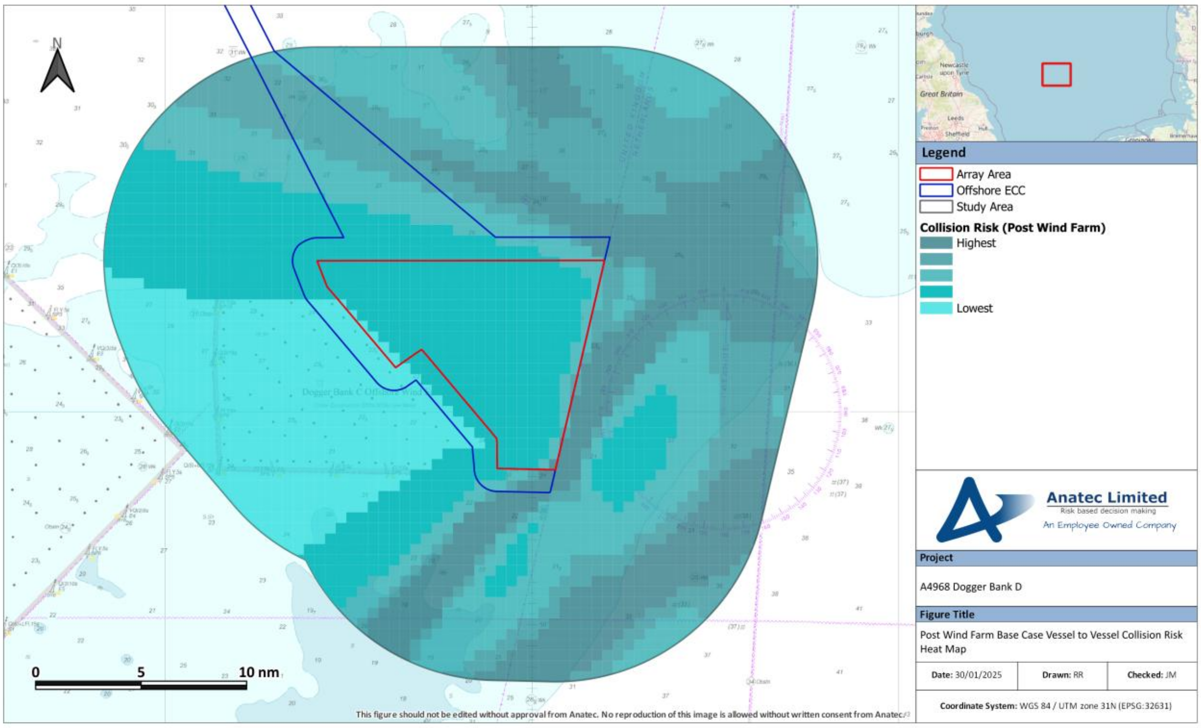


Figure 16-4 Post-Wind Farm Base Case Vessel to Vessel Collision Risk Heat Map

326. Assuming base case vessel traffic levels, the annual collision frequency pre-wind farm was estimated to be 2.23×10^{-5}, corresponding to a return period of approximately one in 44,813 years. This represents a 25% increase in collision frequency compared to the pre-wind farm base case result. However, this frequency is still lower than average for other UK offshore wind farms.

327. The change in vessel to vessel collision risk between the base case pre-wind farm and post-wind farm scenarios is presented in a heat map on **Figure 16-5**.

328. The greatest change in collision risk is associated with the north-east and southern points of the Array Area where the busiest routes are deviated. As the deviations are minor (three deviations no greater than 0.6nm (1km)) the change in collision risk is local to the areas through which these routes pass.

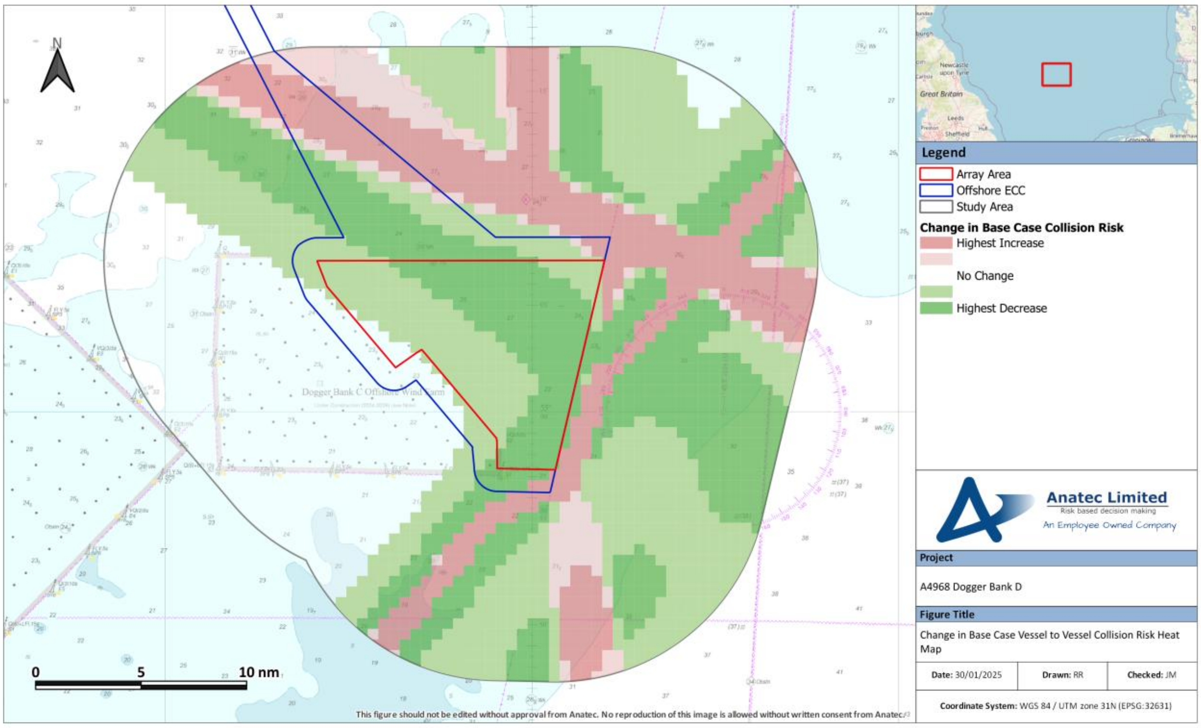


Figure 16-5 Change in Base Case Vessel to Vessel Collision Risk Heat Map

16.4.3 Powered Vessel to Structure Allision Risk

329. Based upon the vessel routeing identified in the Study Area, the anticipated re-routeing as a result of the presence of the Project, and assumptions that relevant commitments are in place (**Section 21**), the frequency of an errant vessel under power deviating from its route to the extent that it came into proximity with a wind farm structure associated with the Project is considered to be low.

330. From consultation with the shipping industry, it is also assumed that commercial vessels would be highly unlikely to navigate between wind farm structures due to the restricted sea room, and so will instead be directed by the aids to navigation located in the region and those present at the Project. During the construction and decommissioning phases this will primarily consist of the buoyed construction / decommissioning area, whilst during the O&M phase this will primarily consist of the lighting and marking of the wind farm structures themselves.

331. Using the post-wind farm routeing as input, together with the worst-case indicative array layout and local meteorological ocean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the wind farm structures within the Array Area whilst under power. In order to maintain a worst-case scenario, the model did not consider one structure shielding another.

332. A plot of the annual powered allision frequency per structure for the base case is presented on **Figure 16-6**, with the chart background removed to increase the visibility of those structures with lower allision frequencies.

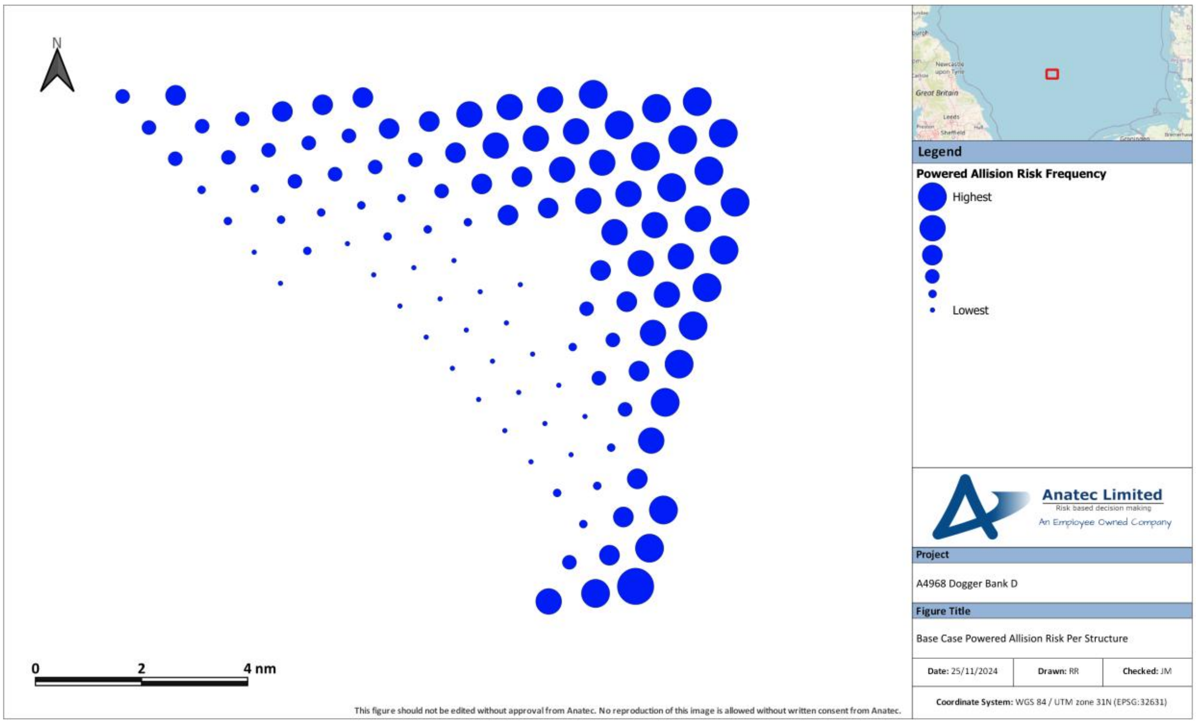


Figure 16-6 Base Case Powered Allision Risk Per Structure

333. Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 9.93×10^{-5}, corresponding to a return period of approximately one in 10,038 years. This return period is lower than the average recorded for powered allision risk in other UK offshore wind farm developments due to the low volume of vessel traffic routeing in proximity to the Array Area.

334. The greatest powered vessel to structure allision risk was associated with structures at the southern extent of the Array Area. The greatest individual powered allision risk was associated the wind turbine on the south-east corner (approximately 2.23×10^{-5} or one in 44,830 years). This is where the busiest main commercial route is deviated slightly south around this corner of the Array Area.

16.4.4 Drifting Vessel to Structure Allision Risk

335. Using the post-wind farm routeing as input, together with the worst-case indicative layout and local meteorological ocean data, Anatec's COLLRISK model was run to estimate the likelihood of a drifting commercial vessel alliding with one of the wind farm structures within the Array Area. The model is based on the premise that propulsion on a vessel must fail before drifting will occur. The model takes account of the type and size of the vessel, the number of engines and the average time

required to repair but does not consider navigational errors caused by human actions.

336. The exposure times for a drifting scenario are based upon the vessel hours spent in proximity to the Array Area (up to 10nm (19km) from the Array Area). These have been estimated based on the vessel traffic levels, speeds, and revised routeing patterns. The exposure is divided by vessel type and size to ensure that these specific factors, which based upon analysis of historical incident data have been shown to influence incident rates, are taken into account for the modelling.

337. Using this information, the overall rate of mechanical failure in proximity to the Array Area was estimated. The probability of a vessel drifting towards a wind farm structure and the drift speed are dependent on the prevailing wind, wave, and tidal conditions at the time of the incident. Therefore, three drift scenarios were modelled, each using the meteorological ocean data provided in **Section 8**:

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

338. The probability of vessel recovery from drift is estimated based upon the speed of the drift and hence the time available before arriving at a wind farm structure. Vessels which do not recover within this time are assumed to allide. Conservatively, no account is made for another vessel (including a project vessel) rendering assistance.

339. After modelling the three drifting scenarios, it was established that the wind dominated scenario produced the worst-case results. A plot of the annual powered allision frequency per structure for the base case is presented on **Figure 16-7**.

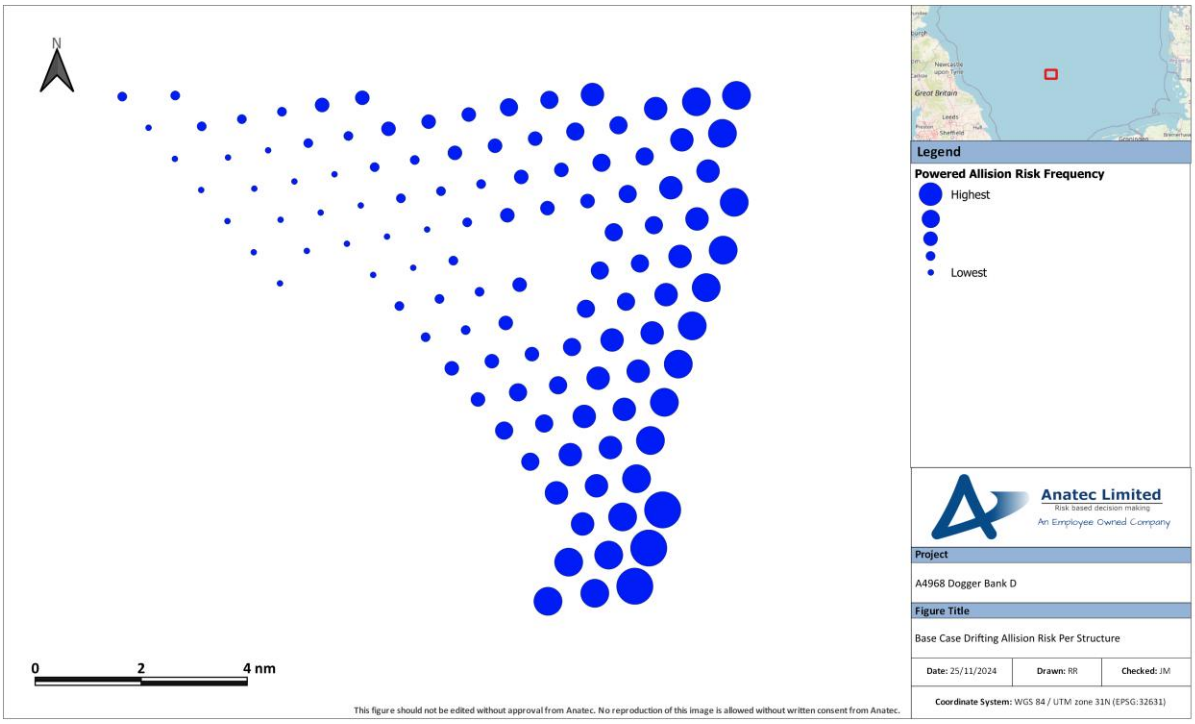


Figure 16-7 Base Case Drifting Allision Risk Per Structure

340. Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 2.25×10^{-5}, corresponding to a return period of approximately one in 44,421 years. This return period is lower than the average recorded for drifting allision risk in other UK offshore wind farm developments due to the low levels of vessel traffic in the area, especially in close proximity to the Array Area.

341. The greatest drifting vessel to structure allision risk was associated with structures at the south-east extent of the Array Area, the same as noted in the powered allision risk (**Section 16.4.3**). The greatest individual drifting allision risk was again associated with the same wind turbine on the south-east corner (approximately 3.12×10^{-6} or one in 320,000 years).

342. It is noted that historically there have been no reported drifting allision incidents with wind farm structures in the UK. Whilst drifting vessels do occur every year in UK waters, in most cases the vessel has been recovered prior to any allision incident occurring (such as by anchoring, restarting engines, or being taken in tow).

16.4.5 Fishing Vessel to Structure Allision Risk

343. Using the vessel traffic survey data as input, Anatec's COLLRISK model was run to estimate the likelihood of a fishing vessel alliding with one of the wind farm structures within the Array Area.

344. A fishing vessel allision is classified separately from other allisions since, unlike in the case of the commercial traffic characterised using the main commercial routes,

fishing vessels may be either in transit or actively fishing within the Study Area. Moreover, fishing vessels could be observed internally within the Array Area in addition to externally. Anatec's COLLRISK 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 wind farm arrays.

345. The model conservatively assumes no change in baseline fishing activity i.e. no account is made of vessels passing over or in close proximity to structure locations choosing to increase passing distance post-wind farm.

346. A plot of the annual fishing vessel allision frequency per structure for the base case is presented on **Figure 16-8**.

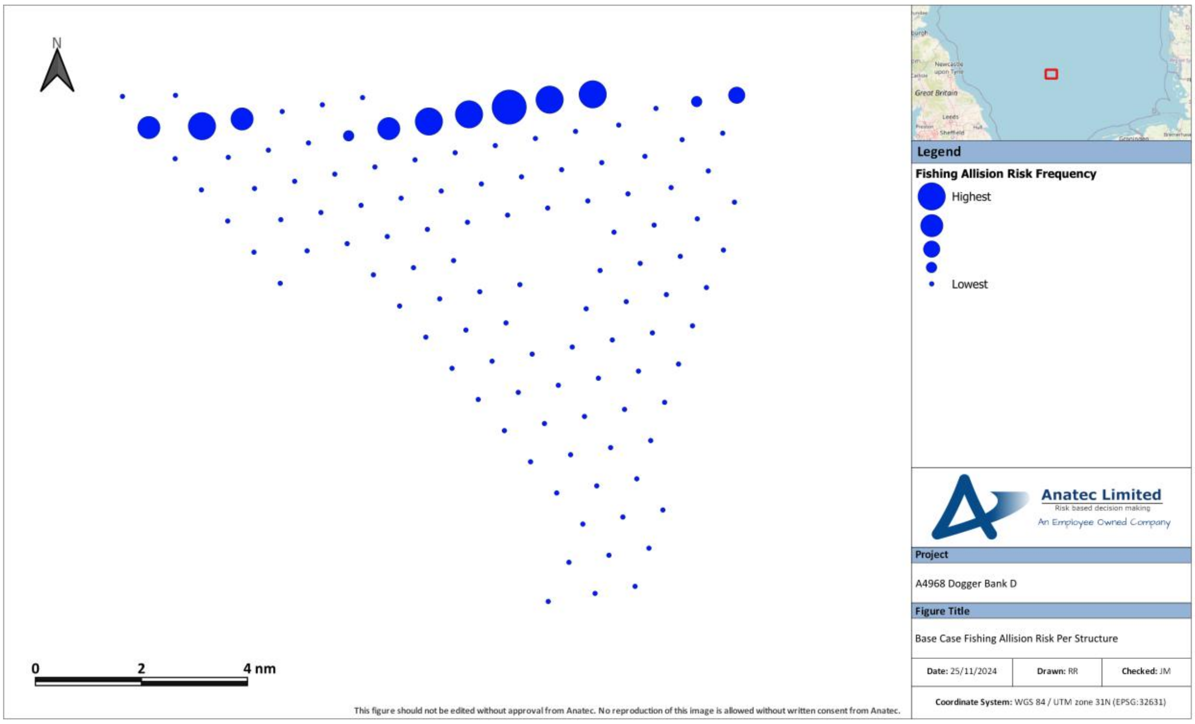


Figure 16-8 Base Case Fishing Allision Risk Per Structure

347. Assuming base case vessel traffic levels, the annual fishing vessel to structure allision frequency was estimated to be 1.23×10^{-2} years, corresponding to a return period of approximately one in 81 years.

348. The greatest fishing vessel to structure allision risk was associated with various periphery wind turbines to the north of the Array Area where one fishing vessel transit was observed during the survey period. The greatest individual allision risk was associated with a wind turbine on the northern periphery of the Array Area (approximately 1.34×10^{-3} or one in 745 years).

16.5 Risk Results Summary

349. The previous sections modelled two scenarios, namely the pre- and post-wind farm scenarios with base case traffic levels. To incorporate the potential for future traffic growth pre- and post-wind farm scenarios, each with future case traffic levels, have also been modelled (10% and 20% increases). **Table 16-1** summarises the results of all six scenarios.

Table 16-1 Risk Results Summary

Risk	Scenario	Annual Frequency (Return Period)		
		Pre-Wind Farm	Post-Wind Farm	Change
Vessel to vessel collision	Base case	1.78×10^{-5} (1 in 56,177 years)	2.23×10^{-5} (1 in 44,813 years)	4.51×10^{-6} (1 in 221,540 years)
	Future case (10%)	2.17×10^{-5} (1 in 46,091 years)	2.72×10^{-5} (1 in 36,792 years)	5.48×10^{-6} (1 in 182,353 years)
	Future case (20%)	2.56×10^{-5} (1 in 39,127 years)	3.21×10^{-5} (1 in 31,200 years)	6.49×10^{-6} (1 in 153,984 years)
Powered vessel to structure allision	Base case	-	9.96×10^{-5} (1 in 10,038 years)	9.96×10^{-5} (1 in 10,038 years)
	Future case (10%)	-	1.10×10^{-4} (1 in 9,105 years)	1.10×10^{-4} (1 in 9,105 years)
	Future case (20%)	-	1.20×10^{-4} (1 in 8,367 years)	1.20×10^{-4} (1 in 8,367 years)
Drifting vessel to structure allision	Base case	-	2.25×10^{-5} (1 in 44,421 years)	2.25×10^{-5} (1 in 44,421 years)
	Future case (10%)	-	2.48×10^{-5} (1 in 40,364 years)	2.48×10^{-5} (1 in 40,364 years)
	Future case (20%)	-	2.70×10^{-5} (1 in 37,098 years)	2.70×10^{-5} (1 in 37,098 years)
Fishing vessel to structure allision	Base case	-	1.22×10^{-2} (1 in 82 years)	1.22×10^{-2} (1 in 82 years)
	Future case (10%)	-	1.34×10^{-2} (1 in 75 years)	1.34×10^{-2} (1 in 75 years)
	Future case (20%)	-	1.46×10^{-2} (1 in 68 years)	1.46×10^{-2} (1 in 68 years)
Total	**Base case**	**1.78×10^{-5} (1 in 56,177 years)**	**1.23×10^{-2} (1 in 81 years)**	**1.23×10^{-2} (1 in 81 years)**
	Future case (10%)	**2.17×10^{-5} (1 in 46,091 years)**	**1.36×10^{-2} (1 in 74 years)**	**1.35×10^{-2} (1 in 74 years)**
	Future case (20%)	**2.56×10^{-5} (1 in 39,127 years)**	**1.48×10^{-2} (1 in 68 years)**	**1.48×10^{-2} (1 in 68 years)**

17 Introduction to Risk Assessment

350. **Section 18** provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to the Project in isolation, based on baseline data, expert opinion, stakeholder concerns and lessons learnt from existing offshore developments. The hazards assessed are as follows:

- Vessel displacement;
- Increased third-party vessel collision risk;
- Third-party with project vessel collision risk;
- Creation of vessel to structure allision risk;
- Reduction of under keel clearance as a result of cable protection and cable crossings,
- Anchor interaction with sub-sea cables; and
- Reduction of emergency response capability including SAR.

351. The Shipping and Navigation users considered are as follows:

- Commercial vessels;
- Recreational vessels;
- Commercial fishing vessels in transit; and
- Emergency responders.

352. For each hazard, embedded mitigation measures which have been identified as relevant to reducing risk are listed, with full descriptions provided in **Section 21**. This is followed by statements defining the frequency of occurrence, severity of consequence, and subsequent significance of risk based on the methodology defined on **Section 3**.

353. The cumulative risk assessment is detailed in **Section 19** and provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to the Project cumulatively with those other developments identified from the cumulative screening (**Section 13**). The same inputs outlined for the in-isolation risk assessment are applicable.

354. The risk control log (**Section 20**) summarises the risk assessment and a concluding risk statement is provided (**Section 23.4**).

18 Risk Assessment

18.1 Vessel Displacement Due to the Presence of the Project and Increased Vessel to Vessel Collision Risk Between Third-Party Vessels (Route-Based) Due to Displacement

355. *Activities associated with the installation, maintenance and decommissioning of structures and sub-sea cables as well as the presence of surface structures may displace third-party vessels from their existing routes or activity, increasing the collision risk with other third-party vessels.*

18.1.1 Qualification of Risk

356. Each element of this hazard is considered in turn in terms of frequency of occurrence and severity of consequence, with the resulting significance of the residual risk across the various elements summarised at the end of the assessment. The elements considered include:

- Vessel displacement from main commercial routes;
- Adverse weather routeing; and
- Increased third-party to third-party vessel collision risk.

18.1.1.1 Vessel Displacement from Main Commercial Routes

357. During the construction and decommissioning phases, a buoyed construction / decommissioning area will be deployed around the Array Area. No restrictions on entry would be enforced for the buoyed construction / decommissioning area or the operational array during the O&M phase outside of any statutory Safety Zones. However, based on experience at previously under construction and existing operational offshore wind farms, inclusive of the neighbouring under construction sites, it is anticipated that commercial vessels would choose not to navigate internally within the buoyed construction / decommissioning area or the operational array.

358. Main commercial routes have been identified in line with the principles set out in MGN 654 (MCA, 2021) and have been based primarily on vessel traffic data collected during the dedicated survey, Vissim AIS data and Anatec's ShipRoutes database. Further details of the methodology for main commercial route identification are provided in **Section 11.1**, noting that the vessel traffic data has been agreed as appropriate by the MCA and Trinity House. As part of the future case considerations, increases in 10% and 20% of all traffic including commercial vessels is assumed (**Section 14**).

359. A deviation would be required for all phases of the Project for three of the main commercial routes. The level of deviation varies between an increase of 0.4nm (0.7km) for Route 1 and an increase of 1.7nm (3km) for Route 6, with the maximum percentage change in total route length being 0.4% for Route 6. The size of these

deviations are proportionally small when considered relative to the length of the routes overall, all of which cross the North Sea and are transcontinental.

360. The deviated route with the highest vessel traffic volume was Route 1 (cargo vessels and tankers routeing between Humber ports and Norway), with approximately five transits per week, i.e. deviations are expected to be a moderate occurrence. As per the vessel traffic analysis in **Section 10.1** and the main commercial route identification in **Section 11.2**, RoRo or RoPax vessels were not recorded on any route and so no deviation of any timetabled commercial ferries would occur as a result of surface structures within the Array Area.

361. From the vessel traffic survey data, which incorporated Radar and visual observations in addition to AIS (although AIS was prioritised on each occurrence), infrequent transits by commercial fishing vessels and recreational vessels were recorded through the Array Area (noting that the displacement of active commercial fishing activity is assessed in **Volume 1, Chapter 14 Commercial Fisheries**. Based on experience at previously under construction offshore wind farms, it is anticipated that commercial fishing vessels and recreational vessels would choose not to navigate internally within the buoyed construction / decommissioning area. Therefore, some displacement of transits by small craft may be required during the construction and decommissioning phases. For the O&M phase, based on experience at existing operational offshore wind farms, commercial fishing vessels and recreational vessels may choose to navigate internally within the operational array, particularly in favourable weather conditions and as awareness of the arrays increases throughout the O&M phases. In situations where small craft do navigate internally, the level of displacement is considered negligible. Also, if a recreational vessel was transiting as far offshore as the Array Area, the vessel is likely transiting transcontinental and would be expected to undertake due diligence of their intended route (i.e. adequate passage planning).

362. Given the location and length of the offshore ECC, it is considered likely that cable installation / removal activities will lead to displacement with many commercial vessels routeing in a north south bearing crossing the offshore ECC as well as those transiting to / from locations on the English east coast at times routeing parallel with the offshore ECC, although as illustrated by the vessel traffic analysis (**Section 10.2**) this is not as common. Any activity will be short-term and temporary in nature and cover only a small extent at any given time and so any displacement associated with the offshore ECC will be temporary and spatially limited to the area around the activity. The greatest concern would be the displacement of commercial ferries routeing across the offshore ECC but again, any deviation will be minor and temporary.

363. There will be no displacement impact in relation to the offshore ECC once the cables are laid, other than during any periods of maintenance, which would be anticipated to be a low frequency event; maximum of 35 visits to the offshore ECC over the

lifetime of the project or once per year. Therefore, deviations are expected to be manageable, particularly with the promulgation of information allowing mariners to passage plan accordingly.

364. The most likely consequences of vessel displacement would be increased journey times and distances for affected third-party vessels. The hazard will occur over a local spatial extent given that the buoyed construction / decommissioning area would be deployed around the maximum extent of the Array Area. Vessels are expected to comply with international and flag state regulations (including the COLREGs and International Convention for the Safety of Life at Sea (SOLAS)) and will be able to passage plan in advance given the promulgation of information relating to the Project and relevant nautical charts. This high level of awareness will assist with ensuring that vessels make safe and effective deviations which minimise journey increases. It is also noted that vessels are already familiar with deviating and routeing in this area of the North Sea due to the four sites under construction in proximity to the Project, inclusive of DBC which shares its border with DBD.

365. As a worst-case, there could be disruption to schedules. However, given the size of the deviations, that no timetabled commercial ferries are present on any main commercial routes, the international nature of routeing in the area and the ability to passage plan, it is anticipated that disruption to schedules are expected to be minimal.

18.1.1.2 Adverse Weather Routeing

366. From the vessel traffic survey data, there were no instances of alternative routeing due to possible adverse weather conditions.

367. The most likely consequences of displacement of adverse weather routeing are similar to that of displacement of standard weather routeing, i.e. increased journey times and distances for affected third-party vessels with the hazard occurring over a local spatial extent given that the buoyed construction / decommissioning areas and infrastructure will be deployed around the maximum extent of the Array Area. All vessels are expected to comply with flag state regulations including Regulation 34 of SOLAS Chapter V – which states that "*the voyage plan shall identify a route which… anticipates all known navigational hazards and adverse weather conditions*" (IMO, 1974) – and IMO Resolution A.893(21) on the Guidelines for Voyage Planning (IMO, 1999). The promulgation of information relating to the Project will assist such passage planning.

368. As a worst-case, the deviated route may be considered unsafe for navigation in adverse weather conditions resulting in the vessel being unable to make the transit. It is considered highly unlikely that the vessel would undertake an unsafe transit and therefore risk to the vessel or crew are negligible due to the very low frequency of occurrence.

18.1.1.3 Increased Third-Party to Third-Party Vessel Collision Risk

369. It is anticipated that three of the seven main commercial routes identified will deviate as a result of the presence of the Project. This could lead to increased vessel densities within the area, which could in turn lead to an increase in vessel to vessel encounters and therefore increased collision risk.

370. Based on the pre-wind farm modelling, the baseline collision risk levels within the Study Area are very low with an estimated vessel to vessel collision risk of one every 56,176 years. This is due to the low volume of traffic in the area relative to available sea room. This baseline collision frequency increases to one every 44,813 years in the post-wind farm scenario using the main commercial route deviations as input, rising to one every 31,200 years for the highest tier of future case traffic levels post-wind farm (20%).

371. The increase in frequency, albeit still very low, is due to a further reduction in navigable sea room and vessel traffic being condensed, particularly to the south-east of the array where the busiest main commercial routes have been deviated. It is also conservatively anticipated that two routes (Route 2 and 7) will coincide in terms of mean position, exacerbating collision risk. The base case collision result represents a 25% increase compared to the pre-wind farm base case result indicating that the influence of the array on the overall collision risk for commercial traffic is notable. However, the overall change in base case collision risk between pre- and post-wind scenarios was one in 221,540 years.

372. The baseline assessment of MAIB incident data (see **Section 9.5**) indicated no collisions were recorded in the 10-year period between 2013 and 2022 within the Study Area.

373. Due to the construction of the DBC, Sofia, DBA, and DBB developments to the west of the Project, vessels routeing in the area will already have good familiarity and experience operating in proximity to surface structures and buoyed construction areas. As DBC shares its perimeter with the Array Area, there is no anticipated corridors for vessels to transit between projects and so there is no increased collision risk between Projects. All vessels operating in the area are expected to comply with international flag state regulations (including the COLREGs and SOLAS) and will have a raised level of awareness of construction and decommissioning activities of the Project given the promulgation of information relating to the Project including the charting of the construction / decommissioning areas on relevant nautical charts and the use of Safety Zones. The buoyed construction / decommissioning areas will also serve to maximise awareness. Likewise, during the O&M phase infrastructure will be appropriately marked on relevant nautical charts and awareness of the operational arrays will be very high and continue to increase with the longevity of the Project.

374. In poor visibility, third-party vessels may experience limitations regarding visual identification of other third-party vessels, either when passing on another side of the buoyed construction / decommissioning areas and operational array, or when navigating internally within the operational array (small craft only). These limitations may increase the potential for an encounter. However, this would be mitigated by the application of the COLREGs (including reduced speeds) in adverse weather conditions. Moreover, the minimum spacing between structures (826m) will be sufficient to ensure any visual hindrance is very short-term in nature.

375. It is anticipated that fishing vessels may still navigate within the operational array, particularly in favourable weather conditions and as awareness of the array increases throughout the O&M phase, and so any displacement of fishing vessels is expected to be minimal during the construction / decommissioning phases. This is based on experience at existing operational wind farms. If displacement was to occur, the levels of vessels are low, and it is anticipated potential users will be able to navigate in the presence of any activity. In situations where small craft do navigate internally, the level of displacement is considered negligible and thus so is third-party collision risk.

376. Given that recreational traffic is very low in proximity to the Array Area, the effect of the main commercial route deviations outlined on such traffic is expected to be negligible. The application of good seamanship including compliance with the fundamental principles of safe navigation such as COLREGs and SOLAS, the likelihood of an encounter between small craft developing into a collision situation is low. In the event of a collision incident the likelihood of a worst-case outcome (the small craft foundering with Potential Loss of Life (PLL) and pollution) is greater due to the size and likely hull material of the small craft.

377. With respect to all vessels, the risk will be present throughout all phases of the Project, but the promulgation of information relating to construction / decommissioning and O&M activities – including the deployment of the buoyed construction / decommissioning area, and charting of infrastructure will allow vessel masters to passage plan in advance, minimising disruption. Additionally, information for fishing vessels will be promulgated through ongoing liaison with fishing fleets via an appointed Fisheries Liaison Officer (FLO). Experience from previous under construction offshore wind farms indicated that the extensive promulgation of information is an effective mitigation, with evidence suggesting that masters regularly choose to transit further than 1nm (1.9km) from any ongoing works. The Applicant will exhibit lights, marks, sounds, signals and other aids to navigation as required by Trinity House and MCA including the buoyed construction / decommissioning area. These navigational aids will further maximise mariner awareness when in proximity, both in day and night conditions including in poor visibility.

378. As for all vessel types intersecting the offshore ECC, the crossing distance is minimal and there is ample sea room available for the temporary minor deviations that may need to occur to avoid any ongoing activities. This is also relevant to small craft that transit north south across the offshore ECC which are low volume, again with ample sea room available for minor deviations as required. Mariners navigating in proximity to the offshore ECC will have a raised level of awareness of the area given the proximity to the coast and this will be heightened by the promulgation of information relating to the Project including the publication of Notifications to Mariners as cable installation / removal progresses and maintenance activities are required.

379. Once installed, the presence of the offshore ECC will not directly result in vessel displacement (noting that impacts associated with under keel clearance is assessed separately in **Section 18.4**). Therefore, this impact is only considered in relation to installation / removal and O&M activities. Given that displacement associated with installation / removal and O&M activities will be small-scale, increases in collision risk will be limited.

380. If vessels are displaced, the risk of encounters increase. In the event that an encounter does occur, it is likely to be very localised and occur for only a short duration, with collision avoidance action implemented by the vessels involved, in line with the COLREGs, thus ensuring that the situation does not develop into a collision incident. This is supported by experience at previous under construction wind farms, where no collision incidents involving two third-party vessels have been reported.

381. The most likely consequences in the event of an encounter between two or more third-party vessels is the implementation of avoidance action in line with the COLREGs, with the vessels involved able to resume their respective passages with no long-term consequences.

382. Should an encounter develop into a collision incident, it is most likely to involve minor contact resulting in minor damage to the vessels with no harm to people and no substantial reputational risks. As a worst-case with very low frequency of occurrence one of the vessels could incur substantial damage or founder with PLL and pollution, with this outcome more likely where one of the vessels is a small craft (e.g. fishing vessel, recreational vessel or CTV).

383. It is acknowledged that vessel traffic monitoring will be undertaken throughout the construction phase to characterise changes to routeing patterns. These will be compared against anticipated deviations to allow a comprehensive review of the embedded mitigation measures applied at the time.

18.1.2 Embedded Mitigation Measures

384. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Compliance with MGN 654 (CO7);
- Marking and lighting (CO9);
- Traffic monitoring (CO10);
- Promulgation of information (CO11);
- Guard vessel(s) (CO17);
- Charting of infrastructure (CO16);
- Application for Safety Zones (CO17);
- Decommissioning programme (CO21); and
- Pollution Planning (C025).

18.1.3 Significance of Risk

385. The frequency of occurrence in relation to vessel displacement for the Array Area during all phases is considered **frequent**. The severity of consequence in relation to vessel displacement and third-party collision risk is considered **minor**. Overall, it is predicted that the significance of risk due to vessel displacement and third-party collision risk is **Tolerable with Mitigation**.

386. The frequency of occurrence in relation to vessel displacement for the offshore ECC during all phases is considered **reasonably probable**. The severity of consequence in relation to vessel displacement and third-party collision risk is considered **minor**. Overall, it is predicted that the significance of risk due to vessel displacement is **Tolerable with Mitigation**.

387. The frequency of occurrence in relation to increased third-party collision risk due to displacement for the Array Area during all phases is considered **remote**. The severity of consequence in relation to increased third-party collision risk due to displacement is considered **moderate**. Overall, it is predicted that the significance of risk to increased third-party collision risk due to displacement is **Tolerable with Mitigation**.

388. The frequency of occurrence in relation increased third-party collision risk due to displacement for the offshore ECC during all phases is considered **extremely unlikely**. The severity of consequence in relation to increased third-party collision risk due to displacement is considered **moderate**. Overall, it is predicted that the significance of risk to increased third-party collision risk due to displacement is **Broadly Acceptable**.

18.1.4 Additional Mitigation Measures and Residual Significance of Risk

389. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Tolerable with Mitigation** for all scenarios.

18.2 Vessel to Vessel Collision Risk Between a Third-Party Vessel and a Project Vessel

390. *Project vessels associated with construction, O&M, and decommissioning activities may increase encounters and collision risk for other third-party vessels already in the area.*

18.2.1 Qualification of Risk

391. The construction phases may last for up to approximately five years and decommissioning will occur over one phase of up to three and a half years. For both phases up to 159 construction / decommissioning vessels may be located on site simultaneously, in turn making a maximum of 7,527 return trips to port, however it is anticipated a peak of 90 vessels will be on site at any given time. The O&M phase may last for up to 35 years with up to a peak of 16 O&M vessels making a maximum of 96 annual return trips to port. Some project vessels may be Restricted in Ability to Manoeuvre (RAM) and it is anticipated that project vessels will undertake construction / decommissioning or O&M works associated with the array within the buoyed construction / decommissioning areas or operational array, both of which third-party vessels are generally expected to avoid.

392. From historical incident data, there has been one instance of a third-party vessel colliding with a project vessel associated with a UK offshore wind farm. In this incident, occurring in 2011, moderate vessel damage was reported with no harm to persons. Since then, awareness of offshore wind farm developments and the application of the measures outlined below has improved, or been refined, considerably in the interim, with no further collision incidents reported since.

393. Project vessel movements will be managed by the Applicant’s marine coordination and any associated procedures implemented will account for those areas where collision risk is assessed as greatest (where regular commercial routeing passes close to the array). Additionally, project vessels will carry AIS and be compliant with Flag State regulations including IMO conventions such as the COLREGs, and information for fishing vessels will be promulgated through ongoing liaison with fishing fleets via an appointed FLO.

394. In poor visibility, third-party vessels may experience limitations regarding visual identification of project vessels entering and exiting the buoyed construction / decommissioning areas and the operational array; however, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and AIS carriage by project vessels.

395. Up to two offshore export cables with a combined maximum length of approximately 432nm (800km) may be installed within the offshore ECC. Once installed the presence of the offshore export cables will not directly result in third-party with project vessel

collision risk. Therefore, this hazard is considered only in relation to offshore ECC installation / removal and maintenance activities.

396. It is anticipated that up to 15 main vessels will be involved in the cable laying activities; three large cable lay vessels and up to 12 support vessels. During the O&M visits to the offshore ECC for corrective maintenance, repairs, or replacement is anticipated 35 times over the lifetime of the Project; or once per operational year. The spatial extent of the hazard will be limited to where installation / removal or maintenance activities are ongoing, with routeing vessels required to make deviations to pass around installation / removal or maintenance works which may involve project vessels which are RAM. These deviations will only be small and will be short-term.

397. The level of exposure to this hazard for third-party vessels will depend upon the location of offshore ECC installation / removal or maintenance at any given time. The portions of the offshore ECC that are considered to have higher exposure are those areas in which main commercial routes are intersecting, especially routes passing to the north of the Array Area and those in shallower waters, closer to the coast. As highlighted by the offshore ECC vessel traffic analysis in **Section 10.2**, certain commercial ferry routes intersect the offshore ECC, but the spatial extent of these routes are small.

398. There is sea room available for minor deviations as required, noting such deviations would be relatively small. This is also relevant to small craft that transit through the offshore ECC; this is again low volume and highly seasonal. The majority of these vessels are passing perpendicular across the offshore ECC, and this will also reduce exposure time in periods of project vessel activity.

399. Shipping is also international in nature and the majority of vessels present within this area of the North Sea are routeing transcontinental and will be familiar with navigating in proximity to offshore wind farms at different stages of development and operation. Therefore, mariners will likely be experienced in working around offshore wind farm activities. This may be less common for local fishing and recreational users; however, with the ongoing construction of the neighbouring Dogger Bank and Sofia developments, vessels will be aware of construction activities if transiting this far offshore. To help aid local and international mariner knowledge, details of authorised minimum advisory safe passing distances, as defined by a risk assessment, may be applied with advanced warning and accurate locations of any minimum advisory passing distances provided by Notifications to Mariners and Kingfisher Bulletins. These will be particularly effective in the event of smaller craft such as commercial fishing vessels and recreational vessels choosing to navigate internally within the operational array, where a project vessel may be undertaking major maintenance at a structure. This information promulgated alongside the details of any ongoing activity will maximise awareness for all third-party users, including in both day and night conditions. A guard vessel may also be deployed

based on a risk assessment, particularly during the O&M phase where there is a cable exposure requiring reburial.

400. Should an encounter occur between a third-party vessel and a project vessel, it is likely to be very localised and occur for only a short duration and so the most likely consequence (during any phase) would be collision avoidance action implemented in line with the COLREGs. The vessels involved will likely be able to resume their respective passages and / or activities with no long-term consequences.

401. Should an encounter develop into a collision incident, the most likely consequences will be similar to that outlined for the case of a collision between two third-party vessels. As an unlikely effect, one of the vessels could founder resulting in PLL and pollution, with this outcome more likely where one of the vessels is a small craft (e.g. fishing vessel, recreational vessel or CTV) with comparatively weaker structural integrity given hull materials.

18.2.2 Embedded Mitigation Measures

402. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Compliance with MGN 654 (CO7);
- Marking and lighting (CO9);
- Traffic monitoring (CO10);
- Promulgation of information (CO11);
- Project vessel compliance with international marine regulations (CO12);
- Marine coordination of project vessels (CO14);
- Guard vessel(s) (CO17);
- Charting of infrastructure (CO16);
- Application for Safety Zones (CO17);
- Decommissioning programme (CO21);
- Pollution planning (CO25); and
- O&M Strategy (CO28).

18.2.3 Significance of Risk

403. The frequency of occurrence in relation to vessel to vessel collision risk between a third-party vessel and a project vessel for the Array Area during construction and decommissioning is considered **extremely unlikely** and during O&M is considered **negligible**. The severity of consequence in relation to vessel to vessel collision risk between a third-party vessel and a project vessel is considered **moderate** for all phases. Overall, it is predicted that the significance of risk due to vessel to vessel collision risk between a third-party vessel and a project vessel is **Broadly Acceptable** for all phases.

404. The frequency of occurrence in relation to vessel to vessel collision risk between a third-party vessel and a project vessel for the offshore ECC during the construction phase is considered **negligible** for all phases. The severity of consequence in relation to vessel to vessel collision risk between a third-party vessel and a project vessel is considered **moderate**. Overall, it is predicted that the significance of risk due to vessel to vessel collision risk between a third-party vessel and a project vessel is **Broadly Acceptable**.

18.2.4 Additional Mitigation Measures and Residual Significance of Risk

405. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Broadly Acceptable** for all scenarios.

18.3 Vessel to Structure Allision Risk for Third-Party Vessels Due to the Presence of Project Structures

406. *The presence of surface structures within the Array Area may result in the creation of a risk of allision for vessels.*

407. This hazard is considered only in relation to the Array Area since there are no surface structures associated with the offshore ECC (underwater allision risk due to reduction in under keel clearance is considered separately in **Section 18.4**).

18.3.1 Qualification of Risk

408. The main commercial route deviations and future case considerations described for the vessel displacement hazard have also been assumed for this hazard, noting that a full build out of the array is assumed and internal navigation by commercial vessels is not anticipated. However, commercial fishing vessels and recreational vessels may choose to navigate internally within the array, particularly in favourable weather conditions.

409. Shipping is international in nature and the majority of vessels present within the datasets are on routes to / from areas where offshore wind farms are present, including the under construction Dogger Bank sites to the west of the Array Area – which most main commercial routes are in proximity to. Therefore, mariners will be experienced in working around offshore wind farm installations. Smaller craft which transit this far offshore should also be familiar with offshore wind farm installation and be familiar with undertaking adequate passage planning. To help aid local and international mariner knowledge, details of authorised minimum advisory safe passing distances, as defined by a risk assessment, may be applied, with advanced warning and accurate locations of any minimum advisory passing distances provided by Notifications to Mariners and Kingfisher Bulletins. These will be particularly effective in the event of smaller craft such as commercial fishing vessels and recreational vessels choosing to navigate internally within the operational array. This

information promulgated alongside the details of any ongoing activity will maximise awareness for all third-party users, including in both day and night conditions.

410. The spatial extent of the hazard is small given that a vessel must be in close proximity to a surface structure for an allision incident to occur. However, it is acknowledged that the presence of new surface structures does introduce new allision risk which can be considered across three forms, all of which are localised in nature given that a vessel must be in close proximity to a structure for an allision incident to occur:

- Powered allision risk;
- Drifting allision risk; and
- Internal allision risk.

18.3.1.1 Powered Allision Risk

411. Post-wind farm modelling using the main commercial route deviations as input gives an estimated powered allision return period of one in 10,038 years for base case traffic levels, rising to one in 8,376 years for future case traffic levels (20%). This allision risk is lower than the average recorded for powered allision risk in other UK offshore wind farm developments. The greatest allision risk was associated with structures on the south-east of the array with higher risk also estimated on the eastern extent of the array, where a higher volume of traffic from multiple main commercial routes, including those associated with vessel deviations, pass in the closest proximity to the array (minimum mean distance of 1nm (1.9km) from the array).

412. From historical incident data, there have been two instances of a third-party vessel alliding with an operational wind farm structure in the UK. These incidents each involved a fishing vessel, with a RNLI lifeboat attending on each occasion and a helicopter deployed in one case. Given the volume of vessel traffic in the area and subsequent heightened mariner alertness, it is unlikely that such an incident will occur at the Project.

413. Additionally, vessels are expected to comply with international flag state regulations (including COLREGs and SOLAS) and will be able to effectively passage plan a route which minimises effects given the promulgation of information relating to the Project including the charting of infrastructure on relevant nautical charts. On approach, the operational lighting and marking of the array will also assist in maximising marine awareness.

414. The Offshore Platforms carry increased powered allision risk and consequences due to their greater size and resistant force, albeit one is located internally within the array. The increase is not considered substantial and may be mitigated by the effective use of operational lighting and marking in accordance with requirements from Trinity House and MCA. Moreover, since one of the Offshore Platforms is located within the array and the other on the perimeter of the array where vessel

traffic is low (due to the construction of DBC), exposure will be greatly reduced (as indicated by the powered allision modelling).

415. Should a powered allision incident occur, the consequences will depend on multiple factors including the energy of the contact, structural integrity of the vessel involved, type of structure contacted, and the sea state at the time of the contact. Small craft including commercial fishing vessels and recreational vessels are considered most vulnerable to the hazard given the potential for a non-steel construction and possible internal navigation within the array. In such cases the most likely consequences will be minor damage with the vessel able to resume passage and undertake a full inspection at the next port. As part of the worst-case scenario, the vessel could allide with an Offshore Platform, resulting in the vessel foundering with PLL and pollution, although this is highly unlikely to occur.

18.3.1.2 Drifting Allision Risk

416. A vessel adrift may only develop into an allision situation where the vessel is in proximity to a structure and the direction of the wind and / or tide is such as to direct the vessel towards the structure.

417. With the main commercial route deviations associated with the presence of the Project in place, an estimated drifting allision return period of one in 40,364 years for base case traffic levels, rising to one in 37,098 years for future case traffic levels (20%). This is a low allision risk compared to that estimated for UK offshore wind farm developments and is reflective of the volume of vessel traffic in the area. The greatest allision risk was again associated with structures on the south-east.

418. From historical incident data, there have been no instances of a third-party vessel alliding with an operational wind farm structure whilst Not Under Command (NUC). However, there is some potential for a vessel to be adrift but this is not common in the area surrounding the Project as no machinery failure incidents (which may involve the errant vessel being adrift) were reported by the RNLI or MAIB in proximity to the Array Area.

419. In circumstances where a vessel drifts towards a structure, there are actions which may be taken to prevent the incident developing into an allision situation. For a powered vessel, the ideal and likely solution would be regaining power prior to reaching the array (by rectifying any faults). Failing this, an emergency anchoring event may be initiated following a check of the relevant nautical charts to ensure the deployment of the anchor will not lead to other effects (such as the anchor snagging on a sub-sea cable) but as there are no sub-sea cables or pipelines in proximity to the Array Area, as well as relatively shallow water depths, then emergency anchoring is a feasible option.

420. Where the deployment of the anchor is not possible (such as for small craft) then project vessels, if on-site, may be able to render assistance including under SOLAS

obligations (IMO, 1974) and this response will be managed via marine coordination and depends on the type and capability of vessels on site. This would be particularly relevant for sailing vessels whose propulsion is dictated solely by the metocean conditions, although if the vessel becomes adrift in proximity to a structure there may be limited time to render assistance. As per the vessel traffic analysis in **Section 10.1**, recreational activity in the area is minimal, as expected this far offshore.

421. Should a drifting allision incident occur, the consequences will be similar to those outlined for a powered allision incident, including the determining factors. However, the speed at which the contact occurs will likely be lower than for a powered allision, resulting in the contact energy being lower.

422. It is acknowledged that as per the assessment of powered allision risk, an allision with an Offshore Platform is likely to create higher consequence given the size of the structure although this is highly unlikely given the Offshore Platform will be located internally within the array or, if located on the perimeter, then in an area where less vessel traffic passes in proximity.

18.3.1.3 Internal Allision Risk

423. As described for the vessel displacement impact, commercial vessels are not anticipated to navigate internally within the array and therefore the likelihood of an internal allision risk for such vessels is negligible. It is anticipated that commercial fishing and recreational vessels may choose to navigate internally within the array. This is more likely by fishing vessels as based on the vessel traffic survey data (**Section 10.1**), recreational vessels tend to stay closer to the coast and activity near the Array Area is limited. Fishing vessels are also not common in the area and vessels recorded during the summer survey period were all in transit as opposed to engaged in any fishing activity.

424. Post-wind farm modelling using the vessel traffic survey data as input gives an estimated commercial fishing allision return period of one in 82 years for base case traffic levels, rising to one in 68 years for future case traffic levels (20%). Although this is a high return period, it is low in comparison to the average internal allision risk estimated for UK offshore wind farm developments and is reflective of the low volume of fishing vessel transits through the array.

425. The minimum spacing between structures (826m) is sufficient for safe internal navigation and is greater than that associated with many UK offshore wind farms, some of which are located close to shore and navigated by commercial fishing vessels in favourable conditions. The final array layout will be developed post consent and will be compliant with the requirements of MGN 654 (MCA, 2021) and a layout plan will be agreed following appropriate consultation with Trinity House and the MCA.

426. As with any passage, a vessel navigating internally within the array is expected to passage plan in accordance with SOLAS Chapter V (IMO, 1974). The lighting and

marking of the array and MGN 654 (MCA, 2021) compliant unique identification marking of structures in an easily identifiable pattern will assist with minimising the likelihood of a mariner becoming disoriented whilst navigation internally within the array. Such mitigation will take account of the equivalent mitigation for the adjacent DBC – this is discussed further in **Section 21.1**.

427. For recreational vessels under sail navigating internally within the array there is also potential for effects such as a wind shear, masking, and turbulence to occur. From previous studies of offshore wind developments, it has been concluded that wind turbines do reduce wind velocity downwind of a wind turbine (MCA, 2022) but that no negative effects on recreational craft have been reported on the basis of the limited spatial extent of the effect and its similarity to that experienced when passing a large vessel or close to other large structures (such as bridges) or the coastline. In addition, no practical issues have been reported by recreational users to date when operating in proximity to existing offshore wind developments.

428. An additional allision risk associated with the wind turbine blades applies for recreational vessels with a mast when navigating internally within the array. However, the minimum air gap will be 26.37m above MHWS which is greater than the minimum clearance the RYA recommend for minimising allision risk (RYA, 2019) and which is also noted in MGN 654.

429. Should an internal allision occur, the consequences will be similar to those outlined for a powered allision incident, including the determining factors. However, as with a drifting allision incident, the speed at which the contact occurs will likely be lower than for an external allision since internal navigation would likely be undertaken with caution, resulting in the contact energy being lower.

18.3.2 Embedded Mitigation Measures

430. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Layout plan (CO2);
- Compliance with MGN 654 (CO7);
- Marking and lighting (CO9);
- Promulgation of information (CO11);
- Minimum blade clearance (CO13);
- Guard vessel(s) (CO17);
- Fishery liaison (CO15);
- Charting of infrastructure (CO16);
- Application for Safety Zones (CO17); and
- Pollution Planning (C025).

18.3.3 Significance of Risk

431. The frequency of occurrence in relation to vessel to structure allision risk for third-party vessels due to the presence of project structures for the Array Area during the O&M phase is considered **extremely unlikely**. The severity of consequence in relation to vessel to structure allision risk for third-party vessels due to the presence of project structures is considered **moderate**. Overall, it is predicted that the significance of risk due to vessel to structure allision risk for third-party vessels due to the presence of project structures is **Broadly Acceptable**.

18.3.4 Additional Mitigation Measures and Residual Significance of Risk

432. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Broadly Acceptable**.

18.4 Reduction of Under Keel Clearance Due to the Presence of Cable Protection or Cable Crossings

433. *The presence of cable protection associated with the sub-sea cables may result in reductions to water depth and the creation of an under keel clearance risk for vessels.*

18.4.1 Qualification of Risk

434. For the inter-array cables and offshore export cables the minimum burial depth is 0.2m, with a target burial depth of 3.5m. Seabed burial will be the primary means of cable burial and the burial depth plus any external cable protection will be determined by the cable burial risk assessment. Indicatively up to 10% of inter-array cables and up to 20% of offshore export cables will need additional cable protection with a maximum height of 1.5m for additional protection in the form of rock placement or mattressing.

435. It is noted that up to 16 cable crossings could occur for the offshore export cable and up to five cable crossings for the inter-array cables. Again, all crossings will be determined via the cable burial risk assessment, but the Applicant intends to follow the guidance contained in MGN 654 in relation to cable protection, namely that cable protection will not change the charted water depth by more than 5%, unless otherwise agreed with the MCA and Trinity House. This aligns with the RYA's recommendation that the "*minimum safe under keel clearance over submerged structures and associated infrastructure should be determined in accordance with the methodology set out in MGN 543 [since superseded by MGN 654]*" (RYA, 2019). With this guidance adhered to, the likelihood of an underwater allision is considered very low.

436. Should this percentage be exceeded, further assessment including consultation with the MCA and Trinity House may be required to determine whether any additional

mitigation measures (e.g. post consent lighting and marking, charting, etc.) are necessary to ensure the safety of navigation.

437. Charted water depths within the Array Area are between 21.2 and 34.6m below CD. With the anticipated water depth reduction and expectation that deep draught vessels will not transit within the array, this limits the risk of an underwater allision occurring. Vessels likely to transit within the array include small fishing vessels and recreational vessels which tend to have smaller draughts than those associated with commercial vessels and so there would be no substantial risk to under keel clearance to these vessel types.

438. There is a higher risk of an under keel clearance interaction with the offshore export cables when compared to the inter-array cables. This is due to the offshore export cables being more exposed to shallower water depths closer to the coast, as well as having increased crossing traffic volumes.

439. Charted water depths within the offshore ECC range between zero (at landfall nearshore) and 118m below CD. The charted 10m contour in the offshore ECC is 3.7nm (7km) at its farthest distance from the coast and the charted 20m contour is less than 7nm (13nm) at its farthest distance from the coast. However, due to the location of Flamborough Head to the north of the offshore ECC, the majority of routeing vessels are recorded further offshore, routeing to the east of Flamborough Head and so crossing the offshore ECC at a minimum distance of approximately 10nm (19km) offshore where water depths are greater than 30m below CD. From the vessel traffic data analysed in **Section 10.2**, only 11 unique transits were recorded inshore of these routeing vessels, and all were fishing vessels on transit to / from Bridlington. Any vessels at transit further inshore are more at risk of an underwater allision; however, the vessels recorded in this area are small fishing vessels (less than 20m length) which typically have shallower vessel draughts, and thus minimal exposure to under keel clearance risks.

440. Should an underwater allision occur, the consequences may include the grounding of the vessel. Minor damage incurred is the most likely consequence, and foundering of the vessel resulting in a PLL and pollution are the unlikely worst-case consequences, with the environmental risks of the latter minimised by the implementation of the pollution planning protocols.

18.4.2 Embedded Mitigation Measures

441. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Compliance with MGN 654 (CO7);
- Promulgation of information (CO11);
- Guard vessel(s) (CO17);
- Charting of infrastructure (CO16);

- Cable burial risk assessment (CO24);
- Pollution Planning (C025);
- Under keel clearance (CO23 & CO24);
- O&M Strategy (CO28); and
- Offshore cable installation plan (CO24).

18.4.3 Significance of Risk

442. The frequency of occurrence in relation to reduction of under keel clearance due to the presence of cable protection or cable crossings for the Project during the O&M phase is considered **extremely unlikely**. The severity of consequence in relation to reduction of under keel clearance due to the presence of cable protection or cable crossings is considered **minor**. Overall, it is predicted that the significance of risk due to reduction of under keel clearance due to the presence of cable protection or cable crossings is **Broadly Acceptable**.

18.4.4 Additional Mitigation Measures and Residual Significance of Risk

443. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Broadly Acceptable**.

18.5 Vessel Interaction with Sub-Sea Cables Associated with the Project

444. *The presence of sub-sea cables may result in the creation of a risk of a vessel anchor making contact with sub-sea cable.*

18.5.1 Qualification of Risk

445. Up to 216nm (400km) of inter-array cables may be located within the Array Area. Up to 432nm (800km) of offshore export cables may be located within the offshore ECC. Where available, the primary means of cable protection will be by seabed burial, with an indicative minimal burial depth of 0.2m but a target depth of 2.5m. Where seabed burial is not possible, it is anticipated that up to 10% of inter-array cables and up to 20% of offshore export cables may require alternative cable protection with a height (including for crossings) of 1.5m. The burial depth will be informed by the cable burial risk assessment.

446. There are three anchoring scenarios which are considered for this hazard:

- Planned anchoring – most likely as vessel awaits a berth to enter port but may also result from adverse weather conditions, machinery failure, or sub-sea operations;
- Unplanned anchoring – generally resulting from an emergency situation where the vessels has experienced steering failure; and
- Anchor dragging – caused by anchor failure.

447. Since the inter-array cables would be fully contained within the Array Area, it is considered unlikely that a vessel will choose to anchor in close proximity to an inter-array cable due to the distance offshore.

448. Unlike for the inter-array cables, the offshore export cables may be crossed frequently by vessels on transit offshore. Given that an interaction risk exists only where the anchoring occurs in proximity to a sub-sea cable, the hazard is local in nature and has a short temporal overlap – vessels enroute will generally be located over the offshore export cables for only a short period of time.

449. However, the export cables associated with DBA and DBB run parallel with the offshore ECC for considerable length. Therefore, the spatial extent of the interaction risk will be greater for this section of the offshore ECC.

450. Despite being localised, the risk is elevated in areas where a sub-sea cable has been exposed. Following the cable burial risk assessment, and in order to increase third-party vessel awareness, a guard vessel may be deployed to the area of interest.

451. From the vessel traffic data, there was no anchoring activity within and in proximity to the offshore ECC. There are no charted anchorage areas located in proximity to the offshore ECC with the closest charted anchorage area approximately 25nm (46km) south of the offshore ECC.

452. It is anticipated that the charting of infrastructure including all sub-sea cables will inform the decision to anchor, as per Regulation 34 of SOLAS (IMO, 1974). This includes in an emergency situation with general feedback from mariners indicating that even where time for decision-making is limited a key priority for the bridge crew whilst the anchor is being readied would be to check charts.

453. Anchor dragging features a relatively wider extent than planned or unplanned anchoring. However, from the vessel traffic data, the likelihood of a vessel dragging anchor close enough to interact with a sub-sea cable is very low. In such a circumstance, it is likely that the anchor dragging will be stopped prior to any interaction with a sub-sea cable becoming possible.

454. The most likely consequences in the event of a vessel anchoring over an inter-array cable is that no interaction occurs given the protection applied to the cable (by burial or other means). Should an interaction occur, historical incident data suggests that the consequences would be negligible, with no damage caused to the vessel or sub-sea cable.

455. As a worst-case, a snagging incident could occur to a commercial fishing vessel with damage caused to the anchor and / or the cable, compromising the stability of the vessel.

18.5.2 Embedded Mitigation Measures

456. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Promulgation of information (CO11);
- Guard vessel(s) (CO17);
- Charting of infrastructure (CO16);
- Cable burial risk assessment (CO24);
- Under keel clearance (CO23 & CO24);
- O&M Strategy (CO28); and
- Offshore cable installation plan (CO24).

18.5.3 Significance of Risk

457. The frequency of occurrence in relation to vessel interaction with sub-sea cables associated with the project for the Project during the O&M phase is considered **extremely unlikely**. The severity of consequence in relation to vessel interaction with sub-sea cables associated with the Project is considered **minor.** Overall, it is predicted that the significance of risk due to vessel interaction with sub-sea cables associated with the Project is **Broadly Acceptable**.

18.5.4 Additional Mitigation Measures and Residual Significance of Risk

458. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Broadly Acceptable**.

18.6 Reduction of Emergency Response Capability Due to Increased Incident Rates and / or Reduced Access for Seach and Rescue Responders

459. *The presence of surface structures within the Array Area and O&M activities associated with the Array Area and offshore ECC may result in an increased likelihood of an incident occurring which requires an emergency response and may reduce access for surface air responders, including SAR assets.*

18.6.1 Qualification of Risk

18.6.1.1 Emergency Response Resources

460. The O&M phase may last for up to 35 years with up to 96 annual round trips made by a peak of 16 vessels undertaking O&M activities. With a full build out of the Array Area, these vessels will increase the likelihood of an incident requiring an emergency response and subsequently increase the likelihood of multiple incidents occurring simultaneously, diminishing emergency response capability.

461. Given the distance that may be covered by the air-based SAR support (the SAR helicopter base at Humberside is located approximately 142nm (263km) south-west

of the Array Area), but also the national nature of this resource, the spatial extent of this hazard is considered large. Additionally, the Array Area covers approximately 76nm^2 (262km^2) which represents a large area to search. However, it is unlikely that a SAR operation will require the entire Array Area to be searched; it is much more likely that a search could be restricted to a smaller area within which a casualty is known to be located (inclusive of any assumptions relating to the drift of the casualty). As part of an unlikely worst-case scenario, the consequences of such a situation could include a failure of emergency response to an incident, resulting in a PLL and pollution.

462. From historical incident data, there is a moderate rate of incidents in the region of the offshore ECC, however, for the Array Area, there were no SAR helicopter taskings or RNLI incidents, and only four MAIB incidents recorded across the data periods within the Study Area; none of these were within the Array Area itself. A total of six SAR helicopter taskings across a nine-year period occurred within the offshore ECC, six RNLI responded to incidents across a 10-year period, and three MAIB reported incidents across a 10-year period. The likelihood of an incident related to the Project occurring at the same time is very low.

463. Additionally, based on the number of collision and allision incidents associated with UK offshore wind farms reported to date, there is an average of one incident per 1,310 operational wind turbine years (as of December 2024). Therefore, the Project itself is not expected to result in a marked increase in the frequency of incidents requiring an emergency response.

464. With project vessels to be managed through marine coordination and compliance with Flag State regulations, the likelihood of an incident is minimised. Additionally, should an incident occur, project vessels will be well equipped to assist, either through self-help capability or – for an incident involving a nearby third-party vessel – through SOLAS obligations (IMO, 1974), all in liaison with HM Coastguard. This is reflected in past experience, with 12 known instances of a vessel (or persons on a vessel) being assisted by an industry vessel for a nearby UK offshore wind farm.

465. The most likely consequences in the event of an incident in the region requiring an emergency response is that emergency responders are able to assist without any limitations on capability. As part of the worst-case scenario, there could be a delay to a response request due to a simultaneous incident associated with the Project leading to PLL, pollution, and vessel damage. However, this worst-case scenario is highly unlikely.

18.6.1.2 Search and Rescue Access

466. With a full build out of the Array Area, its physical presence may restrict access for SAR responders, either due to the incident in question occurring within the array or the array itself obstructing the most effective path to an incident. With sharing its

western boundary with DBC, there is an increased likelihood of this scenario arising. Access issues are more likely to be a concern in adverse weather conditions also. The Applicant would work within the parameters of MGN 654 to minimise risks by assuring there is alignment in array layout with the DBC layout and if not a set-back may be required, again in line with MGN 654. This was raised by HM Coastguard during consultation (outlined in **Volume 1, Chapter 15 Shipping and Navigation**) with agreement that this will be addressed post consent during the final array layout development, at which time the as-built layout for DBC will be known.

467. The total area covered by the Array Area is approximately 76nm^2 (262km^2), which represents a relatively moderate area to search compared to other offshore wind farms. It is unlikely that a SAR operation will require the full extent of the Array Area to be searched; it is much more likely that a search could be restricted to a specific portion of the Array Area depending upon the information available regarding the casualty location (inclusive of any assumptions on the drift of the casualty). The minimum spacing between all structures of 826m is similar to many other consented offshore wind farms in the UK (Dogger Bank A and Dogger Bank B were consented with a minimum spacing of 700m (Forewind, 2013) and Dogger Bank C consented with a minimum of 750m, (Forewind, 2014)). The array layout includes two lines of orientation; should a SLoO layout be taken forward post consent then this would be subject to a safety justification, including consideration of accessibility for SAR operations.

468. A layout plan will be agreed with the Marine Management Organisation (MMO) following appropriate consultation with Trinity House and the MCA, with the final array layout agreed with the MCA and Trinity House post consent. However, the final array layout will be compliant with the requirements of MGN 654 (MCA, 2021), including:

- Safety justification for a SLoO (if taken forward);
- Inclusion of Helicopter Refuge Areas (HRA) as deemed necessary including in conjunction with the adjacent DBC;
- Completion of a SAR Checklist;
- Completion of an Emergency Response Cooperation Plan (ERCoP); and
- Application of unique identification marking of structures in an easily identifiable pattern.

469. The SAR Checklist and ERCoP will remain live documents throughout the O&M phase.

470. The most likely consequences in the event of a SAR operation are that SAR assets are able to fulfil their objectives without any limitations on capability. As a worst-case, it may not be possible to undertake an effective search. However, given compliance with MGN 654 for the final array layout, this is considered highly unlikely.

18.6.2 Embedded Mitigation Measures

471. The embedded mitigation measures which have been identified as relevant to reducing risk are as follows:

- Layout plan (CO2);
- Compliance with MGN 654 (CO7);
- Marking and lighting (CO9);
- Promulgation of information (CO11);
- Project vessel compliance with international marine regulations (CO12);
- Marine coordination of project vessels (CO14);
- Charting of infrastructure (CO16);
- Pollution Planning (C025); and
- O&M Strategy (CO28).

18.6.3 Significance of Risk

472. The frequency of occurrence in relation to reduction of emergency response capability due to increased incident rates and / or reduced access for SAR responders for the Project during the O&M phase is considered **extremely unlikely**. The severity of consequence in relation to reduction of emergency response capability due to increased incident rates and / or reduced access for SAR responders is considered **moderate**. Overall, it is predicted that the significance of risk due to reduction of emergency response capability due to increased incident rates and / or reduced access for SAR responders is **Broadly Acceptable**.

18.6.4 Additional Mitigation Measures and Residual Significance of Risk

473. No additional mitigation measures are proposed for this hazard and therefore the residual significance of risk remains **Broadly Acceptable**.

19 Cumulative Risk Assessment

474. This section provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to the Project cumulatively with those other developments identified from the cumulative screening (see **Section 13**). The same inputs outlined for the in-isolation risk assessment are applicable. The hazards assessed are as per the in-isolation risk assessment.

475. As outlined in **Section 13**, the only screened in development to the Project is DBS, located approximately 39nm (72km) south-west of the Array Area and was classified as a Tier 2 cumulative development. The cumulative risk assessment will only be relevant to this development.

476. Again, the risk control log (**Section 20**) summarises the risk assessment and a concluding risk statement is provided (**Section 23.4**).

19.1 Vessel Displacement Due to the Presence of the Project and Increased Vessel to Vessel Collision Risk Between Third-Party Vessels (Route-Based) Due to Displacement

477. *Activities associated with the installation, maintenance and decommissioning of structures and sub-sea cables as well as the presence of surface structures may displace third-party vessels from their existing routes or activity, increasing the collision risk with other third-party vessels at a cumulative level.*

19.1.1 Tier 2

478. Based on the cumulative assessment of vessel routeing (see **Section 14.6**), a deviation will be required for four of the seven main commercial routes identified. Of these deviations, two are as per the in-isolation scenario and are not further affected and deviated by the presence of DBS; Route 2 and Route 6.

479. Route 3 would require a deviation at a cumulative level and was not already deviated in isolation. The deviation for this route due to the presence of DBS is 0.6nm (1km) which would be an increase of 0.2% on the total route length. Given that this deviation is not associated with the Project and results in the route passing further away from the Array Area it is not considered relevant to assess further in relation to the Project.

480. Route 1 was deviated in isolation but would require a further deviation due to the presence of DBS to a total increase of 1nm (1.9km) which would be an increase of 0.3% on the total route length.

481. Should activities between the offshore ECCs for both the Project and DBS coincide, then it is assumed that suitable marine coordination will be implemented on a cumulative basis to minimise disruption for passing third party vessels.

482. The same main consequences (increased journey times and distances) and mitigation measures relevant for each phase of the equivalent hazard for the Project in isolation are again applicable, including promulgation of information and marking on relevant nautical charts. Given the greater length of deviations, although still minimal, compared to the in-isolation scenario, the severity of consequence is greater, although remains within low parameters given the increased distances relative to the length of routes as a whole.

483. Again, vessels navigating in the area will already be familiar with deviating and routeing in this area of the North Sea due to the already under construction developments in proximity to both the Project and DBS. 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 relevant nautical charts. This high level of awareness will assist with ensuring that vessels make safe and effective deviations which minimise journey increases.

19.1.2 Significance of Risk

484. The frequency of occurrence in relation to cumulative vessel displacement for theArray Area is considered **frequent**. The severity of consequence in relation to vessel displacement is considered **minor**. Overall, it is predicted that the significance of risk due to cumulative vessel displacement is **Tolerable with Mitigation**.

485. The frequency of occurrence in relation to cumulative vessel displacement for the offshore ECC is considered **reasonably probable**. The severity of consequence in relation to vessel displacement and third-party collision risk is considered **minor**. Overall, it is predicted that the significance of risk due to cumulative vessel displacement and third-party collision risk is **Tolerable with Mitigation**.

486. The frequency of occurrence in relation to cumulative increased third-party collision risk due to displacement for the Array Area is considered **remote**. The severity of consequence in relation to increased third-party collision risk due to displacement is considered **moderate**. Overall, it is predicted that the significance of risk due to cumulative increased third-party collision risk due to displacement is **Tolerable with Mitigation**.

487. The frequency of occurrence in relation to cumulative increased third-party collision risk due to displacement for the offshore ECC is considered **extremely unlikely**. The severity of consequence is **moderate**. Overall, it is predicted that the significance of risk due to cumulative increased third-party collision risk due to displacement is **Broadly Acceptable**.

19.2 Vessel to Vessel Collision Risk Between a Third-Party Vessel and a Project Vessel

488. *Project vessels associated with construction, O&M, and decommissioning activities may increase encounters and collision risk for other vessels already operating in the area on a cumulative level.*

19.2.1 Tier 2

489. There is potential for DBS construction activities to overlap with that of the Project, especially if the same base port(s) or similarly located ports could be used for construction, O&M, and decommissioning. However, details of base ports are not currently available and so a detailed risk assessment is not possible.

490. Nevertheless, in such circumstances the marine coordination applicable to project vessels associated with the Project would be collaboratively extended as appropriate across both developments, thus ensuring that disruption to third-party vessel movements is minimised. This will also apply for O&M activities across all Dogger Bank developments, although with lower traffic volumes than would be applicable during construction. It is also anticipated that embedded mitigation measures identified for the equivalent in isolation impact would be applied across project including AIS carriage and compliance with Flag State regulations for project vessels, ongoing liaison with fishing fleets via an appointed FLO, an application for Safety Zones, and promulgation of information. However, given the distance between the Project and DBS, it is very likely that no cumulative overlap in activities would occur.

19.2.2 Significance of Risk

491. The frequency of occurrence in relation to cumulative third-party to project vessel collision risk for the Array Area for is considered to be **extremely unlikely**. The severity of consequence in relation to cumulative third-party to project vessel collision risk is considered to be **moderate**. Overall, it is predicted that the significance of risk due to cumulative third-party to project vessel collision risk is **Broadly Acceptable**.

492. The frequency of occurrence in relation to cumulative third-party to project vessel collision risk for the offshore ECC for all phases is considered to be **extremely unlikely**. The severity of consequence in relation to cumulative third-party to project vessel collision risk is considered to be **moderate**. Overall, it is predicted that the significance of risk due to cumulative third-party to project vessel collision risk is **Broadly Acceptable**.

19.3 Vessel to Structure Allision Risk for Third-Party Vessels Due to the Presence of Project Structures

493. *The presence of surface piercing structures during the O&M phase may result in the creation of a risk of allision for vessels on a cumulative level.*

19.3.1 Tier 2

494. Given the localised nature of vessel to structure allision risk, the cumulative risk for this hazard is limited noting that DBS is located approximately 39nm (72km) south-west of the Array Area and this is sufficient that no potential allision risk is considered. There may be an increased exposure to allision risk with perimeter structures due to the further deviation of Route 1 and the deviation of Route 3, which in isolation is not required. However, this is expected to be minor. Each development will be required to implement marine lighting and marking in agreement with Trinity House and in compliance with IALA G1162 (IALA, 2021), meaning the localised risk is managed.

19.3.2 Significance of Risk

495. The frequency of occurrence in relation to cumulative vessel to structure allision risk for third-party vessels due to the presence of project structures for the Array Area during the O&M phase is considered **extremely unlikely.** The severity of consequence in relation to cumulative vessel to structure allision risk for third-party vessels due to the presence of project structures is considered **moderate**.

496. Overall, it is predicted that the significance of risk due to cumulative vessel to structure allision risk for third-party vessels due to the presence of project structures is **Broadly Acceptable**.

19.4 Reduction of Under Keel Clearance Due to the Presence of Cable Protection or Cable Crossings

497. *The presence of cable protection associated with the sub-sea cables may result in reductions to water depth and the creation of an under keel clearance risk for vessels on a cumulative level.*

19.4.1 Tier 2

498. Given the localised nature of under keel clearance risk and the lack of proximity between inter-array cables associated with the Project and cumulative developments, no additional under keel clearance risk is identified at the cumulative level.

499. However, given the potential for the offshore ECCs for the Project and DBS to cross, there may be some potential cumulative under keel clearance risk associated with the presence of cable protection. These portions of the offshore ECC which may be

shared with the DBS export cable routes are expected to be outside of the nearshore area such that the likelihood of a reduction in charted water depth greater than 5% is low. Nevertheless, as per the assessment of the Project in isolation, in such circumstances the MCA will be consulted on appropriate mitigation (if required) to ensure the under keel interaction risk is ALARP.

19.4.2 Significance of Risk

500. The frequency of occurrence in relation to the cumulative reduction of under keel clearance due to the presence of cable protection or cable crossings for the Project during the O&M phase is considered **remote**. The severity of consequence in relation to the cumulative reduction of under keel clearance due to the presence of cable protection or cable crossings is considered **minor**.

501. Overall, it is predicted that the significance of risk due to the cumulative reduction of under keel clearance due to the presence of cable protection or cable crossings **Broadly Acceptable**.

19.5 Vessel Interaction with Sub-Sea Cables Associated with the Project

502. *The presence of sub-sea cables at a cumulative level may result in the creation of a risk of a vessel anchor making contact with sub-sea cable.*

19.5.1 Tier 2

503. Given the localised nature of anchor interaction and the lack of proximity between inter-array cables associated with the Project and cumulative developments, no additional anchor interaction risk is identified at the cumulative level.

504. Given the offshore ECCs for the Project and DBS will cross, there may be some potential cumulative anchor interaction. However, it is assumed that DBS will be subject to the same forms of mitigation as the Project for cable burial and protection such as a cable burial risk assessment.

19.5.2 Significance of Risk

505. The frequency of occurrence in relation to cumulative vessel interaction with sub-sea cables associated with the Project during the O&M phase is considered **extremely unlikely.** The severity of consequence in relation to cumulative anchor interaction is considered to be **minor**. Overall, it is predicted that the significance of risk due to the cumulative vessel interaction with sub-sea cables associated with the Project is **Broadly Acceptable**.

19.6 Reduction of Emergency Response Capability Due to Increased Incident Rates and / or Reduced Access for Search and Rescue Responders

506. *The presence of surface structures increased vessel activity, and personnel numbers on a cumulative level, may result in an increased likelihood of an incident occurring which requires an emergency response and may reduce access for surface air responders, including SAR assets.*

19.6.1 Tier 2

507. The presence and activities associated with cumulative developments may further increase the likelihood of incidents requiring an emergency response and could subsequently increase the likelihood of multiple incidents occurring simultaneously, adding additional stress on emergency responders.

508. As with the Project, DBS will have mitigation measures in place to reduce the likelihood of emergency response capability being compromised. This includes marine coordination for project vessels and compliance with Flag State regulations. SOLAS obligations will also be applicable to all cumulative developments and may have a positive effect, e.g. a project vessel for the Dogger Bank developments may be able to assist with an incident associated with the Project, or vice-versa. Nevertheless, the presence of structures and associated activities across multiple developments will increase the likelihood of an incident occurring that requires an emergency response.

19.6.2 Significance of Risk

509. The frequency of occurrence in relation to the cumulative reduction of emergency response capability due to increased incident rates and / or reduced access for SAR responders for the Project during the O&M phase is considered **remote**. The severity of consequence in relation to the cumulative reduction of emergency response capability due to increased incident rates and / or reduced access for SAR responders is considered **moderate**. Overall, it is predicted that the significance of risk due to the cumulative reduction of emergency response capability due to increased incident rates and / or reduced access for SAR responders is **Tolerable with Mitigation**.

20 Risk Control Log

510. **Table 20-1** presents a summary of the assessment of Shipping and Navigation hazards risk assessed. This includes the proposed embedded mitigation measures, frequency of occurrence, severity of consequence and significance of risk, per hazard.

511. Addition mitigation measures and subsequent residual significance of risk is considered in **Section 23**.

Table 20-1 Risk Control Log

Hazard	Scenario	Component	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel displacement due to the presence of the Project	In isolation	Array Area	Construction	▪ Compliance with MGN 654 (CO7); ▪ Marking and lighting (CO09); ▪ Traffic monitoring (CO10); ▪ Promulgation of information (CO11); ▪ Guard vessel(s) (CO17); ▪ Charting of infrastructure (CO16); ▪ Application for Safety Zones (CO17); and ▪ Decommissioning programme (CO21).	Frequent	Minor	**Tolerable with Mitigation**	None	**Tolerable with Mitigation**
			O&M		Frequent	Minor	**Tolerable with Mitigation**		**Tolerable with Mitigation**
			Decommissioning		Frequent	Minor	**Tolerable with Mitigation**		**Tolerable with Mitigation**
		Offshore ECC	Construction		Reasonably Probable	Minor	**Tolerable with Mitigation**		**Tolerable with Mitigation**
			O&M		Reasonably Probable	Minor	**Tolerable with Mitigation**		**Tolerable with Mitigation**
			Decommissioning		Reasonably Probable	Minor	**Tolerable with Mitigation**		**Tolerable with Mitigation**
	Cumulative	Array Area	All Phases		Frequent	Minor	**Tolerable with Mitigation**		**Tolerable with Mitigation**
		Offshore ECC	All Phases		Reasonably Probable	Minor	**Tolerable with Mitigation**		**Tolerable with Mitigation**

Hazard	Scenario	Component	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel to vessel collision risk between third-party vessels	In isolation	Array Area	Construction	▪ Compliance with MGN 654 (CO7); ▪ Marking and lighting (CO9); ▪ Traffic monitoring (CO10); ▪ Promulgation of information (CO11); ▪ Guard vessel(s) (CO17); ▪ Charting of infrastructure (CO16); ▪ Application for Safety Zones (CO17); ▪ Decommissioning programme (CO21); and ▪ Pollution planning (CO25).	Remote	Moderate	**Tolerable with Mitigation**	None	**Tolerable with Mitigation**
			O&M		Remote	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
			Decommissioning		Remote	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
		Offshore ECC	Construction		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
			O&M		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
			Decommissioning		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
	Cumulative	Array Area	All Phases		Remote	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**
		Offshore ECC	All Phases		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**

Hazard	Scenario	Component	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel to vessel collision risk between a third-party vessel and a project vessel	In isolation	Array Area	Construction	▪ Compliance with MGN 654 (CO7); ▪ Marking and lighting (CO9); ▪ Traffic monitoring (CO10); ▪ Promulgation of information (CO11); ▪ Project vessel compliance with international marine regulations (CO12); ▪ Marine coordination of project vessels (CO14); ▪ Guard vessel(s) (CO17); ▪ Charting of infrastructure (CO16); ▪ Application for Safety Zones (CO17); ▪ Decommissioning programme (CO21); ▪ Pollution planning (CO25); and ▪ O&M Strategy (CO28).	Extremely Unlikely	Moderate	**Broadly Acceptable**	None	**Broadly Acceptable**
			O&M		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
			Decommissioning		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
		Offshore ECC	Construction		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
			O&M		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
			Decommissioning		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
	Cumulative	Array Area	All Phases		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
		Offshore ECC	All Phases		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**

<table>
<tr><th>Hazard</th><th>Scenario</th><th>Component</th><th>Phase</th><th>Embedded Mitigation Measures</th><th>Frequency of Occurrence</th><th>Severity of Consequence</th><th>Significance of Risk</th><th>Additional Mitigation Measures</th><th>Residual Risk</th></tr>
<tr><td rowspan="2">Vessel to structure allision risk for third-party vessels due to the presence of Project structures</td><td>In isolation</td><td>Array Area</td><td>O&M</td><td rowspan="2">Layout plan (CO2);
Compliance with MGN 654 (CO7);
Marking and lighting (CO9);
Promulgation of information (CO11);
Minimum blade clearance (CO13);
Guard vessel(s) (CO17);
Fishery liaison (CO15);
Charting of infrastructure (CO16);
Application for Safety Zones (CO17); and
Pollution planning (CO28).</td><td>Extremely Unlikely</td><td>Moderate</td><td>Broadly Acceptable</td><td rowspan="2">None</td><td>Broadly Acceptable</td></tr>
<tr><td>Cumulative</td><td>Array Area</td><td>O&M</td><td>Extremely Unlikely</td><td>Moderate</td><td>Broadly Acceptable</td><td>Broadly Acceptable</td></tr>
<tr><td rowspan="2">Reduction of under keel clearance due to the presence of cable protection or cable crossings</td><td>In isolation</td><td>Project</td><td>O&M</td><td rowspan="2">Compliance with MGN 654 (CO7);
Promulgation of information (CO11);
Guard vessel(s) (CO17);
Charting of infrastructure (CO16);
Cable burial risk assessment (CO24);
Under keel clearance (CO23 & CO24);
O&M Strategy (CO28); and
Offshore cable installation plan (CO24).</td><td>Extremely Unlikely</td><td>Minor</td><td>Broadly Acceptable</td><td rowspan="2">None</td><td>Broadly Acceptable</td></tr>
<tr><td>Cumulative</td><td>Project</td><td>O&M</td><td>Remote</td><td>Minor</td><td>Broadly Acceptable</td><td>Broadly Acceptable</td></tr>
</table>

Hazard	Scenario	Component	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel interaction with sub-sea cables associated with the Project	In isolation	Project	O&M	▪ Promulgation of information (CO11); ▪ Guard vessel(s) (CO17); ▪ Charting of infrastructure (CO16); ▪ Cable burial risk assessment (CO24); ▪ Pollution planning (CO25); ▪ Under keel clearance (CO23 & CO24); ▪ O&M Strategy (CO28); and ▪ Offshore cable installation plan (CO24).	Extremely Unlikely	Minor	**Broadly Acceptable**	None	**Broadly Acceptable**
	Cumulative	Project	O&M		Extremely Unlikely	Minor	**Broadly Acceptable**		**Broadly Acceptable**
Reduction of emergency response capability due to increased incident rates and / or reduced access for SAR responders	In isolation	Project	O&M	▪ Layout plan (CO2); ▪ Compliance with MGN 654 (CO7); ▪ Marking and lighting (CO9); ▪ Promulgation of information (CO11); ▪ Project vessel compliance with international marine regulations (CO12); ▪ Marine coordination of project vessels (CO14); ▪ Charting of infrastructure (CO16); ▪ Pollution planning (CO25); and ▪ O&M Strategy (CO28).	Extremely Unlikely	Moderate	**Broadly Acceptable**	None	**Broadly Acceptable**
	Cumulative	Project	O&M		Remote	Moderate	**Tolerable with Mitigation**		**Tolerable with Mitigation**

21 Embedded Mitigation Measures

512. As part of the Project design process, a number of embedded mitigation measures have been adopted to reduce the potential for risk to Shipping and Navigation users.

513. These measures typically include those that have been identified as good or standard practice and include actions that would be undertaken to meet existing legislation requirements. As there is a commitment to implementing these measures, and also to various standard sectoral practices and procedures, they are considered inherently part of the design of the Project.

514. The embedded mitigation measures within the design relevant to Shipping and Navigation are outlined in **Table 21-1**.

Table 21-1 Embedded Mitigation Measures Relevant to Shipping and Navigation

Commitment ID	Embedded Mitigation Measure	Detail
CO2	**Layout Plan**	A Layout Plan (including sub-sea cables and the wind turbines) will be provided and agreed with the Marine Management Organisation (MMO) following consultation with Trinity House and the Maritime and Coastguard Agency (MCA). The Layout Plan will take account of the distribution of geophysical anomalies of archaeological interest and the requirement to avoid Archaeological Exclusion Zones (AEZ).
CO7	**Compliance with MGN 654**	The Project will ensure compliance with Marine Guidance Note (MGN) 654 and its annexes, where applicable, including implementation of an Emergency Response Cooperation Plan (ERCoP) for all phases of the Project and completion of a Search and Rescue (SAR) checklist.
CO9	**Marking and Lighting**	Aids to navigation (marking and lighting) will be deployed in accordance with the latest relevant available standard industry guidance and as advised by Trinity House, Maritime and Coastguard Agency (MCA) and Civil Aviation Authority (CAA) and Ministry of Defence (MoD) as appropriate. This will include a buoyed construction area around the Array Area. Consultation with Trinity House, MCA, and CAA will occur to determine appropriate lighting and marking.
CO10	**Traffic Monitoring**	A Vessel Traffic Monitoring Plan will be developed and will include provision for monitoring of vessel traffic during the construction phase.

Commitment ID	Embedded Mitigation Measure	Detail
CO11	**Promulgation of Information**	Advanced warning and accurate location details of construction, maintenance, and decommissioning operations, associated safety zones and advisory safe passing distances will be given via Notifications to Mariners and Kingfisher Bulletins at least 14 days prior where possible. The Project will ensure that local Notifications to Mariners are updated and reissued at weekly intervals during construction activities and at least five days before any planned operation and maintenance works and supplemented with very high frequency (VHF) radio broadcasts agreed with the Maritime and Coastguard Agency (MCA) in accordance with the construction and monitoring programme approved under the relevant Deemed Marine Licence (DML) condition. In the event of any cable exposure on or above the seabed, notification to other marine users will be issued via Notices to Mariners and Kingfisher Bulletins confirming the location and extent of the exposure.
CO12	**Project Vessel Compliance with International Marine Regulations**	Project vessels will ensure compliance with Flag State regulations including the Convention on the International Regulations for Preventing Collisions at Sea (COLREG) (International Maritime Organization (IMO), 1972/77) and International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974).
CO13	**Minimum Blade Clearance**	There will be a minimum blade tip clearance of at least 26m above highest astronomical tide, and 28m above lowest astronomical tide.
CO14	**Marine Coordination of Project Vessels**	Marine coordination for project vessels will be implemented through Detailed Construction and Monitoring Programme (Construction Phase) and Offshore Operations and Maintenance Plan (O&M Phase).

Commitment ID	Embedded Mitigation Measure	Detail
CO15	**Fishery Liaison**	A Fisheries Liaison and Coexistence Plan (FLCP) will be provided in accordance with the Outline FLCP. The FLCP will include commitment to ongoing liaison with fishermen throughout all stages of the Project, based upon the Fisheries Liaison with Offshore Wind and Wet Renewables Group (FLOWW) (2014, 2015) guidance (or latest relevant available guidance) and specifically the following: - The appointment of a company Fisheries Liaison Officer (FLO) to maintain effective communications between the Project and fishermen; - Appropriate liaison with relevant fishing interests to ensure that they are appropriately fully informed of development planning and any offshore activities and works; - The provision of advance warning and accurate location details of construction, maintenance and decommissioning operations, associated safety zones and advisory passing distances, to be given via Notices to Mariners and Kingfisher Bulletins; and - Specific to the UK potting fishery the implementation of evidence-based mitigation in line with relevant FLOWW guidelines.
CO16	**Charting of Infrastructure**	There will be appropriate marking of all offshore infrastructure associated with the Project on suitably scaled UK Hydrographic Office (UKHO) Admiralty Charts.
CO17	**Guard Vessel(s)**	Safety zones of up to 500m will be applied for during construction, major maintenance and decommissioning phases and up to 50m for installed structures pre-commissioning. Where defined by risk assessment, guard vessels will also be used to ensure adherence with safety zones or advisory passing distances to mitigate impacts which pose a risk to surface navigation during construction, maintenance and decommissioning phases. Where deemed appropriate by risk assessment, guard vessels will be used to reduce risks to surface navigation during construction, maintenance and decommissioning.
CO21	**Decommissioning Programme**	An Offshore Decommissioning Programme will be provided prior to the construction of the offshore works and implemented at the time of decommissioning, based on the relevant guidance and legislation.
CO23	**Trenchless Techniques**	At the landfall, trenchless installation techniques will be implemented and exit pits will be located beyond Mean Low Water Springs (MLWS). Installation will be at a suitable depth below the base of the cliff to avoid potential impacts to the Withow Gap Site of Special Scientific Interest (SSSI).

Commitment ID	Embedded Mitigation Measure	Detail
CO24	**Cable Burial Risk Assessment (CBRA)**	A Cable Specification and Installation Plan will be provided and submitted for approval prior to offshore construction. The Cable Specification and Installation Plan will detail the methods used for construction of offshore export and inter-array cables. Where possible, cable burial will be the preferred method for cable protection. Where cable protection is required, this will be minimised so far as is feasible. All cable protection will adhere to the requirements of Marine Guidance Note (MGN) 654 with respect to changes greater than 5% to the under-keel clearance in consultation with the Maritime and Coastguard Agency (MCA) and Trinity House. Any damage, destruction or decay of cables must be notified to the MCA, Trinity House, Kingfisher and UK Hydrographic Office (UKHO) no later than 24 hours after being discovered.
CO25	**Pollution Planning**	A Project Environmental Management Plan (PEMP) will be provided in accordance with the Outline PEMP and will include: - A Marine Pollution Contingency Plan (MPCP), which will include plans to address the risks, methods and procedures to deal with any spills and collision incidents in relation to all activities carried out below Mean High Water Springs (MHWS) to safeguard the marine environment; - Best practice measures for the storage, use and disposal of lubricant and chemicals will be undertaken throughout the construction phase; - A Chemical Risk Assessment (CRA) to ensure any chemicals, substances and materials to be used will be suitable for use in the marine environment and in accordance with the Health and Safety Executive and the Environment Agency Pollution Prevention Control Guidelines or latest relevant available guidelines; - A marine biosecurity plan detailing how the risk of introduction and spread of invasive non-native species will be minimised; and - Details of waste management and disposal arrangements.
CO28	**O&M Strategy**	An Offshore Operations and Maintenance Plan (O&M) will be provided prior to commencement of operation and will outline the reasonably foreseeable O&M offshore activities.

21.1 Marine Aids to Navigation

515. Throughout all phases, AtoNs will be provided in accordance with Trinity House and MCA requirements, with consideration being given to IALA Recommendation O-139 and Guideline G1162 (IALA, 2021a), and MGN 654 (MCA, 2021).

21.1.1 Construction and Decommissioning Phases

516. During the construction and decommissioning phases, buoyed construction and decommissioning areas will be established and marked, where required, in accordance with Trinity House requirements based on the IALA Maritime Buoyage System. In addition, where advised by Trinity House, additional marking on structures may also be applied.

21.1.2 Operation and Maintenance Phase

517. Marking during the O&M phase will be agreed in consultation with Trinity House once the final array layout has been selected post consent; however, the following subsections summarise likely requirements.

21.1.2.1 Marking of Individual Array Structures

518. As per IALA Guideline G1162, each surface structure within the Array Area will be painted yellow from the level of HAT to at least 15m above HAT. Each structure will also be clearly marked with a unique alphanumeric identifier which will be clearly visible from all directions. The MCA will advise post consent on the specific requirements for the identifiers, but a logical pattern with potential for additional visual marks may be considered by statutory stakeholders. Each identifier will be illuminated by a low-intensity light such that the sign is available from a vessel thus enabling the structure to be identified at a suitable distance to avoid an allision incident.

519. The identifiers will be situated such that, under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer (with the naked eye), stationed 3m above sea level and at a distance of at least 150m from the wind turbine. The light will be either hooded or baffled so as to avoid unnecessary light pollution or confusion with navigational marks.

21.1.2.2 Marking of Array as a Whole

520. The marking of the array as a whole will be agreed with Trinity House once the final array layout has been selected and will be in line with IALA Recommendation O-139 and Guideline G1162. As per the IALA guidance, and in consultation with Trinity House, it will be ensured that:

- All corner structures will be marked as a Significant Peripheral Structure (SPS) and where necessary, to satisfy the spacing requirements between SPSs, additional periphery structures may also be marked as secondary SPSs;
- Structures designated as an SPS will exhibit a flashing yellow five second (flash yellow every five seconds) light of at least 5nm (9km) nominal range and omnidirectional fog signals as appropriate and where prescribed by Trinity House, and will be sounded at least when the visibility is 2nm (4km) or less;

- Further periphery structures may be marked as Intermediate Peripheral Structures (IPS) including a flashing yellow light with a distinctly different flash character from those displayed on the SPSs and at least 2nm (4km) nominal range;
- All lights will be visible to shipping through 360˚ and if more than one lantern is required on a structure to meet the all-round visibility requirement, then all the lanterns on that structure will be synchronised;
- All lights will be exhibited at the same height at least 6m above HAT and below the arc of the lowest wind turbine blades;
- Remote monitoring sensors using Supervisory Control and Data Acquisition (SCADA) will be included as part of the lighting and marking scope to ensure a high level of availability for all aids to navigation;
- Aviation lighting will be as per CAA requirements; however, will likely be synchronised Morse “W” at the request of Trinity House; and
- All lighting will be considered cumulatively with existing aids to navigation including the neighbouring DBC to avoid the potential for light confusion to passing traffic.

521. Consideration will also be given to the use of marking via AIS, or other electronic means (such as Racon) to assist safe navigation particularly in reduced visibility. AIS transmitters or virtual buoys could also be considered internally to assist with safe navigation within the Array Area.

522. Additionally, consideration will be given to the cumulative lighting and marking of the Projects alongside DBC, again in consultation with Trinity House.

21.1.2.3 Marking of Offshore Export Cables

523. No lighting or physical marking will be required during the O&M phase for the offshore export cables.

21.2 Design Specifications Noted in Marine Guidance Note 654

524. The individual wind turbines and other structures will have functions and procedures in place for generator shut down in emergency situations, as per MGN 654 (MCA, 2021).

22 Through Life Safety Management

22.1 Quality, Health, Safety and Environment

525. QHSE documentation including a Safety Management System (SMS) will be in place for the Project and will be continually updated throughout the development process. The following subsections provide an overview of this documentation and how it will be maintained and reviewed with reference, where required, to specific marine documentation.

526. Monitoring, reviewing, and auditing will be carried out on all procedures and activities and feedback actively sought. Any designated person (identified in QHSE documentation), managers, and supervisors are to maintain continuous monitoring of all marine operations and determine if all required procedures and processes are being correctly implemented.

22.2 Incident Reporting

527. After any incidents, including near misses, an incident report form will be completed in line with the Project QHSE documentation. This will then be assessed for relevant outcomes and reviewed for possible changes required to operations.

528. The Applicant will maintain records of investigation and analyse incidents in order to:

- Determine underlying deficiencies and other factors that may be causing or contributing to the occurrence of incidents;
- Identify the need for corrective action;
- Identify opportunities for preventative action;
- Identify opportunities for continual improvement; and
- Communicate the results of such investigations.

529. All investigations shall be performed in a timely manner.

530. A database of lessons learnt from all marine incidents will be developed. It will include the outcomes of investigations and any resulting actions. The Applicant will promote awareness of incident occurrence and provide information to assist monitoring, inspection and auditing of documentation.

531. When appropriate, the designated person (noted within the ERCoP) should inform the MCA of any exercise or incidents including any implications on emergency response. If required, the MCA should be invited to take part in incident debriefs.

22.3 Review of Documentation

532. The Applicant will be responsible for reviewing and updating all documentation including the risk assessments, ERCoP, SMS and, if required, will convene a review panel of stakeholders to quantify risk.

533. Reviews of the risk register should be made after any of the following occurrences:

- Changes to the development, conditions of operation and prior to decommissioning;
- Planned reviews; and
- Following an incident or exercise.

534. A review of potential risks should be carried out annually. A review of the response charts should be undertaken annually to ensure that response procedures are up to date and should include any amendments from audits, incident reports and identified deficiencies.

22.4 Inspection of Resources

535. All vessels, facilities, and equipment necessary for marine operations are to be subject to appropriate inspection and testing to determine fitness for purpose and availability in relation to their performance standards. This will include monitoring and inspection of all aids to navigation to determine compliance with the performance standards specified by Trinity House.

22.5 Audit Performance

536. Auditing and performance review are the final steps in QHSE management systems. The feedback loop enables an organisation to reinforce, maintain and develop its ability to reduce risks to the fullest extent, and to ensure the continued effectiveness of the system. The Applicant will carry out audits and periodically evaluate the efficiency of the marine safety documentation.

537. The audits and possible corrective actions should be undertaken in accordance with standard procedures and results of the audits and reviews should be brought to the attention of all personnel having responsibility in the area involved.

22.6 Safety Management System

538. The Applicant will manage the risk associated with the activities undertaken at the Project. An integrated SMS, which ensures that the safety and environmental risks of those activities are ALARP, will be established. This includes the use of remote monitoring and switching for aids to navigation to ensure that if a light is faulty a quick fix can be instigated, which will allow IALA availability requirements to be met.

22.7 Cable Monitoring

539. The sub-sea cable routes will be subject to periodic inspection post-construction to monitor the condition of the cable, any installed cable protection, and cable burial depths. Maintenance of the cable protection will be undertaken as necessary.

540. If exposed cables or ineffective cable protection measures are identified during post-construction monitoring, these would be promulgated to relevant sea users including via Notifications to Mariners and Kingfisher Bulletins. Where immediate risk was observed, the Applicant would also employ additional temporary measures (such as a guard vessel or temporary buoyage) until such time as the risk was adequately mitigated.

541. Details will be included in full within the assessment of cable burial and protection document, to be produced post-consent.

22.8 Hydrographic Surveys

542. As required by Annex 4 of MGN 654, detailed and accurate hydrographic surveys will be undertaken periodically at intervals agreed with the MCA.

22.9 Decommissioning Programme

543. A decommissioning programme will be developed post consent. With regards to hazards to Shipping and Navigation, this will also include consideration of the scenario where upon decommissioning and completion of removal operations, an obstruction is left on-site (attributable to the Project) which is considered to be a danger to navigation and which it has not proved possible to remove. Such an obstruction may result is a requirement for the Applicant or Operator of the Project to implement marking until such time as it is either removed or no longer considered a danger to navigation.

23 Summary

23.1 Consultation

544. The NRA process has included consultation with stakeholders of relevance to Shipping and Navigation. This has included consideration of the outputs of the scoping process, direct liaison with key stakeholders and outreach to Regular Operators of the area. Stakeholders which have been consulted to date include the following:

- MCA;
- Trinity House; and
- UK Chamber of Shipping.

545. The Hazard Workshop has been agreed by the above Stakeholders to be undertaken post-PEIR based on baseline data still being collected at PEIR and the baseline is still evolving in proximity to the Array Area due to the progression of DBC. Further consultation with additional stakeholders, including at the Hazard Workshop, will be included post-PEIR, at the ES stage.

23.2 Baseline Environment

23.2.1 Navigational Features

546. Key navigational features in proximity to the Project include the under construction baseline offshore wind developments; DBC, Sofia, DBA, and DBD. These developments are located to the west of the Array Area with DBC sharing its eastern boundary with the Project. Several construction buoys associated with DBC also intersect the Array Area.

547. The eastern boundary of the Array Area aligns with the international maritime boundary between the UK and the Netherlands.

548. Three existing pipelines and sixteen existing sub-sea cables, including those offshore export cables under construction for DBA, DBB and Sofia, intersect the offshore ECC. No sub-sea cables or pipelines intersect the Array Area.

549. The closest harbour to the Project is Bridlington Harbour, located approximately 5nm (9km) north of the offshore ECC and approximately 117nm (217km) south-west of the Array Area.

550. There are no IMO routeing measures, charted anchorage areas, or marine aggregate dredging areas in close proximity to the Project.

23.2.2 Maritime Incidents

551. From DfT SAR helicopter taskings data recorded between April 2015 and March 2024, there were a total of 28 helicopter taskings recorded within the offshore ECC Study Area, equating to an average of three per year. A total of 57% of these incidents were within 10nm (19km) of the coast. No taskings were recorded within the Array Area Study Area.

552. From RNLI recorded incident data recorded between 2014 and 2023, there were a total of 34 unique incidents recorded within the offshore ECC Study Area, equating to an average of three to four per year. A total of 88% of all RNLI incidents were recorded within 10nm (19km) of the coast. No taskings were recorded within the Array Area Study Area.

553. From MAIB reported incident data recorded between 2013 and 2022, there were a total of four incidents reported within the Study Area, none of which were within the Array Area, equating to one every two to three years. A total of 18 unique incidents recorded within the offshore ECC Study Area, equating to an average of three to four per year.

23.2.3 Vessel Traffic Movements

23.2.3.1 Array Area

554. From the combined 54-days of vessel traffic data from the vessel traffic survey and supplementary AIS data within the Study Area, there was an average of four to five unique vessels recorded per day. Of these vessels 29% intersected the Array Area of an equivalent of one to two unique vessels per day. The main vessel types recorded within the Study Area during the combined dataset were cargo vessels (42%) and tankers (20%).

555. A total of seven main commercial routes were identified from the vessel traffic data The highest use main commercial route was a commercial vessel (cargo and tanker) route between Humber ports and ports in Norway. Approximately five vessels per week were recorded on this route.

23.2.3.2 Offshore ECC

556. During the 40-days of AIS-only vessel traffic data from 2024 within the offshore ECC Study Area, there was an average of 21 unique vessels per day during the data period, with an average of 19 unique vessels recorded crossing the offshore ECC. The main vessel types within the offshore ECC Study Area were cargo vessels (45%) and tankers (24%).

23.3 Collision and Allision Risk Modelling

557. Of the seven main commercial routes identified, it is anticipated that three will be required to deviate as a result of the Project. The largest increase was to Route 6 (North Sea Oil and Gas – Netherlands / Belgium), with a 1.7nm (3km) increase – however, the percentage increase to this route was 0.4%, and so overall is relatively small.

558. The NRA process included quantitative modelling of the change in collision and allision frequency as a result of the Project, with consideration given to future cases in terms of potential future traffic increases. For allision modelling, an indicative layout including 115 locations was used, noting that this provides conservative results for quantifying allision risk.

559. Assuming commercial routes deviate in the presence of the Array Area, it was estimated that the return period of a vessel being involved in a collision post wind farm was 44,813 years assuming base case traffic levels. This represents a 25% increase in collision frequency compared to the pre wind farm base case result.

560. The powered allision return period post wind farm was estimated at 10,038 years assuming base case traffic levels. The corresponding drifting allision return period post wind farm was estimated at 44,421 years. The fishing vessel allision return period was estimated at 82 years, noting that this conservatively assumes that there is no change in baseline fishing activity within or in proximity to the Array Area.

23.4 Preliminary Environmental Information Report Risk Statement

561. Using the baseline data, expert opinion, stakeholder concerns and lessons learnt from existing offshore developments, shipping and navigation hazards have been risk assessed in line with the FSA methodology. The full risk control log including details of hazards, embedded mitigation measures and significance of risk for relevant phases and across both in isolation and cumulative scenarios at the PEIR stage is presented in **Section 20**.

562. The significance of risk has been determined as **Broadly Acceptable** or **Tolerable with Mitigation** (both ALARP levels) for all hazards assessed.

563. As acknowledged in **Section 23.5**, there are various additional steps which remain to be undertaken for the NRA submitted at the ES stage which will lead to further inputs being available to inform the risk assessment at the ES stage.

23.5 Next Steps

564. Although this NRA considers the requirements of the MGN 654 Checklist (see **Annex A**), it is acknowledged that various additional steps will be required post-PEIR to ensure a comprehensive NRA is submitted at the ES stage. These include:

- Additional consultation with shipping and navigation stakeholders;
- Completion of a Hazard Workshop with relevant stakeholders and subsequent hazard log;
- Collection and analysis of MGN 654 compliant vessel traffic surveys for both winter and summer seasonal periods in 2025;
- Consideration of the RYA Coastal Atlas of Recreational Boating (RYA, 2019) to inform the baseline, in particular the offshore ECC;
- Updating of the risk assessment based on the additional information gathered above;
- Review of the cumulative screening for new information available; and
- Updating of the MGN 654 Checklist with consideration of all of the above to ensure that the NRA is fully compliant with MGN 654.

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Annex A MGN 654 Checklist

565. The MGN 654 Checklist can be divided into two distinct checklists, one considering the main MGN 654 guidance document and one considering the Methodology for Assessing Marine Navigational Safety and Emergency Response Risks of OREIs (MCA, 2021) which serves as Annex 1 to MGN 654.

566. The checklist for the main MGN 654 guidance document is presented in **Table A-1**. Following this, the checklist for the MCA's methodology annex is presented in **Table A-2**. For both checklists, references to where the relevant information and / or assessment is provided in the NRA is given.

Table A-1 MGN 654 Checklist for Main Document

Issue	Compliance	Comments
Site and Installation Coordinates. Applicants are responsible for ensuring that formally agreed coordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 (European Terrestrial Reference System 1989 (ETRS89)) datum.		
Traffic Survey. Includes:		
All vessel types.	✓	**Section 10: Vessel Traffic Movements** All vessel types are considered with specific breakdowns by vessel type given within the Study Area.
At least 28 days duration, within either 12 or 24 months prior to submission of the EIAR.	**Will be completed at ES**	**Section 5: Data Sources** A total of 14 full days of vessel traffic survey data from July / August 2023 has been assessed within the Study Area. A further 14 days will be collected in winter 2025 as agreed with the MCA and Trinity House and included in the NRA at ES. Likewise, a 14-day vessel traffic survey is planned for summer 2025.
Multiple data sources.	✓	**Section 5: Data Sources** The vessel traffic survey data (summer 2023) includes AIS, Radar and visual observations to maximise coverage of vessels not broadcasting on AIS.
Seasonal variations.	**Will be completed at ES**	**Section 5: Data Sources** A total of 14 full days of vessel traffic survey data from July / August 2023 has been assessed within the Study Area. A further 14 days will be collected in winter 2025 as agreed with the MCA and Trinity House and included in the NRA at ES. Likewise, a 14-day vessel traffic survey is planned for summer 2025.
MCA consultation.	✓	**Section 4: Consultation** The MCA has been consulted as part of the NRA process.

Issue	Compliance	Comments
General Lighthouse Authority (GLA) consultation.	✓	**Section 4: Consultation** Trinity House has been consulted as part of the NRA process.
UK Chamber of Shipping consultation.	✓	**Section 4: Consultation** The UK Chamber of Shipping has been consulted as part of the NRA process.
Recreational and fishing vessel organisations consultation.	**Will be completed at ES**	**Section 4: Consultation** Will be undertaken post-PEIR through the Hazard Workshop.
Port and navigation authorities consultation, as appropriate.	**Will be completed at ES**	**Section 4: Consultation** Will be undertaken post-PEIR through the Hazard Workshop.
Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed. **Section 17: Introduction to Risk Assessment** The hazards due to the Project have been introduced and then assessed for each phase in **Section 18**. **Section 19: Cumulative Risk Assessment** The hazards due to the Project and cumulative developments have been assessed for each phase.
ii. Numbers, types and sizes of vessels presently using such areas.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed and includes breakdowns of daily vessel count, vessel type and vessel size.
iii. Non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, personal watercraft, etc.	✓	**Section 10: Vessel Traffic Movements** No non-transit users were identified in the vessel traffic survey data. Fishing vessels and recreational vessels were recorded but were in transit.
iv. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✓	**Section 11: Base Case Vessel Routeing** Main commercial routes have been identified using the principles set out in MGN 654 in proximity to the Project, with these routes taking into account coastal, deep-draught and internationally scheduled vessels.
v. Alignment and proximity of the site relative to adjacent shipping lanes.	✓	**Section 7: Navigational Features** No IMO routeing measures were in proximity to the Project with the closest the Off Botney Ground TSS approximately 60nm (111km) south of the Array Area.

Issue	Compliance	Comments
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	✓	**Section 7: Navigational Features** No IMO routeing measures or military PEXAs were in proximity to the Array Area. The closest routeing measure is the Off Botney Ground TSS approximately 60nm (111km) south of the Array Area and the closest PEXA is the D412 approximately 46nm (85km) to the west of the Array Area and overlaps the offshore ECC.
vii. Proximity of the site to areas used for anchorage (charted or uncharted), safe haven, port approaches and pilot boarding or landing areas.	✓	**Section 7: Navigational Features** Due to the distance offshore, port approaches and pilot boarding stations are not in proximity to the Project. No anchorage areas are in proximity to the Project.
viii. Whether the site lies within the jurisdiction of a port and / or navigation authority.	✓	**Section 7: Navigational Features** Due to the distance offshore, there are no ports in proximity to the Project. The closest port or harbour is Bridlington at 117nm (216km) from the Array Area and 5nm (9km) north of the offshore ECC.
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	**Section 10: Vessel Traffic Movements** Fishing vessel movements are considered within the Study Area. Detailed analysis of dedicated fishing vessel activities is undertaken in **Volume 1, Chapter 14 Commercial Fisheries**.
x. Proximity of the site to offshore firing / bombing ranges and areas used for any marine military purposes.	✓	**Section 7: Navigational Features** There are no military PEXAs in proximity to the Array Area the closest PEXA is the D412 approximately 46nm (85km) to the west of the Array Area which overlaps a portion of offshore ECC.
xi. Proximity of the site to existing or proposed submarine cables or pipelines, offshore oil / gas platforms, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Areas or other exploration / exploitation sites.	✓	**Section 7: Navigational Features** There are no marine aggregate dredging areas in proximity to the Project and **Section 7.6** identifies the charted wrecks in proximity to the Project.
xii. Proximity of the site to existing or proposed OREI developments, in cooperation with other relevant Applicants, within each round of lease awards.	✓	**Section 7: Navigational Features** **Section 7.1** Identifies other offshore wind farm developments in proximity to the Project. **Section 13: Cumulative and Transboundary Overview** Considers other OREI sites in proximity to the Project cumulatively.
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground.	✓	**Section 7: Navigational Features** **Section 7.6** identifies spoil and dumping grounds in proximity to the Project.

Issue	Compliance	Comments
xiv. Proximity of the site to AtoNs and / or VTS in or adjacent to the area and any impact thereon.	✓	**Section 7: Navigational Features** There are no VTS areas in proximity to the Project and **Section 81** identifies AtoNs in proximity to the Project.
xv. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of 'choke points' in areas of high traffic density and nearby or consented OREI sites not yet constructed.	✓	**Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project including pinch (or choke) points in proximity to the Project.
xvi. With reference to xv. above, the number and type of incidents to vessels which have taken place in or near to the proposed site of the OREI to assess the likelihood of such events in the future and the potential impact of such a situation.	✓	**Section 9: Emergency Response and Incident Overview** Historical vessel incident data published by DfT (**Section 9.1**), RNLI (**Section 9.1**) and MAIB (**Section 9.5**) in proximity to the Project has been considered alongside historical offshore wind farm incident data throughout the UK (**Section 9.6**).
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area.	✓	**Section 10: Vessel Traffic Movements** Non-transit users were identified in the vessel traffic survey data and included recreational activities.
Predicted effect of OREI on traffic and interactive boundaries. Where appropriate, the following should be determined:		
a. The safe distance between a shipping route and OREI boundaries.	✓	**Section 14: Future Case Vessel Traffic** A methodology for post-wind farm routeing is outlined and includes a minimum distance of 1nm (1.9km) from offshore installations and existing offshore wind farm boundaries.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	**Section 19: Cumulative Risk Assessment** The safe passage of shipping between developments is discussed cumulatively.
OREI Structures. The following should be determined:		
a. Whether any feature of the OREI, including auxiliary platforms outside the main generator site, mooring and anchoring systems, inter-device and export cabling could pose any type of difficulty or danger to vessels underway, performing normal operations, including fishing, anchoring and emergency response.	✓	**Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project. **Section 17: Introduction to Risk Assessment** The hazards due to the Project have been introduced and then assessed for each phase and include consideration of users such as commercial vessels, commercial fishing vessels in transit, recreational vessels, anchored vessels and emergency responders in **Section 18**.

Issue	Compliance	Comments
b. Clearances of fixed or floating wind turbine blades above the sea surface are not less than 22m (above MHWS for fixed). Floating turbines allow for degrees of motion.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** **Section 6.2** outlines the Shipping and Navigation worst-case design for wind turbines including the minimum air gap above MHWS.
c. Underwater devices: i. Changes to charted depth; ii. Maximum height above seabed; and iii. Under keel clearance.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** **Section 6.3** outlines the Shipping and Navigation worst-case design for sub-sea cables including the cable burial specifications.
d. Whether structures block or hinder the view of other vessels or other navigational features.	✓	**Section 17: Introduction to Risk Assessment** The hazards due to the Project have been introduced and then assessed for each phase and include consideration of the potential for vessels navigating in proximity to structures to be visually obscured in **Section 18**.
The effect of tides, tidal streams and weather. It should be determined whether:		
a. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide, i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** **Section 6.6** outlines the Shipping and Navigation worst-case design for the Project and includes the range of existing water depths. **Section 8: Meteorological Ocean Data** **Section 8.4** provides meteorological data in proximity to the Project relating to various states of the tide. **Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed including vessel draught. **Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project including accounting for tidal conditions.
b. The set and rate of the tidal stream, at any state of the tide, has a significant effect on vessels in the area of the OREI site.	✓	**Section 8: Meteorological Ocean Data** **Section 8.4** provides meteorological data in proximity to the Project relating to various states of the tide. **Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project including accounting for tidal conditions.
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓	
d. The set is across the major axis of the layout at any time, and, if so, at what rate.	✓	

Issue	Compliance	Comments
e. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream, including unpowered vessels and small, low speed craft.	✓	**Section 8: Meteorological Ocean Data** **Section 8.4** provides meteorological data in proximity to the Project relating to various states of the tide. **Section 16: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the Project including accounting for tidal conditions and assessment of whether machinery failure could cause vessels to be set into danger.
f. The structures themselves could cause changes in the set and rate of the tidal stream.	✓	**Section 8: Meteorological Ocean Data** **Section 8.4** provides meteorological data in proximity to the Project relating to various states of the tide and notes that no effects are anticipated.
g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the wind farm area or adjacent to the area.	✓	**Section 8: Meteorological Ocean Data** **Section 8.4** provides meteorological data in proximity to the Project relating to various states of the tide. **Section 17: Introduction to Risk Assessment** The hazards due to the Project have been introduced and then assessed for each phase in **Section 18**, including consideration of the potential for reduction in under keel clearance.
h. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	✓	**Section 8: Meteorological Ocean Data** Provides meteorological data in proximity to the Project relating to weather and visibility. **Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed including recreational vessels. **Section 12: Adverse Weather Routeing** **Section 12.2** identifies potential alternative vessel routeing in proximity to the Project in adverse weather. No adverse weather routeing was identified. **Section 17: Introduction to Risk Assessment** The hazards due to the Project have been introduced and then assessed for each phase in **Section 18**, including consideration of adverse weather.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	**Section 17: Introduction to Risk Assessment** The hazards due to the Project have been introduced and then assessed for each phase in **Section 18**, including consideration of internal allision risk for vessels under sail.

<table>
<tr><th>Issue</th><th>Compliance</th><th>Comments</th></tr>
<tr><td>j. 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 to above.</td><td>✓</td><td>Section 8: Meteorological Ocean Data
Provides meteorological data in proximity to the Project relating to wind direction and various states of the tide.

Section 16: Collision and Allision Risk Modelling
Provides quantification of collision and allision risk resulting from the Project including accounting for weather conditions and assessment of whether machinery failure could cause vessels to be set into danger.

Section 17: Introduction to Risk Assessment
The hazards due to the Project have been introduced and then assessed for each phase in Section 18, including consideration of drifting allision risk.</td></tr>
<tr><td colspan="3">Assessment of access to and navigation within, or close to, an OREI. To determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:</td></tr>
<tr><td colspan="3">a. Navigation within or close to the site would be safe:</td></tr>
<tr><td>i. For all vessels.</td><td rowspan="5">✓</td><td rowspan="5">Section 4: Consultation
Section outlines Regular Operator consultation undertaken following the vessel traffic surveys.

Section 12: Adverse Weather Routeing
Section 12.2 considers potential alternative vessel routeing in proximity to the Project in adverse weather.

Section 16: Collision and Allision Risk Modelling
Provides quantification of collision and allision risk resulting from the Project including accounting for weather and tidal conditions.

Section 17: Introduction to Risk Assessment
The hazards due to the Project have been introduced and then assessed for each phase in Section 18, including consideration of internal allision.</td></tr>
<tr><td>ii. For specified vessel types, operations and / or sizes.</td></tr>
<tr><td>iii. In all directions or areas.</td></tr>
<tr><td>iv. In specified directions or areas.</td></tr>
<tr><td>v. In specified tidal, weather or other conditions.</td></tr>
</table>

<table>
<tr><th>Issue</th><th>Compliance</th><th>Comments</th></tr>
<tr><td colspan="3">b. Navigation in and / or near the site should be prohibited or restricted:</td></tr>
<tr><td>i. For specified vessel types, operations and / or sizes.</td><td>✓</td><td rowspan="5">Section 15: Navigation, Communication and Position Fixing Equipment
Assesses potential hazards on navigation of the different communications and position fixing devices used in and around offshore wind farms.

Section 14: Future Case Vessel Traffic
A methodology for post-wind farm routeing is outlined and includes a minimum distance of 1nm (1.9km) from offshore installations and existing offshore wind farm boundaries, i.e. it is assumed that commercial vessels will avoid the Array Area.

Section 17: Introduction to Risk Assessment
The hazards due to the Project have been introduced and then assessed for each phase in Section 18, including consideration of vessel displacement.</td></tr>
<tr><td>ii. In respect of specific activities.</td><td>✓</td></tr>
<tr><td>iii. In all areas or directions.</td><td>✓</td></tr>
<tr><td>iv. In specified areas or directions.</td><td>✓</td></tr>
<tr><td>v. In specified tidal or weather conditions.</td><td>✓</td></tr>
<tr><td>c. Where it is not feasible for vessels to access or navigate through the site it could cause navigational, safety or routeing problems for vessels operating in the area, e.g. by preventing vessels from responding to calls for assistance from persons in distress.</td><td>✓</td><td>Section 17: Introduction to Risk Assessment
The hazards due to the Project have been introduced and then assessed for each phase in Section 18, including consideration of vessel displacement and emergency response capability.</td></tr>
<tr><td>d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered.</td><td></td><td>Section 14: Future Case Vessel Traffic
A methodology for post-wind farm routeing is outlined and includes consideration of the Shipping Route Template.</td></tr>
</table>

Issue	Compliance	Comments
SAR, maritime assistance service, counter pollution and salvage incident response.		
The MCA, through HM Coastguard, is required to provide SAR and emergency response within the sea area occupied by all OREIs in UK waters. To ensure that such operations can be safely and effectively conducted, certain requirements must be met by Applicants and operators.		
a. An ERCoP will be developed for the construction, O&M and decommissioning phases of the OREI.	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards.
b. The MCA's guidance document *Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response* (MCA, 2021) for the design, equipment and operation requirements will be followed.	✓	**Section 4: Guidance and Legislation** Outlines the guidance and legislation used within the NRA including Annex 5 of MGN 654. **Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards including compliance with MGN 654 and its annexes.
c. A SAR Checklist will be completed to record discussions regarding the requirements, recommendations and considerations outlined in Annex 5 (to be agreed with MCA).	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards including compliance with MGN 654 which includes the completion of the SAR Checklist.
6. Hydrography. In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:		
i. Pre-construction: The proposed generating assets area and proposed cable route.	✓	**Section 22: Through Life Safety Management** Confirms that hydrographic surveys will be undertaken in agreement with the MCA.
ii. On a pre-established periodicity during the life of the development.	✓	
iii. Post construction: Cable route(s).	✓	
iv. Post decommissioning of all or part of the development: the installed generating assets area and cable route.	✓	

Issue	Compliance	Comments
Communications, Radar and positioning systems. To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:		
a. The structures could produce radio interference such as shadowing, reflections or phase changes, and emissions with respect to any frequencies used for marine positioning, navigation and timing (PNT) or communications, including GMDSS and AIS, whether ship borne, ashore or fitted to any of the proposed structures, to:		
i. Vessels operating at a safe navigational distance.	✓	**Section 15: Navigation, Communication and Position Fixing Equipment** Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the Project including in relation to radio interference.
ii. Vessels by the nature of their work necessarily operating at less than the safe navigational distance to the OREI, e.g. support vessels, survey vessels, SAR assets.	✓	
iii. Vessels by the nature of their work necessarily operating within the OREI.	✓	
b. The structures could produce Radar reflections, blind spots, shadow areas or other adverse effects:		
i. Vessel to vessel.	✓	**Section 15: Navigation, Communication and Position Fixing Equipment** Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the Project including in relation to marine Radar.
ii. Vessel to shore.	✓	
iii. VTS Radar to vessel.	✓	
iv. Racon to / from vessel.	✓	
c. The structures and generators might produce SONAR interference affecting fishing, industrial or military systems used in the area.	✓	**Section 15: Navigation, Communication and Position Fixing Equipment** Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the Project including in relation to SONAR.
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	**Section 15: Navigation, Communication and Position Fixing Equipment** Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the Project including in relation to noise.
e. Generators and the seabed cabling within the site and onshore might produce EMFs affecting compasses and other navigation systems.	✓	**Section 15: Navigation, Communication and Position Fixing Equipment** Assesses the potential risks associated with the use of navigation, communication and position fixing equipment due to the Project including in relation to electromagnetic interference.

Issue	Compliance	Comments
Risk mitigation measures recommended for OREI during construction, O&M and decommissioning.		
Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the EIA. The specific measures to be employed will be selected in consultation with the MCA and will be listed in the Applicant's ES. These will be consistent with international standards contained in, for example, SOLAS Chapter V (IMO, 1974), and could include any or all of the following:		
i. Promulgation of information and warnings through notices to mariners and other appropriate MSI dissemination methods.	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards including promulgation of information.
ii. Continuous watch by multi-channel VHF, including DSC.	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards including marine coordination.
iii. Safety zones of appropriate configuration, extent and application to specified vessels[5].	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards including the application for Safety Zones.
iv. Designation of the site as an Area to be Avoided (ATBA).	✓	There are no plans to designate the Project as an ATBA.
v. Provision of aids to navigation as determined by the GLA.	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards including lighting and marking in accordance with Trinity House and MCA requirements.
vi. Implementation of routeing measures within or near to the development.	✓	There are no plans to implement any new routeing measures in proximity to the Project.
vii. Monitoring by Radar, AIS, Closed Circuit Television (CCTV) or other agreed means.	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards including traffic monitoring.
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of Safety Zones.	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards including the application for Safety Zones and use of guard vessels, which will be considered in further detail in the Safety Zone Application, submitted post consent.

[5] As per SI 2007 No 1948 "The Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007.

Issue	Compliance	Comments
ix. Creation of an ERCoP with the MCA's SAR Branch for the construction phase onwards.	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards including compliance with MGN 654 which includes the provision of an ERCoP.
x. Use of guard vessels, where appropriate.	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards including the use of guard vessels.
xi. Update NRAs every two years, e.g. at testing sites.	✓	Not applicable to the Project.
xii. Device-specific or array-specific NRAs.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** All offshore elements of the Project have been considered in this NRA including all infrastructure (surface and sub-sea) within the Array Area and offshore ECC.
xiii. Design of OREI structures to minimise risk to contacting vessels or craft.	✓	There is no additional risk posed to craft compared to previous offshore wind farms and so no additional measures are identified.
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	**Section 22: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of Shipping and Navigation hazards. **Section 22: Through life safety management** Outlines how QHSE documentation will be maintained and reviewed.

Table A-2 MGN 654 Annex 1 Checklist

Item	Compliance	Comments
A risk claim is included that is supported by a reasoned argument and evidence.	✓	**Section 17: Introduction to Risk Assessment** The risk assessment provides a risk claim for a range of hazards based on a number of inputs including (but not limited to) baseline data, expert opinion, stakeholder concerns and lessons learnt from existing offshore developments – **Section 18**.
Description of the marine environment.	✓	**Section 7: Navigational Features** Relevant navigational features in proximity to the Project have been described including (but not limited to) other offshore wind farm developments, aids to navigation, sub-sea cables and pipelines, oil and gas infrastructure, and charted wrecks. **Section 13: Cumulative and Transboundary Overview** Potential future developments have been screened into the cumulative risk assessment where a cumulative or in combination activity has been identified based upon the location and distance from the Project, including consideration of other offshore wind farms and oil and gas infrastructure.
SAR overview and assessment.	✓	**Section 9: Emergency Response and Incident Overview** Existing SAR resources in proximity to the Project are summarised including the UK SAR operations contract, RNLI stations and assets and HM Coastguard stations. **Section 17: Introduction to Risk Assessment** The risk assessment in **Section 18** includes an assessment of how activities associated with the Project may restrict emergency response capability of existing resources.
Description of the OREI development and how it changes the marine environment.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** The maximum extent of the Project for which any Shipping and Navigation hazards are assessed is provided including a description of the Array Area and offshore ECC infrastructure, construction phase programme and indicative vessel and helicopter numbers during the construction and O&M phases. **Section 14: Future Case Vessel Traffic** Worst-case alternative routeing for commercial traffic has been considered.

Annex B Consequences

B.1 Introduction

567. This appendix presents an assessment of the consequences of collision and allision incidents, in terms of people and the environment, due to the presence of the Project.

568. The significance of the risk due to the presence of the Project is also assessed based on risk evaluation criteria and comparison with historical incident data in UK waters[6].

B.2 Risk Evaluation Criteria

B.2.1 Risk to People

569. Regarding the assessment of risk to people two measures are considered, namely:

- Individual risk; and
- Societal risk.

B.2.2 Individual Risk

570. Individual risk considers whether the risk from an incident to a particular individual changes significantly due to the presence of the Project. Individual risk considers not only the frequency of the incident and the consequences (e.g. 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 incident.

571. The purpose of estimating the individual risk is to ensure that individuals who may be affected by the presence of the Project 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 Project relative to the UK background individual risk levels.

572. Annual risk levels to crew (the annual risk to an average crew member) for different vessel types are presented on **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, 2001). The annual individual risk level to crew falls within the ALARP region for each of the vessel types presented.

[6] For the purposes of this assessment, UK waters is defined as the UK EEZ and UK territorial waters refers to the 12nm (22km) limit from the British Isles, excluding the Republic of Ireland.

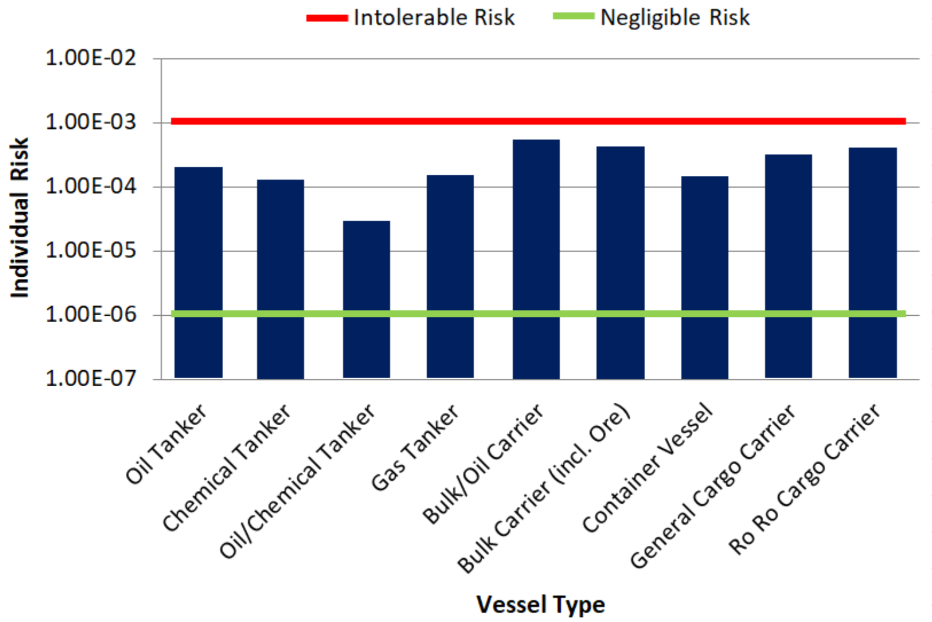

Figure B-1 Individual Risk Levels and Acceptance Criteria per Vessel Type

573. The typical bounds defining the ALARP regions for decision making within shipping are presented in **Table B-1**. For a new vessel, the target upper bound for ALARP is set lower since new vessels are expected to benefit (in terms of design) from changes in legislation and improved maritime safety.

Table B-1 Individual Risk ALARP Criteria

Individual	Lower Bound for ALARP	Upper Bound for ALARP
To crew member	10^{-6}	10^{-3}
To passenger	10^{-6}	10^{-4}
Third-party	10^{-6}	10^{-4}
New vessel target	10^{-6}	Above values reduced by one order of magnitude

574. On a UK basis, the MCA have presented individual risks for various UK industries based on HSE data from 1987 to 1991. The risks for different industries are presented on **Figure B-2**.

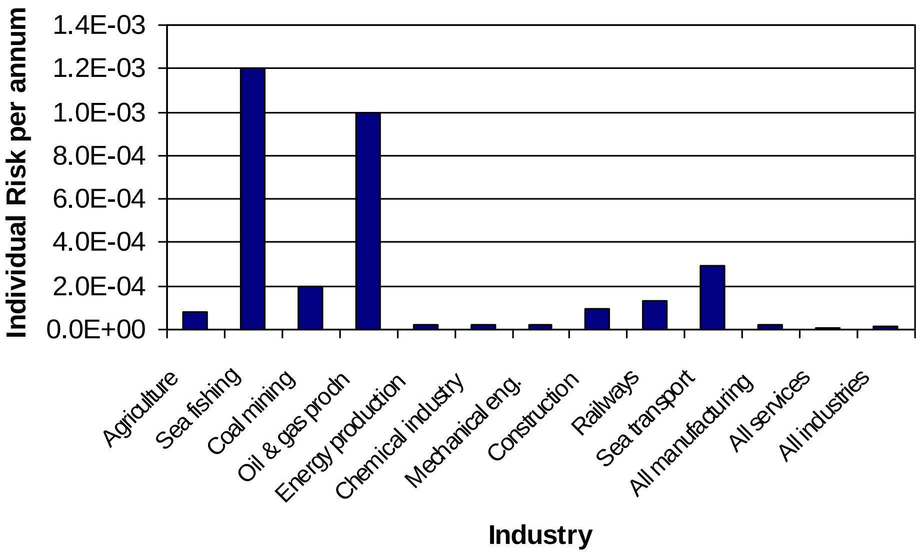

Figure B-2 Individual Risk per Year for Various UK Industries

575. The individual risk for sea transport of 2.9×10^{-4} per year is consistent with the worldwide data presented on **Figure B-2**, whilst the individual risk for sea fishing of 1.2×10^{-3} per year is the highest across all of the industries included.

B.2.3 Societal Risk

576. Societal risk is used to estimate risks of incidents affecting many persons (catastrophes) and acknowledging risk adverse or neutral attitudes. Societal risk includes the risk to every person, even if a person is only exposed to risk on one brief occasion. 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.

577. Within this assessment, societal (navigation based) risk can be assessed for the Project, giving account to the change in risk associated with each incident scenario cause by the introduction of the wind farm 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
- F-N diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

578. When assessing societal risk this study focuses on PLL, which accounts for the number of people likely to be involved in an incident (which is higher for certain vessel types) and assesses the significance of the change in risk compared to the UK background risk levels.

B.2.4 Risk to Environment

579. For risk to the environment the key criteria considered in terms of the risk due to the Project is the potential quantity of oil spilled from a vessel involved in an incident.

580. It is recognised that there will be other potential pollution, e.g. hazardous containerised 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 compared to UK background pollution risk levels.

B.3 Marine Accident Investigation Branch Incident Data

B.3.1 All Incidents in UK Waters

581. All UK flagged commercial vessels are required to report incidents to the MAIB. Non-UK flagged vessels do not have to report an incident to the MAIB unless located at a UK port or within 12nm (22km) territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report incidents to the MAIB; however, a significant proportion of such incidents are reported to and investigated by the MAIB.

582. The MCA, harbour authorities and inland waterway authorities also have a duty to report incidents to the MAIB. Therefore, whilst there may be a degree of underreporting of incidents with minor consequences, those resulting in more serious consequences, such as fatalities, are likely to be reported.

583. 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 / harbours and rivers / canals have been excluded since the causes and consequences may differ considerably from an incident occurring offshore, which is the location of most relevance to the Project.

584. Accounting for these criteria, a total of 11,773 accidents, injuries and hazardous incidents were reported to the MAIB in the 20-year period between 2002 and 2021 involving 13,415 vessels (some incidents, such as collisions, involved more than one vessel).

585. The location of all incidents in proximity to the UK are presented on **Figure B-3**. The majority of incidents occur in coastal waters.

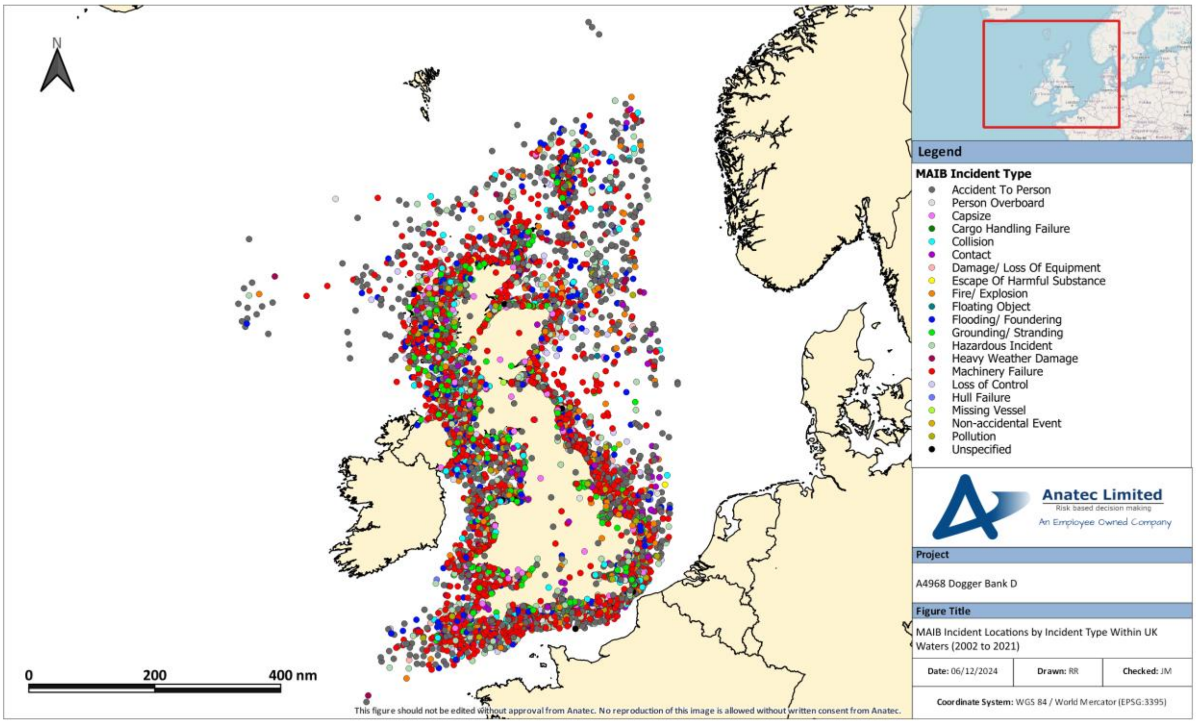

Figure B-3 MAIB Incident Locations within UK Waters (2002 to 2021)

586. The distribution of incidents by year in UK waters is presented on **Figure B-4**.

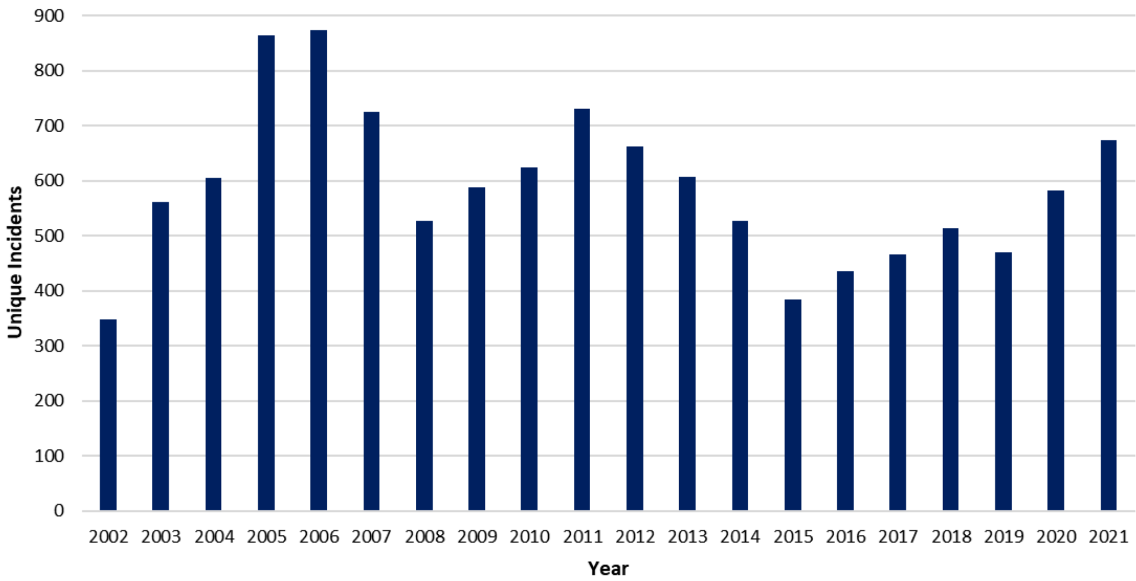

Figure B-4 MAIB Unique Incidents per Year within UK Waters (2002 to 2021)

587. The average number of unique incidents per year was 589. There has generally been a fluctuating trend in incidents over the 20-year period.

588. The distribution of incidents in UK waters by incident type is presented on **Figure B-5**.

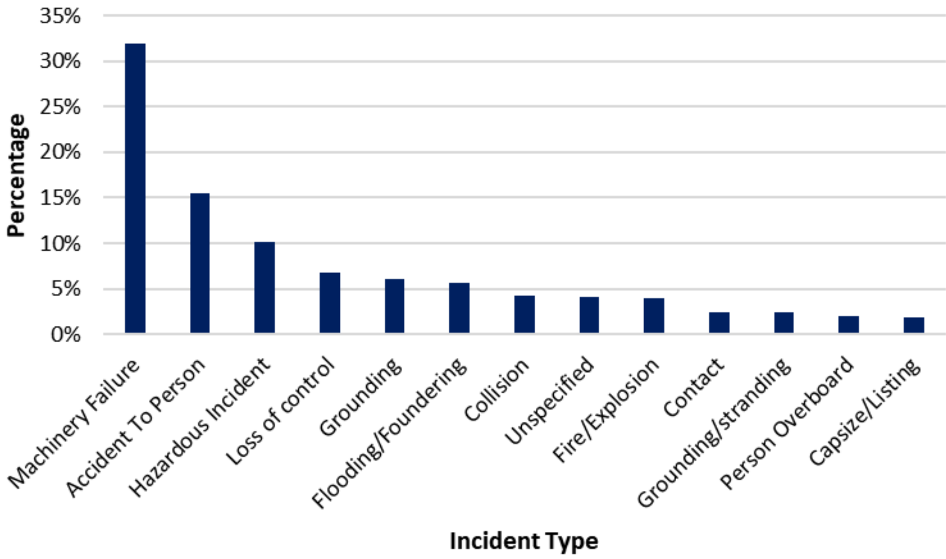

Figure B-5 MAIB Incident Types Breakdown within UK Waters (2002 to 2021)

589. The most frequent incident types were "*machinery failure*" (32%), "*accident to person*" (16%) and "*hazardous incident*" (10%). "*Collision*" and "*contact*" incidents represented 4% and 2% of total incidents, respectively.

590. The distribution of incidents in UK waters by vessel type is presented on **Figure B-6**.

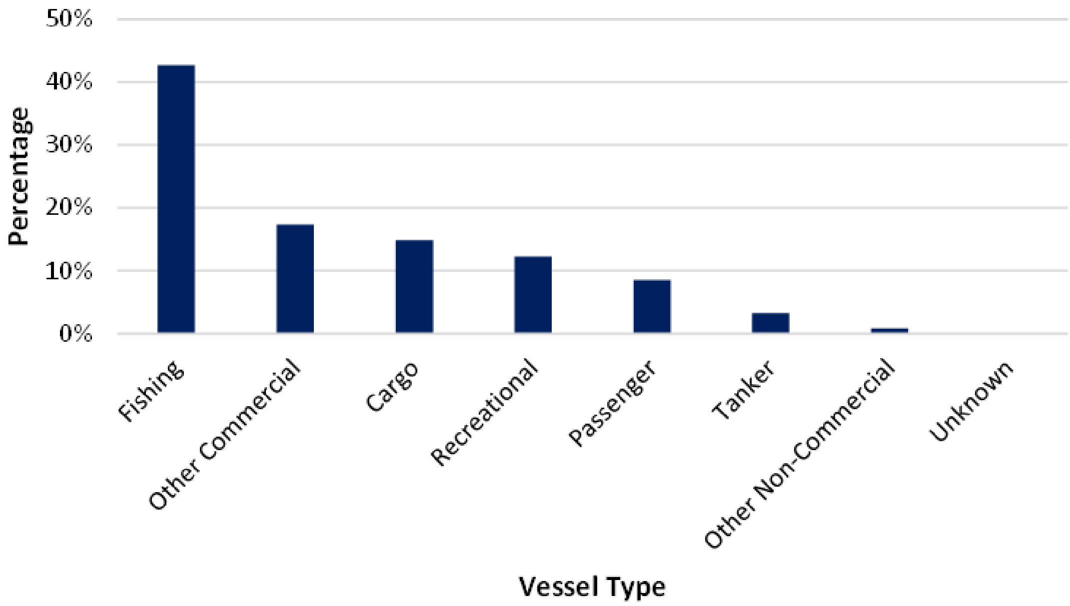

Figure B-6 MAIB Incident Types Breakdown within UK Waters (2002 to 2021)

591. The most frequent vessel types involved in incidents were fishing vessels (43%), other commercial vessels (17%) (including offshore industry vessels, tugs, workboats and pilot vessels) and cargo vessels (15%).

592. A total of 414 fatalities were reported in the MAIB incidents within UK waters between 2002 and 2021, corresponding to an average of 21 fatalities per year.

593. The distribution of fatalities in UK waters by vessel type and person category (crew, passenger and other) is presented on **Figure B-7**.

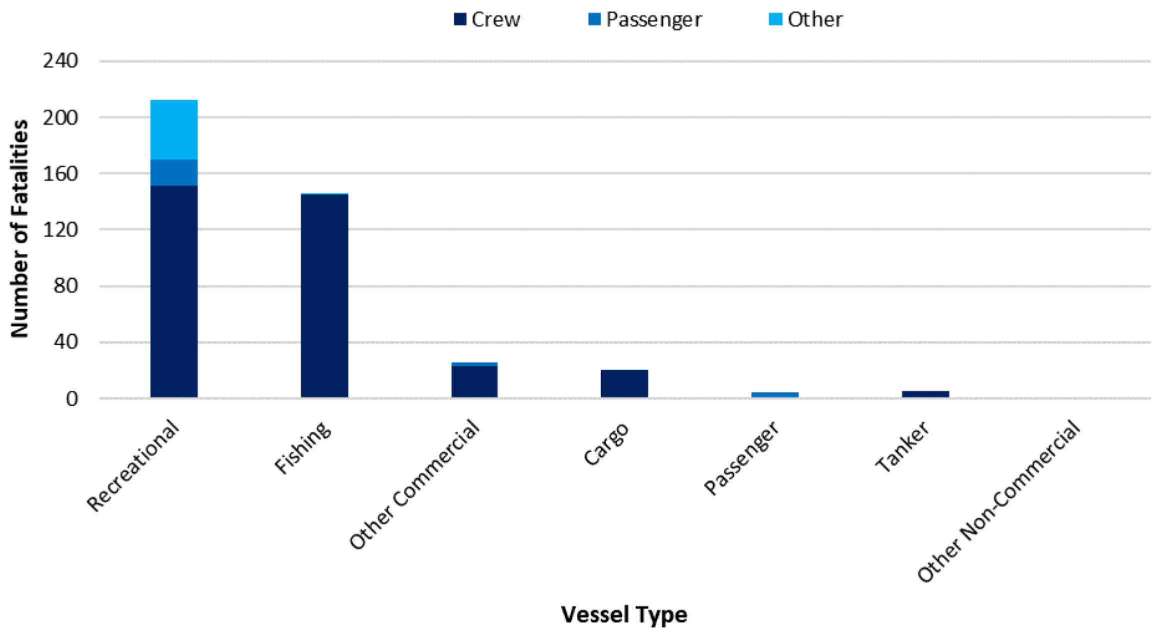

Figure B-7 MAIB Fatalities by Vessel Type within UK Waters (2002 to 2021)

594. The majority of fatalities occurred to recreational vessels (51%) and fishing vessels (35%), with crew members the main people involved (83%).

B.3.2 Collision Incidents

595. The MAIB define a collision incident as "*ships striking or being struck by another ship, regardless of whether the ships are underway, anchored or moored*" (MAIB, 2013).

596. A total of 504 collision incidents were reported to the MAIB in UK waters between 2002 and 2021 involving 1,068 vessels (in a small number of cases the other vessel involved was not logged).

597. The locations of collision incidents reported in proximity to the UK are presented on **Figure B-8**.

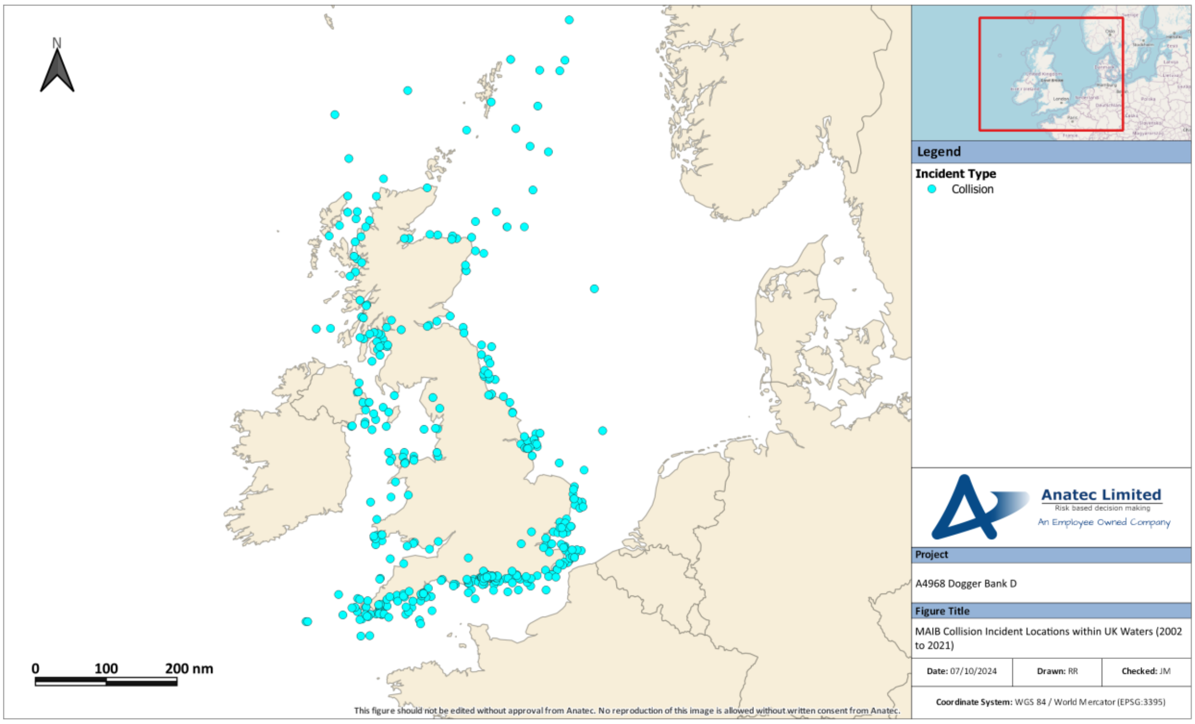

Figure B-8 MAIB Collision Incident Locations within UK Waters (2002 to 2021)

598. The distribution of collision incidents per year is presented on **Figure B-9**.

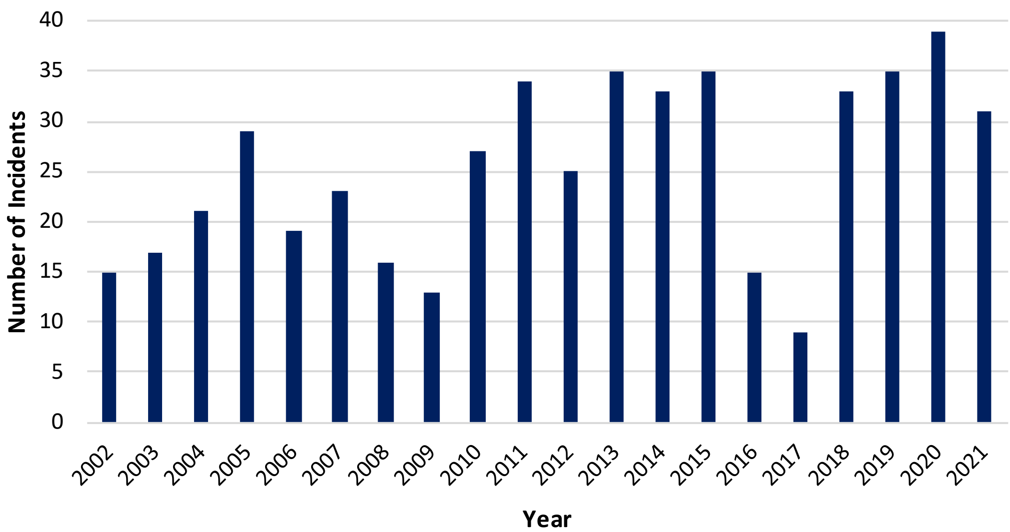

Figure B-9 MAIB Annual Collision Incidents within UK Water (2002 to 2021)

599. The average number of collision incidents per year was 25. There has been an overall slight increasing trend in collision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

600. The most frequent vessel types involved in collision incidents were recreational vessels (29%), fishing vessels (26%), other commercial vessels (24%) and cargo vessels (13%).

601. A total of five fatalities were reported in MAIB collision incidents within UK waters between 2002 and 2021. Details of each of these fatal incidents reported by the MAIB are presented in **Table B-2**.

Table B-2 Description of Fatal MAIB Collision Incidents (2002 to 2021)

Date	Description	Fatalities
July 2005	Collision between two powerboats at night. Both vessels were unlit and both helmsmen had consumed alcohol. One of the helmsmen died.	1
October 2007	Collision between fishing vessel and coastal general cargo vessel following failure to keep an effective lookout. Fishing vessel sank with three of the four crew members abandoning ship into a life raft but the fourth crew member was not recovered.	1
August 2010	Collision between passenger ferry and fishing vessel. Fishing vessel sank with one of the two crew members recovered from the sea but the other member was not recovered despite an extensive search.	1
June 2015	Collision between Rigid-hulled Inflatable Boat (RIB) and yacht. Believed that around a dozen persons were onboard the motorboat with the majority taken ashore by lifeboat. One person seriously injured and airlifted to hospital before being pronounced dead later.	1
June 2018	Collision between power boats during a race. One of the vessels overturned with the pilot pronounced dead at the scene.	1

B.3.3 Allision Incidents

602. The MAIB define a contact incident as "*ships striking or being struck by an external object. The objects can be: floating object (cargo, ice, other or unknown); fixed object, but not the sea bottom; or flying object*" (MAIB, 2013). In line with the NRA as a whole, an allision is considered to involve a moving object and a stationary object at sea, with port infrastructure excluded from consideration; the MAIB contact incidents have been individually inspected and filtered in line with the NRA definition.

603. A total of 119 allision incidents were reported to the MAIB within UK waters between 2002 and 2021 involving 119 vessels.

604. The locations of allision incidents reported in proximity to the UK are presented on **Figure B-10**.

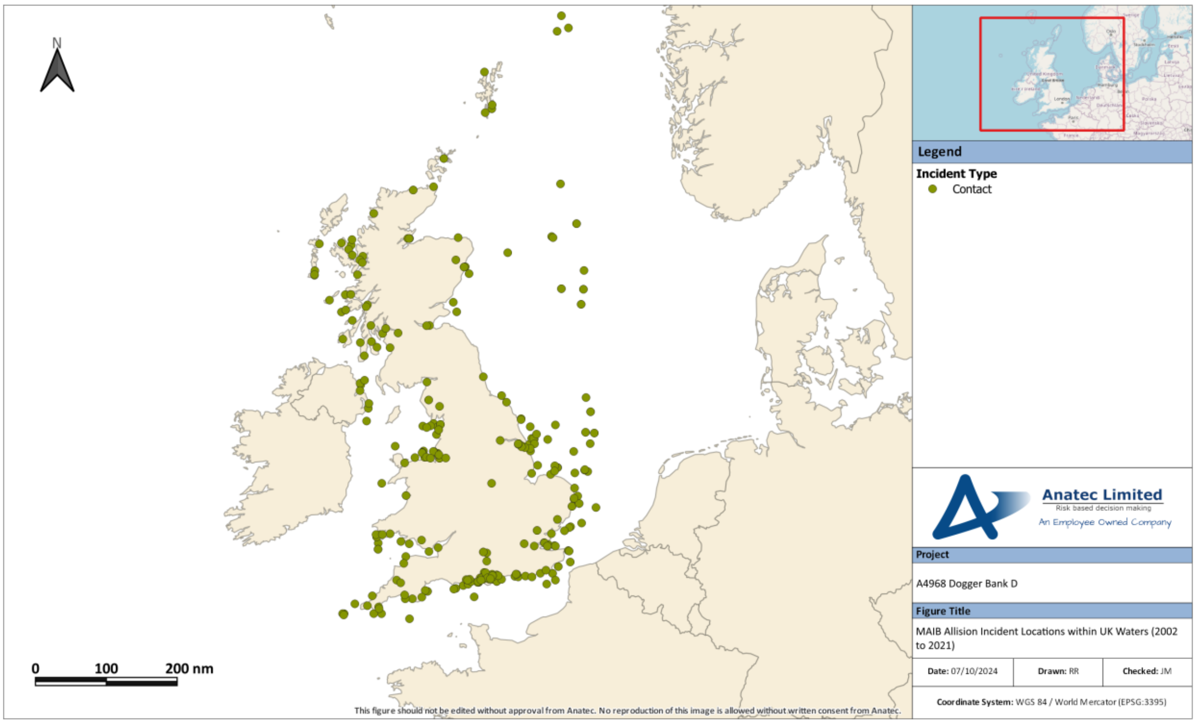

Figure B-10 MAIB Allision Incident Locations within UK waters (2002 to 2021)

605. The distribution of allision Incidents per year is presented on **Figure B-11**.

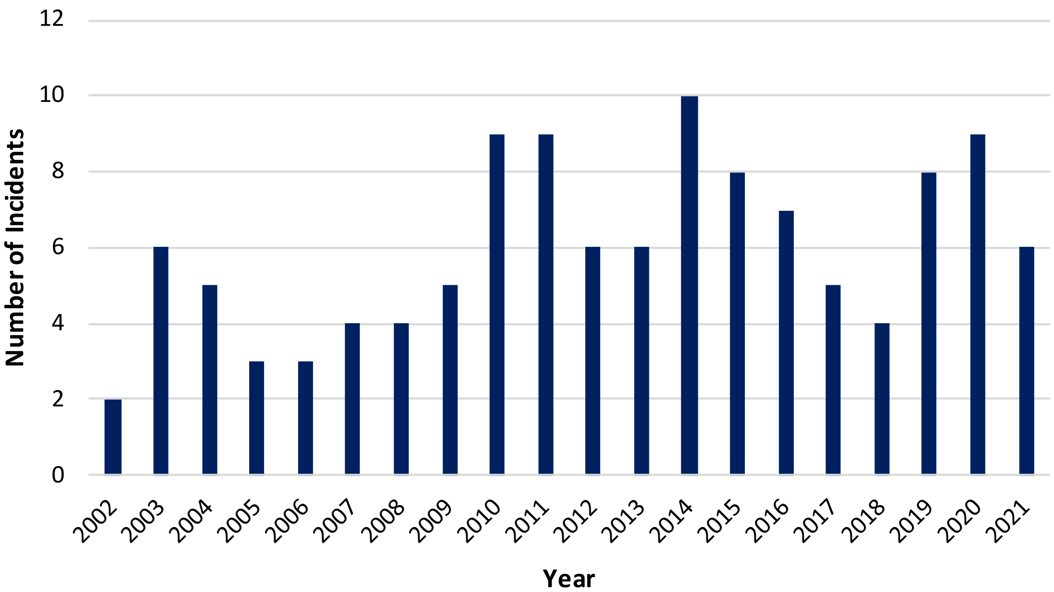

Figure B-11 MAIB Contact Incidents per Year within UK Waters (2000 to 2019)

606. The average number of allision incidents per year was six. As with collision incidents, there has been an overall slight increasing trend in allision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

607. The most frequent vessel types involved in allision incidents were other commercial vessels (50%), recreational vessels (18%) and fishing vessels (15%).

608. No fatalities were reported in MAIB allision incidents within offshore UK waters between 2002 and 2021.

B.4 Fatality Risk

B.4.1 Incident Data

609. This section uses the MAIB incident data along with information on average manning levels per vessel type to estimate the probability of a fatality in a maritime incident associated with the Project.

610. The Project is assessed to have the potential to affect the following incidents:

- Vessel to vessel collision;
- Powered vessel to structure allision;
- Drifting vessel to structure allision; and
- Fishing vessel to structure allision.

611. Of these incident types, only vessel to vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in **Section B.4.2** is considered directly applicable to these types of incidents.

612. The other scenarios of powered vessel to structure allision, drifting vessel to structure allision and fishing vessel to structure allision are not clearly represented by the MAIB data (as discussed in **Section 9.5**). Additionally, none of the allision incidents reported by the MAIB between 2002 and 2021 resulted in a fatality.

613. Therefore, the MAIB collision fatality risk rate has also been conservatively applied for the allision incident types.

B.4.2 Fatality Probability

614. Five of the 504 collision incidents reported by the MAIB within UK waters between 2002 and 2021 resulted in one or more fatalities. This gives a 0.99% probability that a collision incident will lead to a fatal accident.

615. To assess the fatality risk for personnel onboard a vessel (crew, passenger or other) the number of persons involved in the incidents needs to be estimated. **Table B-3** presents the average number of persons on board (POB) estimated for each category of vessel navigating in proximity to the Project. For passenger vessels this is based upon information available for the specific vessels recorded in the vessel traffic survey data. For other vessel categories, this is based upon information available from the MAIB incident data.

Table B-3 Estimated Average POB by Vessel Category

Vessel Category	Sub Categories	Source of Estimated Average POB	Estimated Average POB
Cargo / freight	Dry cargo, other commercial, service ship, etc.	MAIB incident data	15
Tanker	Tanker / combination carrier	MAIB incident data	23
Passenger	Ro-Ro passenger, cruise liner, etc.	Vessel traffic survey data / online information	1,977
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3

616. It is recognised that these average POB numbers can be substantially higher or lower on an individual vessel basis depending upon the size, subtype, etc. but applying reasonable averages is considered sufficient for this analysis, particularly when noting that the average POB for the dominant vessel category (passenger) is based upon the vessel traffic survey data where possible.

617. Using the average POB, along with the vessel type information involved in collision incidents reported by the MAIB there was an estimated 87,799 POB the vessels involved in the collision incidents.

618. Based upon five fatalities during the period 2002 to 2021, the overall fatality probability in a collision for any individual onboard is approximately 5.69×10^{-5} per collision.

619. It is considered inappropriate to apply this rate uniformly as the statistics indicate that the fatality probability associated with smaller craft, such as fishing vessels and recreational vessels, is higher. Therefore, the fatality probability has been subdivided into three categories of vessel as presented in **Table B-4**. In addition, due to zero fatalities resulting from commercial vessel collisions between 2002 and 2021, the time period used to assess the fatality probability for commercial vessels has been extended by five years to ensure a meaningful probability is captured.

Table B-4 Collision Incident Fatality Probability by Vessel Category

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability	Time Period
Commercial	Dry cargo, passenger, tanker, etc.	1	85,848	1.16×10^{-5}	1997 to 2021 (25 years)
Fishing	Trawler, potter, dredger, etc.	2	927	2.2×10^{-3}	2002 to 2021 (20 years)
Recreational	Yacht, small commercial motor yacht, etc.	3	1,023	2.9×10^{-3}	2002 to 2021 (20 years)

B.4.3 Fatality Risk Due to the Project

620. The base case and future case annual collision frequency levels pre- and post-wind farm for the Project are summarised in **Table B-5**.

Table B-5 Summary of Annual Collision and Allision Risk Results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre-Wind Farm	Post-Wind Farm	Change
Vessel to vessel collision	Base case	1.78×10^{-5} (1 in 56,177 years)	2.23×10^{-5} (1 in 44,813 years)	4.51×10^{-6} (1 in 221,540 years)
	Future case (10%)	2.17×10^{-5} (1 in 46,091 years)	2.72×10^{-5} (1 in 36,792 years)	5.48×10^{-6} (1 in 182,353 years)
	Future case (20%)	2.56×10^{-5} (1 in 39,127 years)	3.21×10^{-5} (1 in 31,200 years)	6.49×10^{-6} (1 in 153,984 years)
Powered vessel to structure allision	Base case	-	9.96×10^{-5} (1 in 10,038 years)	9.96×10^{-5} (1 in 10,038 years)
	Future case (10%)	-	1.10×10^{-4} (1 in 9,105 years)	1.10×10^{-4} (1 in 9,105 years)
	Future case (20%)	-	1.20×10^{-4} (1 in 8,367 years)	1.20×10^{-4} (1 in 8,367 years)
Drifting vessel to structure allision	Base case	-	2.25×10^{-5} (1 in 44,421 years)	2.25×10^{-5} (1 in 44,421 years)
	Future case (10%)	-	2.48×10^{-5} (1 in 40,364 years)	2.48×10^{-5} (1 in 40,364 years)
	Future case (20%)	-	2.70×10^{-5} (1 in 37,098 years)	2.70×10^{-5} (1 in 37,098 years)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre-Wind Farm	Post-Wind Farm	Change
Fishing vessel to structure allision	Base case	-	1.22×10^{-2} (1 in 82 years)	1.22×10^{-2} (1 in 82 years)
	Future case (10%)	-	1.34×10^{-2} (1 in 75 years)	1.34×10^{-2} (1 in 75 years)
	Future case (20%)	-	1.46×10^{-2} (1 in 68 years)	1.46×10^{-2} (1 in 68 years)
Total	**Base case**	**1.78×10^{-5} (1 in 56,177 years)**	**1.23×10^{-2} (1 in 81 years)**	**1.23×10^{-2} (1 in 81 years)**
	Future case (10%)	**2.17×10^{-5} (1 in 46,091 years)**	**1.36×10^{-2} (1 in 74 years)**	**1.35×10^{-2} (1 in 74 years)**
	Future case (20%)	**2.56×10^{-5} (1 in 39,127 years)**	**1.48×10^{-2} (1 in 68 years)**	**1.48×10^{-2} (1 in 68 years)**

621. From the detailed results of the collision and allision risk modelling, the distribution of the predicted change in annual collision and allision frequency by vessel type due to the Project for the base case and future case are presented on **Figure B-12**. For clarity, the same distribution is presented on **Figure B-13** with fishing vessels excluded.

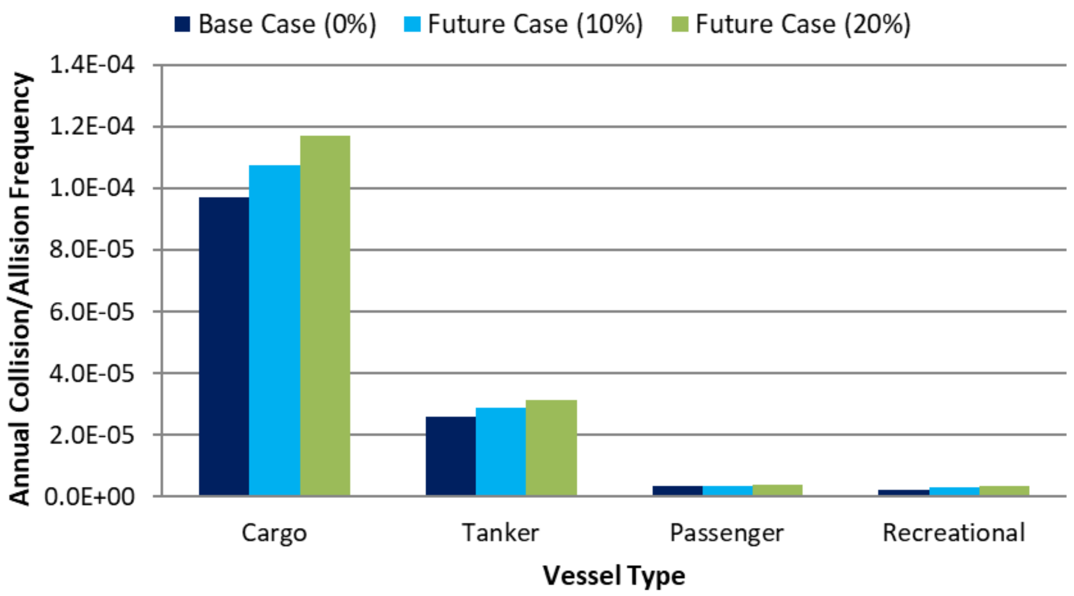

Figure B-12 Estimated Change in Annual Collision and Allision Frequency by Vessel Type

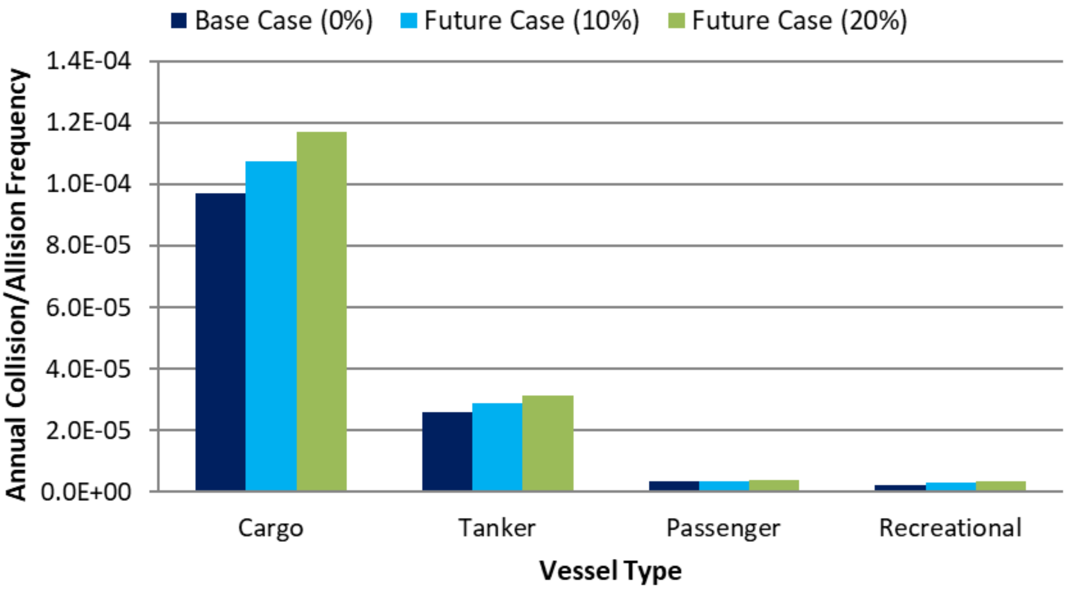

Figure B-13 Estimated Change in Annual Collision and Allision Frequency by Vessel Type (Excluding Fishing Vessels)

622. The change in collision and allision frequency is dominated by fishing vessels due to their presence within and in proximity to the Array Area and the conservative nature of Anatec's COLLRISK model for fishing vessel allisions.

623. The second greatest collision and allision frequency change was associated with cargo vessels but was significantly lower than fishing vessels.

624. Combining the annual collision and allision frequency (**Table B-5**), estimated number of POB for each vessel type (**Table B-3**) and the estimated fatality probability for each vessel type category (**Table B-4**), the annual increase in PLL due to the presence of the Project for the base case is estimated to be 8.20×10^{-5}, equating to one additional fatality every 12,199 years. The estimated incremental increases in PLL due to the Project, distributed by vessel type and for the base case and future case, are presented on **Figure B-14**. For clarity, the same distribution is presented on **Figure B-15** with fishing vessels excluded.

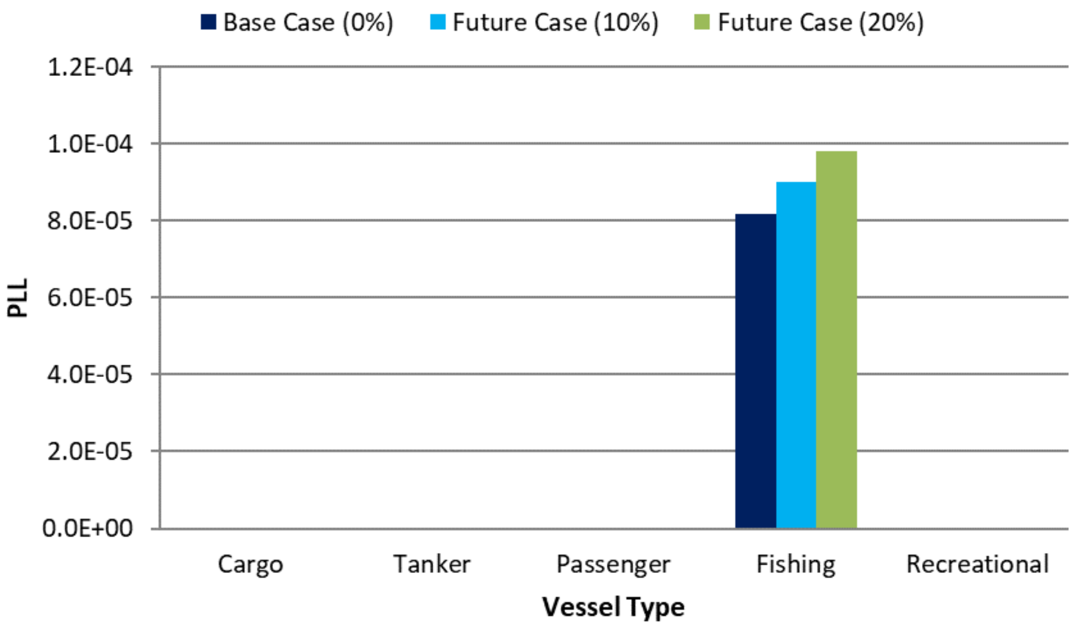

Figure B-14 Estimated Change in Annual PLL by Vessel Type

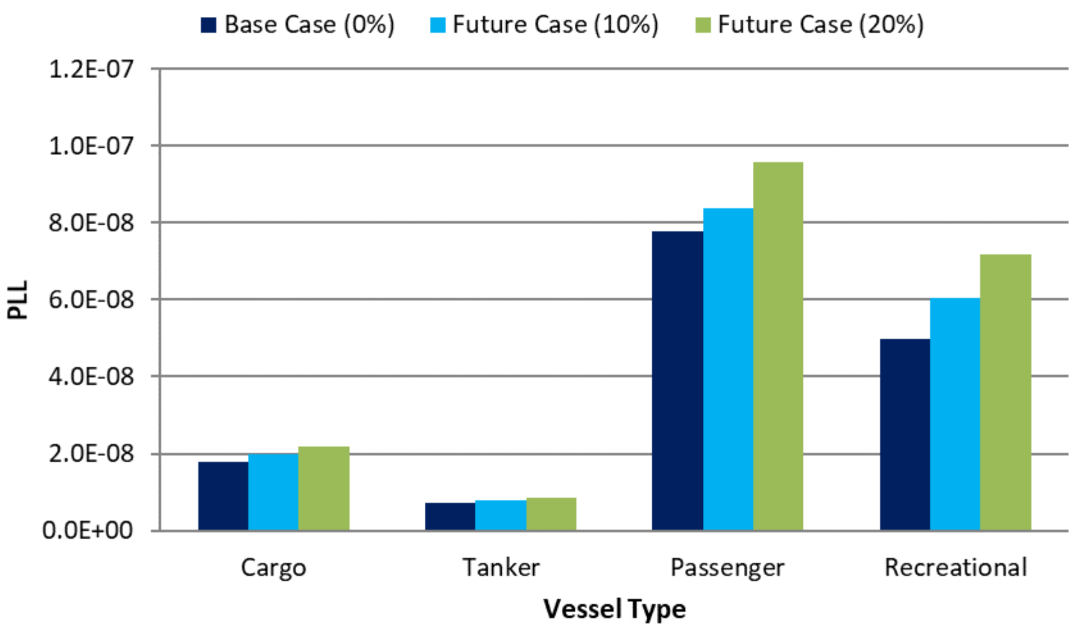

Figure B-15 Estimated Change in Annual PLL by Vessel Type (Excluding Fishing Vessels)

625. As with the change in collision and allision frequency, the change in annual PLL is dominated by fishing vessels which historically have a higher fatality probability than commercial vessels.

626. The second greatest annual PLL change was associated with passenger vessels due to much greater numbers of POB associated with this vessel type compared to others.

627. Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented on **Figure B-16**. For clarity, the same distribution is presented on **Figure B-17** with fishing vessels excluded.

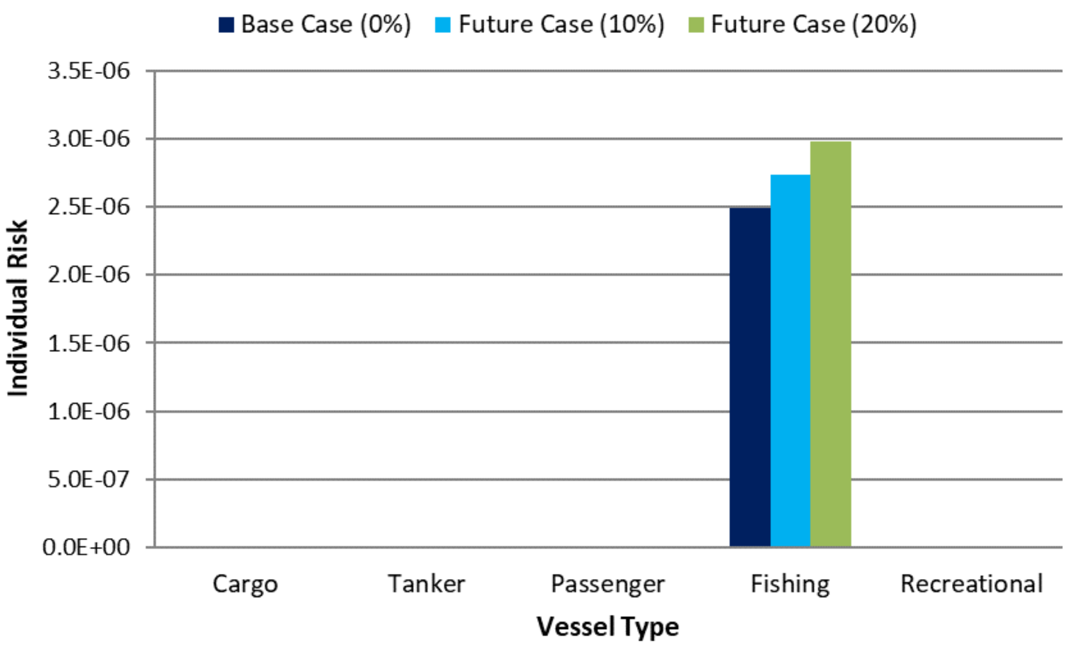

Figure B-16 Estimated Change in Individual Risk by Vessel Type

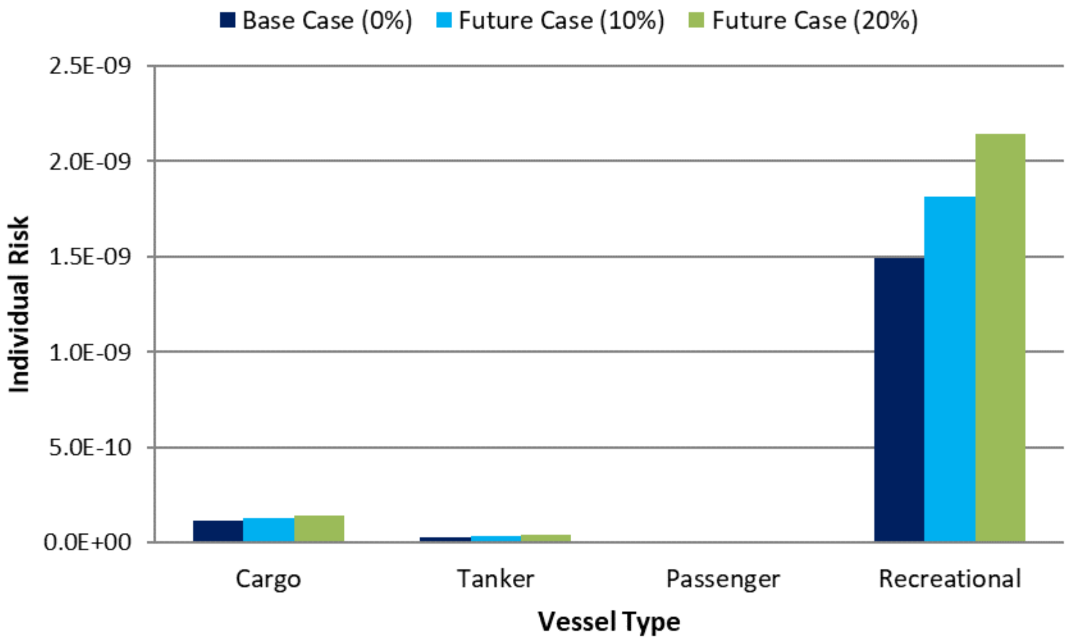

Figure B-17 Estimated Change in Individual Risk by Vessel Type (Excluding Fishing Vessels)

628. The change in individual risk to people is dominated by fishing vessels, again reflecting the higher probability of a fatality occurring in the event of an incident involving a fishing vessel compared to other vessel types.

B.4.4 Significance of Increase in Fatality Risk

629. In comparison to MAIB statistics, which indicate an average of 18 to 19 fatalities per year in UK territorial waters during the 20-year period between 2002 and 2021, the overall increase for the base case in PLL of one additional fatality per 12,199 years represents a very small change.

630. In terms of individual risk to people, the change for commercial vessels attributed to the Project (approximately 1.52×10^{-10} for the base case) is very low compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

631. For fishing vessels, the change in individual risk attributed to the Project (approximately 2.49×10^{-6} for the base case) is very low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

B.5 Pollution Risk

B.5.1 Historical Analysis

632. The pollution consequences of a collision in terms of oil spill depend upon the following criteria:

- Spill probability (i.e. the likelihood of outflow following an incident); and
- Spill size (quantity of oil).

633. Two types of oil spill are considered in this assessment:

- Fuel oil spills from bunkers (all vessel types);
- Cargo oil spills (laden tankers).

634. The research undertaken as part of the DfT's Marine Environmental High Risk Areas (MEHRAs) Project (DfT, 2001) has been used it was comprehensive and based upon worldwide marine oil spill data analysis. From this research, the overall probability of a spill per incident was calculated based upon historical incident data for each incident type as presented on **Figure B-18**.

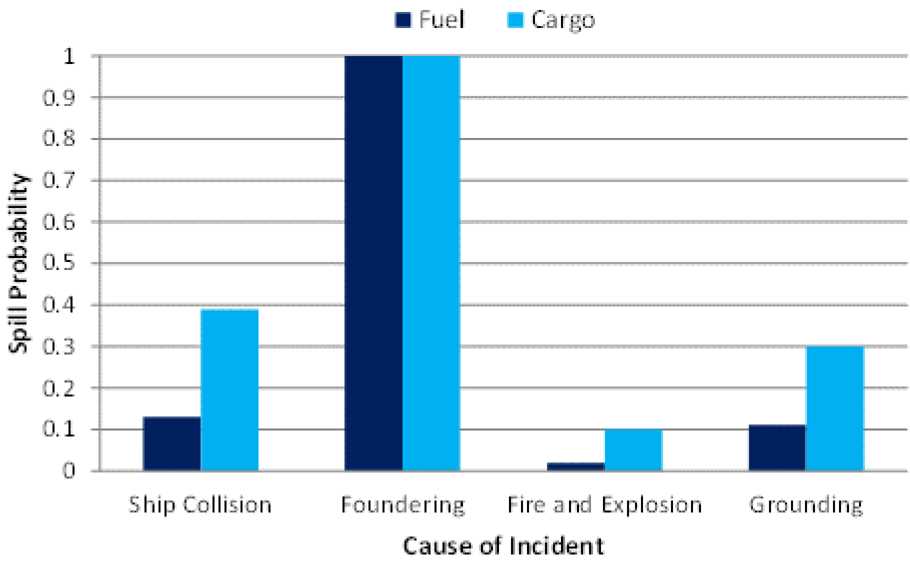

Figure B-18 Probability of an Oil Spill Resulting from an Accident

635. Therefore, 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.

636. 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 below 50% of bunker capacity, and in most incidents much lower.

637. For the types and sizes of vessels exposed to the Project, an average spill size of 100 tonnes of fuel oil is considered a conservative assumption.

638. For cargo spills from laden tankers, the spill size can vary significantly. The ITOPF reported the following spill size distribution for tanker collisions between 1974 and 2004:

- 31% of spills below seven tonnes;
- 52% of spills between seven and 700 tonnes; and
- 17% of spills greater than 700 tonnes.

639. Based upon this data and the tankers transiting in proximity to the Project, an average spill size of 400 tonnes is considered a conservative assumption.

640. For fishing vessel collisions, comprehensive statistical data is not available. Consequently, it is conservatively assumed that 50% of all collisions involving fishing vessels will lead to oil spill with the quantity spilled being on average five tonnes. Similarly for recreational vessels, due to a lack of data 50% of collisions are conservatively assumed to lead to a spill with an average size of one tonne.

B.5.2 Pollution Risk due to the Project

641. Applying the above probabilities to the annual collision and allision frequency by vessel type presented in **Table B-5** 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 0.036 tonnes for the base case, rising to 0.043 tonnes per year for the 20% future case.

642. The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base case and future case are presented on **Figure B-19**.

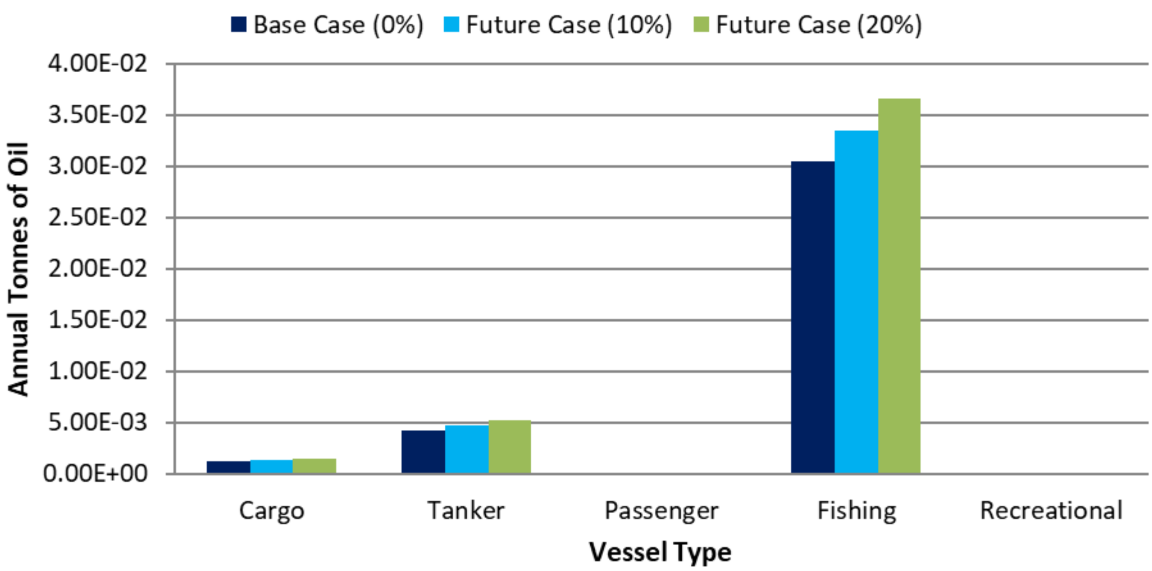

Figure B-19 Estimated Change in Pollution by Vessel Type

643. The annual oil spill results are dominated by fishing vessels due to their high associated annual collision and allision frequency. The second greatest contributor was tankers, reflecting the greater oil spill volume per incident associated with tankers.

B.5.3 Significant of Increase in Pollution Risk

644. To assess the significance of the increased pollution risk from vessels caused by the Project, historical oil spill data for the UK has been used as a benchmark.

645. From the MEHRAs research, the annual average tonnes of oil spilled in UK waters due to maritime incidents in the 10-year period from 1989 to 1998 was 16,111. This is based upon a total of 146 reported oil pollution incidents of greater than one tonne (smaller spills are excluded as are incidents which occurred within port or harbour areas or resulting from operational errors or equipment failure). Commercial vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

646. The overall increase in pollution estimated due to the Project of 0.036 tonnes per year for the base case represents a 0.0002% increase compared to the historical average pollution quantities from maritime incidents in UK waters.

B.6 Conclusion

647. This appendix has quantitively assessed the fatality and pollution risk associated with the Project in the event of a collision or allision incident occurring. The assessment indicates that the fatality and pollution risk associated with fishing vessels is greatest.

648. Overall, the impact of the Project on people and the environment is relatively low compared to the existing background risk levels in UK waters. However, this is the localised impact of a single offshore wind farm development and there will be additional maritime risks associated with other offshore wind farm developments in the Irish Sea and the UK as a whole.

649. Discussion of relevant mitigation measures and monitoring is provided in **Section 21** of the NRA.

Annex C Regular Operator Consultation

650. As part of the consultation process for the Project, Regular Operators identified (from the vessel traffic survey data) in proximity to the Array Area were consulted via email. An example of the correspondence sent to the Regular Operators is presented below.

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

Date: 29th January 2025

Opportunity to Participate in Consultation Relating to Shipping and Navigation for the Proposed Dogger Bank D Offshore Wind Farm

Dear Sir/Madam,

As you may be aware, the Dogger Bank D (DBD) Offshore Wind Farm ('the Project') is being developed by a Joint Venture between SSE Renewables and Equinor ('the Applicant') in the North Sea, approximately 114 nautical miles (nm) off the east coast of Flamborough on the Yorkshire coast. Following a Scoping Report published in June 2024 (see here), a Navigational Risk Assessment (NRA) has been drafted to inform the Preliminary Environmental Information Report (PEIR) and will then subsequently be updated to inform the Environmental Statement (ES).

An overview of the Array Area is provided in **Figure 1**. The Array Area covers an area of approximately 76 square nautical miles (nm^2) within which up to 113 fixed wind turbines and up to two offshore platforms will be installed.

An Offshore export cable corridor (ECC) will be located between the Array Area and a landfall location north of Hornsea, on the Yorkshire coast. **Figure 1** also illustrates the Offshore ECC for reference.

Further information about the Project can be found here.

The Project is one of various offshore wind farm developments being developed as part of the Dogger Bank Wind Farm, and the Project has come forward through an opportunity which was identified to maximise the capacity from the eastern part of the original Dogger Bank C site. A cumulative overview of other offshore wind farm developments is presented in **Figure 2**, including developments which are operational, under construction, or in planning.

Anatec has been contracted by the Project to provide technical support on shipping and navigation matters during the Environmental Impact Assessment (EIA) process that will culminate in the submission of the ES. Anatec is also coordinating consultation with relevant stakeholders. As part of this support, Anatec will undertake an assessment of 28 days of vessel traffic survey data in compliance with the Maritime and Coastguard Agency's (MCA) Marine Guidance Note (MGN) 654, with the methodology agreed with the MCA and Trinity House. To date, a 14-day survey was carried out in summer 2023. A further winter survey and an additional summer survey will be undertaken in 2025.

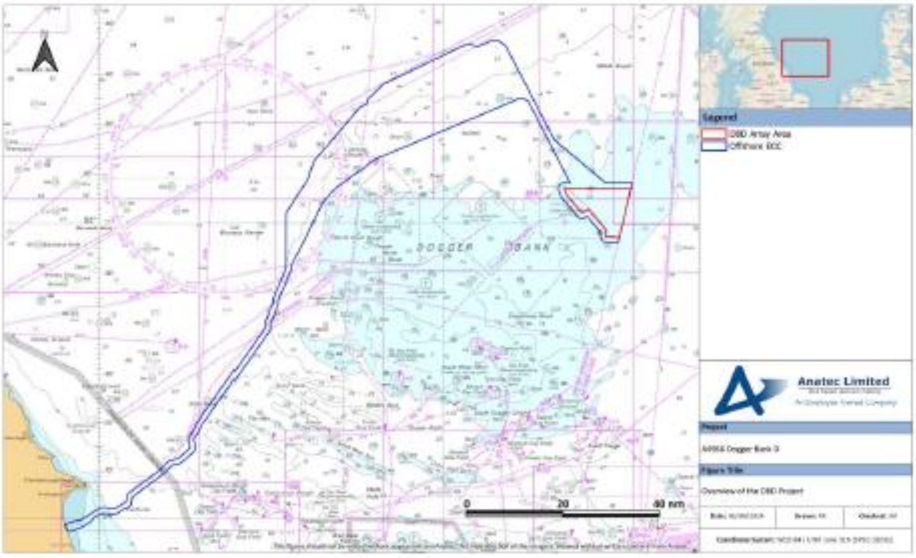

Figure 1 Overview of the DBD Project

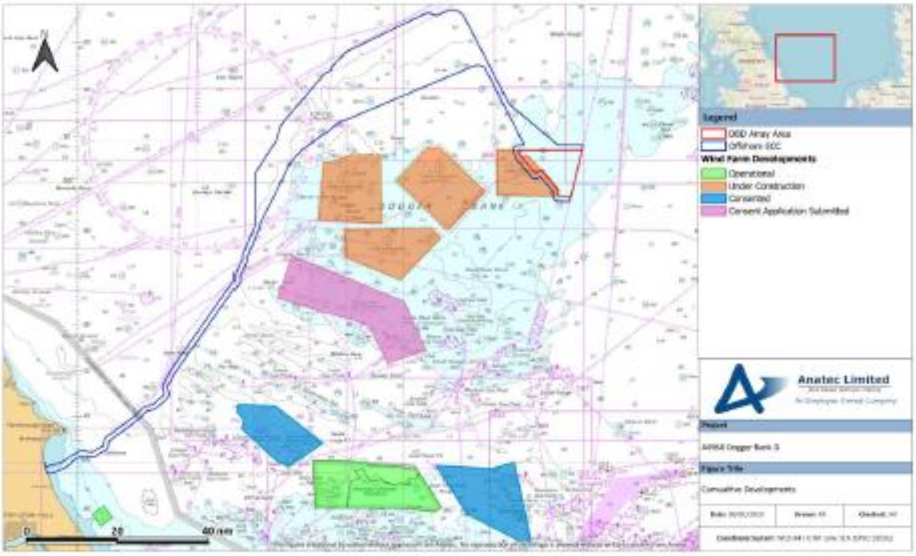

Figure 2 Overview of Cumulative Projects

A review of vessel traffic data collected to date (including the summer 2023 survey and desk-based data from mid-2024) has allowed the identification of regular commercial operators. This exercise has identified your organisation as a regular operator within or in proximity to the Array Area.

We therefore invite your feedback on the Project, including any impact it may have upon the navigation of vessels. Whilst we welcome all feedback we are particularly interested in any comments or feedback relating to the following:

1. Whether the presence of the Project is likely to impact the routeing of any specific vessels and/or routes, including the nature of any change in regular passage.
2. Whether the presence of the Project poses any safety concerns to your vessels, including in relation to adverse weather routeing.
3. Whether your responses to the previous questions are affected by the additional presence of cumulative offshore wind farm developments that have not yet commenced construction.
4. Whether you would choose to make passage internally through the DBD Array Area.
5. Whether you wish to be retained on our list of marine stakeholders and consulted throughout the NRA and EIA process.

Additionally, we wish to invite you to attend a Hazard Workshop which is anticipated to take place later in 2025 following the PEIR and statutory consultation stage; further details will follow but this will likely take place in person with a Microsoft Teams dial-in option available.

We would appreciate that any responses are provided via email to [redacted] and [redacted] by Friday 21st February, as well as an indication of whether you are interested in attending the Hazard Workshop noted above.

Yours sincerely,

[redacted]
Risk Analyst
Anatec Ltd.