

Outer Dowsing Offshore Wind Preliminary Environmental Information Report Volume 2, Appendix 15.1: Navigational Risk Assessment

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Outer Dowsing Offshore Wind Navigational Risk Assessment

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Glossary of Terms

Term	Definition
Adverse Weather Route	Preferred routes by certain vessels during periods of adverse weather conditions.
Automatic Identification System (AIS)	A system by which vessels automatically broadcast their identity, key statistics including location, destination, length, speed and current status. Most commercial vessels and European Union (EU)/UK fishing vessels over 15m in length are required to carry AIS.
Allision	Contact between a vessel and a stationary object.
Collision	Contact between two or more moving vessels.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity as defined by the International Maritime Organization (IMO).
Main Route	A route used on a regular basis by one or more vessels.
Marine Guidance Note (MGN)	Guidance released by the Maritime and Coastguard Agency (MCA) for the purposes of providing advice relating to the improvement of the safety of shipping and of life at sea.
Regular Operator	A commercial operator associated with one or more vessels that transit an area on a regular basis.
Safety Zone	An area around a structure associated with an Offshore Renewable Energy Installation where entry is prohibited under the Energy Act 2004.

Abbreviations Table

Abbreviation	Definition
μ T	Microtesla
ABP	Associated British Ports
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ALB	All-Weather Lifeboats
AtoN	Aid to Navigation
BBC	British Broadcasting Corporation

Abbreviation	Definition
BWEA	British Wind Energy Association
CAA	Civil Aviation Authority
CBA	Cost Benefit Analysis
CCTV	Closed Circuit Television
CD	Chart Datum
CHIRP	Confidential Human Factors Incident Reporting Programme
CoS	Chamber of Shipping
CRO	Coastguard Rescue Officers
CRT	Coastguard Rescue Teams
CTV	Crew Transfer Vessel
DC	Direct Current
DECC	Department of Energy and Climate Change
DESNZ	Department for Energy Security and Net Zero, formerly Department of Business, Energy and Industrial Strategy (BEIS), which was previously Department of Energy & Climate Change (DECC)
DF	Direction Finding
DfT	Department for Transport
dML	Deemed Marine Licence
DSC	Digital Selective Calling
DWR	Deep Water Route
DWT	Deadweight Tonnage
ECC	Export Cable Corridor
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ERCoP	Emergency Response Cooperation Plan
ES	Environmental Statement
FRB	Fast Rescue Boat
FSA	Formal Safety Assessment
GIG	Green Investment Group

Abbreviation	Definition
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
GT	Gross Tonnage
HAT	Highest Astronomical Tide
HMCG	His Majesty's Coastguard
HVAC	High Voltage Alternating Current
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IHO	International Hydrographic Organisation
ILB	Inshore Lifeboats
IMCA	International Marine Contractors Association
IMO	International Maritime Organisation
JRCC	Joint Rescue Coordination Centre
JUV	Jack-up Vessel
kHz	Kilohertz
km	Kilometre
LAT	Lowest Astronomical Tide
LOA	Length Overall
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MGN	Marine Guidance Note
MRCC	Maritime Rescue Coordination Centre
MSC	Maritime Safety Committee
MSI	Maritime Safety Information
MW	Megawatt
NAVTEX	Navigational Telex
NFFO	National Federation of Fishermen's Organisations

Abbreviation	Definition
nm	Nautical Mile
nm ²	Nautical Mile Squared
NPS	National Policy Statement
NRA	Navigational Risk Assessment
NSIP	Nationally Significant Infrastructure Projects
NUC	Not Under Command
O&M	Operation and Maintenance
ORCP	Offshore Reactive Compensation Platform
OREIs	Offshore Renewable Energy Installations
OWF	Offshore Windfarm
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Area
PLL	Potential Loss of Life
PNT	Positioning, Navigation and Timing
QHSE	Quality, Health, Safety and Environment
Racon	Radar Beacon
Radar	Radio Detecting and Ranging
RCS	Reactive Compensation Substation
REZ	Renewable Energy Zone
RNLI	Royal National Lifeboat Institution
RoPax	Roll-On/Roll-Off Passenger
Ro-Ro	Roll-On/Roll-Off Cargo
RYA	Royal Yachting Association
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SMS	Safety Management System
SONAR	Sound Navigation Ranging
SOV	Service Operation Vessel
SPS	Significant Peripheral Structure

Abbreviation	Definition
TCE	The Crown Estate
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UTC	Universal Time Coordinated
UTM	Universal Transverse Mercator
VHF	Very High Frequency
VTS	Vessel Traffic Service
WGS84	World Geodetic System 1984
WTG	Wind Turbine Generator

1 Introduction

1.1 Background

1. This annex to Volume 1, Chapter 15: Shipping and Navigation of the Preliminary Environmental Information Report (PEIR) presents the Navigation Risk Assessment (NRA) for the Outer Dowsing Offshore Wind (the Project).
2. GT R4 Limited (trading as Outer Dowsing Offshore Wind) hereafter referred to as the 'Applicant', is proposing to develop the Project. The Project will be located approximately 54 kilometres (km) from the Lincolnshire coastline in the southern North Sea. The Project will include both offshore and onshore infrastructure including an offshore generating station (windfarm), export cables to landfall, and connection to the electricity transmission network (see Volume 1, Chapter 3: Project Description for full details).
3. The NRA has been undertaken with respect to the offshore components of the Project comprising the array area and Offshore Export Cable Corridor (ECC). High level assessment has been included on the Offshore Reactive Compensation Platform (ORCP) search area, noting that this will be assessed in full post PEIR.

1.2 Navigational Risk Assessment

4. An Environmental Impact Assessment (EIA) is a process which identifies the environmental effects of a project, both negative and positive. An important requirement of the EIA for offshore projects is the NRA. Following the Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 654 (MCA, 2021) including the Methodology (Annex 1 to MGN 654), this NRA includes the following, noting that additional content will be added post PEIR:
 - Outline of methodology applied in the NRA;
 - Summary of consultation undertaken with shipping and navigation stakeholders to date;
 - Lessons learnt from previous offshore windfarm (OWF) developments;
 - Summary of the project description relevant to shipping and navigation;
 - Baseline characterisation of the existing environment;
 - Discussion of potential impacts on navigation, communication and position fixing equipment;
 - Cumulative and transboundary overview;
 - Vessel to vessel collision modelling;
 - Assessment of navigational risk (following the Formal Safety Assessment (FSA) process);
 - Outline of embedded mitigation measures; and
 - Completion of MGN 654 Checklist (noting it has been made clear where further elements will be added post PEIR).

5. Potential hazards are considered for each phase of development as follows:
 - Construction;
 - Operation and maintenance (O&M); and
 - Decommissioning.
6. The assessment of the Project is based on a parameter-based design envelope approach, which is recognised in the Overarching National Policy Statement (NPS) for Energy (EN-1) (Department of Energy and Climate Change (DECC), 2011), the NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011), the draft EN-1 (Department for Energy Security and Net Zero (DESNZ) 2023), the draft EN-3 (DESNZ, 2023) and *Planning Inspectorate Advice Note Nine: Rochdale Envelope* (The Planning Inspectorate, 2018). The design envelope includes conservative assumptions to form a Maximum Design Scenario (MDS) which is considered and assessed for all risks. Further details on the design envelope are provided in **Volume 1, Chapter 3: Project Description**.
7. The shipping and navigation baseline and risk assessment has been undertaken based upon the information available and responses received at the time of preparation, including the MDS as discussed above.

2 Guidance and Legislation

2.1 Legislation

8. Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIP) specifically in relation to shipping and navigation is contained in the NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011). Additionally, planning policy on NSIP 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 PEIR.

2.2 Primary Guidance

9. The primary guidance documents used during the NRA process are the following:
 - 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) including its annexes; and
 - Revised Guidelines for FSA for Use in the Rule-Making Process (International Maritime Organization (IMO), 2018).
10. MGN 654 highlights issues that shall be considered when assessing the effect on navigational safety from offshore renewable energy developments, proposed in UK internal waters, UK territorial sea, the UK Exclusive Economic Zone (EEZ) or Renewable Energy Zones (REZ).
11. 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 (see 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 and what measures are required to ensure the future case remains broadly acceptable or tolerable with mitigation.

2.3 Other Guidance

12. Other guidance documents used during the assessment are as follows:
 - International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, 2021);
 - IALA Guideline G1162 Guidance on the Marking of Offshore Man-Made Structures (IALA, 2021); and
 - The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy (RYA, 2019).

2.4 Lessons Learnt

13. 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 Volume 1, Chapter 15: Shipping and Navigation, includes general consideration for lessons learnt and expert opinion from previous OWF developments and other sea users, capitalising upon the UK's position as a leading generator of offshore wind power.

3 Navigational Risk Assessment Methodology

3.1 Formal Safety Assessment Methodology

14. 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. The assessments presented herein for shipping and navigation users have considered the following criteria:

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

15. 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. A separate methodology and assessment have been applied in Volume 1, Chapter 14: Commercial Fisheries to consider hazards on commercial fishing vessels including safety risks which are directly related to commercial fishing activity (rather than commercial fishing vessels in transit).

3.2 Formal Safety Assessment Process

16. The IMO FSA process (IMO, 2018) as approved by the IMO in 2018 under Maritime Safety Committee (MSC) – Marine Environment Protection Committee (MEPC).2/circ. 12/Rev.2 will be applied to the risk assessment within this NRA, and informs Volume 1, Chapter 15: Shipping and Navigation.

17. The FSA process is a structured and systematic methodology based upon risk analysis and Cost Benefit Analysis (CBA) (if applicable) to reduce impacts to As Low as Reasonably Practicable (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 assessment (investigation of the causes and initiating events and risks of the more important hazards identified in step 1);
- Step 3 – Risk control options (identification of measures to control and reduce the identified risks);
- Step 4 – CBA (identification and comparison of the benefits and costs associated with the risk control options identified in step 3); and

- Step 5 – Recommendations for decision-making (defining of recommendations based upon the outputs of steps 1 to 4).



Figure 3.1 Flow Chart of the FSA methodology

3.2.1 Hazard Workshop Methodology

18. 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 consultees. 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 the hazard log, respectively, completed based on the outputs of the Hazard Workshop.

Table 3.1 Severity of consequence ranking definitions

Rank	Description	Definition			
		People	Property ¹	Environment	Business
1	Negligible	No perceptible impact	No perceptible impact	No perceptible impact	No perceptible impact

¹ Note numerical cost values were shown at the Hazard Workshop for property definition. These were amended post workshop to textual definitions based on general user feedback and to allow for scale based on size of operation.

Rank	Description	Definition			
		People	Property ¹	Environment	Business
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	< 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

19. 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. The significance of risk is defined as Broadly Acceptable (low risk), Tolerable (intermediate risk) or Unacceptable (high risk).

Table 3.3 Tolerable matrix and risk ranking

Severity of Consequence	5					
	4					
	3					
	2					
	1					
			1	2	3	4
		Frequency of Occurrence				
	Unacceptable (high risk)					
	Tolerable (intermediate risk)					
	Broadly Acceptable (low risk)					

20. Once identified the significance of risk will be assessed to ensure it is ALARP. Further risk control measures may be required to further mitigate a hazard in accordance with the ALARP principles. Unacceptable risks are not considered to be ALARP.

3.3 Methodology for Cumulative Risk Assessment

21. The hazards identified in the FSA are also assessed for cumulative risks with the inclusion of other projects and proposed developments. 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.
22. 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 50 nautical miles (nm) of the array area and may impact a main commercial route within 1nm of the array area but the development is only scoped, it may still be allocated to Tier 1.

Table 3.4 Cumulative development screening summary

Tier	Minimum Development Status	Criterion	Minimum Data Confidence Level	Level of Cumulative Risk Assessment
1	Under Determination	<ul style="list-style-type: none"> ▪ May impact a main route identified as passing within the study area (see Section 10.2) ▪ Within 50nm of the array area. 	Medium	Qualitative cumulative re-routing assumptions made for main routes
2	Scoped	<ul style="list-style-type: none"> ▪ Unlikely to impact upon a main route identified as passing within the study area (see Section 10.2) ▪ Within 50nm of the array area. 	Low	General qualitative assumptions.
3	Any	<ul style="list-style-type: none"> ▪ Further than 50nm from array area. 	Low	Screened Out

23. OWF developments are screened out if over 50nm from the array area. This distance is considered to represent a conservative threshold, noting that this is a typical approach undertaken for the cumulative risk assessment in NRAs.
24. It is noted that constructing or operational projects are considered as part of the baseline and therefore are not scoped into the cumulative risk assessment. This includes baseline oil and gas developments.

3.4 Shipping and Navigation Study Area

25. The shipping and navigation study area used within the NRA has been defined as a 10nm buffer of the array area as shown in Figure 3.2. The study area has been defined in order to provide local context to the analysis of risks by capturing the relevant routes, vessel traffic movements and historical incident data within and in proximity to the Project.
26. Navigational features wholly or partially outside the study area are considered where appropriate. A 10nm study area has been used in the majority of UK OWF NRAs with recent examples including Hornsea Three, Norfolk Vanguard and Norfolk Boreas, all of which were successfully consented.
27. The Offshore ECC study area has been defined as a 2nm buffer of the Offshore ECC as shown in Figure 3.2.
28. It is noted that preliminary assessment has been undertaken on the ORCP search area within the PEIR NRA. For the purposes of the PEIR, the associated study area has been defined as a 10nm buffer of the ORCP search area as shown in Figure 3.2.

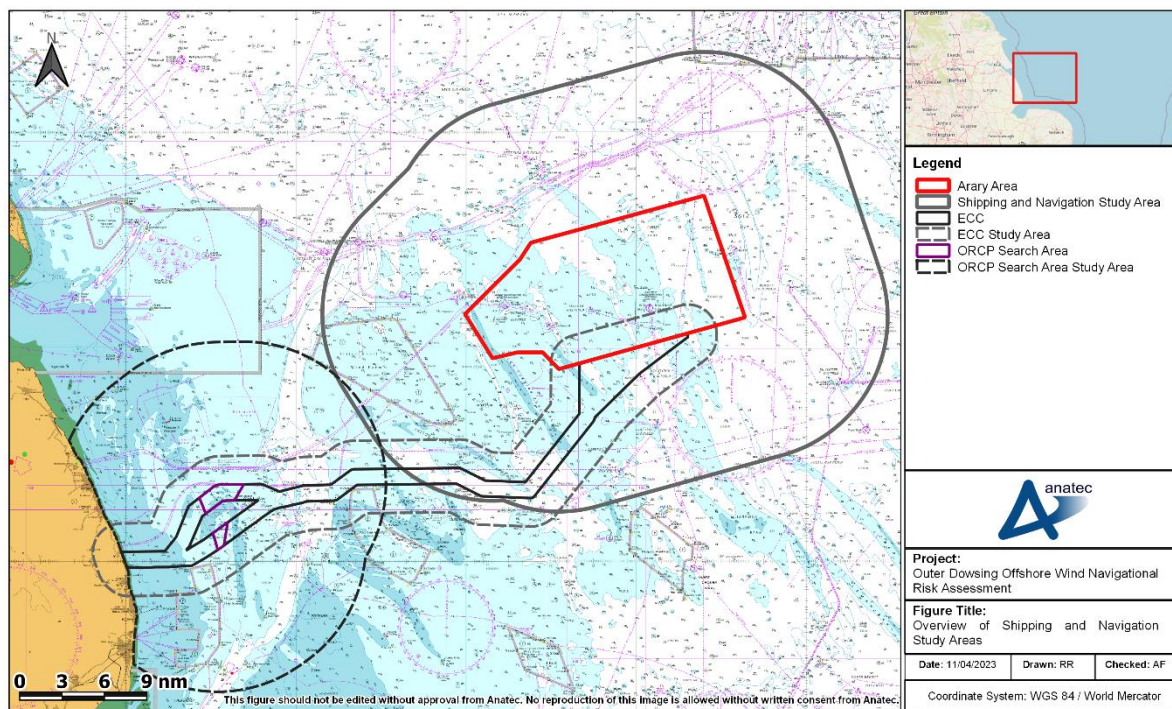


Figure 3.2 Study Areas for Shipping and Navigation

4 Consultation

4.1 Stakeholders consulted in the Navigational Risk Assessment Process

29. Key shipping and navigation stakeholders have been consulted in the NRA process. The following stakeholders have been consulted via dedicated meetings:

- MCA;
- Trinity House;
- UK Chamber of Shipping (CoS); and
- DFDS.

30. As well as consulting with the organisations outlined above, 32 Regular Operators identified from the vessel traffic surveys/long-term annex 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:

- A2B;
- AMASUS;
- Anthony Veder;
- Arklow Shipping;
- BBC Chartering;
- Boomsma Shipping;
- Bore Ltd;
- Boskalis;
- Boston Putford;
- Britannia Aggregates Ltd.;
- Chemgas;
- CLdN;
- DS Norden;
- Deme;
- Den Herder Seaworks;
- DFDS;
- EemsWerken;
- Evergas Shipping;
- Gaschem;
- GEFO;
- Hanson Aggregates;
- James Fisher;
- P&O Ferries;
- Royal Wagenbord;
- Samskip;
- Scheepswerf Bijlsma;
- Sea Tank Chartering AS;
- Smyril Line;
- StenaLine;
- Unigas International;
- Wijnne Barends; and
- Wilson

4.2 Consultation Response

31. Responses have been received from stakeholders during consultation undertaken in the NRA process, either during conference calls, via email correspondence or through the Scoping Opinion. The key points and where they have been addressed in the NRA or Volume 1, Chapter 15: Shipping and Navigation are summarised in this section.

4.2.1 Scoping

32. The Applicant submitted a Scoping Report to the Planning Inspectorate in July 2022. The key points of relevance to shipping and navigation arising from the resultant Scoping Opinion are summarised in Table 4.1, which includes where they have been addressed in the NRA or PEIR.

Table 4.1 Summary of Key Points Raised During Consultation from the Scoping Opinion

Stakeholder(s)	Date of correspondence	Point Raised	Response and where addressed in the NRA
MCA	26 August 2022	<p>The Environmental Impact Report should supply detail on the possible impact on navigational issues for both commercial and recreational craft, specifically:</p> <ul style="list-style-type: none"> ▪ Collision Risk ▪ Navigational Safety ▪ Visual intrusion and noise ▪ Risk Management and Emergency response ▪ Marking and lighting of site and information to mariners ▪ Effect on small craft navigational and communication equipment ▪ The risk to drifting recreational craft in adverse weather or tidal conditions ▪ The likely squeeze of small craft into the routes of larger commercial vessels. 	The listed items and risks are assessed where appropriate in Section 17.
MCA	26 August 2022	<p>The development area carries a moderate amount of traffic with several important commercial shipping routes to/from UK ports, particularly passenger vessels, oil and gas support vessels and cargo ships including tankers. Attention needs to be paid to routing, particularly in heavy weather routing so that vessels can continue to make safe passage without large-scale deviations. The likely cumulative and in combination effects on shipping routes should be considered which will be an important issue going forward. It should consider the proximity to other windfarm developments, particularly with the construction of Hornsea Project 2 and 3 and proposed extension to Dudgeon OWF, other infrastructure, and the impact on safe navigable sea room.</p>	<p>Vessel routing included during adverse weather is assessed in Section 11.</p> <p>Cumulative risk assessment is provided in Section 18.</p>
MCA	26 August 2022	<p>It is noted that a Navigational Risk Assessment will be submitted in accordance with MGN 654.</p>	MGN 654 checklist is detailed in Annex A.

Stakeholder(s)	Date of correspondence	Point Raised	Response and where addressed in the NRA
		This should be accompanied by a detailed MGN 654 Checklist.	
MCA	26 August 2022	A vessel traffic survey must be undertaken to the standard of MGN 654 which will consist of a minimum of 28 days of seasonal data (two x 14-day surveys) collected from a vessel-based survey using Automatic Identification System (AIS), Radio Detection and Ranging (Radar) and visual observations to capture all vessels navigating in the study area. We would expect the details of these consultations to be included within the NRA. Kindly note for all OREI developments, subject to the planning process, the traffic survey must be undertaken within 24 months prior to submission of the DCO application. If the EIA Report is not submitted within 24 months an additional 14-day continuation survey data may be required for each subsequent 12- month period. Should there be a break in the continuation surveys, a new full traffic survey may be required, and the time period starts from the completion of the initial 28-day survey period.	Vessel traffic survey approach has been agreed with the MCA and Trinity House. At PEIR primary assessment is based on a 14 day summer 2022 traffic survey. In the final NRA, an additional 14 days collected during winter 2022 will be added bringing the total up to 28 days.
MCA	26 August 2022	The proximity to other OWFs will need to be fully considered, with an appropriate assessment of the distances between OREI boundaries and shipping routes as per MGN 654. The cumulative impacts of other windfarms in close proximity, in particular the Hornsea 3 and Dudgeon Extension developments will change routing, particularly those that transect the western and northern sections of the site. Attention must be paid for ensuring the established shipping routes within the area can continue safely without unacceptable deviations. Particular attention should also be given to the oil and gas activity within the area.	Cumulative risk assessment is provided in Section 18. Hornsea Three and the Dudgeon Extension have been screened in as Tier 1 projects. Full consideration has been given to oil and gas activity.
MCA	26 August 2022	The Wind Turbine Generator (WTG) layout design will require MCA approval prior to construction to minimise the risks to surface vessels, including rescue boats, and Search and Rescue (SAR) aircraft operating within the site. Any additional navigation safety and/or Search and Rescue requirements, as per MGN 654 Annex 5, will be agreed at the approval stage.	Embedded mitigations include compliance with MGN 654 and layout approval by the MCA and Trinity House (see Section 16).
MCA	26 August 2022	Attention should be paid to cabling routes and where appropriate burial depth for which a	As per Section 16, a cable burial risk assessment

Stakeholder(s)	Date of correspondence	Point Raised	Response and where addressed in the NRA
		Burial Protection Index study should be completed and subject to the traffic volumes, an anchor penetration study may be necessary. If cable protection measures are required e.g. rock bags or concrete mattresses, the MCA would be willing to accept a 5% reduction in surrounding depths referenced to Chart Datum (CD). This will be particularly relevant where depths are decreasing towards shore and potential impacts on navigable water increase, such as at the HDD location.	process will be undertaken to determine cable protection requirements, and there will be full MGN 654 compliance including provisions associated with changes to water depths.
MCA	26 August 2022	Particular consideration will need to be given to the implications of the site size and location on SAR resources and Emergency Response Co-operation Plans (ERCoP). The report must recognise the level of radar surveillance, AIS and shore-based Very High Frequency (VHF) radio coverage and give due consideration for appropriate mitigation such as radar, AIS receivers and in-field, Marine Band VHF radio communications aerial(s) (VHF voice with Digital Selective Calling (DSC)) that can cover the entire windfarm sites and their surrounding areas. A SAR checklist will also need to be completed in consultation with MCA, as per MGN 654 Annex 5 SAR requirements.	As per Section 16, there will be full MGN 654 compliance including provisions associated with the ERCoP, layout, and the SAR Checklist.
MCA	26 August 2022	MGN 654 Annex 4 requires that hydrographic surveys should fulfil the requirements of the International Hydrographic Organisation (IHO) Order 1a standard, with the final data supplied as a digital full density data set, and survey report to the MCA Hydrography Manager. Failure to report the survey or conduct it to Order 1a might invalidate the Navigational Risk Assessment if it was deemed not fit for purpose.	As per Section 16, there will be full MGN 654 compliance including in relation to hydrographic surveys.
Trinity House	26 August 2022	NRA should include: <ul style="list-style-type: none"> ▪ Comprehensive vessel traffic analysis in accordance with MGN 654. ▪ The possible cumulative and in-combination effects on shipping routes and patterns should be adequately assessed. ▪ The potential “corridor” between the project and Triton Knoll OWF, including future traffic patterns should be considered and assessed. 	<ul style="list-style-type: none"> ▪ Vessel traffic survey approach has been agreed with MCA and Trinity House and is MGN 654 compliant. ▪ Cumulative risk assessment is provided in Section 18. ▪ Post windfarm routeing in Section

Stakeholder(s)	Date of correspondence	Point Raised	Response and where addressed in the NRA
			13 includes appropriate assumptions around Triton Knoll OWF.
Trinity House	26 August 2022	We consider that this development will need to be marked with marine aids to navigation (AtoNs) by the developer/operator in accordance with the general principles outlined in IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) Guideline G1162 - The Marking of Offshore Man-Made Structures as a risk mitigation measure. In addition to the marking of the structures themselves, it should be borne in mind that additional AtoNs such as buoys may be necessary to mitigate the risk posed to the mariner, particularly during the construction phase. All marine navigational marking, which will be required to be provided and thereafter maintained by the developer, will need to be addressed and agreed with Trinity House. This will include the necessity for the AtoN to meet the internationally recognised standards of availability and the reporting thereof.	As per Section 16, lighting and marking will be agreed with Trinity House and will be IALA G1162 compliant.
Trinity House	26 August 2022	Assessment of impact on existing AtoNs, to include both offshore and shore based (where any cabling reaches landfall) AtoNs.	AtoN are considered in Section 7.5.
Trinity House	26 August 2022	A decommissioning plan, which includes a scenario where on decommissioning and on completion of removal operations an obstruction is left on site (attributable to the windfarm) which is considered to be a danger to navigation and which it has not proved possible to remove, should be considered. Such an obstruction may require to be marked until such time as it is either removed or no longer considered a danger to navigation, the continuing cost of which would need to be met by the developer/operator.	The Applicant will produce a decommissioning plan as detailed in Section 20.
Trinity House	26 August 2022	The possible requirement for navigational marking of the export cables and the vessels laying them. If it is necessary for the cables to be protected by rock armour, concrete mattresses or similar protection which lies clear of the surrounding seabed, the impact on navigation and the requirement for appropriate risk mitigation measures needs to be assessed.	A cable burial risk assessment process will be undertaken to determine cable protection requirements, and there will be full MGN 654 compliance including provisions associated with changes to water depths.

Stakeholder(s)	Date of correspondence	Point Raised	Response and where addressed in the NRA
			Lighting and marking will be agreed with Trinity House.
Secretary of State	9 September 2022	A study area of 10nm has been proposed for the shipping and navigation assessment, with a likely final study area within the NRA of 10nm proposed for the array and any Offshore Reactive Platforms (ORPs), and 2nm for the Offshore ECC. The ES should explain the rationale behind the choice of study areas and, where possible, the approach should be agreed with the relevant consultation bodies	Details of the study areas are provided in Section 3.4. These were presented and agreed with the MCA, Trinity House and CoS during consultation.
Secretary of State	9 September 2022	The Scoping Report states that a preliminary assessment of navigational features within the AoS for the Offshore ECC has been undertaken; however, no baseline information for the Offshore ECC AoS has been included within the Scoping Report. The Environmental Statement (ES) should describe the shipping and navigational baseline conditions for the entire AoS, accompanied by clear figures.	Section 9.2 provided full baseline details of the offshore ECC including in terms of vessel traffic, Section 7 for navigational features and Section 8 for marine incidents. Associated risk assessment is provided in Section 17.
Secretary of State	9 September 2022	The Scoping Report proposes to determine significance as either broadly acceptable, tolerable, or unacceptable. The ES should clearly set out how the risk assessment approach leads to an assessment of significance of effect consistent/compatible with the terminology used in the ES, for which the intended approach is set out in Chapter 5 (paragraphs 5.7.12 to 5.7.13) of the Scoping Report.	The assessment methodology is described in Section 3, which includes details around how the FSA translates into EIA terminology in terms of significance.
Secretary of State	9 September 2022	Noting the Scoping Report states that it will include changes to baseline routeing associated with submitted or consented OWF projects, notably Hornsea 3 and Hornsea 4, the ES should clearly state any assumptions made with regards to the baseline.	Baseline routeing is summarised in Section 10. Projects screened in on a cumulative basis area shown in Section 14.
Secretary of State	9 September 2022	The ES should identify a future baseline for vessel movements and explain how this has been established, taking into account the existing sea users and the numerous proposed OWF projects in the vicinity.	Post windfarm routeing has been established in Section 13. The final NRA will consider potential future case traffic increases.

4.2.2 Dedicated Meetings

33. Key point raised at dedicated stakeholder meetings of relevance to shipping and navigation are summarised in Table 4.2.

Table 4.2 Key Stakeholder Meetings

Stakeholder(s)	Date and form of correspondence	Key Points Raised	Response and where addressed in the NRA
DFDS and CoS	02 June 2021 Initial Meeting	CoS raised cumulative concerns with the Dudgeon and Sheringham Extensions to the south.	See Section 14 and Section 18.
DFDS and CoS	02 June 2021 Initial Meeting	DFDS noted concern over traffic passing inshore of the Outer Dowsing bank, in particular whether the Project may increase traffic levels in this area or reduce navigable width.	Post windfarm routeing is considered in Section 13.2. Associated impacts are assessed in Section 17.
DFDS and CoS	02 June 2021 Initial Meeting	DFDS stated limited concern with their Newcastle to Ijmuiden Route. However the Immingham-Cuxhaven routeing will be affected. Adverse weather routeing between Immingham and Esbjerg may also be impacted.	Post windfarm routeing is considered in Section 13.2, and adverse weather routeing in Section 11. Associated impacts are assessed in Section 17.
Trinity House	10 January 2022 Pre-Scoping Consultation Meeting	Trinity House has a key interest in where traffic passing north of the Project will route. North / south traffic passing west of the Hornsea sites is also of interest. Tanker traffic from Humber should be considered given the size of the vessels.	Vessel displacement and full details of potential route deviations including on a cumulative basis are provided has been considered in Section 17.
Trinity House	10 January 2022 Pre-Scoping Consultation Meeting	Trinity House prefers straight line edges for the Project with no isolated structures.	As per Section 16, the layout will be agreed with the MCA and Trinity House.
Trinity House	10 January 2022 Pre-Scoping Consultation Meeting	Construction buoyage will need to be thoroughly considered regarding the presence of Triton Knoll OWF and the shallow banks.	As per Section 16, lighting and marking including the buoyed construction area will be agreed with Trinity House.
MCA	14 January 2022 Pre-Scoping Consultation Meeting	Proposed seaweed farms and Dutch windfarms to the north of the East Anglia projects are unlikely to cause any impact but interested in knowing if there is any effect.	Cumulative risk assessment is provided in Section 18. Cumulative development screening has been undertaken in Section 14.1.
MCA	14 January 2022 Pre-Scoping Consultation Meeting	The larger structures and rotor diameters can create challenges for SAR helicopters.	As per Section 16, the layout will be agreed with the MCA and Trinity House. These discussions will include SAR considerations,

Stakeholder(s)	Date and form of correspondence	Key Points Raised	Response and where addressed in the NRA
			noting the Project will be MGN 654 compliant.
CoS	16 August 2022 Consultation Meeting	CoS stated that general trends in vessel traffic will remain similar but cautious over the passenger cruising growth that was present pre-Covid-19 and how that growth may continue but routeing is currently vague.	The potential future case traffic increases is detailed in Section 13.
CoS	16 August 2022 Consultation Meeting	Consideration should be taken in regard to the study area and the location the existing Dudgeon/Sheringham sites and the planned extension projects. CoS requested that PEIR included an idea of scale, possibly through the use of a grid to understand what the size of a certain development in the area will resemble.	Details of the study area are provided in Section 3.4.
DFDS	8 th September 2022 Consultation Meeting	Although King & Princess Seaways intersected or passed in proximity to the site on adverse weather routes, there is limited concern with the associated routeing. Key DFDS concern is the Immingham to Cuxhaven routes.	DFDS routeing has been identified and assessed and the risk assessment is provided in Section 17.

4.2.3 Regular Operators

34. The key points raised as part of the Regular Operators outreach (see Section 4.1) are summarised in Table 4.3, including where each point raised has been addressed within the NRA.

Table 4.3 Summary of Regular Operators Outreach

Regular Operator(s)	Data and form of correspondence	Point Raised	Response and where addressed in the NRA
StenaLine	8 th September 2022 Email correspondence	Presence of the Project will impact vessel routeing and extend current transit lengths as will require re-routeing as well as creating additional safety concerns. Vessels will never transit through the array area but will continue to pass in close proximity.	Likely Post-windfarm routeing has been established in Section 13 and the associated risks assessed in Section 17.
Bore Ltd.	15 th September 2022 Email correspondence	As long as baseline space remains between Outer Dowsing Shoal and Triton Knoll OWF, Bore suggested there would be limited concern.	Likely Post-windfarm routeing has been established in Section 13. This includes consideration of adverse weather

Regular Operator(s)	Data and form of correspondence	Point Raised	Response and where addressed in the NRA
		<p>The optional shallow track to the east of Outer Dowsing Bank cannot be used post windfarm so vessels will route between Outer Dowsing Bank and Triton Knoll OWF. Therefore important that the width between Outer Dowsing Bank and Triton Knoll OWF is not reduced as above.</p> <p>Noted on a cumulative basis if vessels rerouted inshore of Triton Knoll OWF they would need to account for the Humber anchorage areas.</p>	transits and the associated risks assessed in Section 17.
P&O Ferries	30 September 2022 Email correspondence	Vessels will only be affected by Project vessels crossing transit routes. Stated general experience that UK project vessel movements are “well managed and promulgated”.	Impacts associated with project vessels are assessed in Section 17.

4.2.4 Hazard Workshop

35. A key element of the consultation phase was the Hazard Workshop, a meeting of local and national marine stakeholders to identify and discuss potential shipping and navigation hazards. Using the information gathered from the Hazard Workshop, a Hazard Log was produced for use as input into the risk assessment undertaken in Volume 1, Chapter 15: Shipping and Navigation. This ensured that expert opinion and local knowledge was incorporated into the hazard identification process and that the Hazard Log was site-specific.

4.2.4.1 Hazard Workshop Attendance

36. The Hazard Workshop was held virtually via Microsoft Teams on the 10 November 2022. The Hazard Workshop was attended by:

- MCA;
- NFFO (National Federation of Fishermen's Organisations);
- Shell UK,
- Perenco;
- Cruising Association (CA);
- StenaLine;
- DFDS;
- Boskalis Aggregate;
- Associated British Ports (ABP) Humber; and
- Poseidon.

37. It is noted that all regular operators contacted (see Section 4.1) were given the opportunity to attend the Hazard Workshop.

4.2.5 Hazard Workshop Process and Hazard Log

38. During the Hazard Workshop, key maritime hazards associated with the construction, O&M and decommissioning of the Project were identified and discussed. Where appropriate, hazards were considered by vessel type to ensure risk control options could be identified on a type-specific basis.
39. Following the Hazard Workshop, the risks associated with the identified hazards were ranked in the Hazard Log based upon the discussions held during the workshop, with appropriate embedded mitigation measures identified, including any additional measures required to reduce the risks to ALARP. The Hazard Log was then provided to the Hazard Workshop attendees for comment on the 25th November 2022, with final versions then issued on the 9th January 2023. The associated feedback has been incorporated into the NRA. The hazard log has been used to inform the risk assessment from Section 17 and is provided in full in Annex B.
40. Key points raised during the Hazard Workshop deemed of relevance to the NRA are provided in Table 4.4.

Table 4.4 Hazard Workshop Summary

Comment Originator	Point raised	Response and where addressed in the NRA
MCA	Many factors need to be considered when regarding vessel displacement in this specific area including navigational features and water depths etc. and as a whole will be hard to generalise.	Vessel deviation has been considered in Section 13.2. This has accounted for water depths and navigational features.
Boskalis Aggregate	Aggregate activity will continue to become more intense in the area in coming years but will be limited to the boundary of the already assigned dredging areas so minimal impact will occur, but an increase of vessels will be attending areas from the southeast and will avoid the array area.	Marine aggregate dredgers have been considered in the Risk Assessment in Section 17.

Comment Originator	Point raised	Response and where addressed in the NRA
NFFO	<p>AIS for the array area is likely to be representative of fishing activity.</p> <p>Although fisheries in the area are seasonal, whelk, crab and lobster potting are common in the area and static gear vessels will likely continue to fish within the array depending on final layout resulting in gear modifications.</p> <p>Vessels may leave and not fish in area if WTGs are not positioned favourably to the tides.</p> <p>Displacement of commercial vessels will impact static fishing gear in new areas.</p> <p>Displacement of commercial vessels will impact static fishing gear in new areas.</p>	Fishing vessels in transit have been considered in the Risk Assessment in Section 17.
CA	<p>Recreational vessels will avoid main commercial routes and so will move to due to areas of higher activity or displacement as a result of the Project placement.</p> <p>Sail vessels will be more reluctant to transit through the array when compared with motor vessels.</p>	Recreational vessels have been considered in the Risk Assessment in Section 17.
ABP Humber	Impact on Humber Ports will depend on the levels of construction traffic mobilising from the Humber region.	Construction traffic has been assessed in the Risk Assessment in Section 17.

5 Data Sources

41. 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

42. The main data sources used to characterise the shipping and navigation baseline relative to the Project are outlined in Table 5.1.

Table 5.1 Data sources used to inform shipping and navigation baseline

Data	Source(s)	Purpose
Vessel Traffic	Summer vessel traffic survey data consisting of AIS, Radar and visual observations for the shipping and navigation study area (14-days, 2 - 15 August 2022) recorded from a dedicated on-site survey vessel.	Characterising vessel traffic movements within and in proximity to the Offshore Development Area in line with MGN 654 (MCA, 2021) requirements.
	Winter vessel traffic survey data consisting of AIS, Radar, and visual observations for the shipping and navigation study area (14-days, 15–29 November 2022) recorded from a dedicated on-site survey vessel.	
	Winter vessel traffic survey data consisting of AIS, Radar, and visual observations for the ORCP search area study area (14-days, 9–23 January 2023) recorded from a dedicated on-site survey vessel.	
	A second summer survey is planned in 2023, post PEIR.	
	AIS data for the Offshore ECC study area covers same period as the summer vessel traffic survey for the shipping and navigation study area (14-days, 2 – 15 August 2022).	

Data	Source(s)	Purpose
	AIS data for the shipping and navigation study area (12-months April 2021 to March 2022) (hereafter the 'long-term vessel traffic data') recorded from coastal receivers.	Validation of the vessel traffic surveys and characterising seasonal variations.
	Anatec's ShipRoutes database (2022).	Secondary source for characterising vessel traffic movements including cumulatively within and in proximity to the Project.
Maritime incidents	Maritime Accident Investigation Branch (MAIB) marine accidents database (2000 to 2019).	Review of maritime incidents within and in proximity to the Project.
	Royal National Lifeboat Institution (RNLI) incident data (2000 to 2019).	
	DfT UK civilian SAR helicopter taskings (2015 to 2022).	
Marine aggregate dredging	Marine aggregate dredging areas (licenced and active) (The Crown Estate (TCE), 2022).	Characterising marine aggregate dredging areas within and in proximity to the Project.
Other navigational features	Admiralty Charts, 1187, 1503 and 1190 (United Kingdom Hydrographic Office (UKHO), 2020, 2021 and 2022).	Characterising other navigational features in proximity to the Project.
	Admiralty Sailing Directions NP54 (UKHO, 2021).	
Weather	Met Office UK weather station data (12-months, April 2021 to March 2022)	Identify periods of adverse weather in proximity to the Project.

5.2 Vessel Traffic Surveys

43. The vessel traffic surveys were undertaken by the guard vessel *Karima* (IMO number 7,427,403) and in agreement with the MCA and Trinity House. For the shipping and navigation study area, surrounding the array area, the summer survey was carried out from 00:00 Universal Time Coordinated (UTC) on 2 August 2022 and concluded at 00:00 UTC on 16 August 2022, giving 14 full days of survey data. The winter survey was carried out from 01:00 UTC on 15 November 2022 and concluded at 01:00 UTC on 29 November 2022, giving 14 full days of survey data. Combined with the summer survey, a full 28-days of data was gathered for the array area and shipping and navigation study area.

44. The winter vessel traffic survey carried out for the ORCP search area study area was carried out from 20:00 UTC on 9 January 2023 and concluded at 20:00 UTC on 23 January 2023, giving 14 full days of survey data.
45. A number of vessel tracks recorded during the survey periods were classified as temporary (non-routine), such as the tracks of the survey vessel and tracks of vessels associated with windfarm support at the Hornsea Project Two, which at the time of the summer survey was still under construction, as well as the Reactive Compensation Substation (RCS) and were therefore excluded from the characterisation of the vessel traffic baseline. Careful consideration was taken to keep any vessels involved in the operation of Hornsea Project One, which lies directly east to Hornsea Project Two, as this site was fully commissioned by the start of the survey period. Vessel traffic associated with this site is assumed to be routine, and so maintained within the dataset along with vessels associated with the operational Triton Knoll OWF within the shipping and navigation study area.
46. The dataset is assessed in full in Section 9.

5.3 Long -Term Vessel Traffic Data

47. The long-term vessel traffic data consisting of Automatic Identification System (AIS) covering 12-months from 1 April 2021 to 31 March 2022 was collected from both coastal receivers and the survey vessel *Guard Celena*, from which data was available from the 20th August 2021 to the 2nd January 2022. The assessment of this dataset allowed seasonal variations to be captured in addition to low use or adverse weather routing.
48. As for the vessel traffic survey data (see Section 5.2) any traffic deemed to be temporary in nature has been excluded from the dataset.
49. The dataset is assessed in full in Annex D.

5.4 Data Limitations

5.4.1 AIS Data

50. 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 500GT not engaged on international voyages, passenger vessels irrespective of size built on or after 1 July 2002, and fishing vessels over 15 metres (m) Length Overall (LOA).
51. 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) Radio Detecting and Ranging (Radar) on board the *Karima*. A proportion of smaller vessels also carry AIS voluntarily, typically utilising a Class B AIS device.

Throughout the summer survey, approximately 99% of vessel tracks were recorded via AIS with the remaining 1% recorded via Radar and visual observation.

52. The long-term vessel traffic data and Offshore ECC vessel traffic datasets – AIS only datasets – assume that vessels under a legal obligation to broadcast via AIS will do so. Vessels not on AIS are likely to be unrepresented (noting that it was indicated at the hazard workshop that AIS was likely to be representative of overall traffic as per Section 4.2.4).
53. Both the long-term vessel traffic data and the AIS component of the vessel traffic survey data assume that the details broadcast via AIS is accurate (such as vessel type and dimensions) unless there is clear evidence to the contrary.

5.4.2 Historical Incident Data

54. Although all UK commercial vessels are required to report accidents to the Maritime Accident Investigation Branch (MAIB), non-UK vessels do not have to report unless they are within a UK port or within 12nm territorial waters (noting that the shipping and navigation study area is not located within 12nm 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.
55. The Royal National Lifeboat Institution (RNLI) incident data cannot be considered comprehensive of all incidents in the shipping and navigation study area. 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.

5.4.3 United Kingdom Hydrographic Office Admiralty Charts

56. 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 with one example being the Hornsea Project Two construction buoyage which at the time of writing had not been removed from the UKHO charts but are known to have been removed. However, during consultation input has been sought from relevant stakeholders regarding the navigational features baseline.
57. Navigational features are based upon the most recently available UKHO Admiralty Charts and Sailing Directions at the time of writing.

6 Project Description

58. The NRA reflects the design envelope, which is detailed in full in Volume 1, Chapter 3: Project Description. The following subsections outline the maximum extent of the Project for which any shipping and navigation hazards are assessed.

6.1 Project Boundaries

59. The array area is located within the southern North Sea approximately 29nm (or 54km) from the Lincolnshire coast of the UK. The total area covered by the array area is approximately 146 square nautical miles (nm²) with charted water depths ranging between 5 and 46m below Chart Datum (CD). The ORCP search area covers a total area of approximately 1nm² and is split into two sites across the Offshore ECC. Charted water depths for the ORCP search area range between 5m and 15m and encompasses the shallow waters and banks of the Inner Dowsing area. The total area covered by the Offshore ECC is approximately 69nm² with charted water depths ranging between 0m (at landfall) and 32m below CD.

60. The WTGs and substations will be located entirely within the array area, inclusive of blade overfly. It is noted that the current envelope also includes the potential for up to two ORCPs within the Offshore ECC which are discussed separately in Section 6.2.3.

61. The key coordinates defining the boundary of the array area of the Project are illustrated in Figure 6.1 and provided in Table 6.1 using World Geodetic System 1984 (WGS84) Universal Transverse Mercator (UTM) Zone 31N.

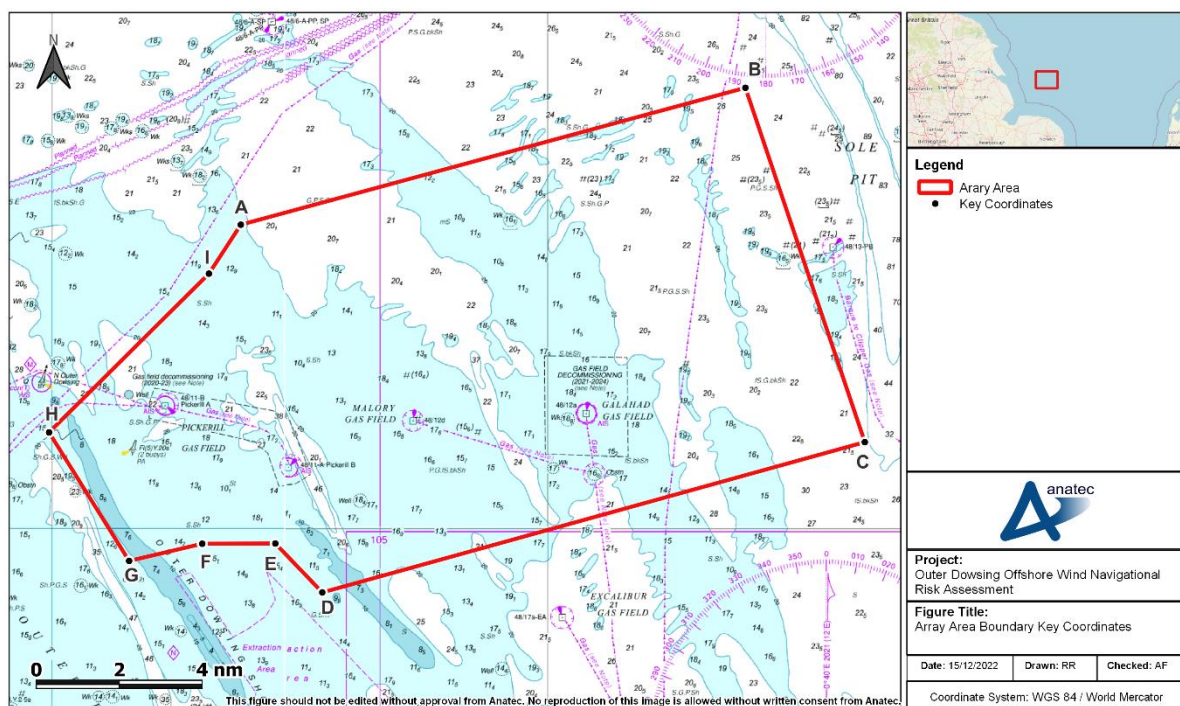


Figure 6.1 Key Coordinates for the Array Area

Table 6.1 Key Coordinates for the Array Area

Point	Latitude (WGS84)	Longitude (WGS84)
A	53° 37' 16.597" N	001° 07' 37.03" E
B	53° 40' 33.265" N	001° 27' 57.75" E
C	53° 32' 03.757" N	001° 32' 46.68" E
D	53° 28' 27.088" N	001° 10' 54.11" E
E	53° 29' 37.647" N	001° 09' 00.05" E
F	53° 29' 37.331" N	001° 06' 03.73" E
G	53° 29' 12.530" N	001° 03' 06.79" E
H	53° 32' 17.704" N	000° 59' 53.06" E
I	53° 36' 06.199" N	001° 06' 19.82" E

6.2 Surface Infrastructure

6.2.1 Wind Turbine Generators (WTGs)

62. WTG capacity (size) will range between 16 Megawatt (MW) and 30MW and the size of WTGs used will dictate final structure numbers.
63. Regardless of the WTG size used, there will be a minimum rotor blade clearance (air draft above MHWS) of 30m, ensuring compliance with MGN 654 (2021).
64. Four-legged jacket foundations on pin piles have been considered as the MDS for shipping and navigation as this foundation type provides the maximum structure dimension at the sea surface and are space frame structures with a steel lattice construction (i.e., comprising tubular steel members and welded joints), pinned to the seabed using piles at the corners of the base on each leg.
65. The MDS WTG measurements assuming use of four-legged jackets with pin pile foundations 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 design envelope overall.

Table 6.2 WTGs MDS for shipping and navigation

Parameter	MDS for shipping and navigation
Number	93
Foundation type	Four-legged jacket with pin piles

Parameter	MDS for shipping and navigation
Dimensions at sea surface	30x30m
Minimum blade tip height (above MHWS))	30m
Maximum rotor diameter	340m

66. As well as jackets with pin pile, the other foundation types under consideration include gravity based foundations, monopiles, and jackets with suction buckets. Descriptions of each foundation type under consideration are provided in Volume 1, Chapter 3: Project Description.

6.2.2 Offshore Substations and other auxiliary structures in Array Area

67. Up to four offshore transformer substations may be installed in the array area, with topside dimensions of 90x90m assuming the maximum number are constructed. A lower number (two) of larger platforms may also be used (topside dimensions of 110 by 160m). The substations may be installed on either four-legged jackets with pin pile, gravity based foundations, monopiles (High Voltage Alternating Current (HVAC only)), and four-legged jackets with suction buckets.

68. It is noted that the current envelope includes potential for use of an accommodation platform within the array area. This has not been assessed at PEIR stage but will be incorporated into the final NRA assuming it remains in the envelope.

6.2.3 ORCPs

69. Up to two ORCPs may be installed within the ORCP search area, within the Offshore ECC. The topside dimensions would be a maximum of 90x90m when constructed.

70. An overview of the ORCP search area within the Offshore ECC is illustrated in Figure 6.2.

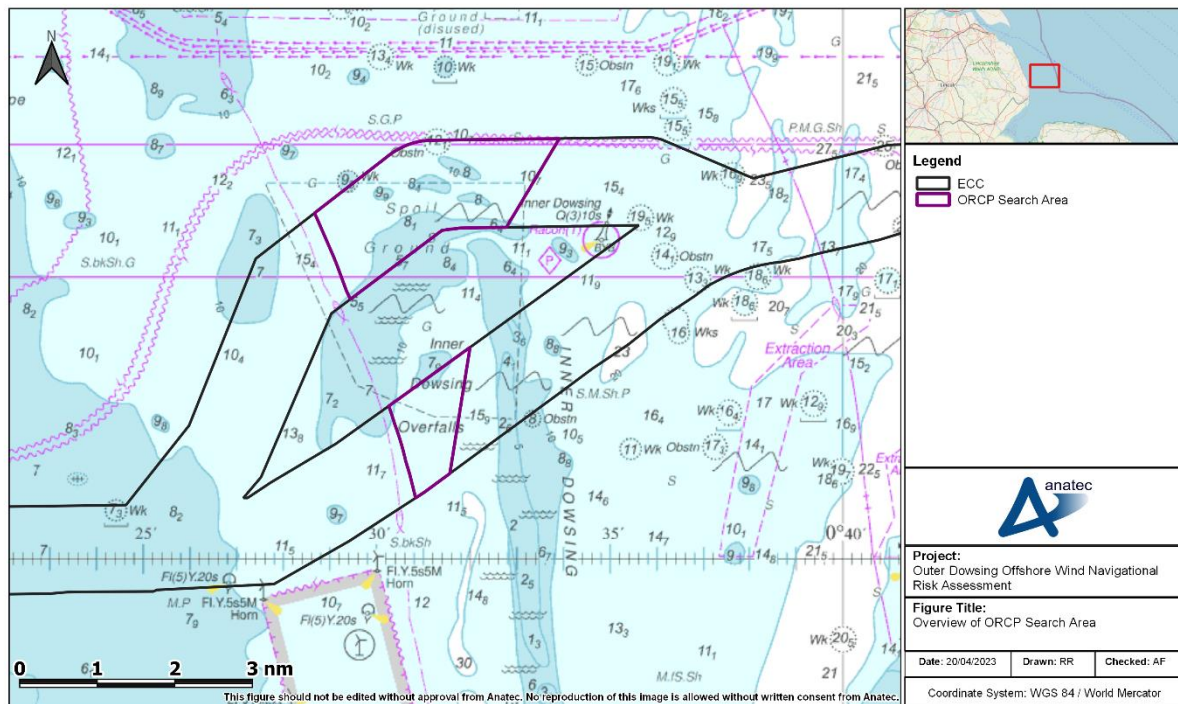


Figure 6.2 Overview of the ORCP Search Area within the Offshore ECC

6.3 Subsea Infrastructure

71. Three types of subsea cables will be installed: inter-array cables, interlink cables and offshore export cables. Each category of subsea cables is summarised in the following subsections.

6.3.1 Inter-Array Cables

72. The inter-array cables will connect individual WTGs to the substations. Up to 190nm (or 351km) of inter-array cables will be required with the final length dependent on the final array layout. All inter-array cables will be installed within the array area. The extent of burial and need for any external protection will be determined via a cable burial risk assessment process (see Section 6.3.4).

6.3.2 Interlink Cables

73. The interlink cables will provide interlink connections between the substations within the array area. A maximum of six interlink cables will be required with a total length of up to 67nm (or 124km). The final length will be dependent on the final array layout. The extent of burial and need for any external protection will be determined via a cable burial risk assessment process (see Section 6.3.4).

6.3.3 Export Cables

74. The export cables will carry the energy generated by the WTGs from the array area to shore. A maximum of four export cables will be required with a combined total length of up to 278nm (or 515km) which will be installed within the Offshore ECC. The export cables will make a proposed landfall south of Wolla Bank on the Lincolnshire coast. The extent of burial and need for any external protection will be determined via a cable burial risk assessment process (see Section 6.3.4).
75. An overview of the Offshore ECC and proposed export cable landfall is illustrated in Figure 6.3.

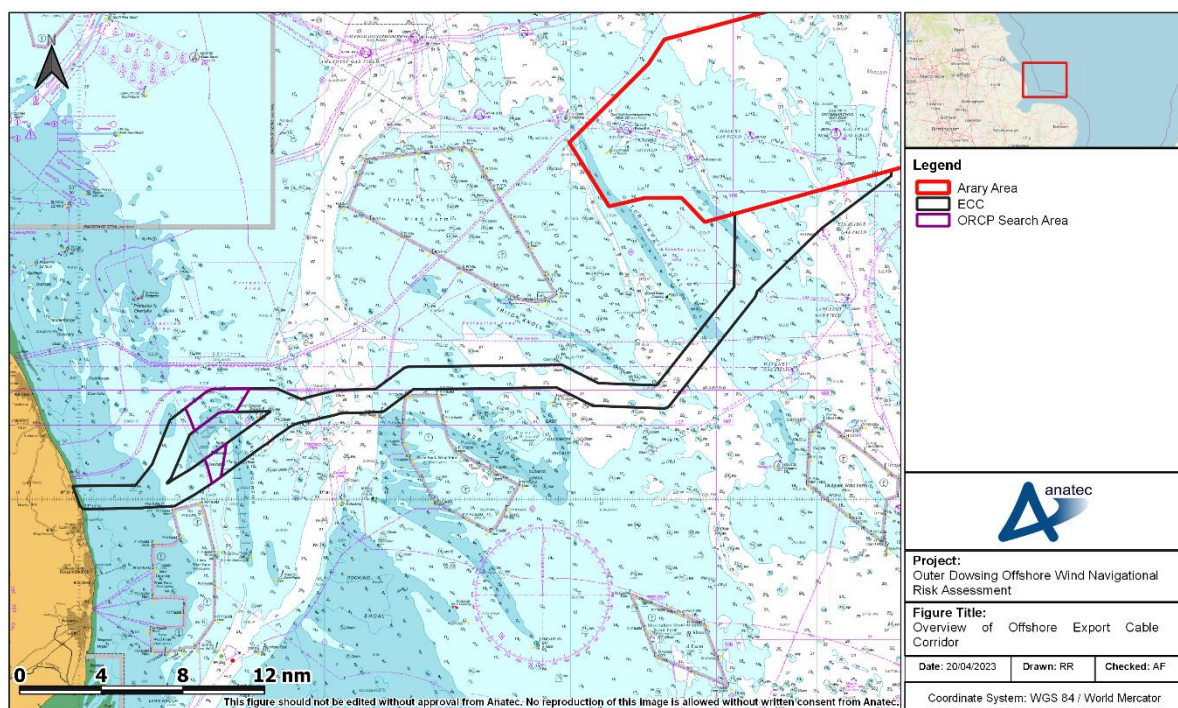


Figure 6.3 Overview of the Offshore Export Cable Corridor

6.3.4 Cable Burial and Protection

76. Where available, the primary means of cable protection will be by seabed burial. The extent and method by which the subsea cables will be buried will depend on the results of a detailed seabed survey of the final cable routes and associated cable burial risk assessment process, with an indicative maximum depth of 3m (when using vertical injection) anticipated. Where cable burial is not possible, alternative cable protection measures may be used all which will be determined within the cable burial risk assessment process. In addition, cable protection will be used where cables cross existing seabed assets, such as existing cables and pipelines. It is anticipated that there will be cable crossings associated with all cable types.

6.4 Vessel Numbers

6.4.1 Construction Phase

77. Up to 3,051 return trips by construction vessels may be made throughout the construction phase, breaking down as summarised in Table 6.3 (noting that numbers are indicative and assumed to be an MDS for shipping and navigation).

Table 6.3 Maximum vessel numbers per construction activity

Activity	Vessel Type	Number of Vessels	Round Trips
WTGs installation	Installation vessels (Jack-up Vessel (JUV) or anchored)	2	47
WTGs installation	Support vessels	18	1376
WTGs installation	Transport vessels	10	140
WTG foundations installation	Installation vessels (JUV and anchored)	3	40
WTG foundations installation	Support vessels	10	50
WTG foundations installation	Transport / feeder vessels (incl. tugs)	8	372
WTG foundations installation	Anchored transport / feeder vessels	8	372
Offshore platforms installation	Installation vessels	2	24
Offshore platforms installation	Support vessels	12	96
Offshore platforms installation	Transport vessels (tugs and barges)	4	48
Offshore platform foundations installation	Installation vessels	2	16
Offshore platform foundations installation	Support vessels	12	48
Offshore platform foundations installation	Transport vessels (tugs and barges)	4	32
Inter-array and offshore interlink cables installation	Main cable laying vessels	3	22
Inter-array and offshore interlink cables installation	Main cable jointing vessels	0	0

Activity	Vessel Type	Number of Vessels	Round Trips
Inter-array and offshore interlink cables installation	Main cable burial vessels	2	16
Inter-array and offshore interlink cables installation	Support vessels	2	44
Offshore export cables installation	Main cable laying vessels	3	20
Offshore export cables installation	Main cable jointing vessels	3	16
Offshore export cables installation	Main cable burial vessels	3	16
Offshore export cables installation	Support vessels	16	256
Total		127	3051

78. Up to 375 return trips by helicopters may be made throughout the construction phase, as summarised in Table 6.4.

Table 6.4 Maximum helicopter numbers per construction activity

Construction activity	Maximum number of return trips
WTG foundation installation	93
WTG installation	176
Offshore substation foundation installation	28
Offshore substation installation	40
Inter-array and interlink cable installation	22
Export cable installation	16
Total	375

6.4.2 Operation and Maintenance

79. An indicative 2,216 return trips per year is assumed to be a worst case for shipping and navigation over an anticipated maximum 35-year operational lifetime O&M phase.

6.4.3 Decommissioning Phase

80. The decommissioning sequence will generally be the reverse of the construction sequence and is likely to involve similar types and numbers of vessels.

6.5 Maximum Design Scenario

81. The MDS for each shipping and navigation hazard is provided in Table 6.5 and is based on the parameters described in the previous subsections.
82. Parameters related to the ORCP (Section 6.2.3) and any other relevant auxiliary structures (Section 6.2.2) will be added post PEIR.

Table 6.5 MDS by Hazard for Shipping and Navigation

Potential Hazard	MDS for Shipping and Navigation	Justification
Construction		
Displacement of vessels leading to increased collision risk between third-party vessels.	<ul style="list-style-type: none"> ▪ Maximum extent of buoyed construction area assuming full build out of array area; ▪ Up to 93 WTGs and six substations in the array area; ▪ Construction phase up to four years; and ▪ 500m safety zones around structures where active construction is ongoing, 50m safety zones otherwise. 	Largest area over maximum period will lead to maximum displacement.
Restriction of adverse weather routeing.	<ul style="list-style-type: none"> ▪ Maximum extent of buoyed construction area assuming full build out of array area; ▪ Up to 93 WTGs and six substations in the array area; ▪ Construction phase up to four years; and ▪ 500m safety zones around structures where active construction is ongoing, 50m safety zones otherwise. 	Largest area over maximum period will lead to maximum potential for restriction of adverse weather routeing options.
Increased vessel-to-vessel collision risk between a third-party vessel and project vessel;	<ul style="list-style-type: none"> ▪ Maximum extent of buoyed construction area assuming full build out of array area; ▪ Up to 93 WTGs and six substations in the array area; ▪ Up to 351km of array cables; ▪ Up to 124km of interlink cables; ▪ Up to 515km of export cables; ▪ Construction phase up to XXX years; and ▪ Up to 127 project vessels with a total of up to 3,051 return trips. 	Maximum number of construction vessels will lead to maximum third party collision risk.

Project A4700 Outer Dowsing Offshore Wind

Client GT R4 Limited

Title Outer Dowsing Offshore Wind Navigational Risk Assessment

Potential Hazard	MDS for Shipping and Navigation	Justification
Increased vessel to structure collision risk (powered, drifting, and internal navigation);	<ul style="list-style-type: none">Maximum extent of buoyed construction area assuming full build out of array area;Up to 93 WTGs and six substations in the array area;Construction phase up to four years; and500m safety zones around structures where active construction is ongoing, 50m safety zones otherwise.	Maximum number of structures will lead to maximum collision risk.
Reduction of emergency response provision including SAR capability.	<ul style="list-style-type: none">Maximum extent of buoyed construction area assuming full build out of array area;Up to 93 WTGs and six substations in the array area;Up to 351km of array cables;Up to 124km of interlink cables;Up to 515km of export cables;Construction phase up to four years; andUp to 127 project vessels with a total of up to 3,051 return trips.	Maximum number of construction vessels will lead to largest potential for increased incident rates.
Operations and Maintenance		
Displacement of vessels leading to increased collision risk between third-party vessels.	<ul style="list-style-type: none">Maximum extent (i.e., full build out) of array area;Up to 93 WTGs and six substations in the array area;Operational life up to 35 years; and500m safety zones around structures where major maintenance is ongoing.	Largest area over maximum period will lead to maximum displacement.
Restriction of adverse weather routing.	<ul style="list-style-type: none">Maximum extent (i.e., full build out) of array area;Up to 93 WTGs and six substations in the array area;Operational life up to 35 years; and500m safety zones around structures where major maintenance is ongoing.	Largest area over maximum period will lead to maximum potential for restriction of adverse weather routing options.

Project A4700 Outer Dowsing Offshore Wind

Client GT R4 Limited

Title Outer Dowsing Offshore Wind Navigational Risk Assessment

Potential Hazard	MDS for Shipping and Navigation	Justification
Increased vessel-to-vessel collision risk between a third-party vessel and project vessel;	<ul style="list-style-type: none">Maximum extent (i.e., full build out) of array area;Up to 93 WTGs and six substations in the array area;Up to 351km of array cables;Up to 124km of interlink cables;Up to 515km of export cables;Operational life up to 35 years; andUp to 2,216 return trips per year from project vessels.	Maximum number of project vessels will lead to maximum third party collision risk.
Increased vessel to structure collision risk (powered, drifting, and internal navigation);	<ul style="list-style-type: none">Maximum extent (i.e., full build out) of array area;Up to 93 WTGs and six substations in the array area;Operational life up to 35 years; and500m safety zones around structures where major maintenance is ongoing.	Maximum number of structures will lead to maximum collision risk.
Reduction of emergency response provision including SAR capability.	<ul style="list-style-type: none">Maximum extent (i.e., full build out) of array area;Up to 93 WTGs and six substations in the array area;Up to 351km of array cables;Up to 124km of interlink cables;Up to 515km of export cables;Operational life up to 35 years; andUp to 2,216 return trips per year from project vessels.	Maximum number of project vessels will lead to largest potential for increased incident rates.
Reduction of Under Keel Clearance	<ul style="list-style-type: none">Maximum extent (i.e., full build out) of array area;Up to 93 WTGs and six substations in the array area;Up to 351km of array cables;Up to 124km of interlink cables;Up to 515km of export cables;Maximum height of rock berm of 3m, up to 25% of export cable requiring external protection.	Maximum length of subsea cable and maximum extent of protection over longest period leading to maximum under keel interaction risk.

Project A4700 Outer Dowsing Offshore Wind

Client GT R4 Limited

Title Outer Dowsing Offshore Wind Navigational Risk Assessment

Potential Hazard	MDS for Shipping and Navigation	Justification
	<ul style="list-style-type: none">Operational life up to 35 years.	
Increased anchor/gear interaction with subsea cables	<ul style="list-style-type: none">Maximum extent (i.e., full build out) of array area;Up to 93 WTGs and six substations in the array area;Up to 351km of array cables;Up to 124km of interlink cables;Up to 515km of export cables;Maximum height of rock berm of 3m, up to 25% of export cable requiring external protection.Operational life up to 35 years.	Maximum length of subsea cable over longest period leading to maximum anchor/gear interaction risk.
Decommissioning		
Analogous to construction phase.		

7 Navigational Features

83. A plot of the navigational features within and in proximity to the Project site have been identified using the relevant UKHO Admiralty Sailing Directions (UKHO, 2021) and the UKHO Admiralty Charts (UKHO, 2022) as is presented in Figure 7.1. Each feature of relevance illustrated is discussed in the following subsections.

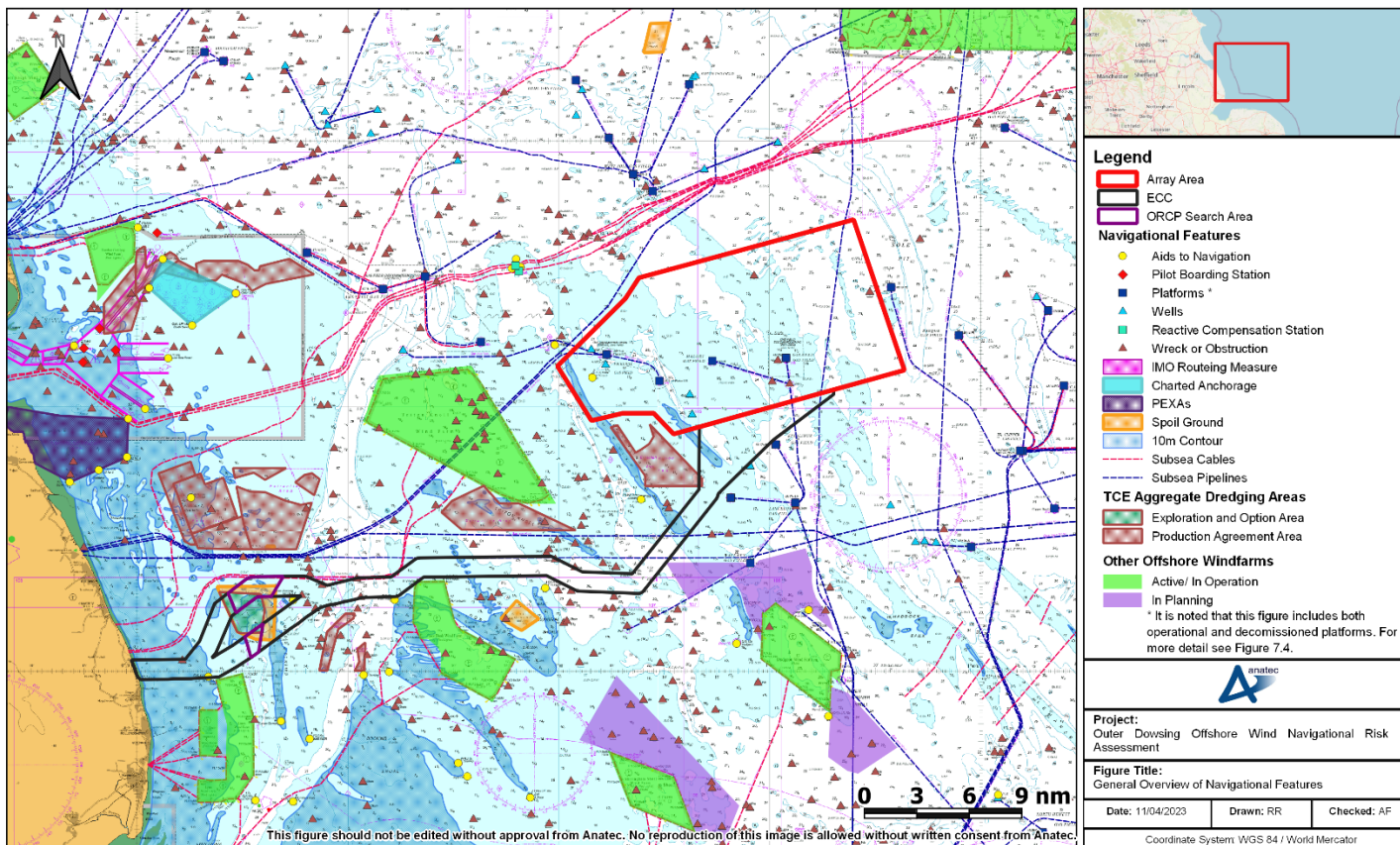


Figure 7.1 General Overview of Navigational Features Relevant to the Project

7.1 Other OWF Developments

84. Triton Knoll OWF is situated approximately 4nm to the west of the array area as illustrated in Figure 7.2. Triton Knoll was fully commissioned and operational in January 2022. Hornsea Project Two also intersects the shipping and navigation study area to the northeast and was fully commissioned and operational at the end of November 2022. As mentioned in Section 5.4.3, the construction buoyage was still present on the UKHO charts at the time of writing but has not been included in Figure 7.1 as it is known to have been removed.
85. The operational Lincs OWF is situated less than 1nm southwest of the ORCP search area and so immediately south of the Offshore ECC. Racebank OWF also intersects the Offshore ECC approximately 16nm offshore and is positioned approximately 7.4nm directly east of the ORCP search area.
86. Other operational windfarms in proximity to the Project include Hornsea Project One approximately 10.6nm to the northeast of the array area, Dudgeon OWF approximately 10.7nm south of the array area, and Race Bank approximately 12.3nm to the southwest (and intersecting the Offshore ECC)
87. Two RCSs are situated approximately 5nm to the northwest of the array area and are associated with the Hornsea projects.
88. It is noted that projects pre construction are not considered baseline and instead are captured within the cumulative assessment (see Section 14).

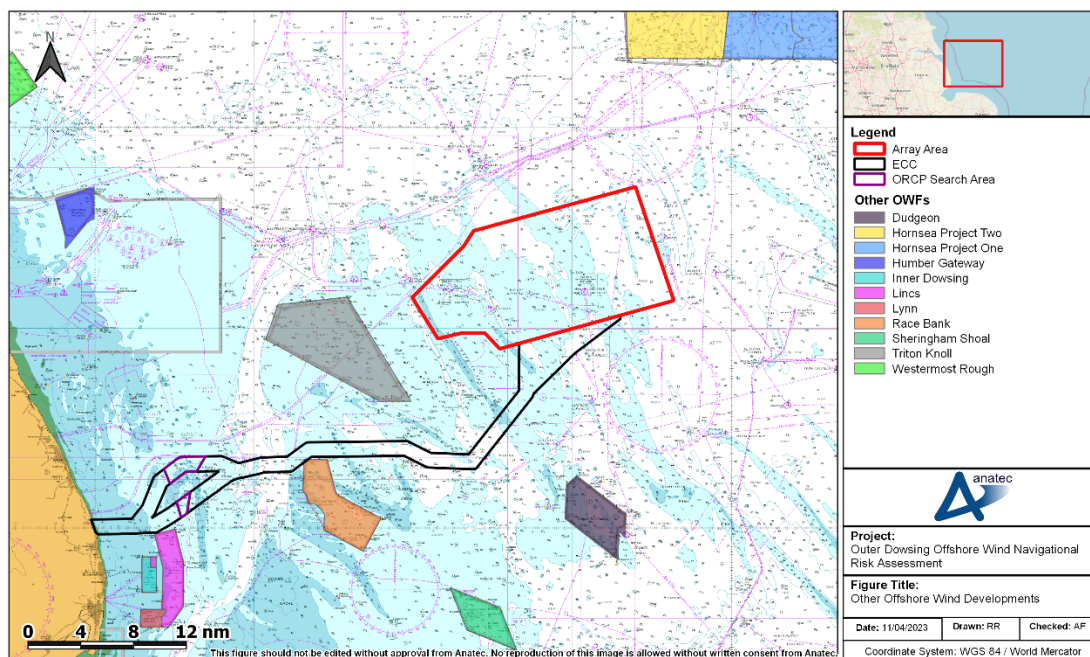


Figure 7.2 Other OWFs in proximity to the Project

7.2 Ports, Harbours, and Related Facilities

89. Several ports and harbours are located along the coast to the west of the Project as illustrated in Figure 7.3.

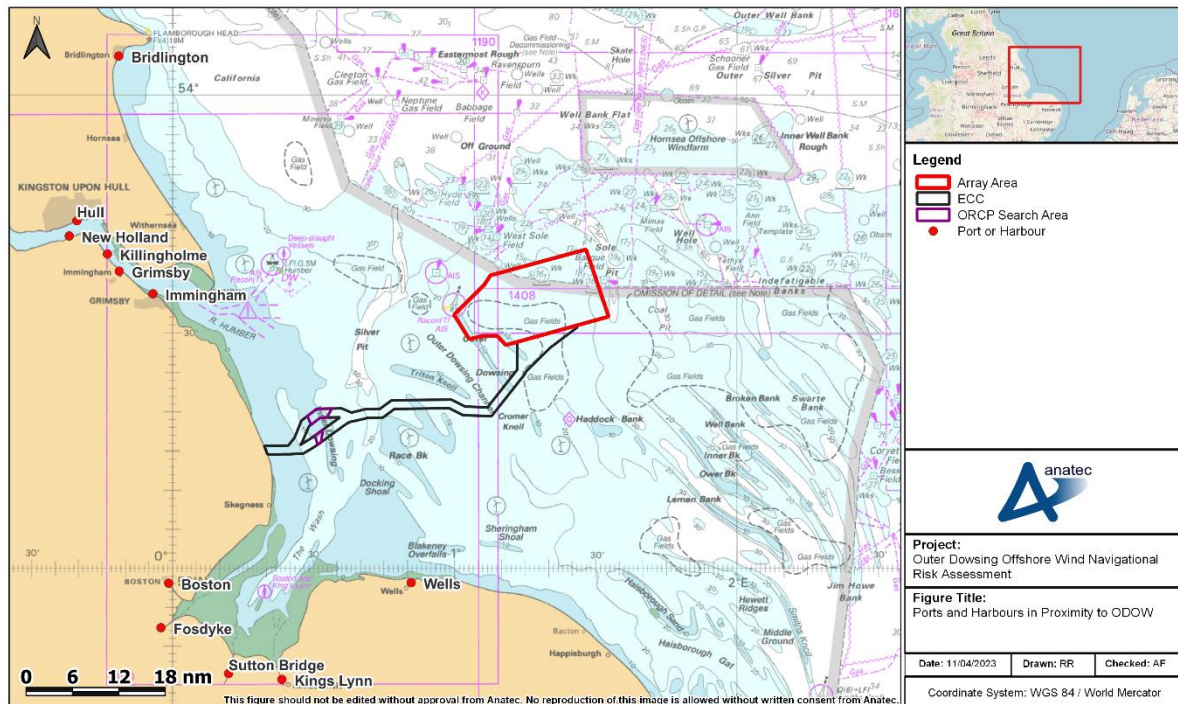


Figure 7.3 Ports and Harbours in Proximity to the Project

90. The closest port or harbour to the array area is Wells Harbour which is located approximately 32nm to the southwest on the Norfolk coast. The Admiralty Sailing Directions describe Wells as a “small port for fishing and recreational craft”. Port of Immingham (38nm northwest), Port of Grimsby (42nm northwest), Port of Killingholme (44nm northwest), Port of Boston (49nm southwest), and Bridlington Harbour (53nm northwest) are also situated within the vicinity as well as many others along the River Humber and within The Wash estuary.

91. The following subsections provide further details on the main ports and harbours in proximity to the Project. Namely commercial ports and harbours within the Humber estuary and within The Wash estuary.

7.2.1 Humber Ports

92. The Humber estuary is an extensive area for both industry and trade with commercial ports of significance including Immingham, Grimsby, Killingholme, Hull, and New Holland, with ports Goole and Flixborough further inland. The Humber estuary is known to be the largest port complex within the UK, handling 14% of all the country’s international trade (Humber Nature Partnership, 2022).

93. A Vessel Traffic Service (VTS) is in operation for the control of shipping within port limits. Participation in the VTS Humber scheme is compulsory for all vessel over 50GT and any vessels carrying dangerous substances. Pilotage in the area is compulsory for vessels of 60m and over in length and for all vessels carrying dangerous substances in bulk when proceeding to and from inner anchorages with the purpose of anchoring. Anchorage within the area is detailed in Section 7.4.

7.2.1.1 Port of Immingham

94. The Port of Immingham is classed as the UKs largest port in terms of tonnage with a handling of approximately 46 million tonnes of cargo each year and is the centre of the Humber side chemical and oil refining industries. The Immingham Oil Terminal will accept and handle vessels of lengths up to 336m and approximately 290,000 Deadweight Tonnage (DWT) partly laden. Between the other jetties and terminals at Immingham, there is collectively eight Roll-On/Roll-Off Cargo (Ro-Ro) berths, and as well as terminals specifically designed for the import and transport of coal, iron ore, and gas and being able to accommodate vessels up to 380,000 DWT.

7.2.1.2 Port of Grimsby

95. The Port of Grimsby is a leading UK port with both fishing and commercial properties and is a major car import terminal for the country importing more than 600,000 vehicles per year. The port specialises in short-sea trade to various locations in Europe and the Baltic while also assisting in O&M activities for the offshore wind industry. The two docks within the harbour will generally accept vessels up to a length of 145m, 20.5m beam, and 5.8m draught and have a combined total of 16 berths and four Ro-Ro berths.

7.2.2 The Wash Ports

96. The Wash estuary situated at the northwest corner of the Norfolk coast at the border of Norfolk and Lincolnshire provides a sheltered bay for many ports and harbours. Those of importance include the Port of Boston, Port of King's Lynn, Port of Sutton Bridge, Fosdyke Yacht Haven, and Wells Harbour.
97. Most of the ports and harbours in the area accommodate recreational craft and fishing vessels including Wells Harbour which is no longer in commercial use but has multiple pontoons in which is used by recreational craft and windfarm vessels in the area. Fosdyke Yacht Haven, previously serving as a commercial port for Boston, has now been converted into a private pleasure craft marina.
98. Commercial ports within the vicinity include Port of Boston and Port of King's Lynn.
99. The Port of Boston handles more than one million tonnes of cargo per year with a focus on importation of steel and timber. Exports of grain, fish, and recyclable material is also common at the port. Pilotage is compulsory at the Port of Boston for

vessels over 30m in length and all commercial vessels. The port offers seven berths and one Ro-Ro berth.

100. The Port of King's Lynn is a smaller commercial port importing steel, timber, fuel, and agricultural products and also exporting grain. Pilotage is compulsory for all vessels over 35m in length and any vessel over 100m in length must be considered by the harbour office regarding draught. All vessels entering the port must have sufficient under-keel clearance.

7.3 Marine Aggregate Dredging Areas

101. Several marine aggregate dredging areas defined by The Crown Estate (TCE) are present in proximity to the array area as seen in Figure 7.1. The extraction areas are Outer Dowsing areas 515/1 which lies approximately 6nm to the southwest of the array area, and 515/2 situated immediately southwest of the array area. Both sites are operated by Westminster Gravels Limited.
102. Intersecting both the north and south ORCP search area sites within the Offshore ECC is exploration and options area Inner Dowsing area 1805 operated by Hanson Aggregates Marine Ltd.
103. Other marine aggregate dredging areas are also located in close proximity to the ORCP search area and the Offshore ECC. Extraction area Van Oord Ltd area 481/1 is situated approximately 0.8nm south of the Offshore ECC and 3.6nm to the east of the ORCP search area. To the north, at approximately 1.5nm to both the ORCP search area and the Offshore ECC, is Humber Estuary extraction areas 400 and 106/3. Sharing boundaries with the Humber Estuary areas is Off Saltfleet area 197 to the north, and Humber Overfalls area 493 to the east.

7.4 Charted Anchorage Areas

104. There are no charted anchorage areas in proximity to the array area, ORCP search area, or the Offshore ECC.
105. The closest charted anchorage area to the Project is the Humber Deep Water Anchorage, north of the River Humber entrance, which is located approximately 15nm north of the ORCP search area and Offshore ECC and approximately 19nm northwest of the array area.

7.5 Aids to Navigation

106. Various Aids to Navigation (AtoNs) are located within proximity to the array area as illustrated in Figure 7.1.
107. Within the array area, there is an AtoN situated to the west between the Outer Dowsing Shoal and Pickerill gas field. Other AtoNs in proximity to the array area

include the three AtoNs at the RCS, associated with Hornsea Project Two, located 5nm to the northwest of the array area; the Northern Outer Dowsing Light Buoy, a north cardinal mark located approximately 1nm to the northwest of the array area above the Outer Dowsing Shoal; and the Mid Outer Dowsing Light Buoy, a lateral mark west of the Outer Dowsing Shoal approximately 4nm to the southwest of the array area.

108. AtoNs in proximity to the ORCP search area include the Inner Dowsing east cardinal mark light buoy which is located approximately 1nm east of the ORCP search area and is positioned on the northeast of the shallow inner dowsing shoal. This AtoN is also on the boundary of the Offshore ECC.
109. In addition to the Inner Dowsing AtoN, other AtoNs bordering the Offshore ECC include the West Ridge west cardinal mark light buoy, situated immediately south of the Offshore ECC to the west of Race Bank OWF; the East Dudgeon east cardinal mark light buoy 0.7nm south of the Offshore ECC on the east of the Dudgeon Shoal; and the Mid Outer Dowsing Light Buoy, a lateral mark west of the Outer Dowsing Shoal approximately 2nm north of the Offshore ECC. The Dudgeon light buoy to the west of Dudgeon OWF as well as the AtoNs to the east and south are also located south of the Offshore ECC.
110. It is noted that Trinity House stated within their Scoping Response (see Section 4.2.1) that any impacts on existing AtoN should be considered. This will be assessed in the final NRA based on the refined site design.

7.6 Subsea Cables

111. There are a number of subsea cables in proximity to the Project including the export cables for Hornsea Project One and Two which make landfall on the Yorkshire Coast. These cables pass through the Hornsea RCSs and pass at approximately 2.4nm north of the array area in an east-west direction. These are the closest subsea cables in proximity to the array area.
112. Export cables for the Triton Knoll OWF intersect the ORCP search area at the northern boundary for approximately 2nm.
113. As for the Offshore ECC, the Triton Knoll OWF export cables also intersect the northern boundary at two locations for a collective distance of approximately 6nm. These cables make landfall approximately 0.5nm north of the Offshore ECC landfall.

7.7 Oil and Gas Infrastructure

114. The oil and gas platforms and pipelines in proximity to the Project are presented in Figure 7.4, with a summary of details of relevance presented in Table 7.1.

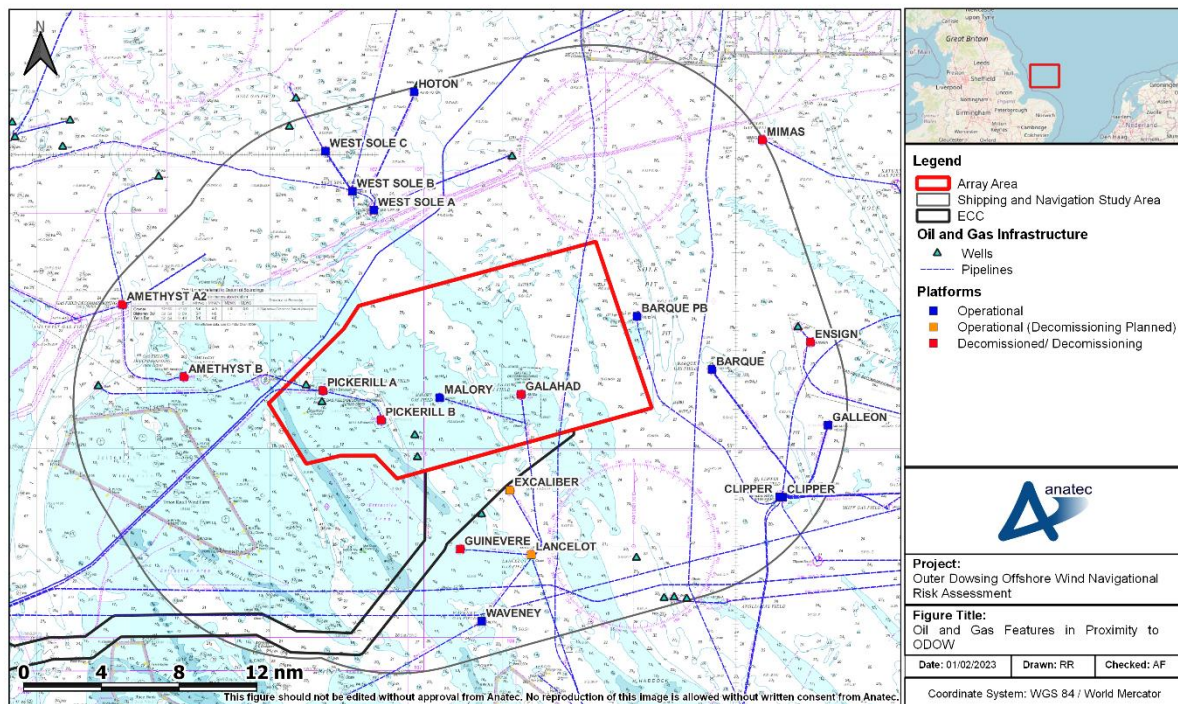


Figure 7.4 Oil and Gas Features in Proximity to the Project

115. A number of platforms and oil and gas fields are within the array area including the partially decommissioned Pickerill Gas Field and its two offshore platforms Pickerill A and B, the pending decommissioning Galahad gas field and its Galahad platform, and the operational Malory gas field and its Malory platform, equating to a total of four offshore platforms within the array area.
116. An additional 15 offshore platforms are within the surrounding shipping and navigation study area within gas fields Clipper, Barque, Audrey, Galleon, Waveney, Lancelot, Excalibur, Amethyst, West Sole, Hoton, and Mimas. The closest offshore platform out with the array area is the Barque PB platform, 0.7nm to the immediate east.
117. There are a total of six charted pipelines from offshore subsea assets to shore within proximity to the array area (including pipeline bundles), with pipelines between assets also present. It is noted that these include pipelines that are planned to be or undergoing decommissioning.
118. Two pipelines also intersect the Offshore ECC at multiple locations, both former gas pipeline which connected the now decommissioned Theddlethorpe gas terminal to the North Valiant and Viking gas fields. These pipelines have been flushed, cleaned, and filled with seawater and disconnected and so are now disused.
119. The cluster of disused pipelines connected to the decommissioned Theddlethorpe gas terminal are the closest pipelines to the ORCP search area at approximately 1nm

north. No pipelines, or any other oil and gas infrastructure intersect the ORCP search area.

120. A summary of details of the relevant oil and gas fields and their current status is provided in Table 7.1.

Table 7.1 Details of Oil and Gas Fields in Proximity to the Project

Name	Type	Distance from Array Area (nm)	Status
Galahad	Gas	0.0	Pending Decommissioning
Malory	Gas	0.0	Operational
Pickerill	Gas	0.0	Partially decommissioned – topsides removed
Barque	Gas	0.7	Operational
Excalibur	Gas	2.0	Operational (decommissioning planned)
Guinevere	Gas	4.3	Decommissioned – topsides and jackets removed
West Sole	Gas	4.5	Operational
Amethyst	Gas	4.5	Pending decommissioning
Lancelot	Gas	5.7	Operational (decommissioning planned)
Clipper	Gas	7.9	Operational
Waveney	Gas	8.1	Operational
Ensign	Gas	8.4	Pending decommissioning
Galleon	Gas	9.0	Operational
Hoton	Gas	9.7	Operational
Mimas	Gas	9.9	Decommissioned

7.8 Charted Wrecks or Obstructions

121. A total of 93 charted wrecks or obstructions are present within the shipping and navigation study area with a total of five of these being present within the array area. The shallowest wreck or obstruction within the array area is at a depth of 5m below CD located within the Outer Dowsing Shoal, approximately 4nm to the southwest of the array area.
122. There are eight charted wrecks within the Offshore ECC, the shallowest at a depth of 7m below CD approximately 3nm offshore.
123. No charted wrecks were recorded within the ORCP search area.

124. Non-charted wrecks (which are not considered a danger to safe navigation) are considered in Volume 1, Chapter 13: Marine and Intertidal Archaeology.

7.9 Spoil Grounds and Foul Areas

125. There are two areas of spoil ground in close proximity to the Offshore ECC. One area of spoil ground intersects both ORCP search area sites and subsequently the Offshore ECC approximately 6nm from the coast, this area is a historic disposal site which is not used for waste disposal (Centre for Environment, Fisheries and Aquaculture Science (Cefas), 2023). Another area, although disused, is present 1.4nm south of the Offshore ECC.

126. A spoil ground is also located 12nm north of the array area.

7.10 International Maritime Organisation Routeing Measures

127. There are no IMO routeing measures in the region. However, the Inner Approaches Traffic Separation Scheme (TSS) consisting of three outer TSSs from a northeast, east, and southeast direction leading into a single TSS into the Humber is located approximately 11nm north of the ORCP search area and Offshore ECC and 22nm to the west of the array area.

7.11 Military Practice and Exercise Areas

128. The Donna Nook firing practice area is located north of the Offshore ECC, approximately 10nm northwest of the ORCP search area, at the south of the Humber entrance. There are no restrictions placed on the right to transit a military PEXA at any time although mariners are advised to exercise caution. Exercises and firing only occur when the area is considered to be clear of all shipping.
129. There are no military practice and exercise areas (PEXAs) in proximity to the array area.

8 Emergency Response and Incident Overview

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

8.1 Search and Rescue Helicopters

131. In July 2022, the Bristow Group were awarded a new 10-year contract by the MCA (as an executive agency of the DfT) commencing in September 2024 to provide helicopter SAR operations in the UK. Bristow have been operating the service since April 2015.
132. There are currently ten base locations for the SAR helicopter service. The closest SAR helicopter base to the Project is located at Humberside Airport, approximately 40nm west of the closest point of the array area, as illustrated in Figure 8.1. This base operates two Sikorsky S-92 helicopters and was purpose built when the Bristow Group took over SAR operations in the UK and *“provides vital life-saving support to the fishing and other marine industries and the offshore energy sector, as well as to land-based incidents including missing persons and other medical emergencies”* (Bristow Group, 2017). The base is most likely to respond to any incident requiring SAR helicopter services based upon the SAR helicopter data for the region.
133. 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 2022. The SAR helicopter taskings undertaken between April 2015 and March 2022 in proximity to the Project are presented in the subsections below.

8.1.1 Array Area

134. The SAR helicopter tasking recorded within the shipping and navigation study area, surrounding the array area, over the 8-year period (2015-2022) are presented in Figure 5.1, colour-coded by tasking type.

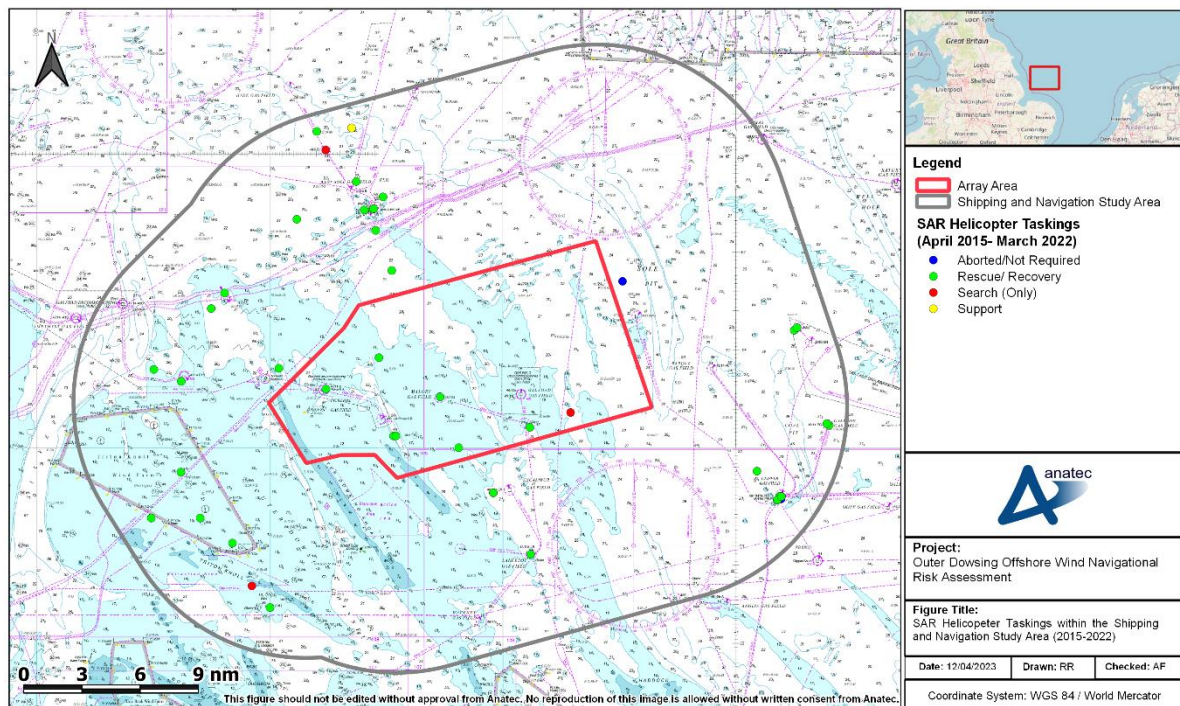


Figure 8.1 SAR Helicopter Taskings Within the Shipping and Navigation Study Area (2015 to 2022)

135. A total of 50 unique SAR helicopter taskings were undertaken for incidents within the shipping and navigation study area between April 2015 and March 2022, corresponding to an average of six taskings per year. The majority of these taskings were “rescue/recovery” (88%). Nine SAR helicopter taskings were undertaken within the array area itself with eight being “rescue/recovery” and one “search”.
136. A number of these SAR helicopter taskings were attending oil and gas platforms within the area. Such platforms with more than one incident recorded were from gas fields Clipper, West Sole, Pickerill, and Galleon.

8.1.2 Offshore Export Cable Corridor

137. The SAR helicopter tasking recorded within the ECC study area over the 8-year period (2015-2022) are presented in Figure 8.2, colour-coded by tasking type.

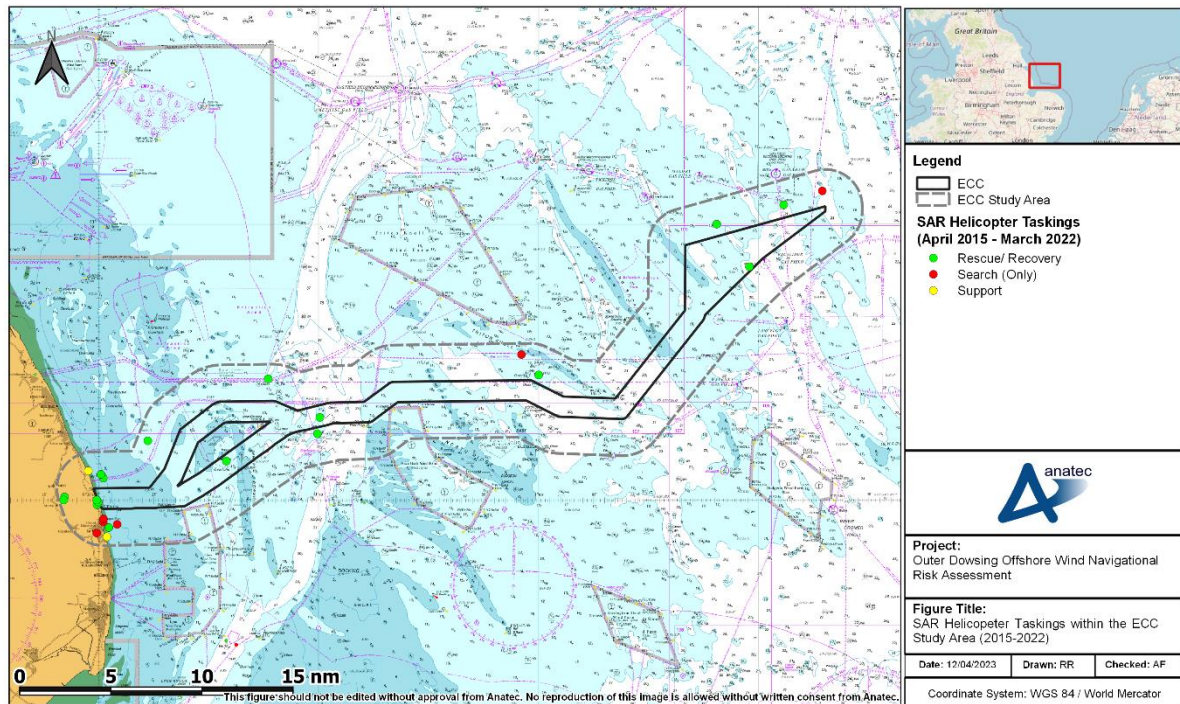


Figure 8.2 SAR Helicopter Bases and Taskings Within the ECC Study Area (2015 to 2022)

138. A total of 26 unique SAR helicopter taskings were undertaken for incidents within the ECC study area between April 2015 and March 2022, corresponding to an average of three taskings per year. The majority of these taskings were “rescue/recovery” (69%). Two SAR helicopter taskings were undertaken within the Offshore ECC itself, with both being “rescue/recovery”.

8.1.3 Offshore Reactive Compensation Platform Search Area

139. The SAR helicopter tasking recorded within the ORCP search area study area over the 8-year period are presented in Figure 8.3, colour-coded by tasking type.

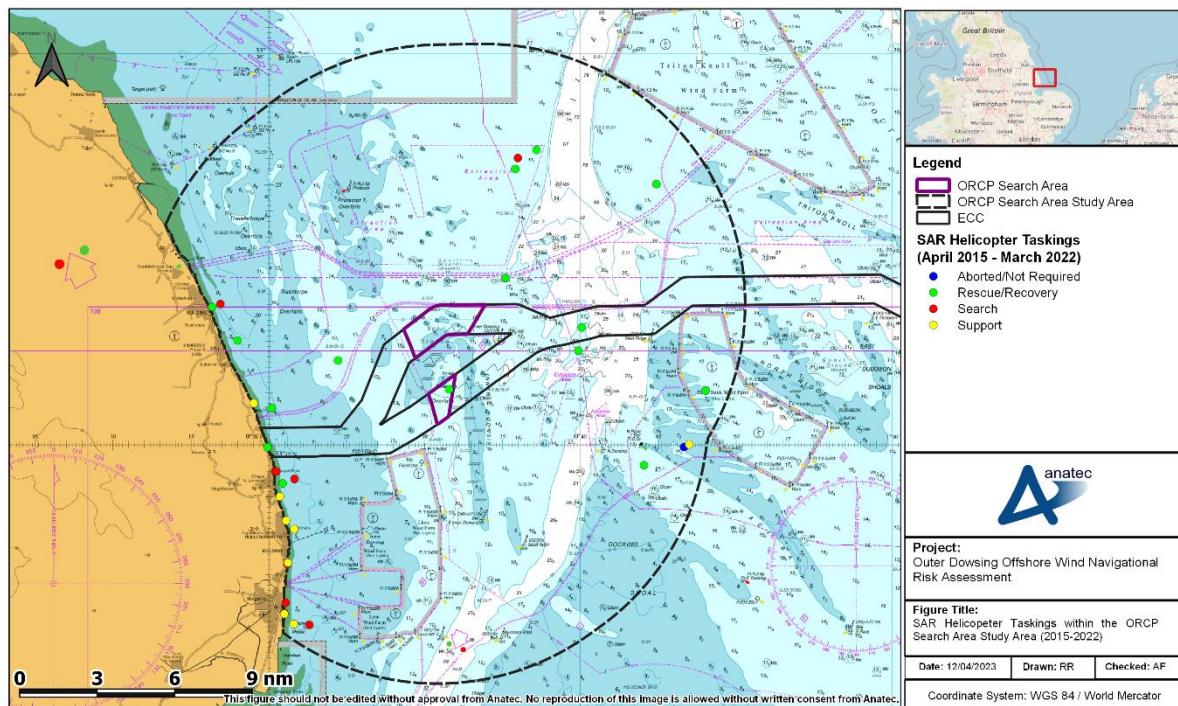


Figure 8.3 SAR Helicopter Bases and Taskings Within the ORCP Search Area Study Area (2015 to 2022)

140. A total of 34 unique SAR helicopter taskings were undertaken for incidents within the ORCP search area study area between April 2015 and March 2022, corresponding to an average of four taskings per year. The majority of these taskings were “rescue/recovery” (47%) and “search” (26%). One SAR helicopter taskings were undertaken within the ORCP search area itself, a “rescue/recovery”.
141. The majority of these taskings within the ORCP search area study area were coastal with 62% of taskings occurring within 1nm of the coastline.

8.2 Royal National Lifeboat Institution

142. The RNLI is organised into six divisions, with the relevant region for the Project being the 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). RNLI lifeboats are available on a 24-hour basis throughout the year. Given that the RNLI have an operational limit of 100nm, it is anticipated that an incident occurring in proximity to the Project may result in a response from an RNLI asset.
143. RNLI stations in proximity to the Project are illustrated in Figure 8.4.

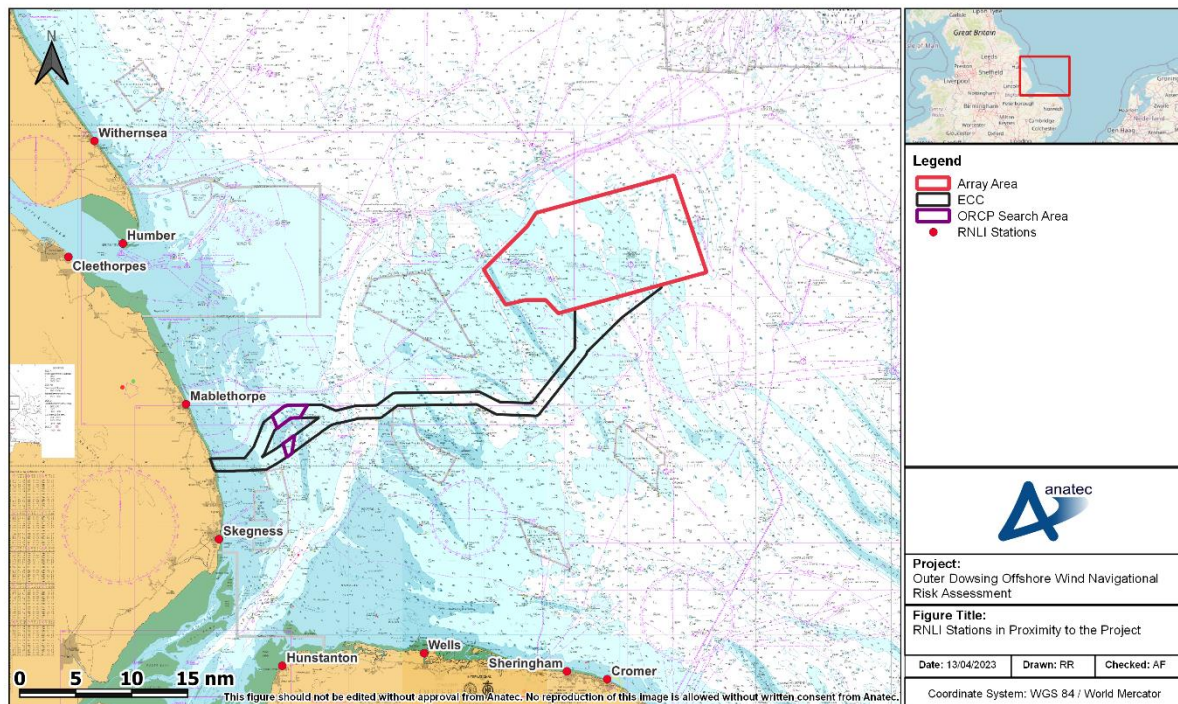


Figure 8.4 RNLi Stations in Proximity to the Project

- 144. RNLi stations Mablethorpe and Skegness are located approximately 5nm north and 6nm south of the Offshore ECC, respectively. Mablethorpe RNLi station is also the closest to the array area at approximately 29nm.
- 145. RNLi incident data from 2010-2019 has been reviewed and is presented in in the following subsections. It is noted that hoaxes and false alarms have been excluded from the analysis.

8.2.1 Array Area

- 146. RNLi incidents recorded within the shipping and navigation study area, surrounding the array area, over the 10-year period are presented in Figure 8.5, colour-coded by incident type. Following this, the same data is presented, colour-coded by casualty type, in Figure 8.6.

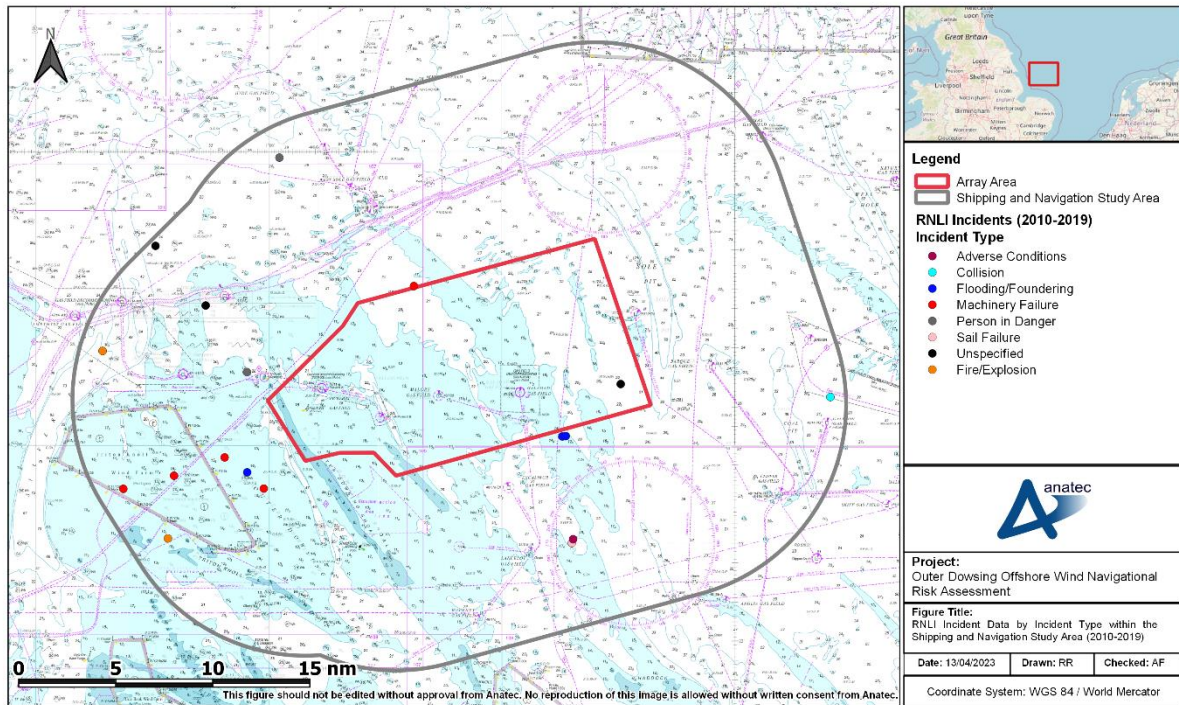


Figure 8.5 RNLi Incidents by Incident Type within the Shipping and Navigation Study Area (2010 to 2019)

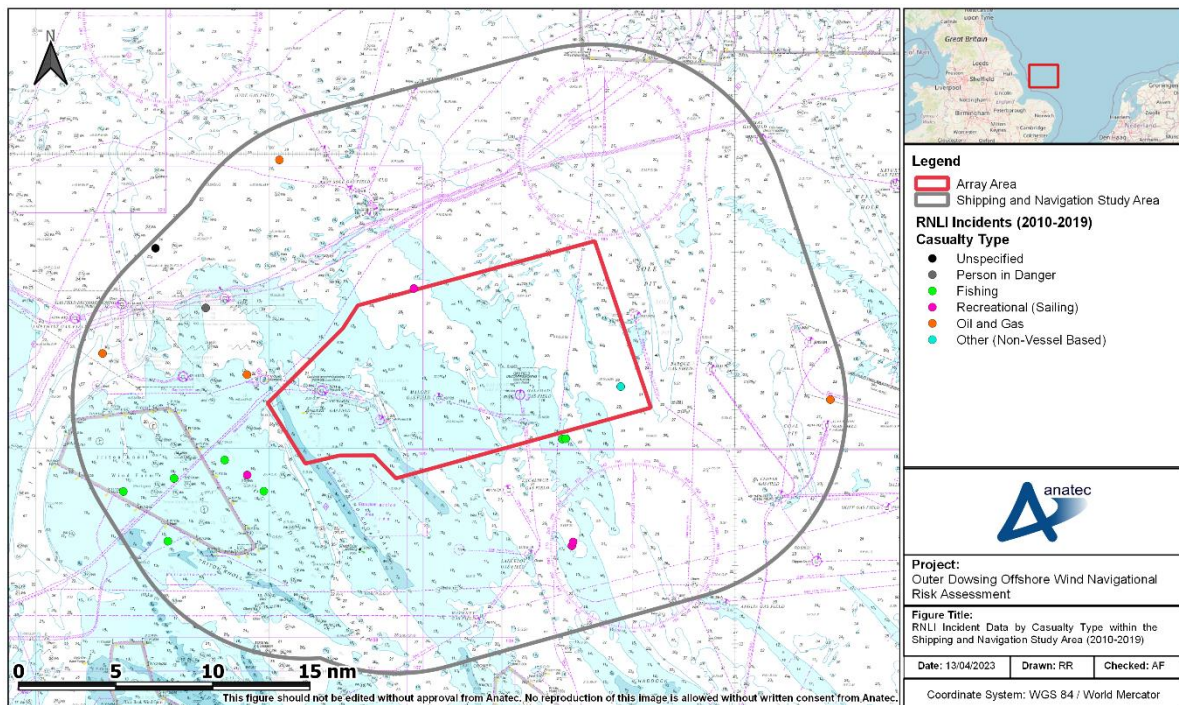


Figure 8.6 RNLi Incidents by Casualty Type within the Shipping and Navigation Study Area (2010 to 2019)

147. A total of 18 unique incidents were responded to by the RNLI within the shipping and navigation study area between 2010 and 2019, corresponding to an average of two incidents per year. Throughout the 10-year period, one incident occurred within the array area itself.
148. Of all the unique incidents recorded within the shipping and navigation study area, the most frequently recorded incident types were “*Machinery Failure*” (28%), “*Flooding/Foundering*” (17%), and “*Unspecified*” (17%). The most common casualty types were “*Fishing Vessels*” (39%), *Oil and Gas Rig/Support* (22%), and “*Recreational Vessels*” (22%).
149. The most common RNLI base stations recorded for lifeboat launches for incidents in the shipping and navigation study area were Humber (83%) and Cromer (17%).

8.2.2 Offshore Export Cable Corridor

150. RNLI incidents recorded within the ECC study area over the 10-year period are presented in Figure 8.7, colour-coded by incident type. Following this, the same data is presented, colour-coded by casualty type, in Figure 8.8.

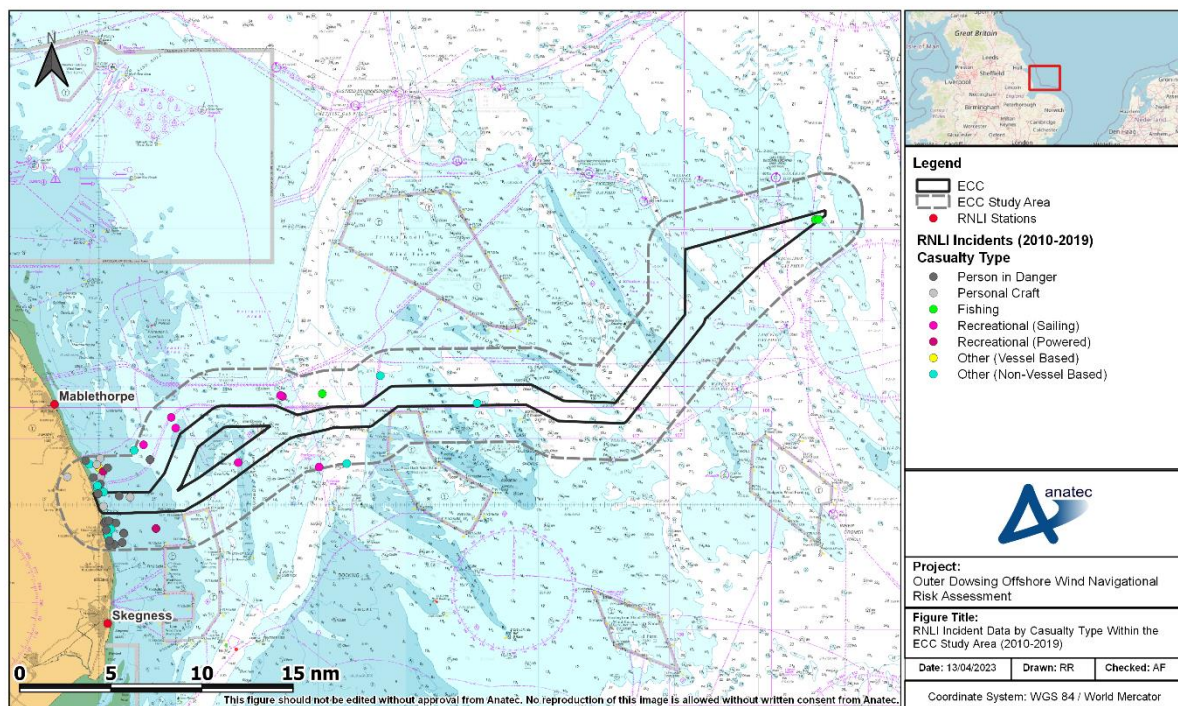


Figure 8.7 RNLI Incidents by Incident Type within the ECC Study Area (2010 to 2019)

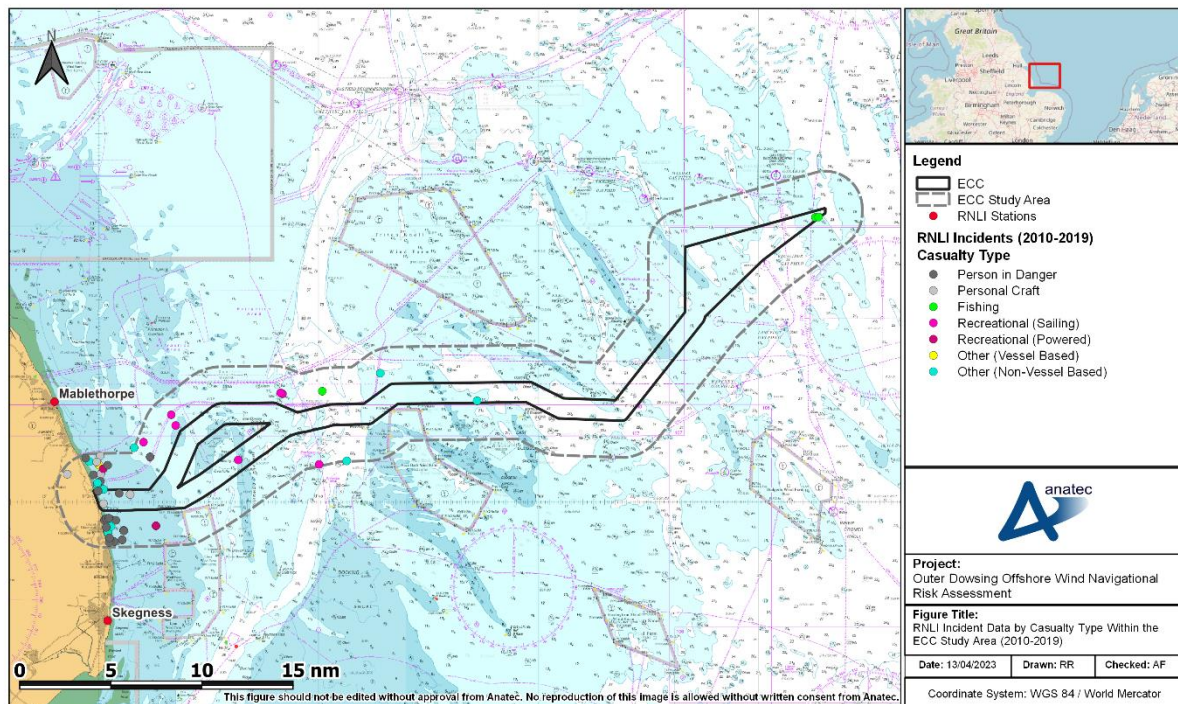


Figure 8.8 RNLi Incidents by Casualty Type Within the ECC Study Area (2010 to 2019)

151. A total of 64 unique incidents were responded to by the RNLi within the ECC study area between 2010 and 2019, corresponding to an average of six to seven incidents per year. Throughout the 10-year period, ten incidents occurred within the Offshore ECC itself. It is noted that of all the incidents recorded within the ECC study area, 82% occurred within 5nm of the coastline.
152. Of all the unique incidents recorded within the ECC study area, the most frequently recorded incident types were “*Person in Danger*” (31%), “*Unspecified*” (22%), and “*Vessel in Trouble*” (16%). The most common casualty types were “*Person in Danger*” (41%) and “*Other (Non-Vessel Based)*” (23%).
153. The most common RNLi base stations recorded for lifeboat launches for incidents in the ECC study area were Skegness (56%) and Mablethorpe (37%).

8.2.3 Offshore Reactive Compensation Platform Search Area

154. RNLi incidents recorded within the ORCP search area study area over the 10-year period are presented in Figure 8.9, colour-coded by incident type. Following this, the same data is presented, colour-coded by casualty type, in Figure 8.10.

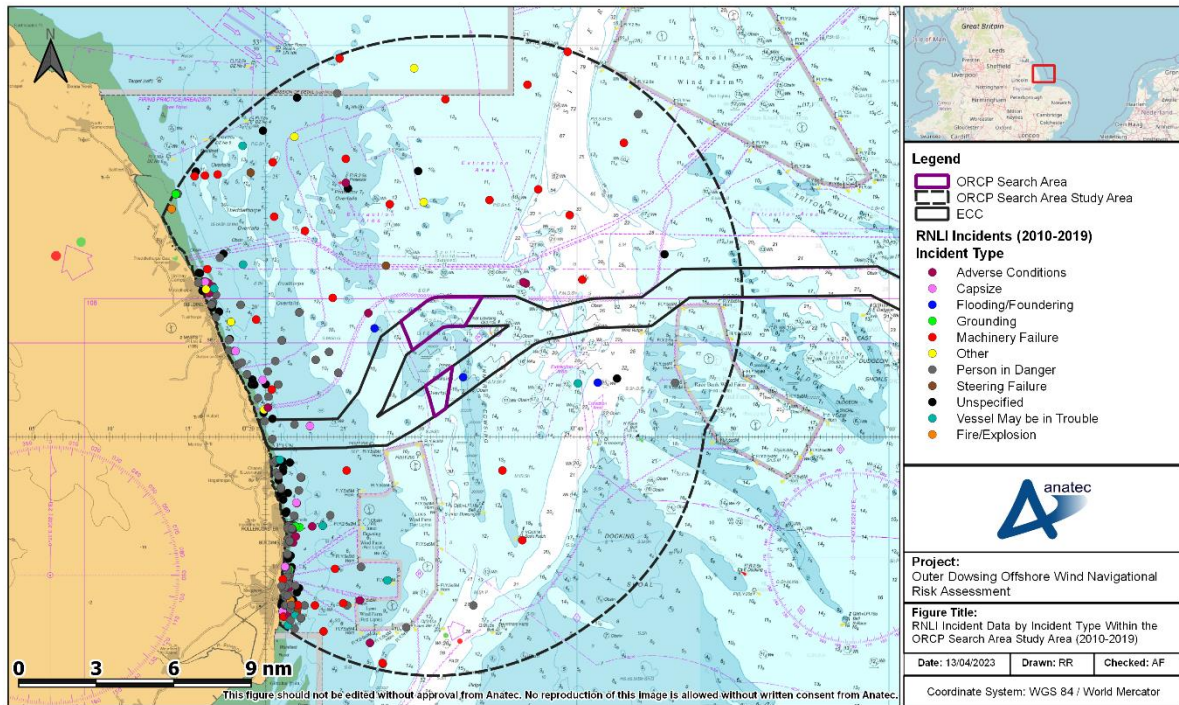


Figure 8.9 RNLI Incidents by Incident Type within the ORCP Search Area Study Area (2010 to 2019)

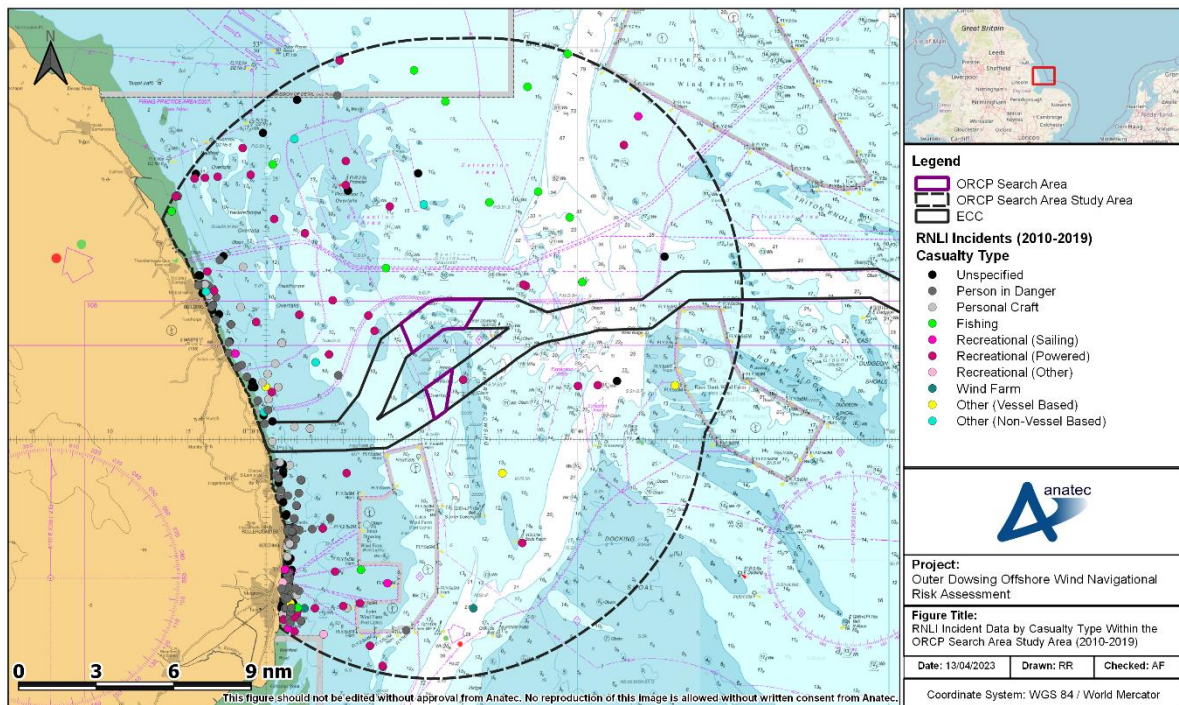


Figure 8.10 RNLI Incidents by Casualty Type within the ORCP Search Area Study Area (2010 to 2019)

155. A total of 363 unique incidents were responded to by the RNLI within the ORCP search area study area between 2010 and 2019, corresponding to an average of 36 incidents per year. Throughout the 10-year period, no incidents occurred within the ORCP search area itself. It is noted that of all the incidents recorded within the ORCP search area study area, 91% occurred within 5nm of the coastline.
156. Of all the unique incidents recorded within the ORCP search area study area, the most frequently recorded incident types were “Person in Danger” (47%), “Unspecified” (20%), and “Machinery Failure” (11%). The most common casualty types were “Person in Danger” (46%), “Unspecified (18%), “Recreational (Powered)” (16%), and “Personal Craft” (10%).
157. The most common RNLI base stations recorded for lifeboat launches for incidents in the ORCP search area study area were Skegness (66%) and Mablethorpe (26%)

8.3 Maritime Rescue Coordination Centres and Joint Rescue Coordination Centres

158. 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).
159. 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. A corps of over 3,500 volunteer Coastguard Rescue Officers (CRO) around the UK from 352 local Coastguard Rescue Teams (CRT) are involved in coastal rescue, searches and surveillance.
160. All of the MCA’s operations, including SAR, are divided into 18 geographical regions. Area 6 – “*East Anglia*” – covers the south of the North Yorkshire and entire East Yorkshire and Lincolnshire coast of England, and therefore covers the area encompassing the Project. The Humber MRCC is located within Area 6 approximately 44nm northwest of the closest point of the array area boundary and coordinates the SAR response for maritime and coastal emergencies within the district boundary.

8.4 Global Maritime Distress and Safety System

161. The Global Maritime Distress and Safety System (GMDSS) is a maritime communications system used for emergency and distress messages, vessel to vessel routing 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.

162. There are four GMDSS sea areas, and in the UK, it is the responsibility of the MCA to ensure Very High Frequency (VHF) coverage from coastal stations within sea area A1. The Project is located close to the extent of the A1 Sea Area, as shown in Figure 8.11.

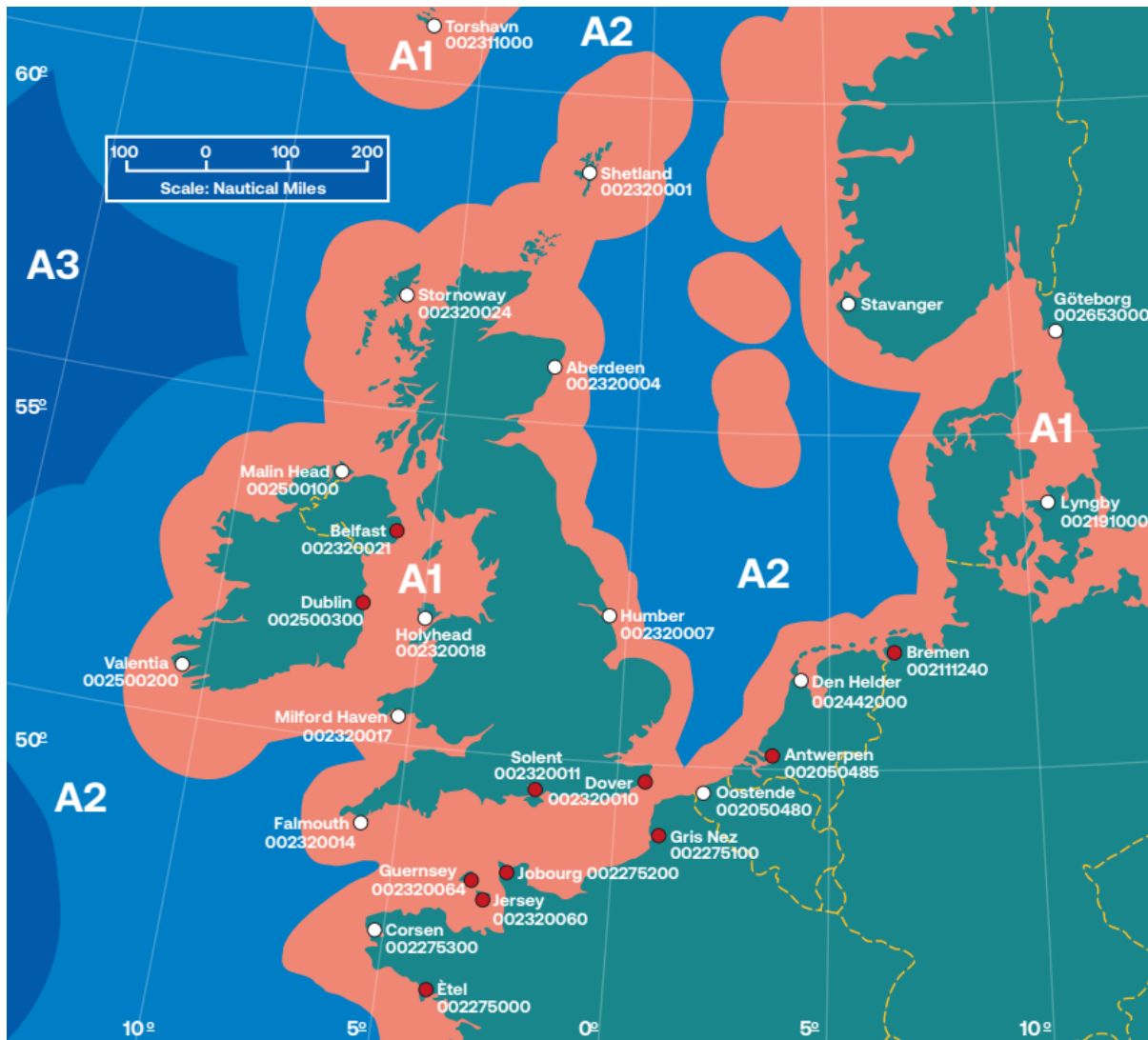


Figure 8.11 GMDSS Sea Areas (MCA, 2021)

8.5 Marine Accident Investigation Branch

163. All UK flagged vessels and non-UK flagged vessels in UK territorial waters (12nm), a UK port or carrying passengers to a UK port are required to report incidents to the MAIB. Between 1,000, and 1,300 incidents have generally been reported to the MAIB annually in recent years. The most recent ten-years of data (2010-2019) has formed the primary assessment tool, with additional validation then undertaken based on the 2000 to 2009 data.

8.5.1 Array Area

164. The locations of accidents, injuries, and hazardous incidents reported to MAIB within the shipping and navigation study area between 2010 and 2019 are presented in Figure 8.12, colour-coded by incident type. Following this, Figure 8.13 shows the same data colour-coded by the type of vessels involved in each incident.

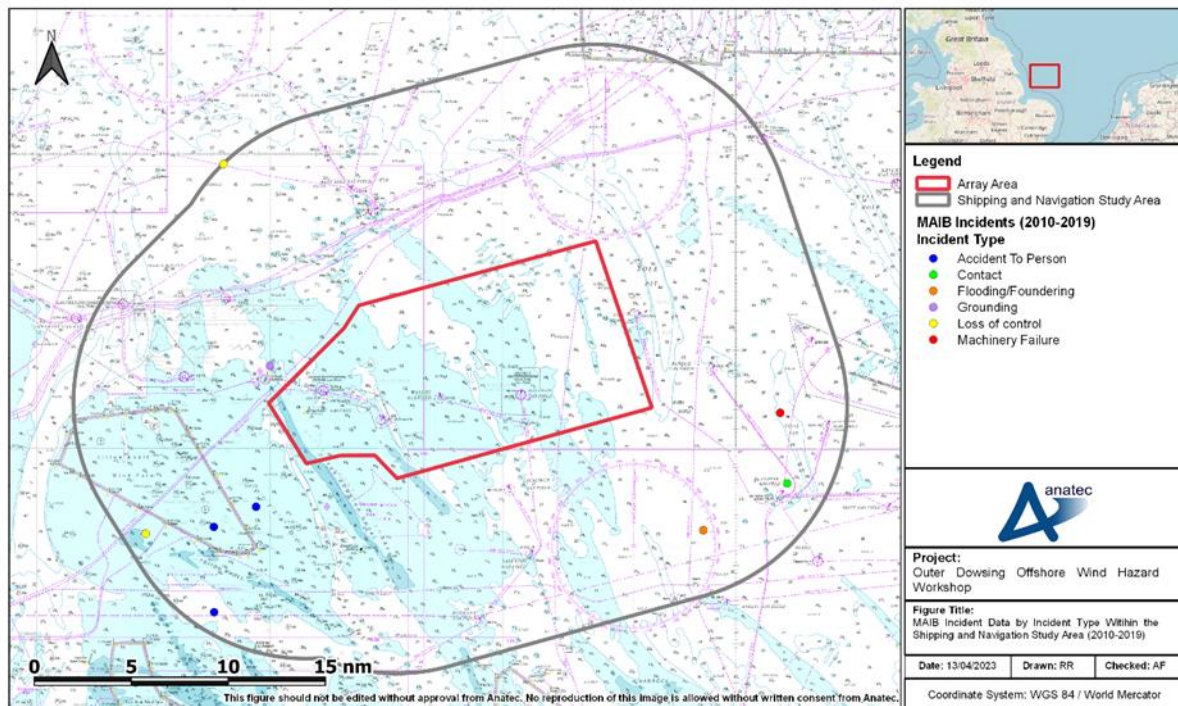


Figure 8.12 MAIB Incidents by Incident Type Within the Shipping and Navigation Study Area (2010-2019)

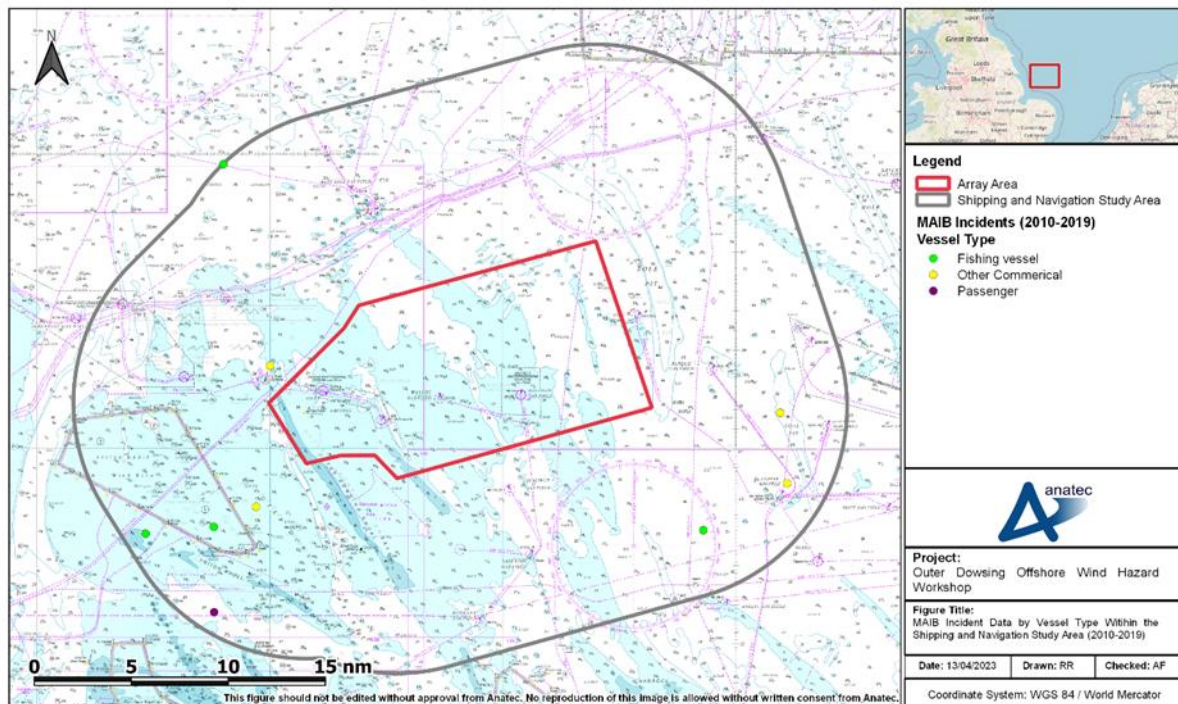


Figure 8.13 MAIB Incidents by Vessel Type Within the Shipping and Navigation Study Area (2010-2019)

165. A total of 13 unique incidents were reported to the MAIB within the shipping and navigation study area between 2010 and 2019, which corresponds to an average of one incident per year. Throughout the 10-year period, no incidents were reported within the array area itself. The closest incident to the array area was a “Grounding” 1nm to the northwest, by a commercial workboat in 2013.
166. The most common incident types recorded within the shipping and navigation study area were “Accident to Person” (31%) and “Flooding/Floundering” (23%), and the most frequently recorded vessel type involved in these incidents were other commercial (62%) and fishing vessels (31%) with one passenger vessel incident recorded.

8.5.2 Offshore Export Cable Corridor

167. The locations of accidents, injuries, and hazardous incidents reported to MAIB within the ECC study area between 2010 and 2019 are presented in Figure 8.14, colour-coded by incident type. Following this, Figure 8.15 shows the same data colour-coded by the type of vessels involved in each incident.

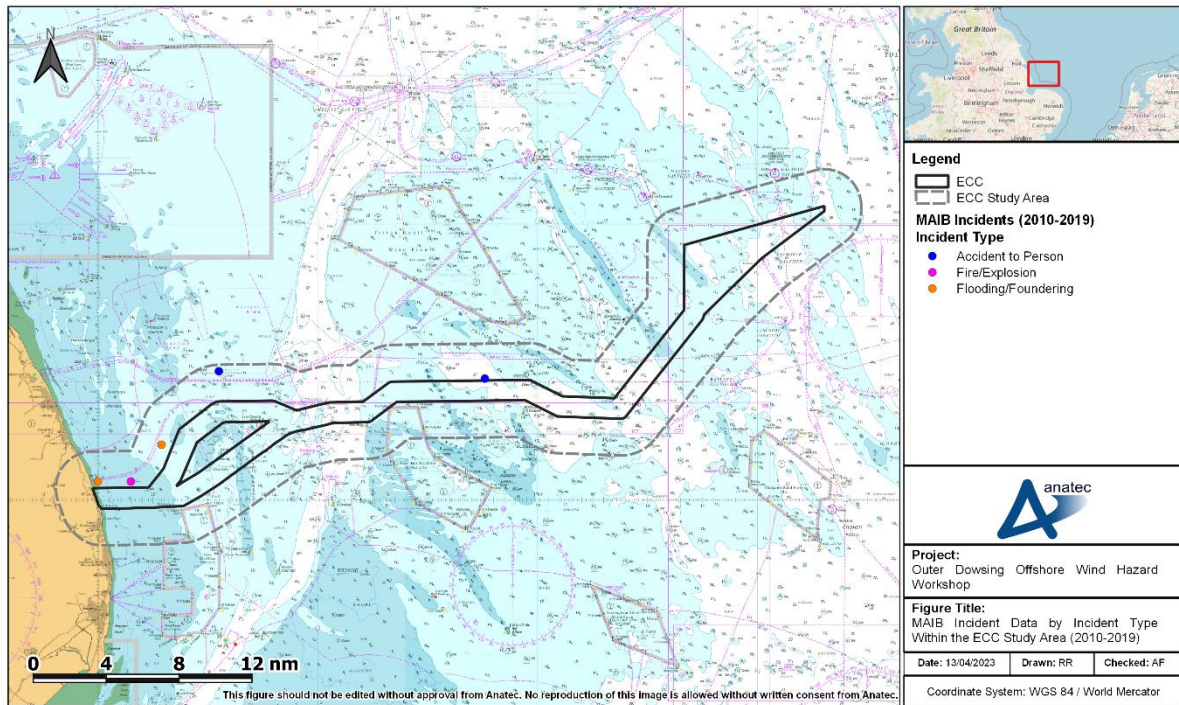


Figure 8.14 MAIB Incidents by Incident Type Within the ECC Study Area (2010-2019)

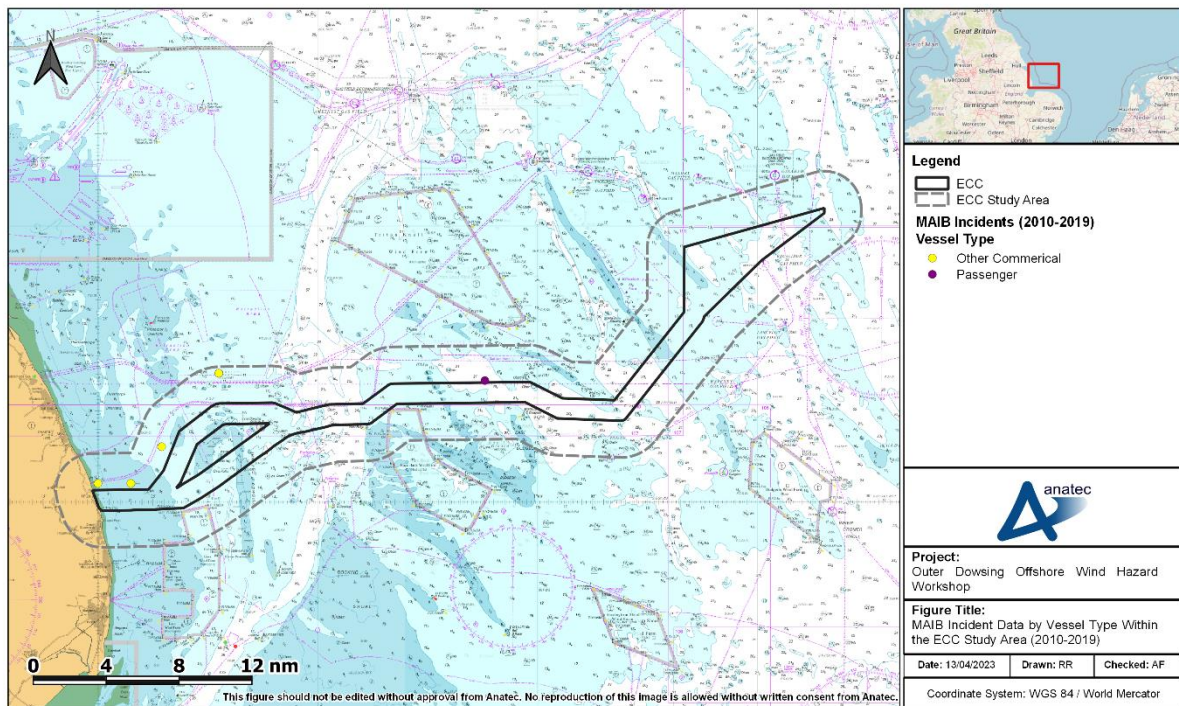


Figure 8.15 MAIB Incidents by Vessel Type Within the ECC Study Area (2010-2019)

168. A total of five unique incidents were reported to the MAIB within the ECC study area between 2010 and 2019, which corresponds to an average of one incident every two-

years. Throughout the 10-year period, no incidents were reported within the Offshore ECC itself, the closest being an “Accident to Person” 0.1nm to the north of the Offshore ECC relating to a passenger vessel in 2010.

169. The most common incident types recorded were “Accident to Person” (40%) and “Flooding/Floundering” (40%) with one “Fire/Explosion” incident record. The most frequently recorded vessel type involved in these incidents were other commercial (80%) with one passenger vessel incident recorded.

8.5.3 Offshore Reactive Compensation Station

170. The locations of accidents, injuries, and hazardous incidents reported to MAIB within the ORCP search area study area between 2010 and 2019 are presented in Figure 8.16, colour-coded by incident type. Following this, Figure 8.17 shows the same data colour-coded by the type of vessels involved in each incident.

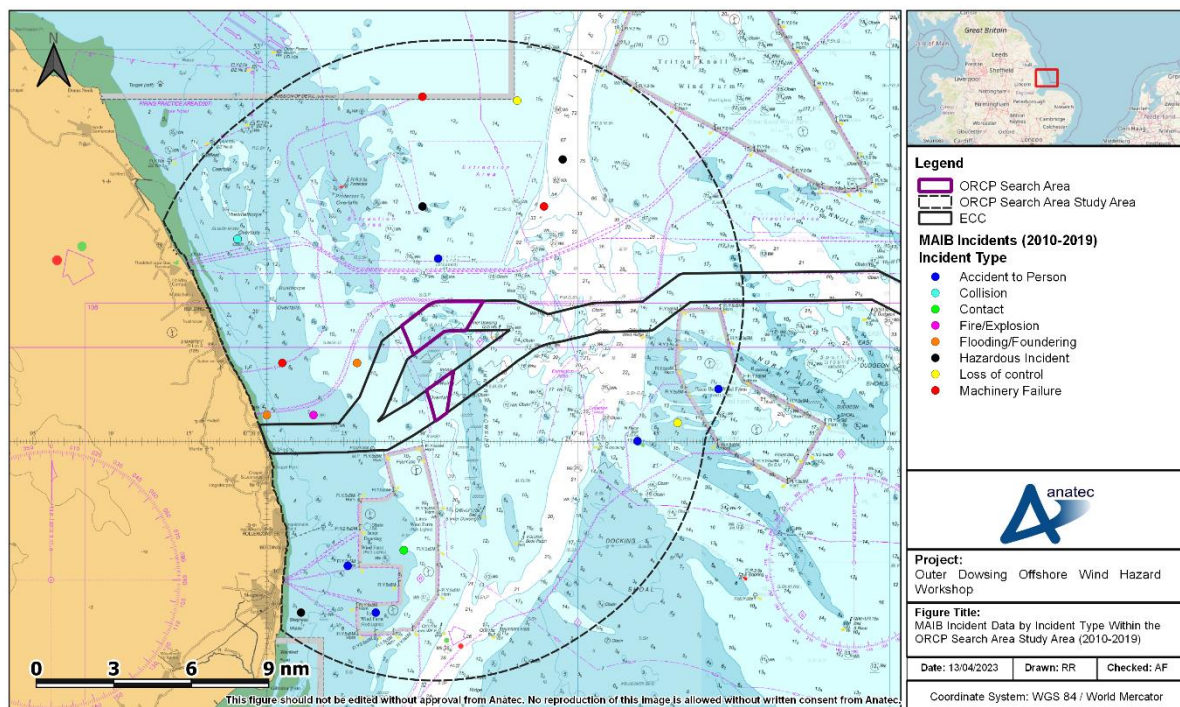


Figure 8.16 MAIB Incidents by Incident Type Within the ORCP Search Area Study Area (2010-2019)

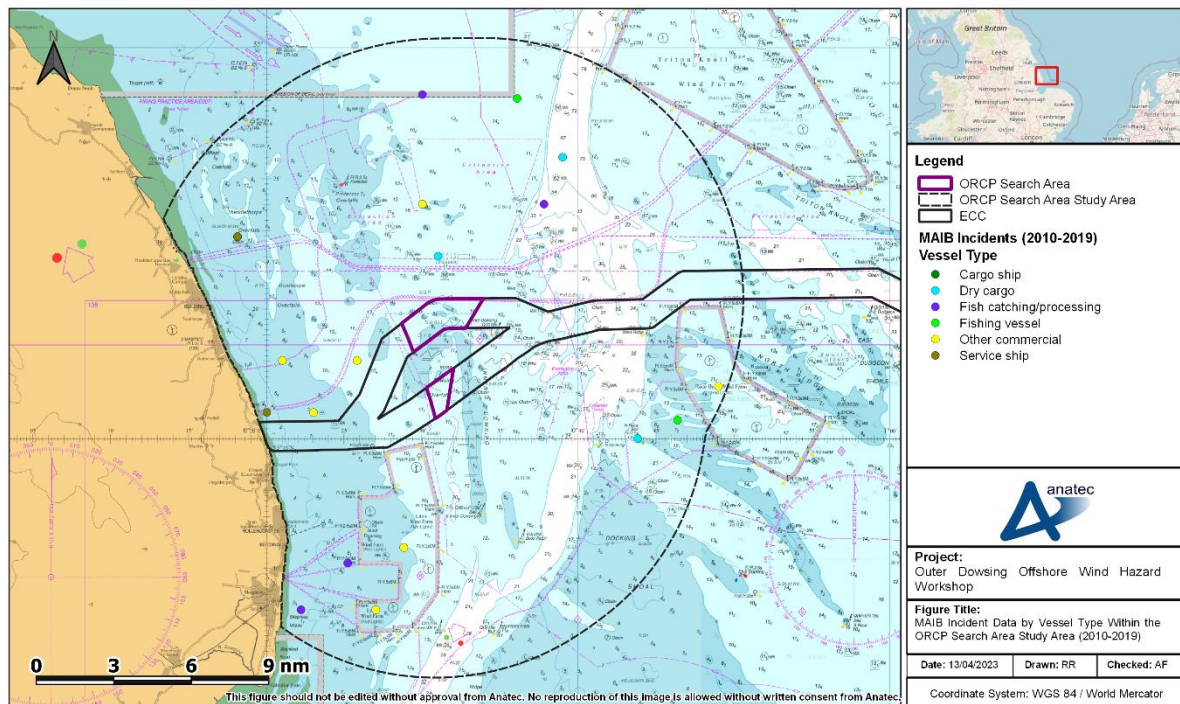


Figure 8.17 MAIB Incidents by Vessel Type Within the ORCP Search Area Study Area (2010-2019)

171. A total of 21 unique incidents were reported to the MAIB within the ORCP search area study area between 2010 and 2019, which corresponds to an average of two incidents per year. Throughout the 10-year period, no incidents were reported within the ORCP search area itself, the closest being an “*Flooding/Foundering*” 2.2nm to the west of the ORCP search area relating to a commercial workboat in 2009.
172. The most common incident types recorded were “*Accident to Person*” (29%), “*Hazardous Incident*” (19%), and “*Machinery Failure*” (14%). The most frequently recorded vessel type involved in these incidents were other commercial (38%), fish catching/processing (19%), and dry cargo (19%).

8.5.4 2000-2009

173. A review of older MAIB incident data within the study areas between 2000 and 2009 indicates that the number of incidents has decreased over time within the shipping and navigation study area, with 44 unique incidents being recorded in the ten-year period, corresponding to an average of between four and five incidents per year. Of the recorded incidents, “*Machinery Failure*” (39%), “*Accident to Person*” (23%), and “*Hazardous Incident*” (20%), were the main incident types recorded.
174. Similarly, the number of incidents recorded within the ECC study area has decreased over time, with 15 unique incidents being recorded in the ten-year period, corresponding to an average of between one and two incidents per year. Of the

recorded incidents, “*Machinery Failure*” (53%), “*Accident to Person*” (20%), and “*Grounding*” (13%) were the main incident types recorded.

175. The number of incidents recorded within the ORCP search area study area has decreased over time also, with 34 unique incidents being recorded in the ten-year period, corresponding to an average of between three and four incidents per year. Of the recorded incidents, “*Machinery Failure*” (47%), “*Hazardous Incident*” (36%), and “*Accident to Person*” (18%) were the main incident types recorded.
176. The decrease in incidents may be attributable to a number of factors, potentially including a reduction of oil and gas activity in the area over time and a trend of improvement in safety standards/regulations.

8.6 Historical OWF Incidents

177. As of April 2023, there are 42 fully commissioned and generating OWFs in the UK, ranging from the North Hoyle OWF (fully commissioned in 2003) to Hornsea Two (fully commissioned in 2022). These developments consist of approximately 20,528 fully operational WTG years.

8.6.1 Incidents involving UK OWF Developments

178. MAIB incident data has been used to collate a list of reported historical collision and allision incidents involving UK OWF developments², which is summarised in Table 8.1. 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. This list is limited to collision and allision incidents given their specific relevance to shipping and navigation. Only incidents that have been formally reported are captured.
179. The worst consequences reported for vessels involved in a collision or allision incident involving a UK OWF development has been flooding, with no life-threatening injuries to persons reported.
180. As of April 2023, there have been no third-party collisions directly as a result of the presence of an OWF in the UK. The only reported collision incident in relation to a UK OWF involved a project vessel hitting a third party vessel whilst in harbour.

² Includes only incidents reported to an accident investigation branch or an anonymous reporting service. Unconfirmed incidents have not been considered.

Table 8.1 Summary of Historical Collision and Allison Incidents Involving UK OWF Developments

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
Project	Allision	7 August 2005	WTG installation vessel allision with WTG base whilst manoeuvring alongside it. Minor damage sustained to a gangway on the vessel, the WTG tower and a WTG blade.	Minor damage to gangway on the vessel	None	MAIB
Project	Allision	29 September 2006	Offshore services vessel allision with rotating WTG 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 WTG 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 in to port.	Moderate	None	UK CHIRP
Project	Allision	20 October 2012	Project vessel allision with WTG 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 WTG transition piece at moderate speed following navigational error. Vessel able to proceed to	Moderate	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage*	Harm to Persons	Source
			port unassisted with no water ingress but some structural damage sustained.			
Project	Allision	1 July 2013	Service vessel allision with WTG foundation following machinery failure. Minor damage sustained by vessel.	Minor	None	IMCA Safety Flash
Project	Allision	14 August 2014	Standby safety vessel allision with WTG 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 WTG due to human error. Lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)
Third party	Allision	24 May 2018	A fishing vessel allided with a WTG within an under-construction windfarm.	Unknown	Unknown	Anatec in-house AIS data
Project	Allision	14 February 2019	A vessel undertaking a survey at an OWF ran too close to a windfarm jacket whilst under autopilot.	Minor	None	MAIB
Project	Allision	16 January 2020	Project vessel allision with WTG. 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 WTG. Minor damage to vessel and WTG sustained, with no personal injuries.	Minor	None	Marine Safety Forum
Third-party	Allision	9 June 2022	Fishing vessel allision with WTG 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)

(*) As per incident reports.

181. As of December 2022, there have been 13 reported³ cases of an allision between a vessel and a WTG (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 1,579 years of WTG operation per WTG allision incident in the UK. This is a conservative calculation given that only operational WTGs years have been included (whereas allision incidents counted include non-operational WTGs).

8.6.2 Incidents Involving Non-UK OWF

182. It is noted that collision and allision incidents involving non-UK OWF developments have also occurred. However, it is not possible to maintain a comprehensive list of such incidents.
183. One high profile non-UK incident is that involving a bulk carrier in January 2022 which dragged anchor during a storm in Dutch waters and collided with another 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 though an under construction OWF where it allided with a WTG foundation and a platform foundation before being taken under tow.

8.7 Incidents Responded to by Vessels Associated with UK OWFs

184. A list has been collated from news reports, basic web searches and experience of working with existing OWF developments, of historical incidents responded to by vessels associated with UK OWF developments. This list is summarised in Table 8.2. It is noted that the initial causes of these incidents were not related to the associated OWFs.
185. Table 8.2 comprises known incidents that were responded to by a windfarm vessel. Additional incidents associated with windfarms themselves 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.

³ Reported to an accident investigation branch or an anonymous reporting service. Unconfirmed incidents have not been considered noting that to date only one further alleged incident has been rumoured but there is no evidence to confirm.

Table 8.2 Historical Incidents Responded to by Vessels Associated with UK OWF Developments

Incident Type	Date	Related Development	Description of Incident	Source
Capsize	21 June 2018	Walney OWF	HMCG 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 OWF	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 OWF	Yacht in difficult sought shelter by tying up to a WTG 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 OWF	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)
Machinery failure	28 September 2019	Race Bank OWF	Fishing vessel suffered mechanical failure and launched flares. Guard vessel and Service Operation Vessel (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 OWF	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 OWF	Coastguard contacted guard vessel for Walney reporting red flare sighting at the windfarm. Guard vessel proceeded to undertake search but did not find anything to report.	Internal daily progress report received by Anatec

Project A4700 Outer Dowsing Offshore Wind

Client GTR4 Limited

Title Outer Dowsing Offshore Wind Navigational Risk Assessment

Incident Type	Date	Related Development	Description of Incident	Source
Aircraft crash	15 June 2020	Hornsea Project One	United States (US) jet crashed into sea during routine flight. CTV and SOV for Hornsea Project One joined the search for the missing pilot.	Web search (4C Offshore, 2020)
Fire/ explosion	15 December 2020	Dudgeon OWF	Fishing vessel experienced explosions on board with crew injured. SOV for Dudgeon deployed its Fast Rescue Boat (FRB) and evacuated the casualty vessel.	Web search (Offshore WIND, 2020)
Vessel in distress	3 June 2021	Robin Rigg	Windfarm CTV fire alarm sounded, with the engine then shut down. A support vessel for Robin Rigg was able to assist in escorting the vessel to port.	Web search (Vessel Tracker, 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 NNG was able to retrieve the children.	Web search (Edinburgh Evening News, 2021)
Allision	9 June 2022	Westermost Rough	Fishing vessel allided with a WTG at Westermost Rough. A supply vessel was among the responders as an RNLI lifeboat escorted the vessel under its own power to port.	Web search (Vessel Tracker, 2022)

9 Vessel Traffic Movements

186. This section presents an analysis of vessel traffic movements in relation to the array area, Offshore ECC, and the ORCP search area. The methodology for vessel traffic data collection, including details of the on-site vessel traffic surveys, is provided in Section 5.2.

9.1 Array Area

187. A plot of the vessel tracks recorded during a 14-day summer survey period, colour-coded by vessel type and excluding temporary traffic, is presented in Figure 9.1. Following this, Figure 10.2 presents the same data converted to a density heat map.

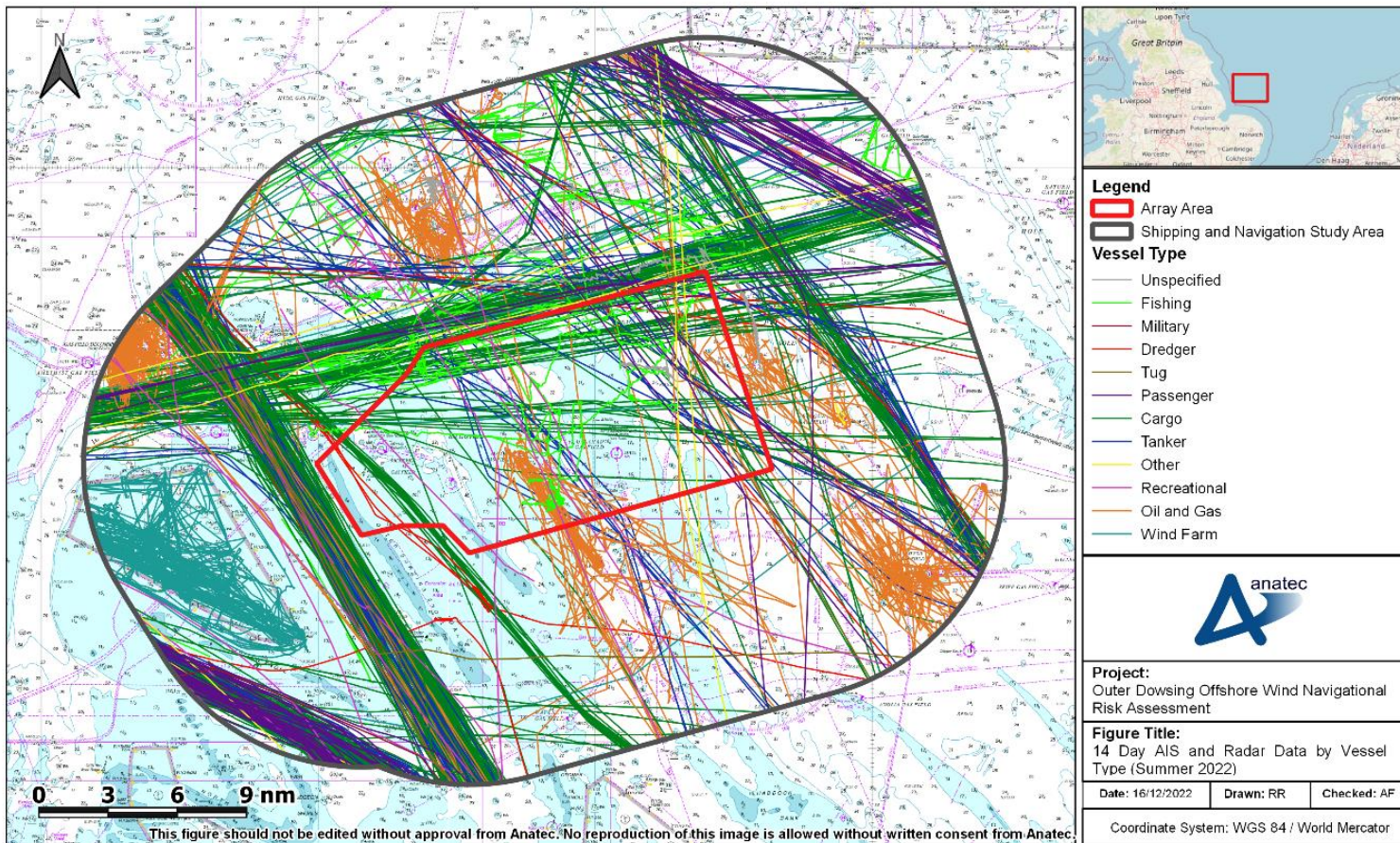


Figure 9.1 Vessel Traffic Survey Data by Vessel Type (14-Days, Summer 2022)

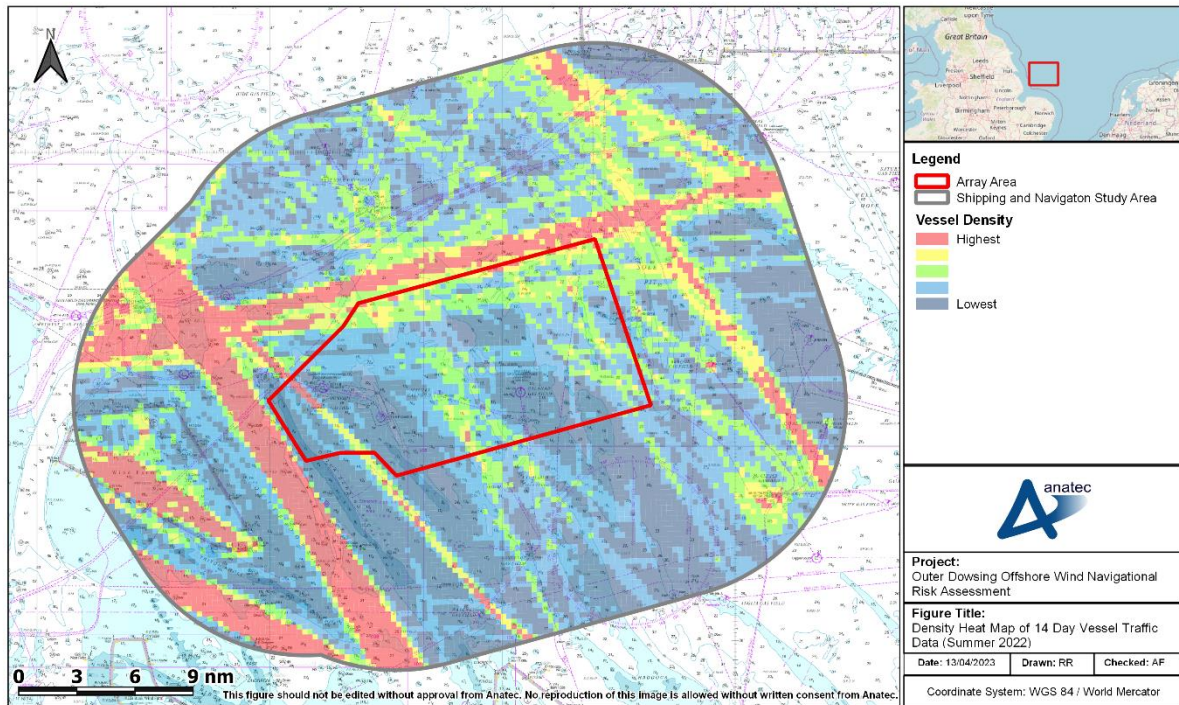


Figure 9.2 Vessel Traffic Density Heat Map (14-Days, Summer 2022)

188. A plot of the vessel tracks recorded during a 14-day winter survey period, colour-coded by vessel type and excluding temporary traffic, is presented in Figure 9.3. Following this, Figure 9.4 presents the same data converted to a density heat map. It is noted that the same density ranges have been used in the winter data as that of the summer to allow direct comparison.

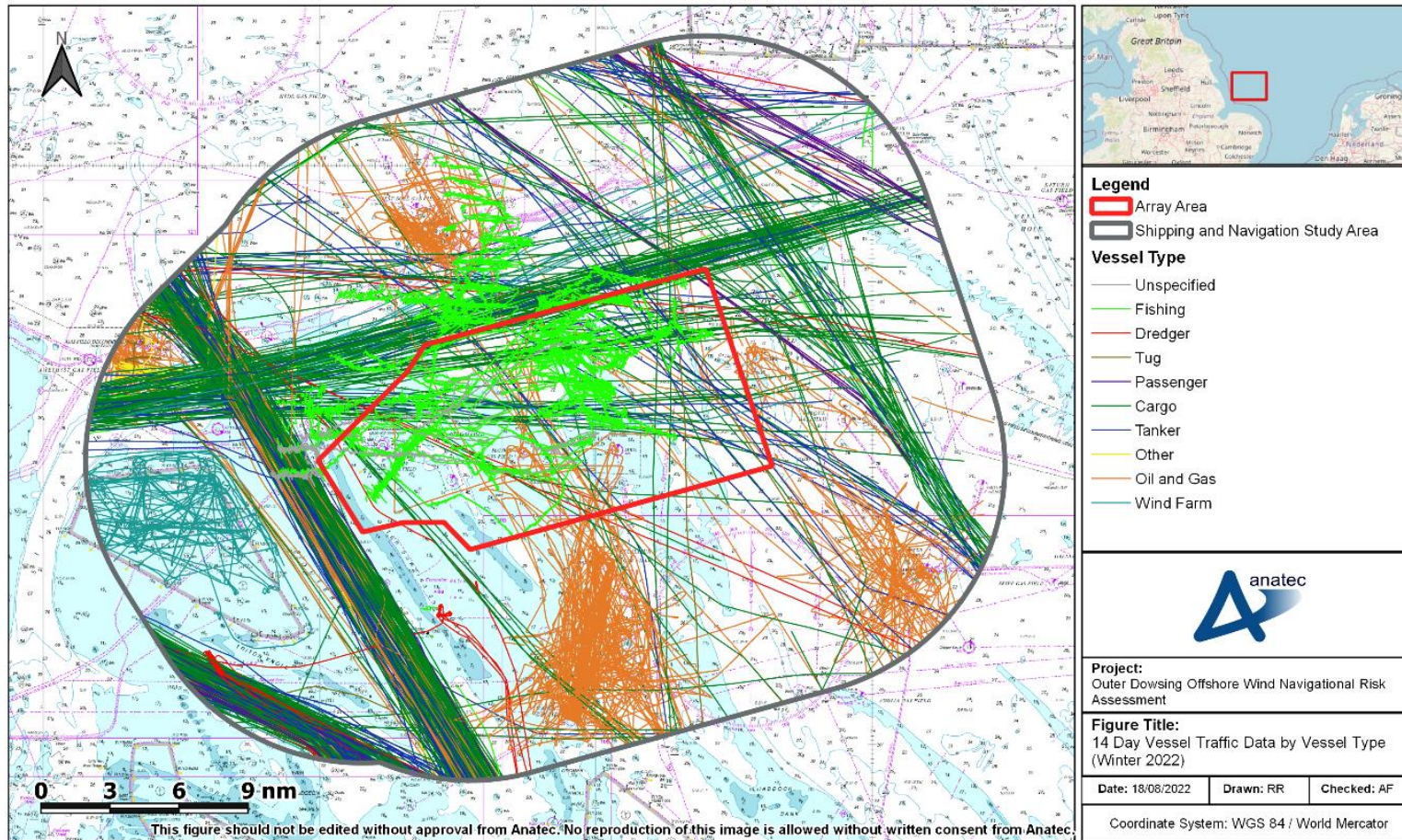


Figure 9.3 Vessel Traffic Survey Data by Vessel Type (14-Days, Winter 2022)

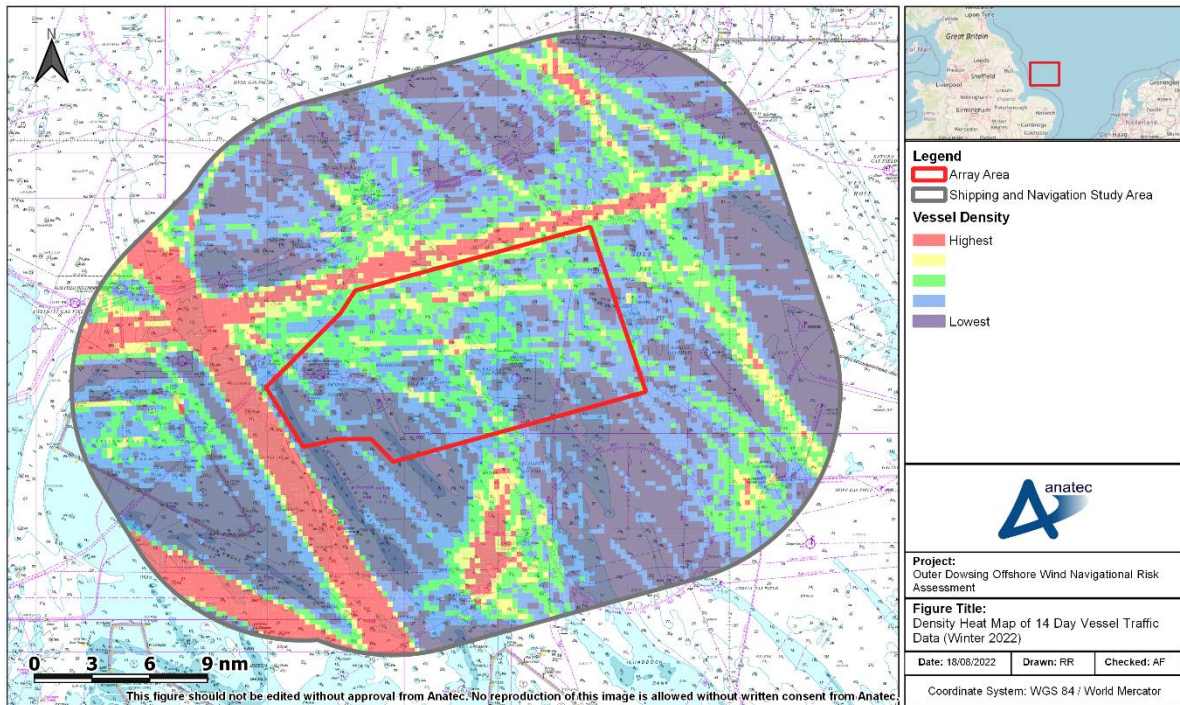


Figure 9.4 Vessel Traffic Density Heat Map (14-Days, Winter 2022)

9.1.1 Vessel Counts

189. The daily number of unique vessels recorded within the shipping and navigation study area, as well as intersecting the array area, during the summer survey period is presented in Figure 9.5. Throughout the summer survey period, approximately 16% of vessel traffic recorded within the shipping and navigation study area intersected the array area.

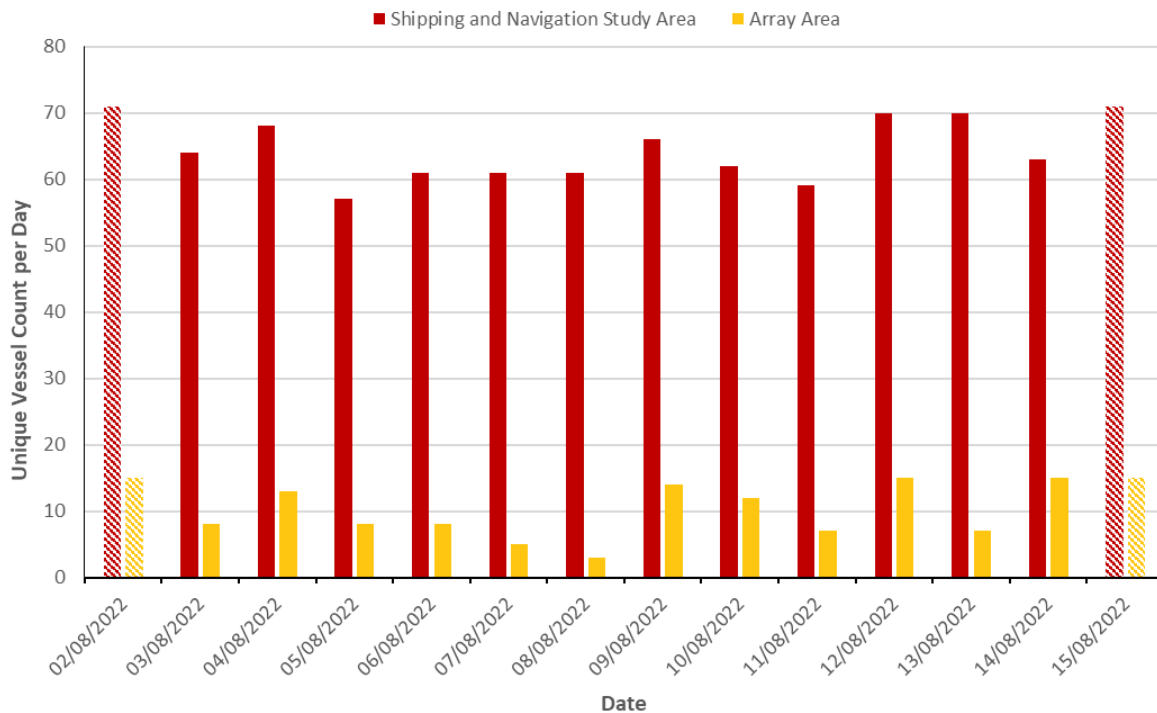


Figure 9.5 Daily Unique Vessel Counts within the Shipping and Navigation Study Area and Array Area (14-Days, Summer 2022)

190. For the 14-days analysed in the summer survey period, there was an average of between 64 and 65 unique vessels recorded per day within the shipping and navigation study area. An average of ten unique vessels per day intersected the array area.
191. The busiest days recorded within the shipping and navigation study area during the summer survey period was 2 and 15 August, on which 71 unique vessels were recorded each day. The busiest days recorded within the array area during the summer survey period was 12 and 14 August, on which 15 unique vessels were recorded each day.
192. The quietest day recorded within the shipping and navigation study area during the summer survey period was 5 August, on which 57 unique vessels were recorded each day. The quietest day recorded within the array area during the summer survey period was 8 August, on which three unique vessels were recorded each day.
193. The daily number of unique vessels recorded within the shipping and navigation study area, as well as intersecting the array area, during the winter survey period is presented in Figure 9.6. Throughout the winter survey period, approximately 15% of vessel traffic recorded within the shipping and navigation study area intersected the array area.

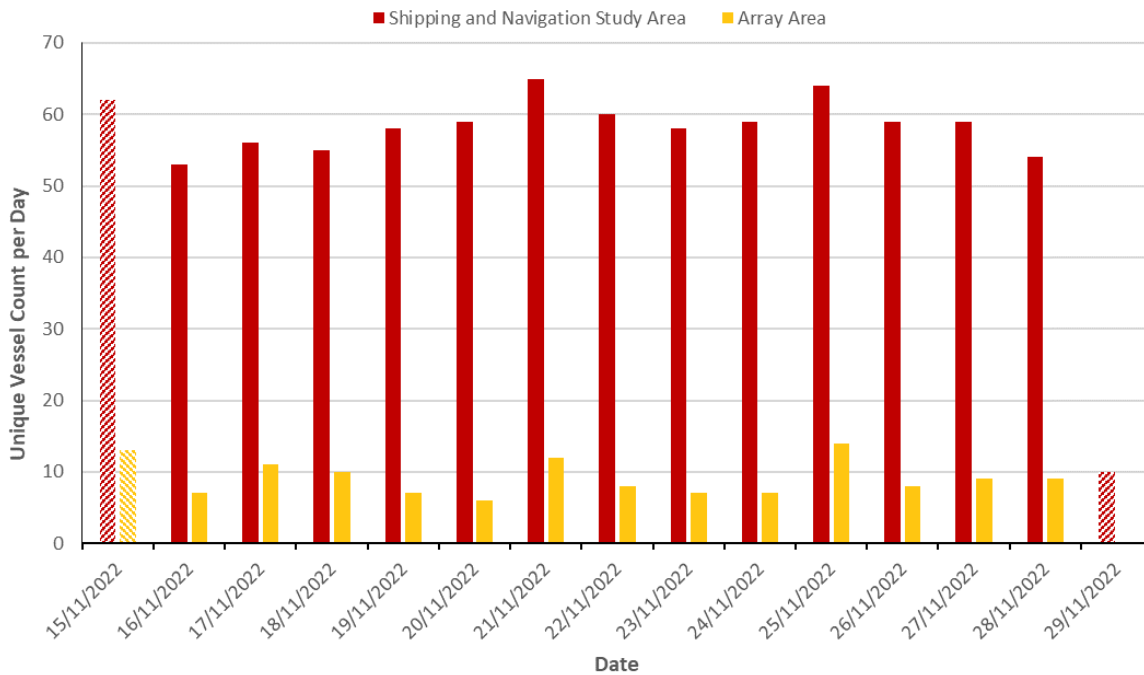


Figure 9.6 Daily Unique Vessel Counts within the Shipping and Navigation Study Area and Array Area (14-Days, Winter 2022)

194. For the 14-days analysed in the winter survey period, there was an average of 58 unique vessels recorded per day within the shipping and navigation study area. An average of nine unique vessels per day intersected the array area.
195. The busiest day recorded within the shipping and navigation study area during the winter survey period was 21 November, on which 65 unique vessels were recorded. The busiest day recorded within the array area during the winter survey period was 25 November, on which 14 unique vessels were recorded each day.
196. The quietest day recorded within the shipping and navigation study area during the winter survey period was 16 November, on which 53 unique vessels were recorded. The quietest day recorded within the array area during the winter survey period was 20 November, on which six unique vessels were recorded.

9.1.2 Vessel Type

197. The percentage distribution of the main vessel types recorded passing within the shipping and navigation study area and the array area during the summer survey period is presented in Figure 9.7.

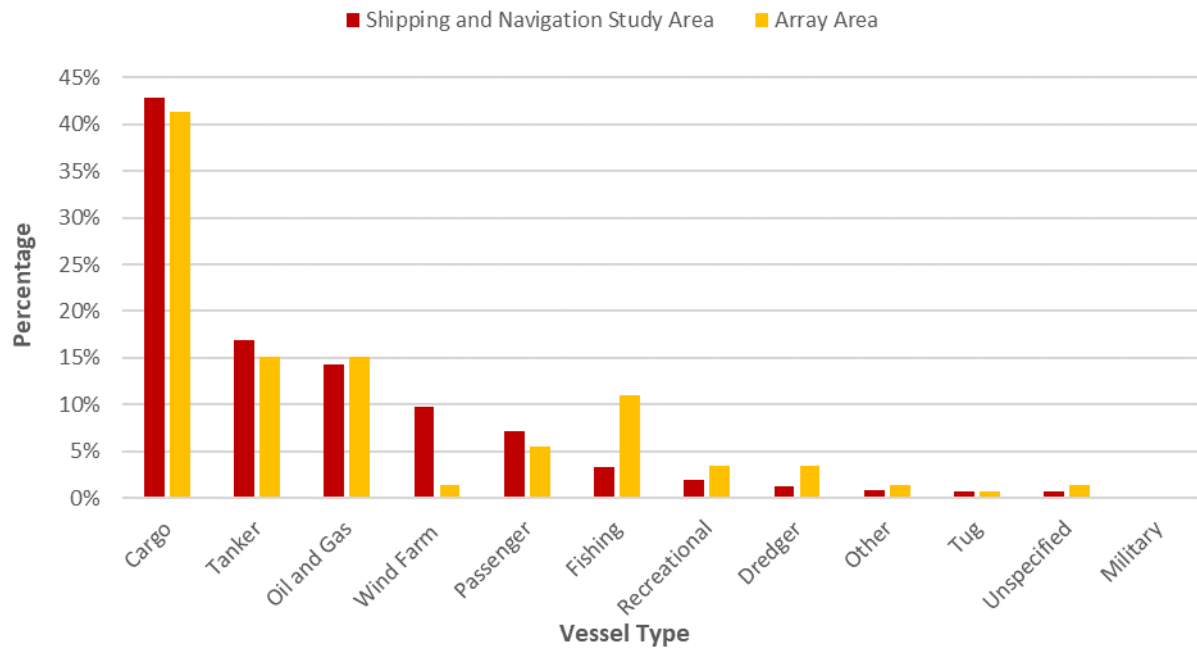


Figure 9.7 Vessel Type Distribution (14-Days, Summer 2022)

198. Throughout the summer survey period, the main vessel types within the shipping and navigation study area were cargo vessels (43%), tankers (17%), and oil and gas vessels (11%). This was the same general trend as for vessel types intersecting the array area.
199. The percentage distribution of the main vessel types recorded passing within the shipping and navigation study area and the array area during the winter survey period is presented in Figure 9.8.

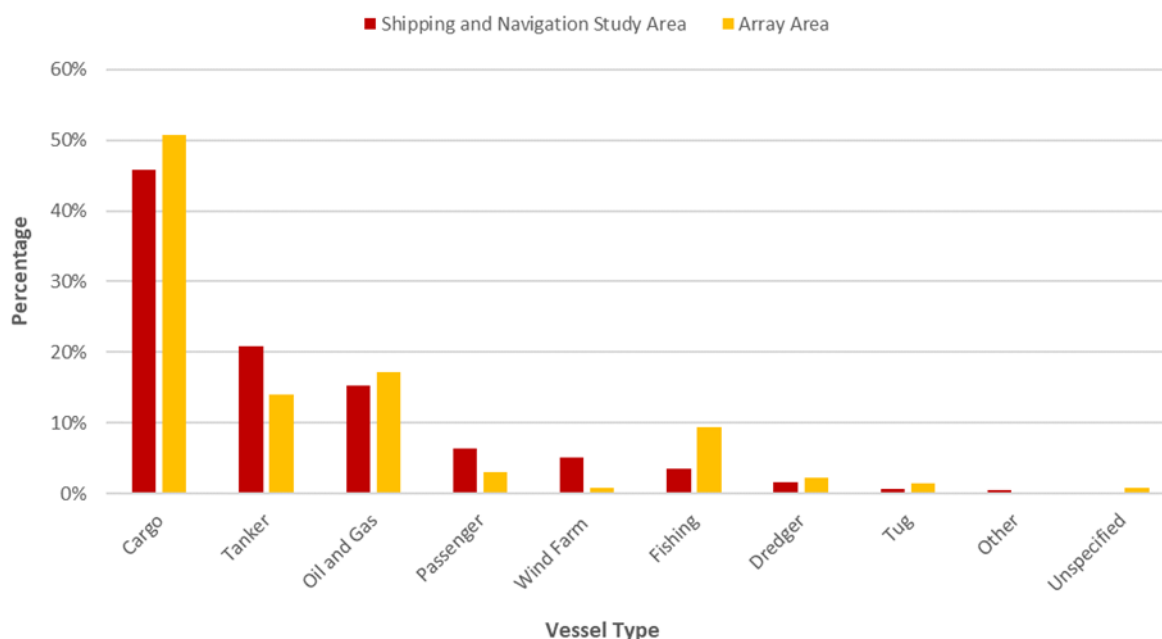


Figure 9.8 Vessel Type Distribution (14-Days, Winter 2022)

200. Throughout the winter survey period, the main vessel types recorded within the shipping and navigation study area were cargo vessels (46%), tankers (21%), and oil and gas vessels (15%). This was the same general trend as for vessel types intersecting the array area.

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

9.1.2.1 Cargo Vessels

202. Figure 9.9 presents a plot of cargo vessels, including commercial ferries, recorded within the shipping and navigation study area during the 14-day summer survey period.

203. Throughout the summer survey period, an average of between 27 and 28 unique cargo vessels per day were recorded within the shipping and navigation study area. The most common cargo vessel sub-types present within the shipping and navigation study area during the summer survey period were general cargo (32%), Ro-Ro (23%), and containerships (22%)

204. The regular cargo vessels operating within the shipping and navigation study area included Roll-On/Roll-Off (Ro-Ro) vessels operated by DFDS Seaways, CLdN, and Bore. Ro-Ro vessels are presented in Figure 9.10 for the 14-day summer survey period, colour-coded by vessel operator.

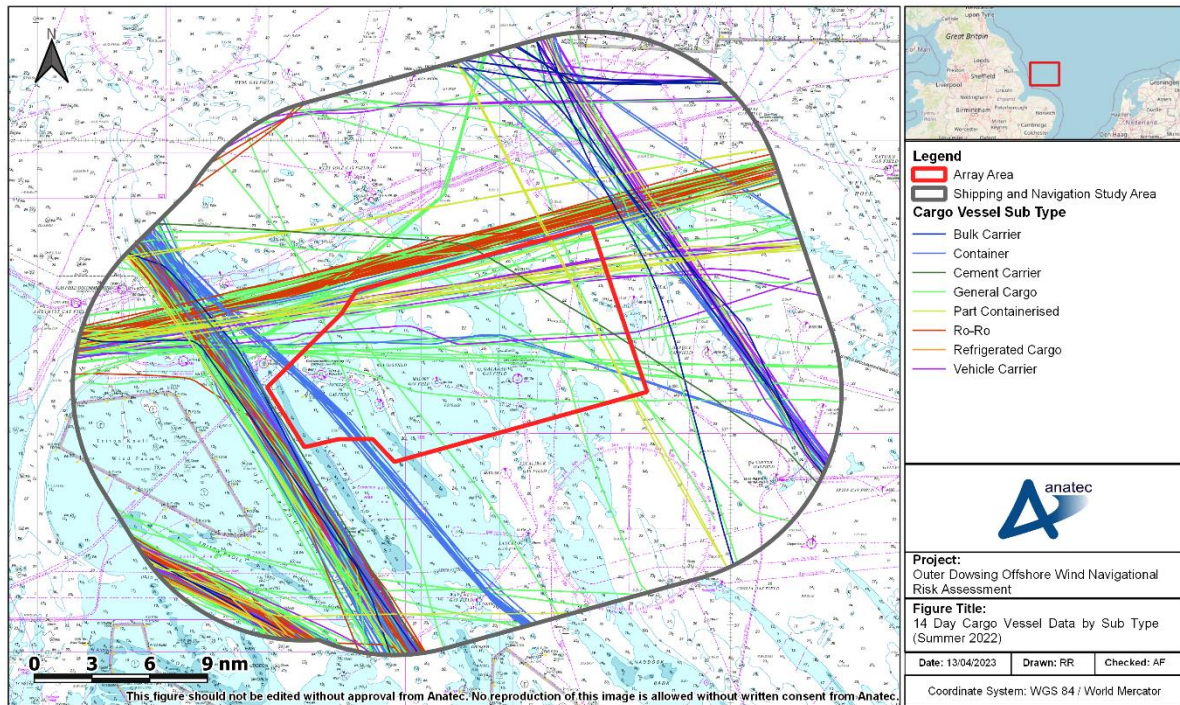


Figure 9.9 Cargo Vessels within the Shipping and Navigation Study Area (14-Days, Summer 2022)

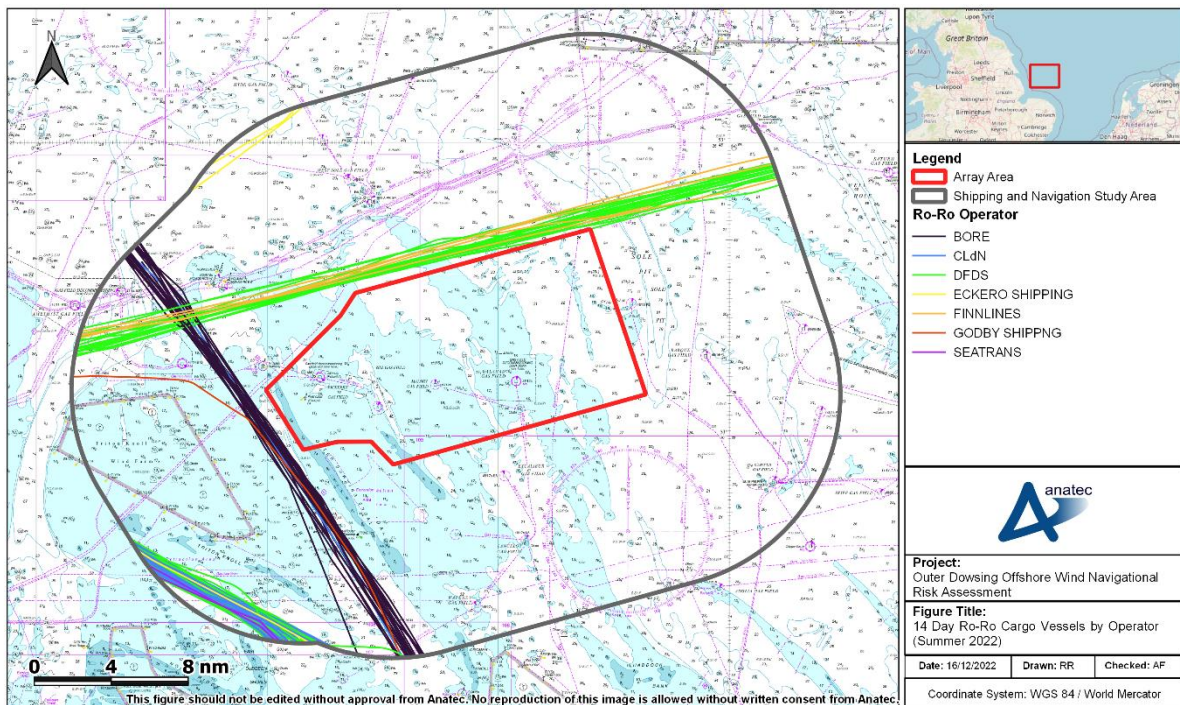


Figure 9.10 Ro-Ro Vessels within the Shipping and Navigation Study Area by Vessel Operator (14-Days, Summer 2022)

205. On average between six and seven unique Ro-Ro vessels per day were recorded within the shipping and navigation study area during the summer survey period. The most common Ro-Ro operators during the summer survey period were DFDS Seaways (30%), CLdN (28%), and Bore (28%).
206. Figure 9.11 presents a plot of cargo vessels, including commercial ferries, recorded within the shipping and navigation study area during the 14-day winter survey period.
207. Throughout the winter survey period, an average of between 27 and 28 unique cargo vessels per day were recorded within the shipping and navigation study area. The most common cargo vessel sub-types present within the shipping and navigation study area during the winter survey period were general cargo (36%), Ro-Ro cargo (21%), container vessels (19%), and vehicle carriers (11%).
208. The regular cargo vessels operating within the shipping and navigation study area included Ro-Ro vessels operated by DFDS Seaways, Bore, and CLdN. Ro-Ro vessels are presented in Figure 9.12 for the 14-day winter survey period, colour-coded by vessel operator.

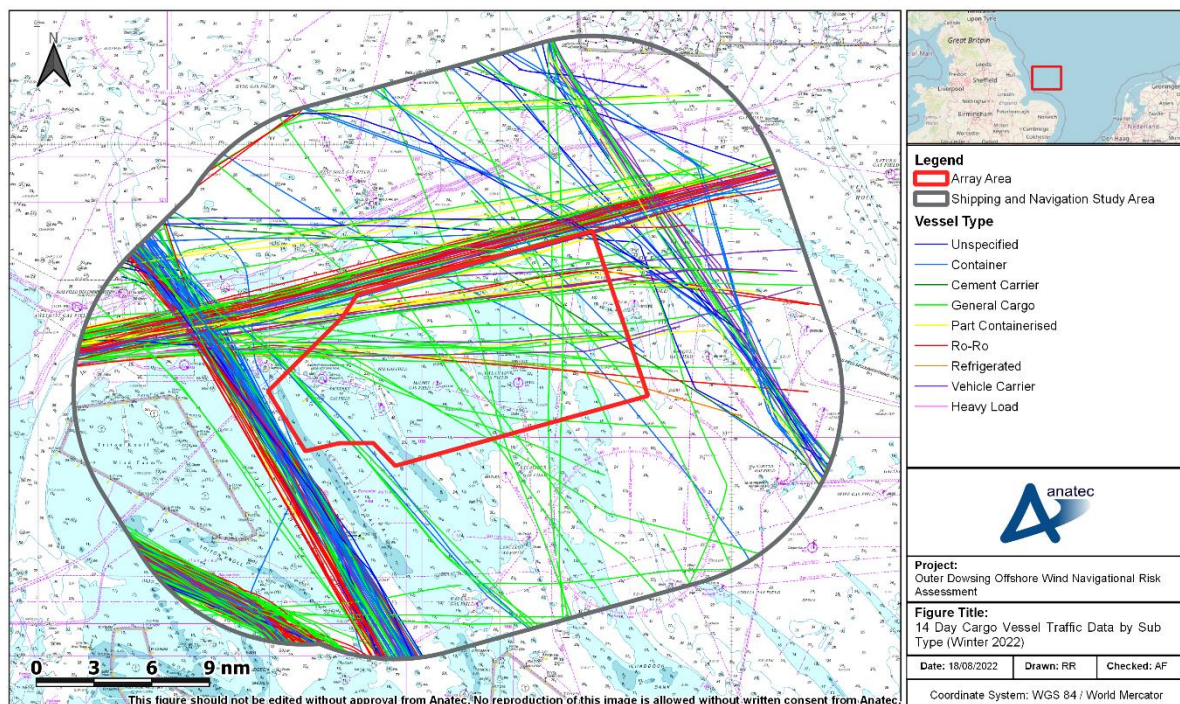


Figure 9.11 Cargo Vessels within the Shipping and Navigation Study Area (14-Days Winter 2022)

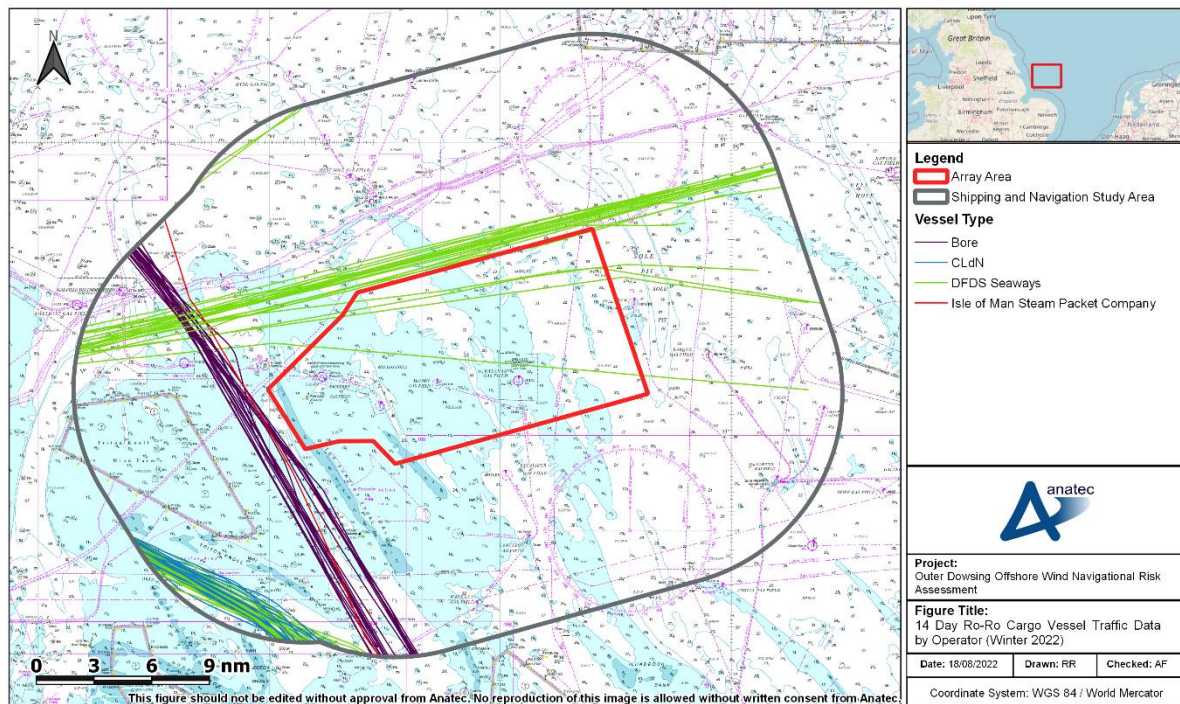


Figure 9.12 Ro-Ro Vessels within the Shipping and Navigation Study Area by Vessel Operator (14-Days Winter 2022)

209. On average between five and six unique Ro-Ro vessels per day were recorded within the shipping and navigation study area during the winter survey period. The most common Ro-Ro operators during the summer survey period were DFDS Seaways (47%), Bore (27%), and CLdN (24%).

9.1.2.2 Tankers

210. Figure 9.13 presents a plot of tankers recorded within the shipping and navigation study area during the 14-day summer survey period.

211. Throughout the summer survey period, an average of between ten and 11 unique tankers per day were recorded within the shipping and navigation study area with them most common tanker sub-types were combined oil/chemical (40%), liquified petroleum gas carriers (LPG) (27%), product tankers (17%), and chemical tankers (12%).

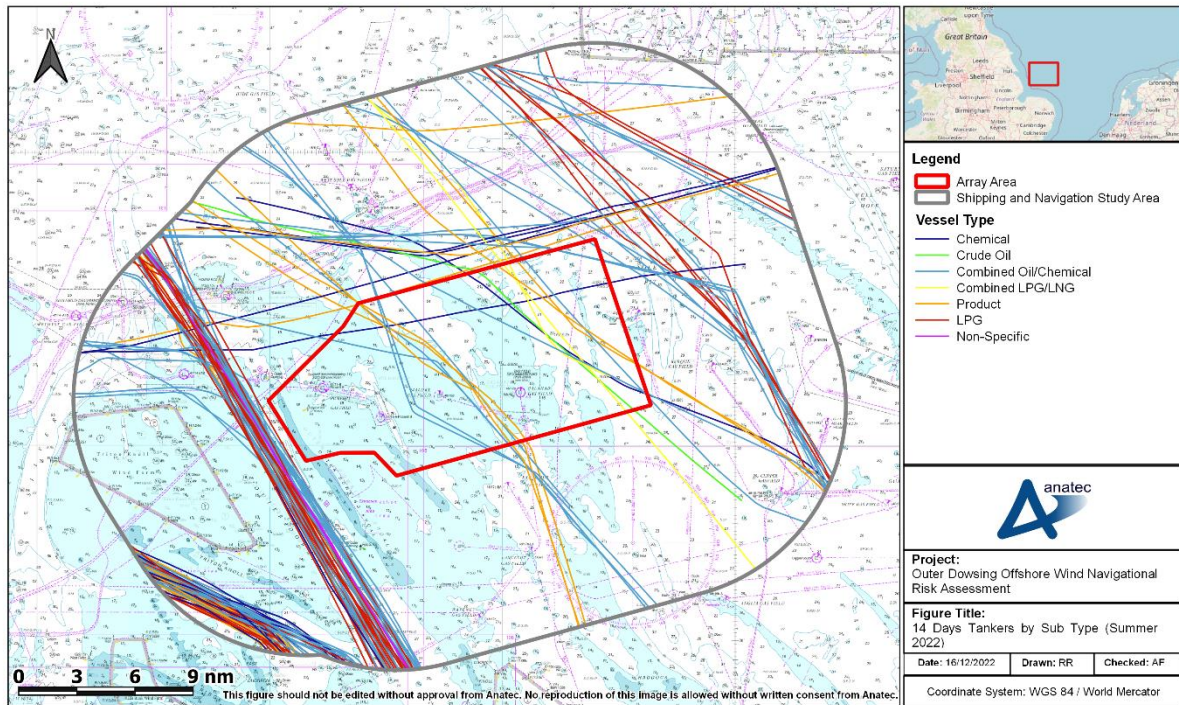


Figure 9.13 Tankers within the Shipping and Navigation Study Area (14-Days, Summer 2022)

212. Figure 9.14 presents a plot of tankers recorded within the shipping and navigation study area during the 14-day winter survey period.
213. Throughout the winter survey period, an average of between 12 and 13 unique tankers per day were recorded within the shipping and navigation study area with them most common tanker sub-types being combined oil/chemical (53%), LPG (24%), chemical tankers (11%), and product tankers (9%).

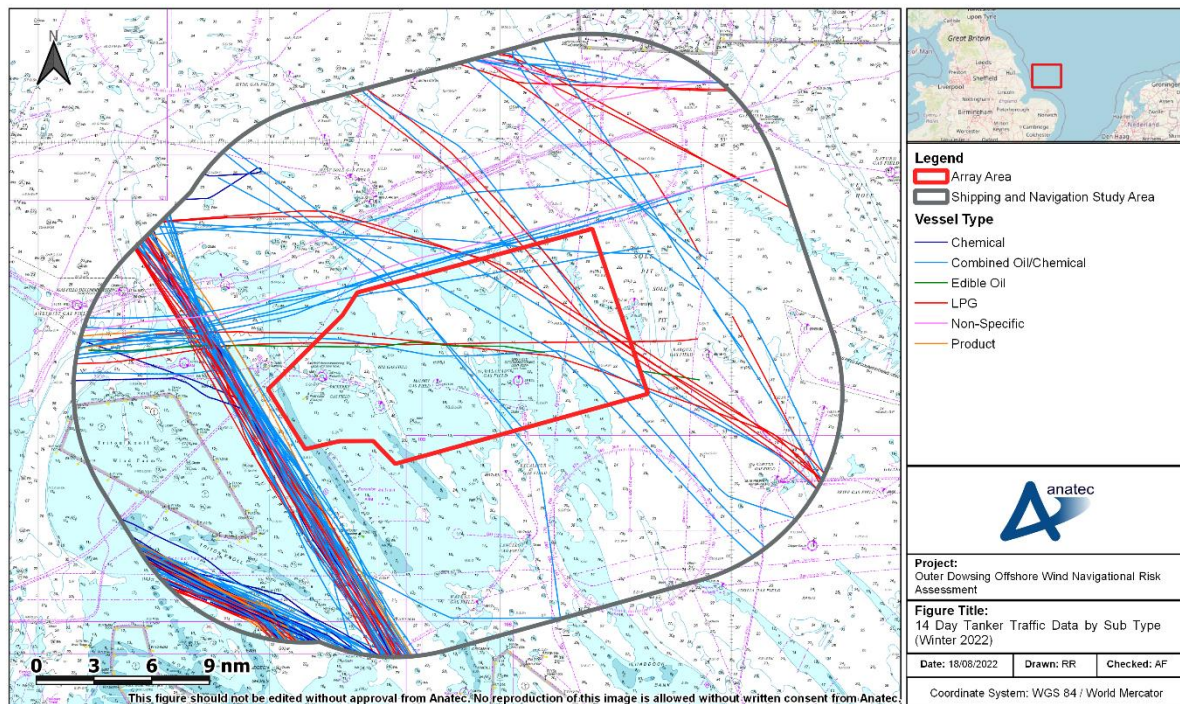


Figure 9.14 Tankers within the Shipping and Navigation Study Area (14-Days, Winter 2022)

9.1.2.3 Passenger Vessels

214. Figure 9.15 presents a plot of passenger vessels recorded within the shipping and navigation study area during the 14-day summer survey period.
215. Throughout the summer survey period, an average of five unique passenger vessels per day were recorded within the shipping and navigation study area with the most common passenger vessel type being Roll-On/Roll-Off Passenger (RoPax) (92%) with the rest being cruise liners.
216. RoPax vessels were operated by DFDS Seaways (50%), P&O Ferries (25%), and StenaLine (25%). Routing of RoPax during the summer period was noted between the UK and the Netherlands on many routes including Killingholme – Hoek Van Holland for StenaLine vessels, Hull – Rotterdam for P&O Ferries, and North Shields – Ijmuiden for DFDS.

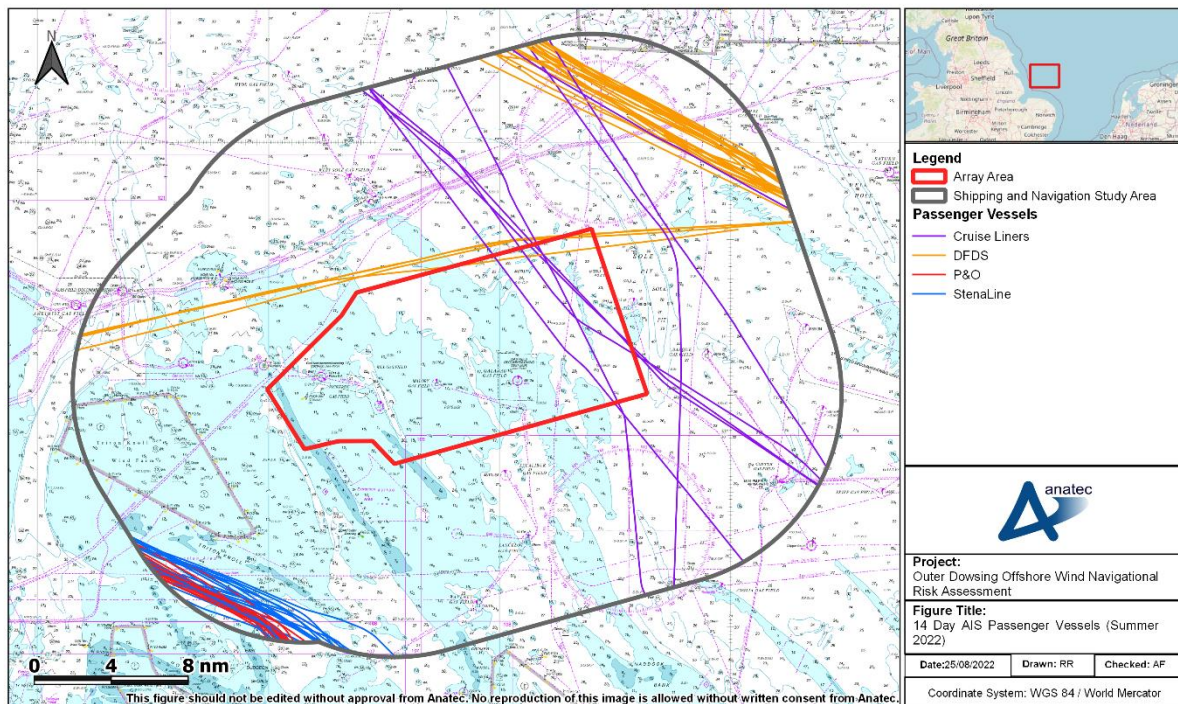


Figure 9.15 Passenger Vessels within the Shipping and Navigation Study Area (14-Days, Summer 2022)

217. Figure 9.16 presents a plot of passenger vessels recorded within the shipping and navigation study area during the 14-day winter survey period.
218. Throughout the winter survey period, an average of between three and four unique passenger vessels per day were recorded within the shipping and navigation study area. All passenger vessels recorded were RoPax.
219. RoPax vessels were operated by DFDS Seaways (47%), P&O Ferries (26%), and StenaLine (26%). DFDS Seaways vessels were routeing between Tyne ports (North Shields and Newcastle (UK)) and Ijmuiden (The Netherlands). These vessels were seen to the north-east of the shipping and navigation study area with vessels also heading to Ijmuiden passing though the navigational corridor to the west of, and within, the north-east of the array area. These two smaller routes on the east and western periphery of the array area are already known to be adverse weather routes for DFDS vessels on this specific route seen to the northeast of the shipping and navigation study area. The timing of these re-routes of vessels correlates with the rougher sea states in the area as noted by crew on board the Karima at the time of the survey. Adverse weather routes are explained in more detail in Section 11.
220. P&O Ferries and StenaLine vessels were seen routeing to the south of Triton Knoll OWF on routes between Hull (UK) and Europoort Rotterdam (The Netherlands) for

P&O Ferries, and between Killingholme (UK) and Hoek Van Holland (The Netherlands) for StenaLine vessels.

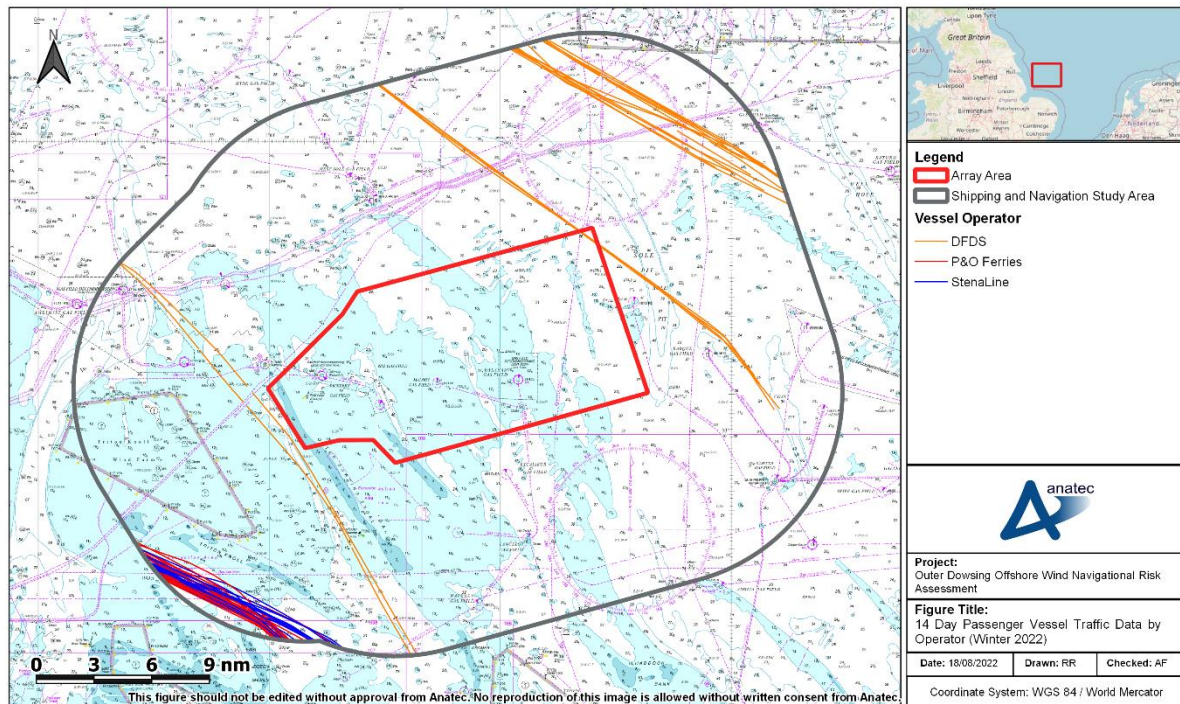


Figure 9.16 Passenger Vessels within the shipping and Navigation Study Area (14-Days, Winter 2022)

9.1.2.4 Oil and Gas Vessels

221. Figure 9.17 presents a plot of oil and gas vessels recorded within the shipping and navigation study area during the 14-day summer survey period, along with the relevant surface platforms in proximity to the array area.
222. Throughout the summer survey period, an average of nine unique oil and gas vessels per day were recorded within the shipping and navigation study area.
223. Vessels were noted to be on transit through the shipping and navigation study area as well as being engaged in activity at platforms and gas fields within the area. Such platforms and gas fields were Clipper, Barque, Galleon, Amethyst, Malory, Excalibur, and West Sole. The vessels passing between Triton Knoll OWF and the array area were transiting to platforms including York, Haeva, Rough, and to ports and harbours including Great Yarmouth, Lowestoft and Ramsgate (all UK).

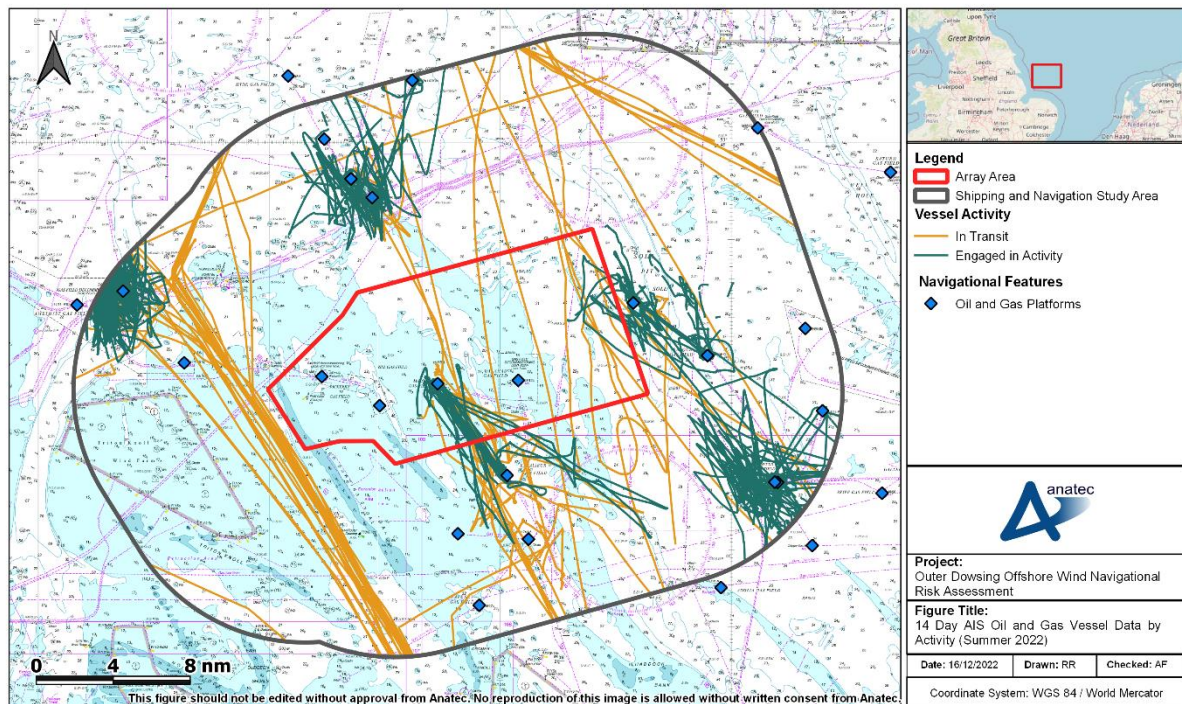


Figure 9.17 Oil and Gas Vessels within the Shipping and Navigation Study Area (14-Days, Summer 2022)

224. Figure 9.18 presents a plot of oil and gas vessels recorded within the shipping and navigation study area during the 14-day winter survey period, along with the relevant surface platforms in the proximity to the array area.
225. Throughout the winter survey period, an average of nine unique oil and gas vessels per day were recorded within the shipping and navigation study area.
226. Vessels were seen on transit and engaged in likely operation and maintenance activity at platforms and oil and gas fields within proximity to the study area including fields Clipper, Barque, Galleon, Amethyst, and West Sole. Transiting vessels seen to the west of the array area were mainly transiting to Great Yarmouth (UK) with other vessels transiting to North Sea oil and gas fields and other UK ports and harbours.

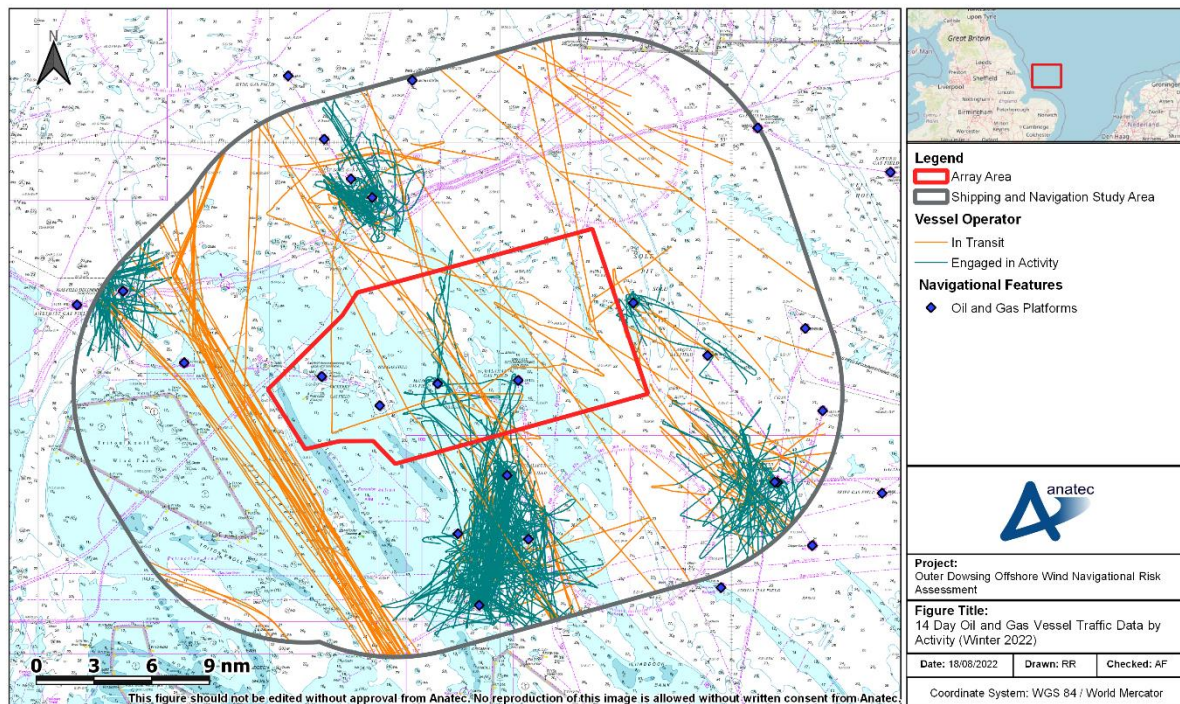


Figure 9.18 Oil and Gas Vessels within the Shipping and Navigation Study Area (14-Days, Winter 2022)

9.1.2.5 Windfarm Vessels

227. Figure 9.19 presents a plot of windfarm vessels recorded within the shipping and navigation study area during the 14-day summer survey period.
228. Throughout the summer survey period, an average of seven unique windfarm vessels per day were recorded within the shipping and navigation study area.
229. Vessels were mostly associated with Triton Knoll OWF with other vessels routing to/from Hornsea Project One or ports and harbours including Grimsby, Hull, Montrose (all UK) and Esbjerg (Denmark).

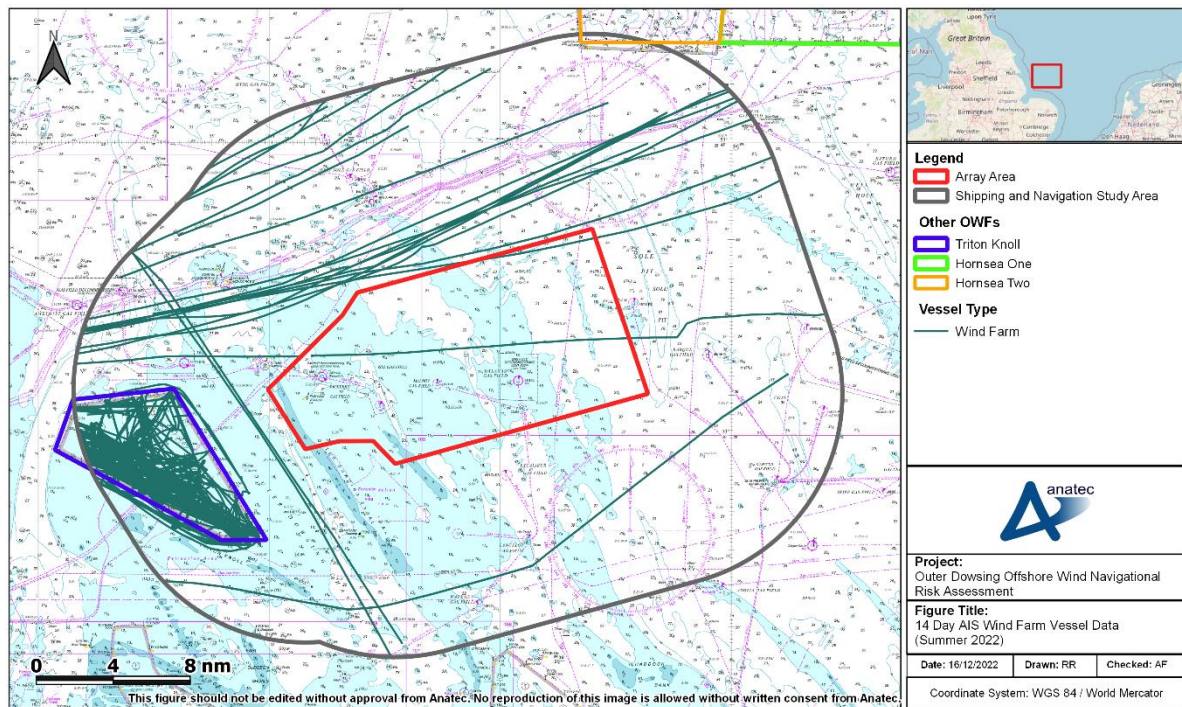


Figure 9.19 Windfarm Vessels within the Shipping and Navigation Study Area (14-Days, Summer 2022)

230. Figure 9.20 presents a plot of windfarm vessels recorded within the shipping and navigation study area during the 14-day winter survey period.
231. Throughout the winter survey period, an average of between two and three unique windfarm vessels per day were recorded within the shipping and navigation study area.
232. The majority of these vessels were either transiting to/from or carrying out operational and maintenance activity at Triton Knoll OWF. Other windfarm vessels were generally transiting through the study area, to the north of the array, routing between Grimsby (UK) and Hornsea Project One.

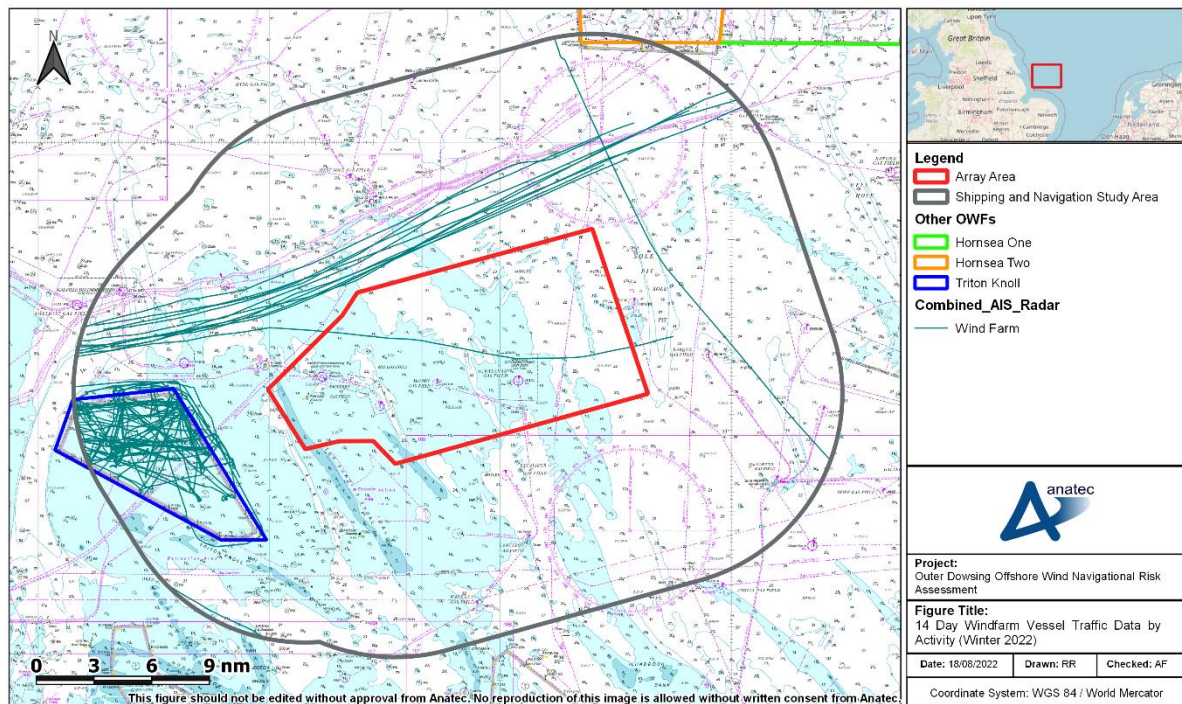


Figure 9.20 Windfarm Vessels within the Shipping and Navigation Study Area (14-Days, Winter 2022)

9.1.2.6 Marine Aggregate Dredgers and Subsea Operation Vessels

233. Figure 9.21 presents a plot of marine aggregate dredger/subsea operation vessels recorded within the shipping and navigation study area during the 14-day summer survey period, along with the relevant TCE aggregate areas.
234. An average of less than one unique marine aggregate dredger/subsea operation vessel per day was recorded within the shipping and navigation study area during the summer survey period.
235. Aggregate dredging activity was present within both Outer Dowsing TCE areas 515/1 and 515/2. Most vessels were routing between marine aggregate dredging areas within the shipping and navigation study area or near the Humber.

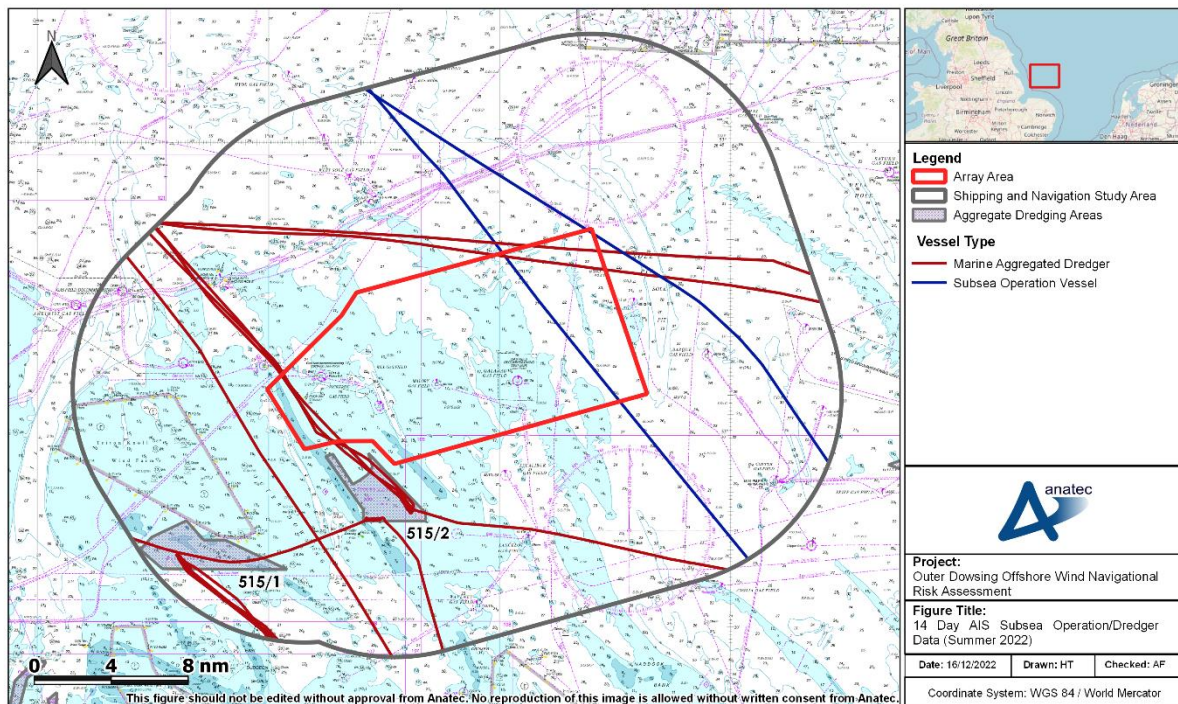


Figure 9.21 Marine Aggregate Dredgers/Subsea Operation Vessels within the Shipping and Navigation Study Area (14-Days, Summer 2022)

236. Figure 9.22 presents a plot of marine aggregate dredger/subsea operation vessels recorded within the shipping and navigation study area during the 14-day winter survey period, along with the relevant TCE aggregate areas.
237. All vessels recorded during the winter survey period were marine aggregate dredgers and an average of one vessel per day was recorded within the shipping and navigation study area.
238. As for summer, aggregate dredging activity was present within both Outer Dowsing TCE areas 515/1 and 515/2, and most vessels were routing between marine aggregate dredging areas within the shipping and navigation study area or near the Humber.

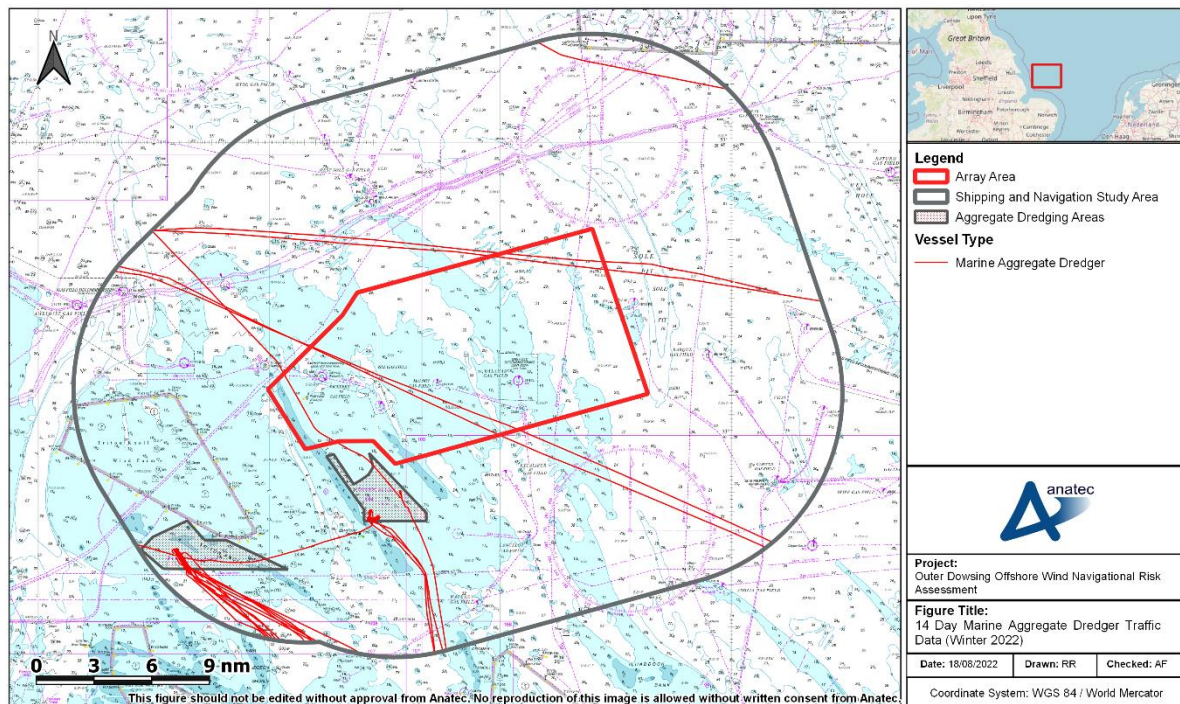


Figure 9.22 Marine Aggregate Dredgers within the Shipping and Navigation Study Area (14-Days, Winter 2022)

9.1.2.7 Fishing Vessels

239. Figure 9.23 presents a plot of fishing vessel activity recorded within the shipping and navigation study area during 14-day summer survey period.
240. Throughout the summer survey period there was an average of two unique fishing vessels per day recorded within the shipping and navigation study area. Fishing vessels were recorded on transit as well as actively engaged in fishing, most notably within the north of the array area and shipping and navigation study area, with the associated vessels being mostly whelkers/potters. Most fishing vessels in transit were routing to/from fishing grounds and Grimsby (UK).
241. For the summer survey data, approximately 90% of fishing vessel tracks were recorded on AIS with the remaining 10% on Radar.
242. Input received from NFFO in the hazard workshop indicates that the data show broad agreement with the patterns of fishing activity in the area with most fishing activity carried out by potter/whelkers and levels of activity regarding the seasonality of the fishery (see Table 4.1).

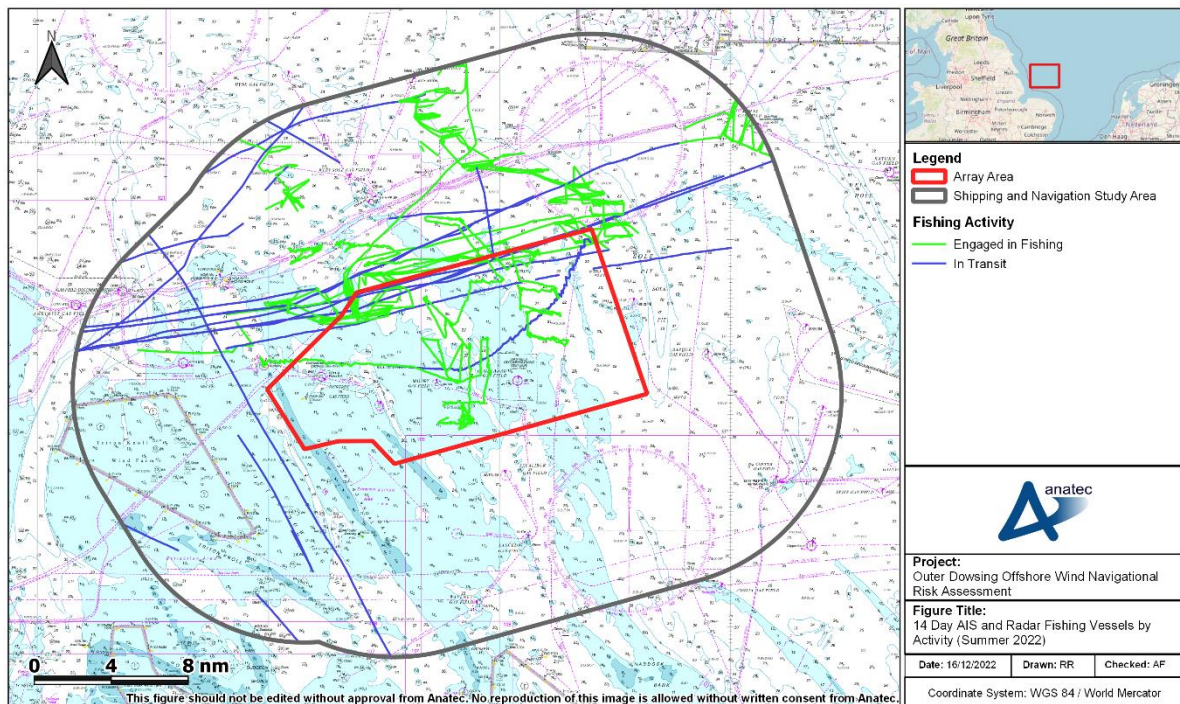


Figure 9.23 Fishing Vessels within the Shipping and Navigation Study Area (14-Days, Summer 2022)

243. Figure 9.24 presents a plot of fishing vessel activity recorded within the shipping and navigation study area during 14-day winter survey period.
244. Throughout the winter survey period there was an average of two unique fishing vessels per day recorded within the shipping and navigation study area. Fishing vessels were recorded on transit as well as actively engaged in fishing, most notably within the of the array area and north of the shipping and navigation study area, with the associated vessels being mostly whelkers/potters. Vessels transiting through the study area were likely enroute to/from fishing grounds.
245. For the winter survey data, approximately 41% of fishing vessel tracks were recorded on AIS with the remaining 59% on Radar.

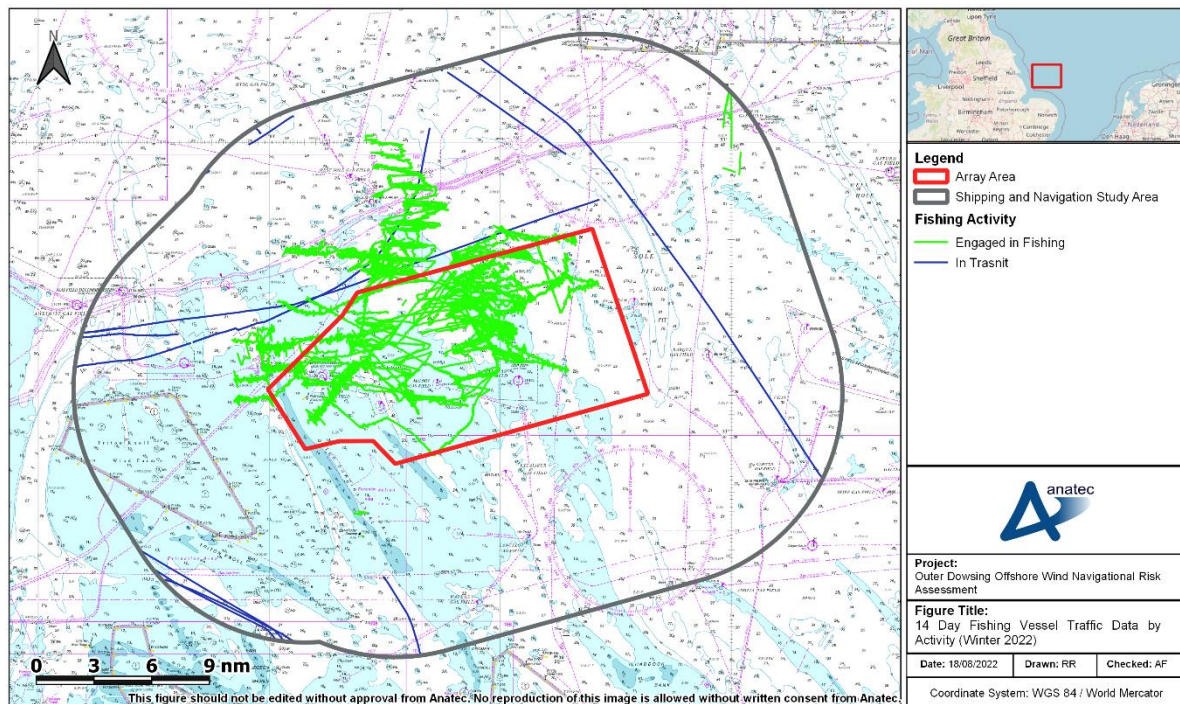


Figure 9.24 Fishing Vessels within the Shipping and Navigation Study Area (14-Days, Winter 2022)

9.1.2.8 Recreational Vessels

246. Figure 9.25 presents a plot of recreational vessel activity recorded within the shipping and navigation study area during the 14-day summer survey period.
247. Throughout the summer survey period, an average of one unique recreational vessel was recorded within the shipping and navigation study area. Most recreational vessels were transiting to the west in shallower waters closer to the coast.
248. For the summer survey data, approximately 85% of recreational vessel tracks were recorded on AIS with the other 15% on Radar.
249. It is noted that no recreational vessels were recorded within the shipping and navigation study area during the winter survey period. This is expected given the distance offshore and time of year the survey was conducted.

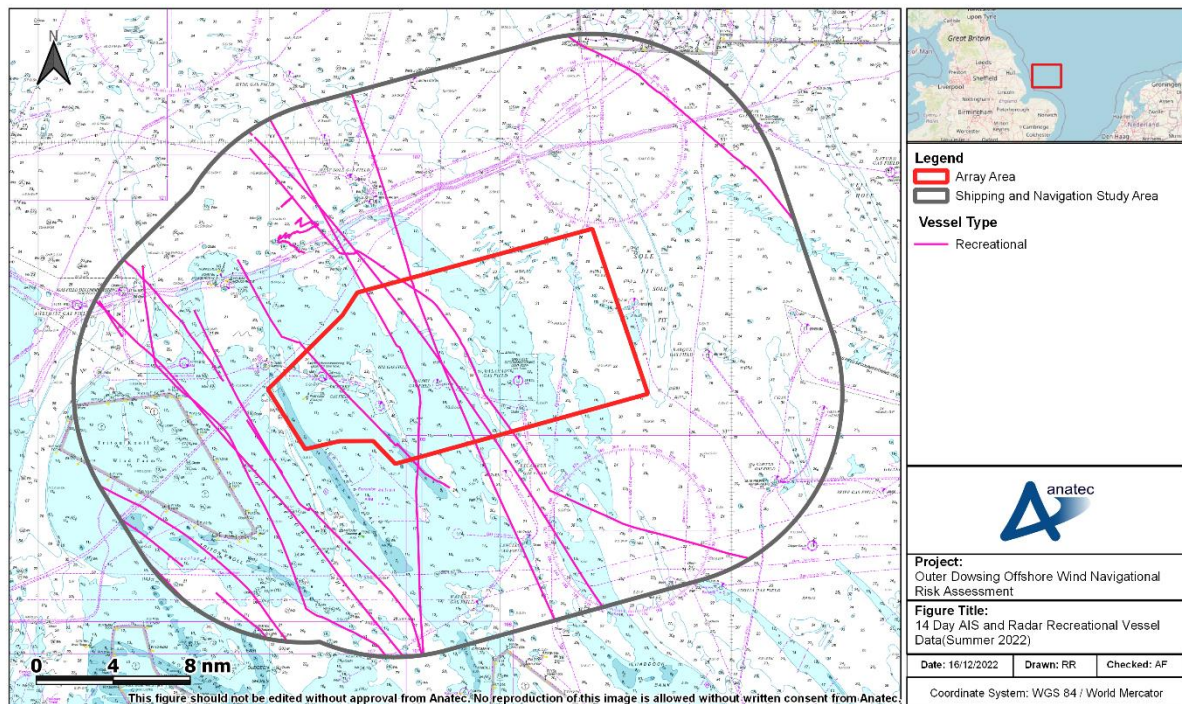


Figure 9.25 Recreational Vessels within the Shipping and Navigation Study Area (14-Days, Summer 2022)

250. The RYA Coastal Atlas will be incorporated into the final NRA.

9.1.3 Vessel Size

9.1.3.1 Vessel Length

251. Vessel length information was available for over 99% of all vessels recorded throughout the 14-day summer survey period. Figure 9.26 illustrates the distribution of vessel length recorded throughout the survey period.

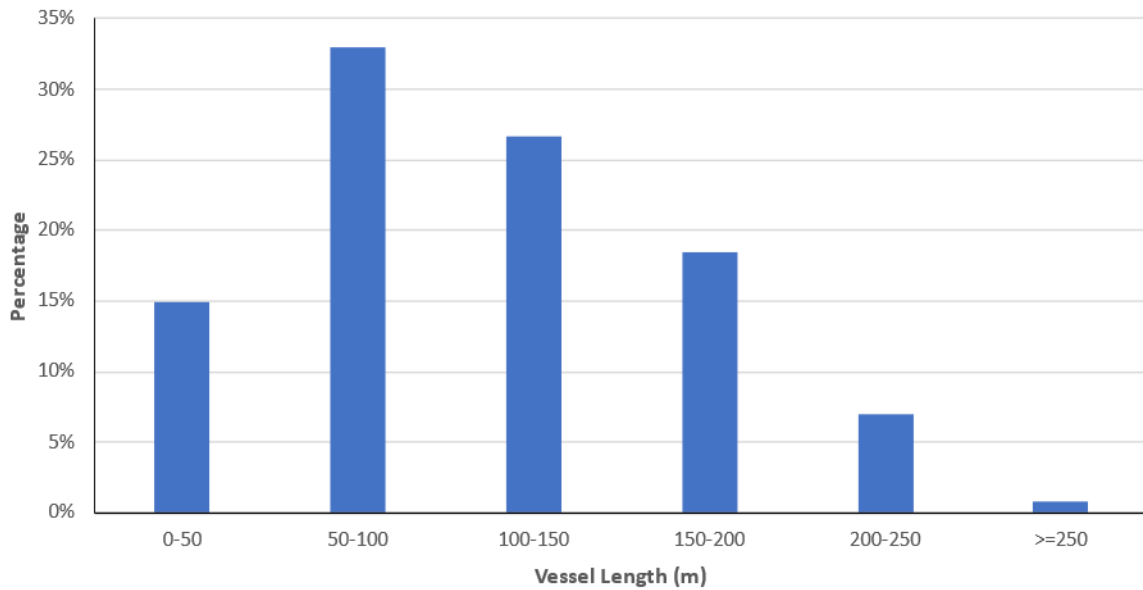


Figure 9.26 Vessel Length Distribution (14-Days, Summer 2022)

252. Excluding the proportion of vessels for which a length was not available the average length of vessels within the shipping and navigation study area throughout the summer survey period was 111m. The largest vessel recorded was a passenger cruise liner at 296m heading to Rotterdam (the Netherlands).
253. The vessel tracks recorded during the summer survey period are colour-coded by vessel length and presented in Figure 9.27.

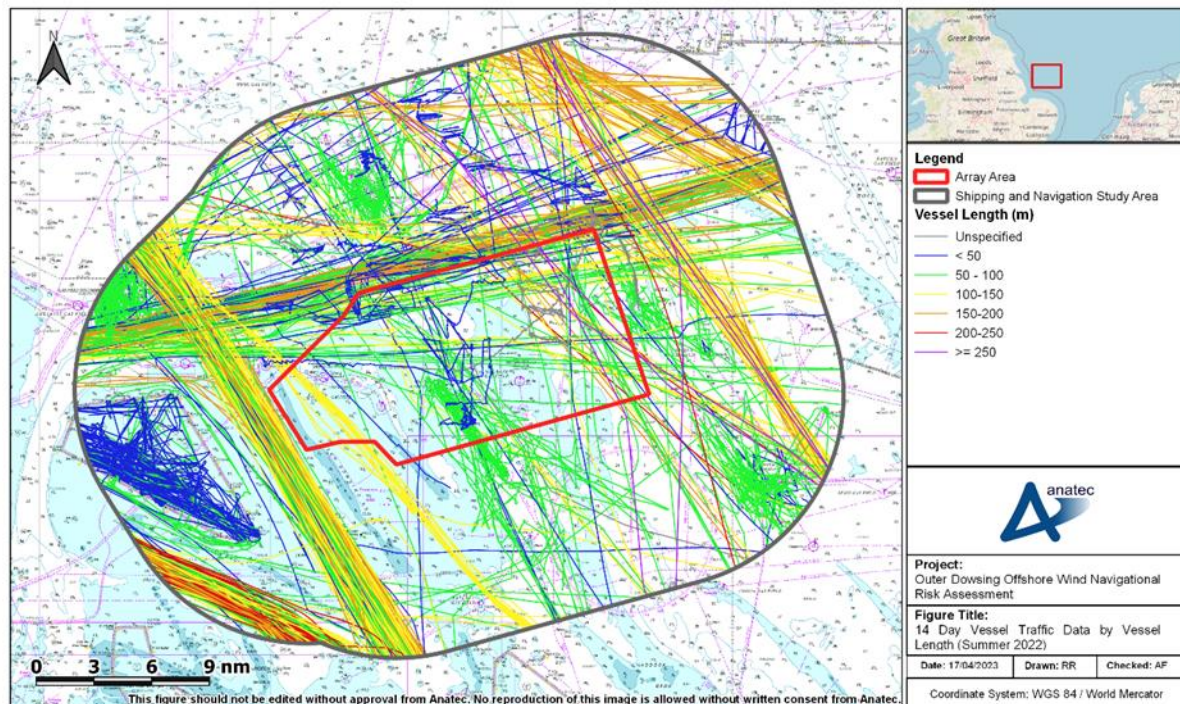


Figure 9.27 14-Day Vessel Traffic Survey Data by Vessel Length (14-Days, Summer 2022)

254. Vessels of greater lengths were primarily commercial vessels. These were seen transiting to the southwest of the shipping and navigation study area passing south of the Triton Knoll OWF and passenger vessels specifically transiting northwest-southeast to the east of the array area. Vessels with smaller recorded lengths were primarily oil and gas, windfarm, fishing, and recreational vessels. Oil and gas vessels were associated with the local platforms and gas fields in proximity to the array area. Windfarm vessels were attending Triton Knoll OWF and transiting between Hornsea Project One and Grimsby (UK).
255. Vessel length information was available for over 99% of vessels recorded throughout the 14-day winter survey period. Figure 9.28 illustrates the distribution of vessel lengths recorded throughout the survey period.

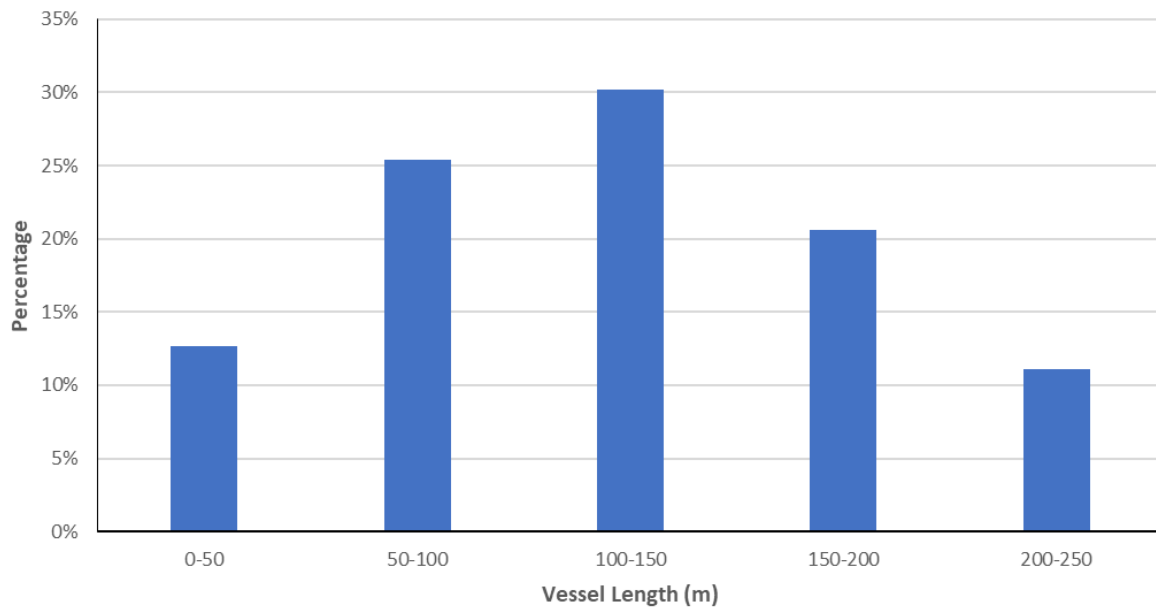


Figure 9.28 Vessel Length Distribution (14-Days, Winter 2022)

- 256. Excluding the proportion of vessels for which a length was not available, the average length of vessels within the shipping and navigation study area throughout the winter survey period was 122m. The largest vessel recorded was a bulk carrier at 250m heading to Glensanda (UK).
- 257. The vessel tracks recorded during the winter survey period are colour-coded by vessel length and presented in Figure 9.29.

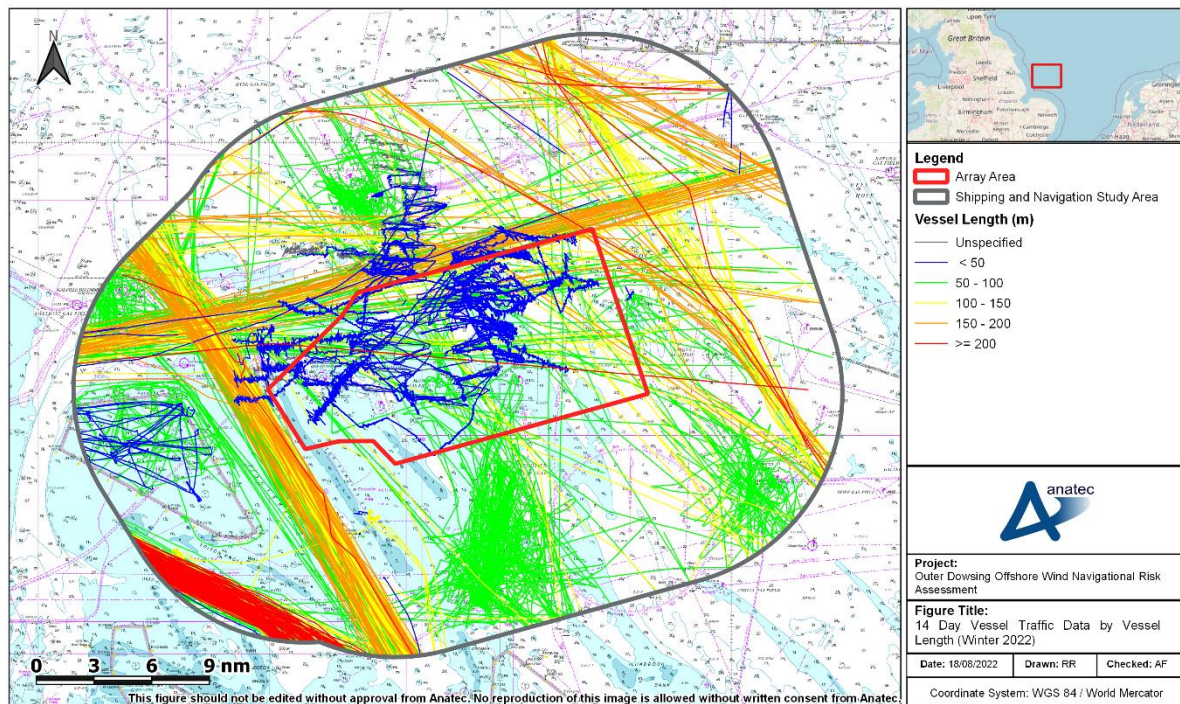


Figure 9.29 14-Day Vessel Traffic Survey Data by Vessel Length (14-Days, Winter 2022)

258. Vessels of greater lengths were primarily cargo and passenger vessels. These were seen transiting heavily to the south-west of the study area passing under Triton Knoll OWF. Vessels with smaller recorded lengths were primarily fishing and windfarm vessels. Those smaller windfarm vessels were concentrated within Triton Koll while the fishing vessels are seen to heavily populate the array area.

9.1.3.2 Vessel Draught

259. Vessel draught information was available for approximately 91% of all vessels recorded during the 14-day summer survey period. Figure 9.30 illustrates the distribution of vessel draught recorded throughout the survey period.

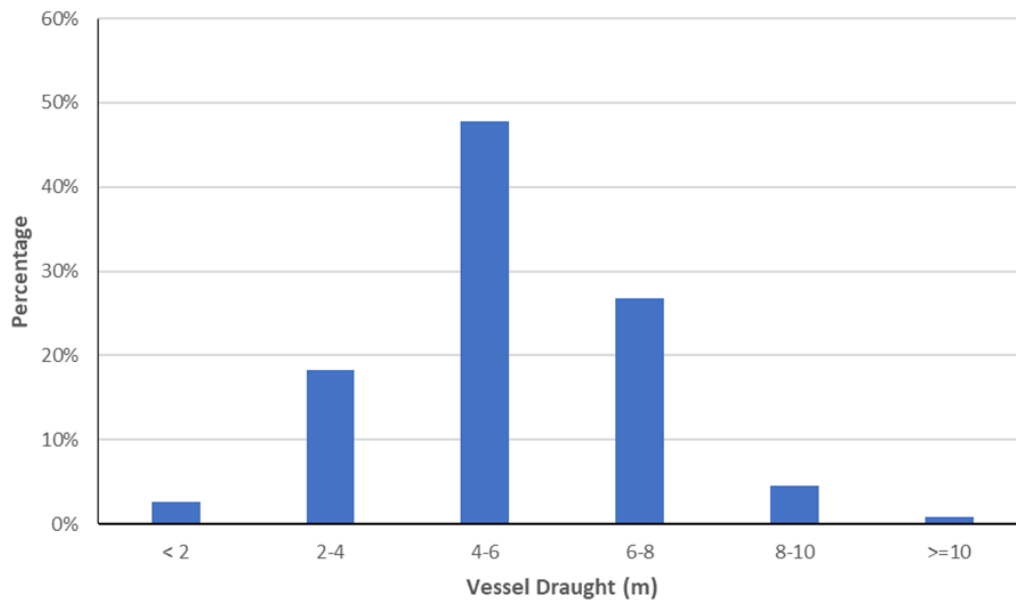


Figure 9.30 Vessel Draught Distribution (14-Days, Summer 2022)

- 260. Excluding the proportion of vessels for which draught was not available the average draught of vessels within the shipping and navigation study area throughout the summer survey period was 5.2m. The vessel with the largest draught recorded was a bulk carrier at 13.5m heading to the Isle of Grain, UK.
- 261. The vessel tracks recorded during the summer survey period are colour-coded by vessel draught and presented in Figure 9.31.

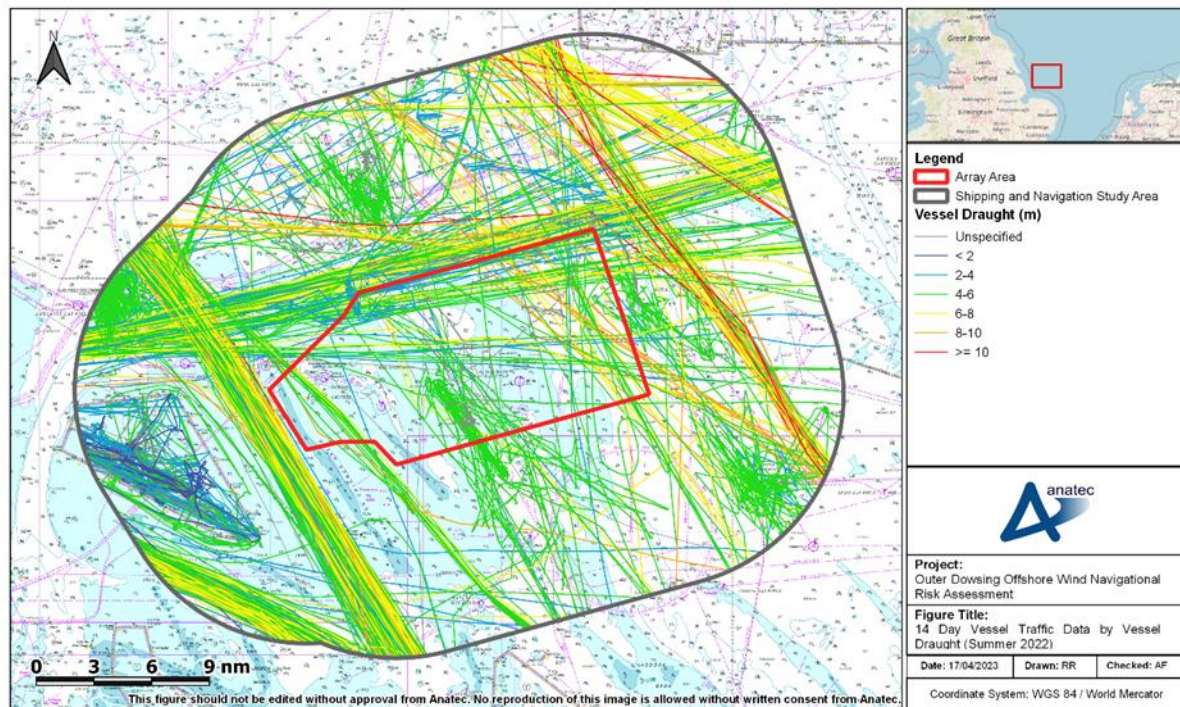


Figure 9.31 14-Day Vessel Traffic Survey Data by Vessel Draught (14-Days, Summer 2022)

262. Vessels with the lowest recorded draughts during the survey period were windfarm vessels. These vessels were attending Triton Knoll OWF and transiting between Hornsea Project One and Grimsby, UK. Vessels with higher draughts were primarily cargo vessels, tankers, and dredgers.
263. Vessel draught information was available for approximately 94% of all vessels recorded during the 14-day winter survey period. Figure 9.32 illustrates the distribution of vessel length recorded throughout the survey period.

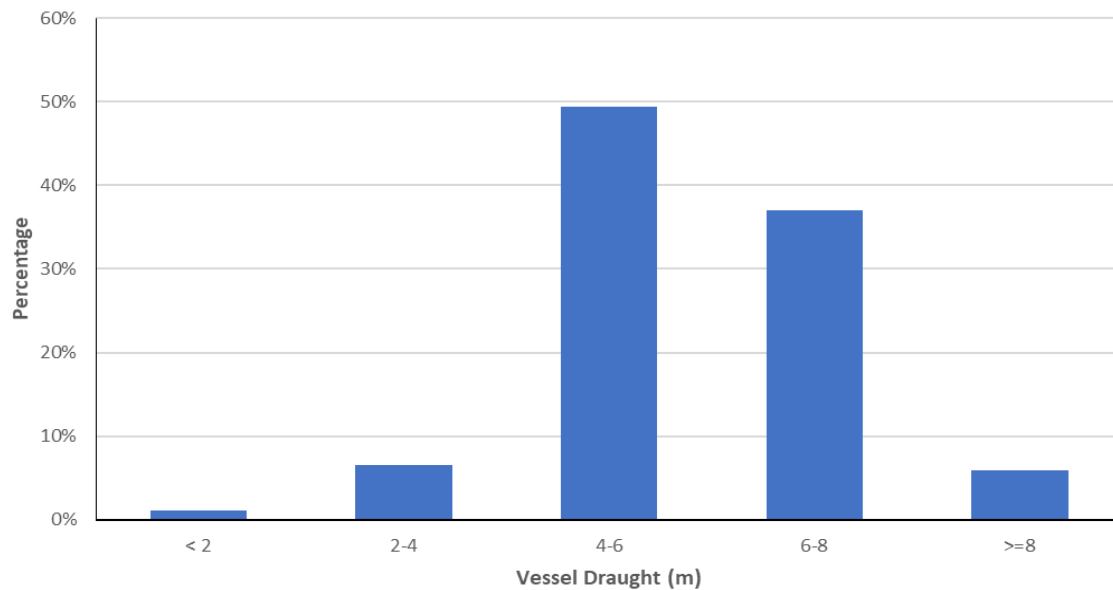


Figure 9.32 Vessel Draught Distribution (14-Days Winter 2022)

264. Excluding the proportion of vessels for which draught was not available, the average draught of vessels within the shipping and navigation study area throughout the winter survey period was 5.7m. The majority of vessels in the had a recorded draught of between 4-6m (49% of all vessels). The vessel with the largest draught recorded was a bulk carrier at 14m heading to Immingham and intersected the north-east corner of the array area.
265. The vessel tracks recorded during the winter survey period are colour-coded by vessel draught and presented in Figure 9.33.

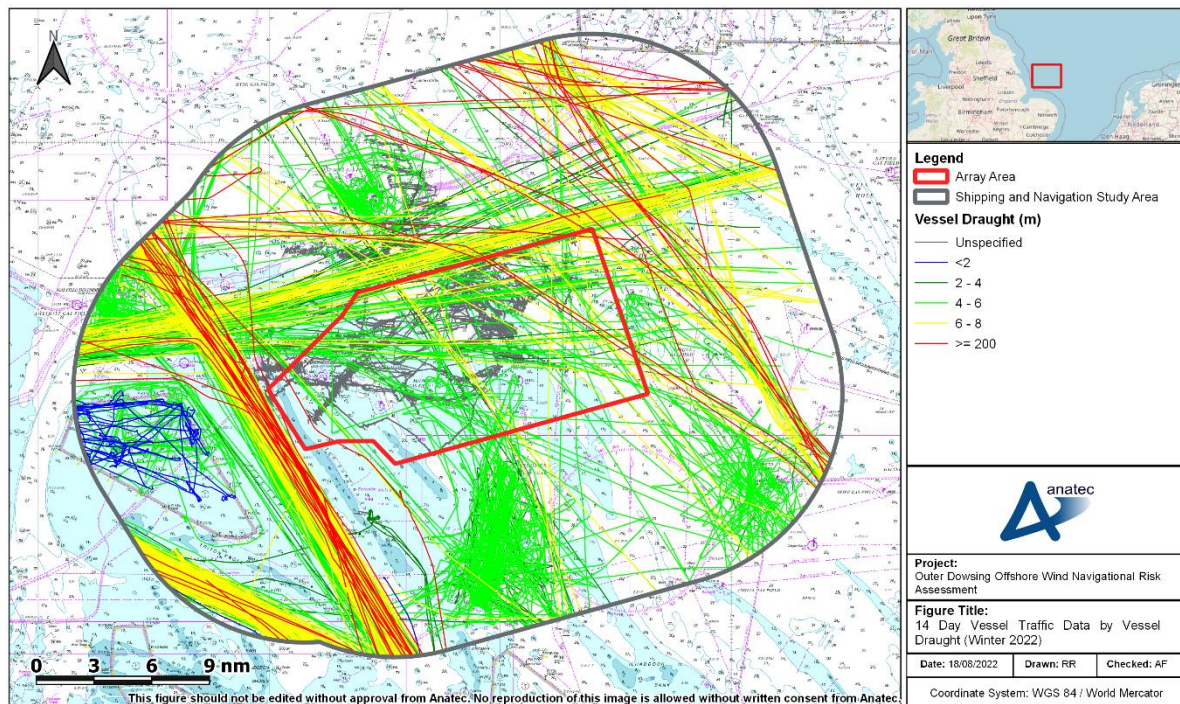


Figure 9.33 14-Day Vessel Traffic Survey Data by Vessel Draught (14-Days Winter 2022)

266. Vessels with the lowest recorded draughts during the winter survey period were windfarm vessels. These vessels were attending Triton Knoll OWF as well as transiting between Hornsea Project One and Grimsby (UK). Oil and gas vessels were also recorded having lower draughts than any other vessel type. Vessels with greater draughts were primarily cargo vessels and tankers and these vessels were transiting mostly to the direct west of the array area between Triton Koll OWF and the Outer Dowsing Shoal as well as some vessels transiting east of the array.

9.2 Offshore Export Cable Corridor

267. This section presents an overview of vessel traffic movements within the ECC study area based on assessment of AIS data alone. The same data periods were used as those for the array area (see Section 9.1).

268. Temporary traffic has been removed in line with the approach taken for the assessment of the array area (see Section 9.1).

269. A plot of the vessel tracks recorded during the 14-day summer data period within the ECC study area is colour-coded by type and presented in Figure 9.34. Following this, Figure 9.35 presents the same data converted to a density heat map.

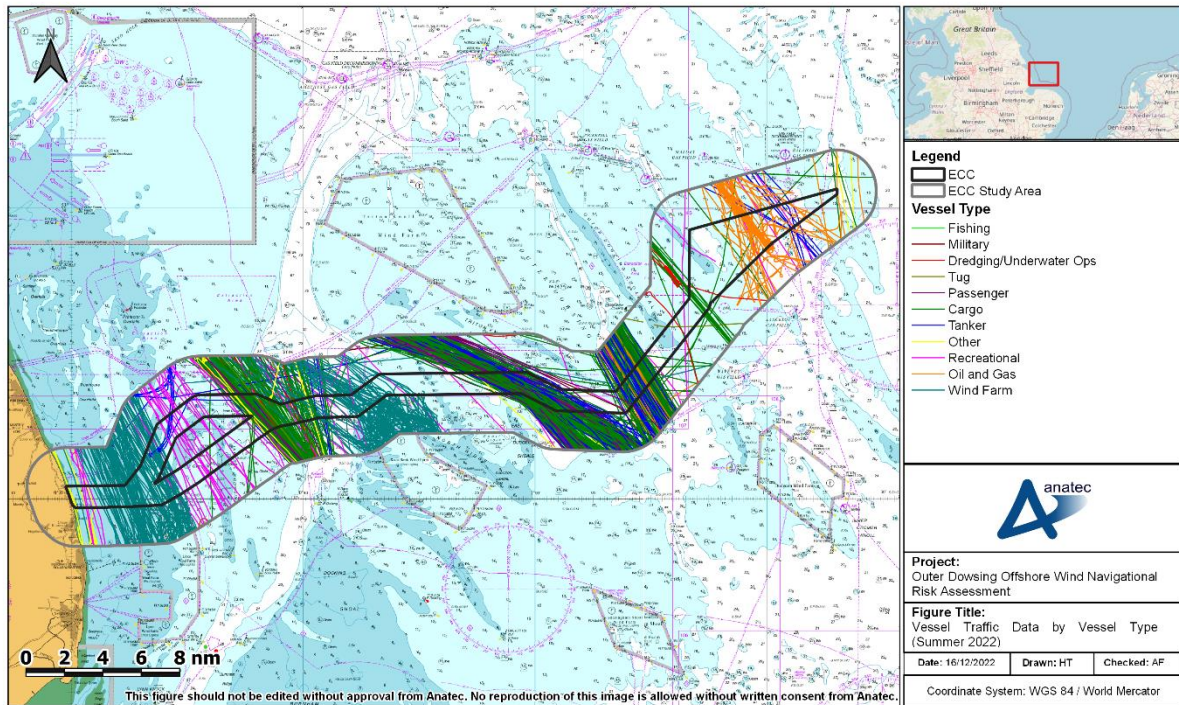


Figure 9.34 14-Day Offshore ECC Vessel Traffic Data by Vessel Type (Summer 2022)

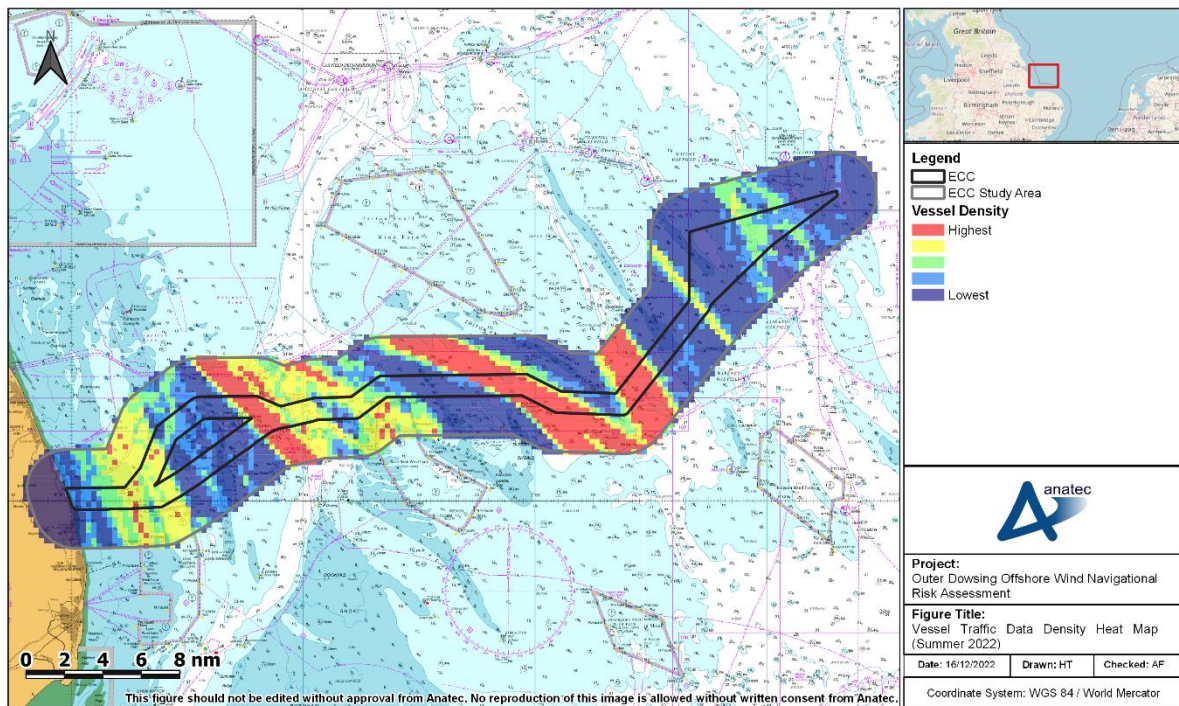


Figure 9.35 14-Day Offshore ECC Vessel Traffic Data Density Heat Map (Summer 2022)

9.2.1 Vessel Counts

270. The daily number of unique vessels recorded within the ECC study area, as well as intersecting the Offshore ECC, during the summer survey period is presented in Figure 9.36. Throughout the summer survey period, approximately 95% of vessel traffic recorded within the ECC study area intersected the Offshore ECC.

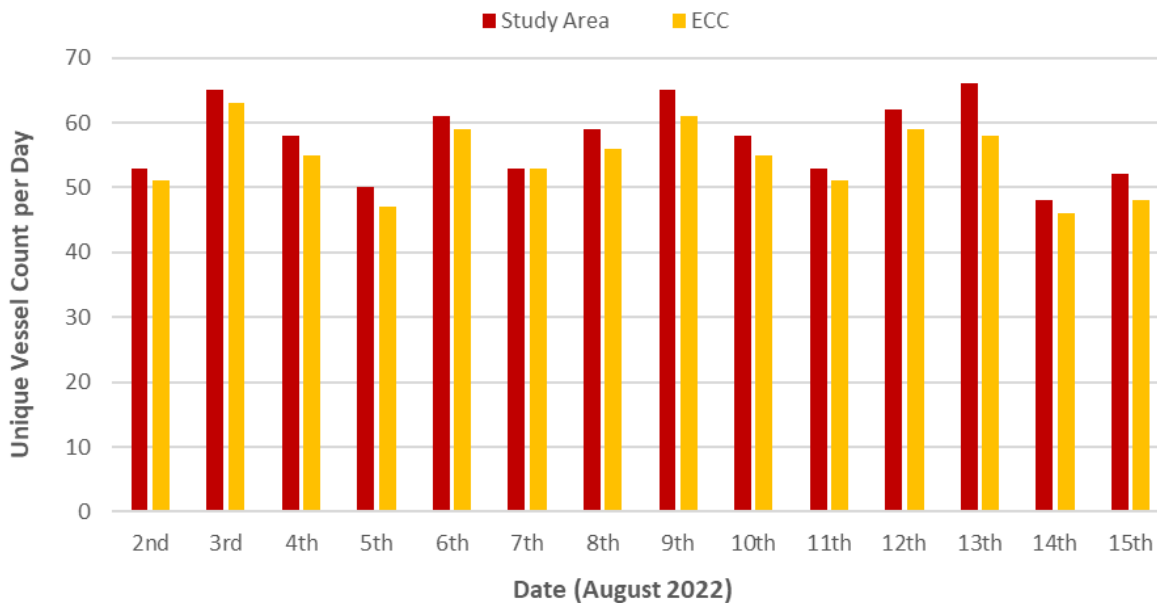


Figure 9.36 Daily Unique Vessel Counts within the ECC Study Area and Offshore ECC (Summer 2022)

271. For the 14-days analysed in the summer survey period, there was an average of 58 unique vessels recorded per day within the ECC study area. An average of 55 unique vessels per day intersected the Offshore ECC.

272. The busiest day recorded within the ECC study area during the summer survey period was 13 August, on which 66 unique vessels were recorded. The busiest day recorded within the Offshore ECC during the summer survey period was 3 August, on which 63 unique vessels were recorded.

273. The quietest day recorded within the ECC study area during the summer survey period was 14 August, on which 48 unique vessels were recorded. The quietest day recorded within the Offshore ECC during the summer survey period was also 14 August, on which 46 unique vessels were recorded.

9.2.2 Vessel Type

274. The percentage distribution of the main vessel types recorded passing within the ECC study area, as well as intersecting the Offshore ECC, during the summer data period is presented in Figure 9.37.

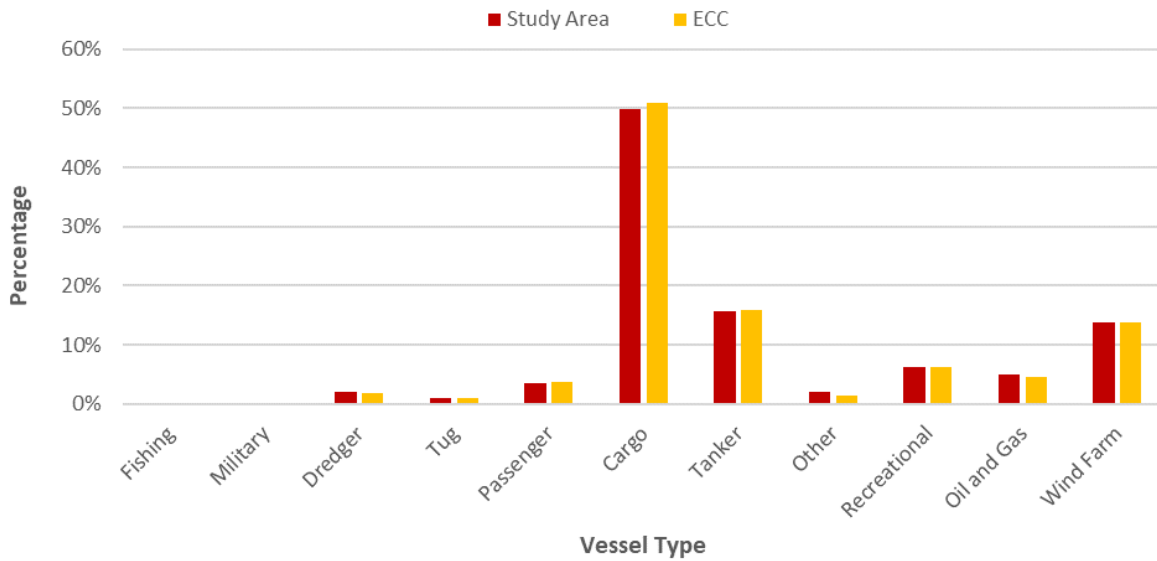


Figure 9.37 Vessel Type Distribution Offshore ECC (Summer 2022)

275. Throughout the summer data period, the main vessel types within the ECC study area were cargo vessels (50%), tankers (16%), and windfarm vessels (14%).

9.2.3 Vessel Size

9.2.3.1 Vessel Length

276. Vessel length information was available for over 99% of all vessels recorded throughout the 14-day data period and ranged from 5m to 238m. Figure 9.38 illustrates the distribution of vessel length recorded throughout the data period.

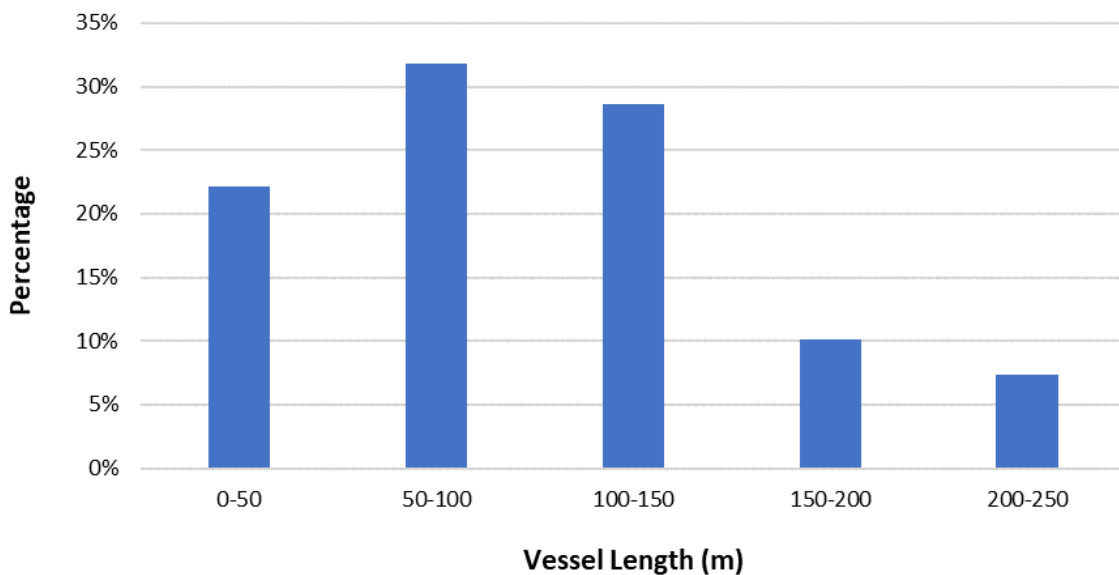


Figure 9.38 Vessel Length Distribution Offshore ECC (14-Days Summer 2022)

277. Excluding the proportion of vessels for which a length was not available the average length of vessels within the ECC study area throughout the summer data period was 98.6m.
278. The vessel tracks recorded during the data period, colour-coded by vessel length are presented in Figure 9.27.

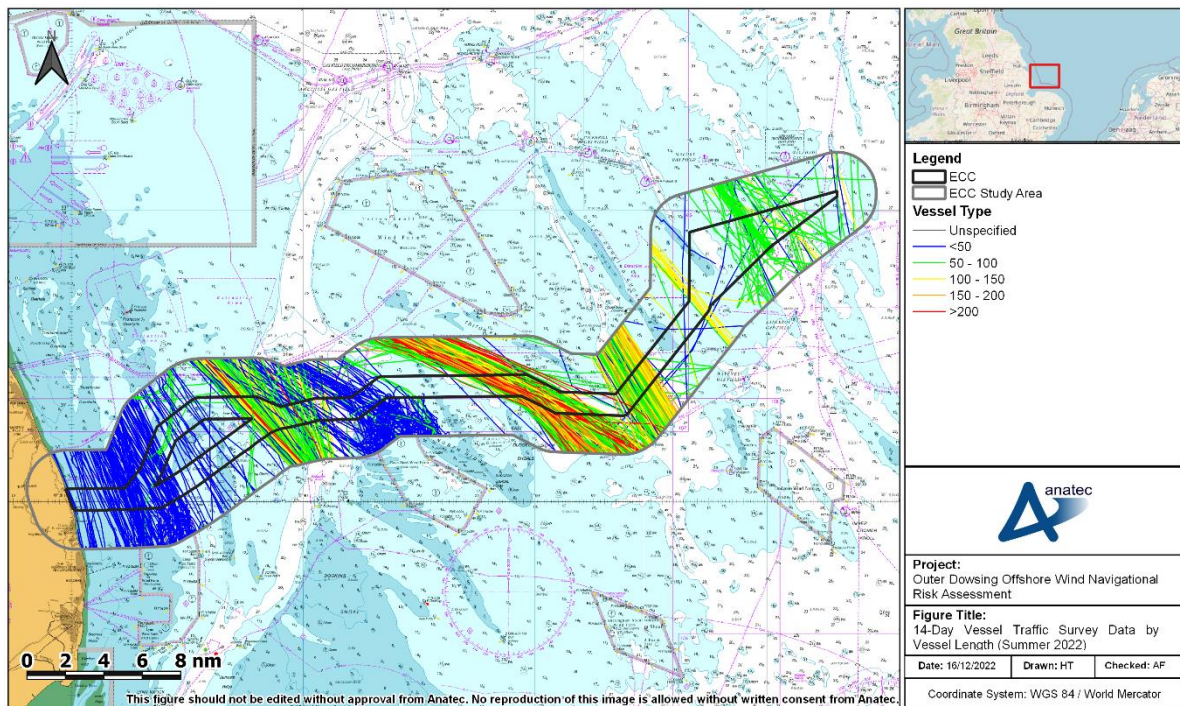


Figure 9.39 14-Day Offshore ECC Vessel Traffic Survey Data by Vessel Length (Summer 2022)

279. The vessels which are shorter in length (less than 50m) were observed transiting nearer to the coast, as well as operating in the north of the Race Bank OWF. Vessels over 200m were recorded travelling in a northwest/southeast direction south of Triton Knoll OWF.

9.2.3.2 Vessel Draught

280. Vessel draught information was available for approximately 89% of all vessels recorded throughout the 14-day data period and ranged from 1.0m to 10.4m. Figure 9.40 illustrates the distribution of vessel draught recorded throughout the data period.

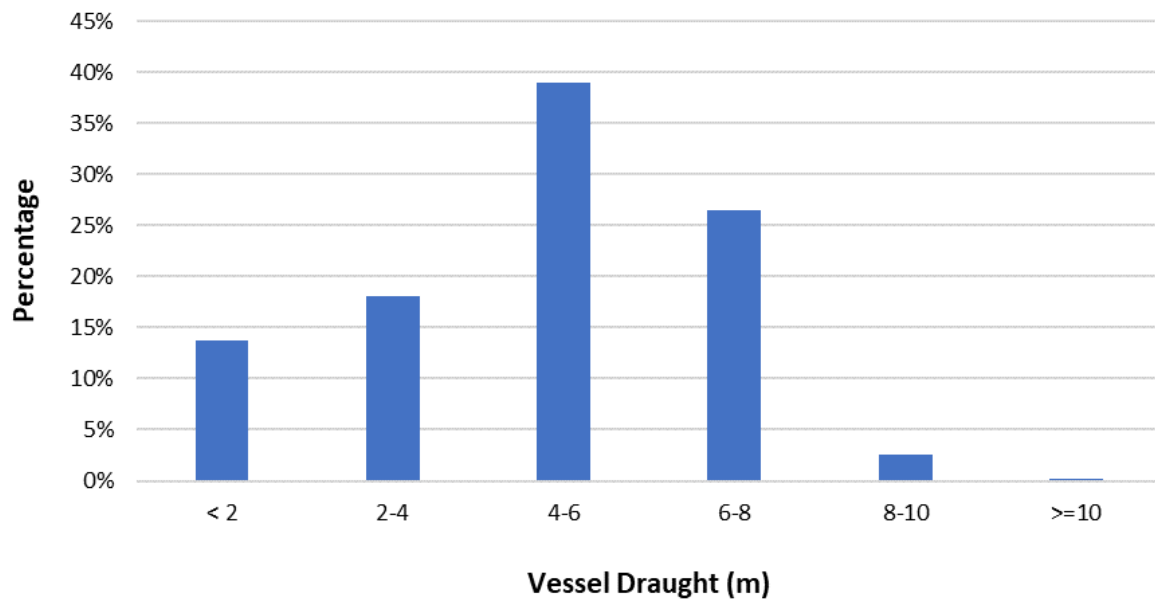


Figure 9.40 Vessel Draught Distribution Offshore ECC (14-Days, Summer 2022)

- 281. Excluding the proportion of vessels for which draught was not available the average draught of vessels within the ECC study area throughout the summer data period was 4.7m.
- 282. The vessel tracks recorded during the data period, colour-coded by vessel length are presented in Figure 9.41.

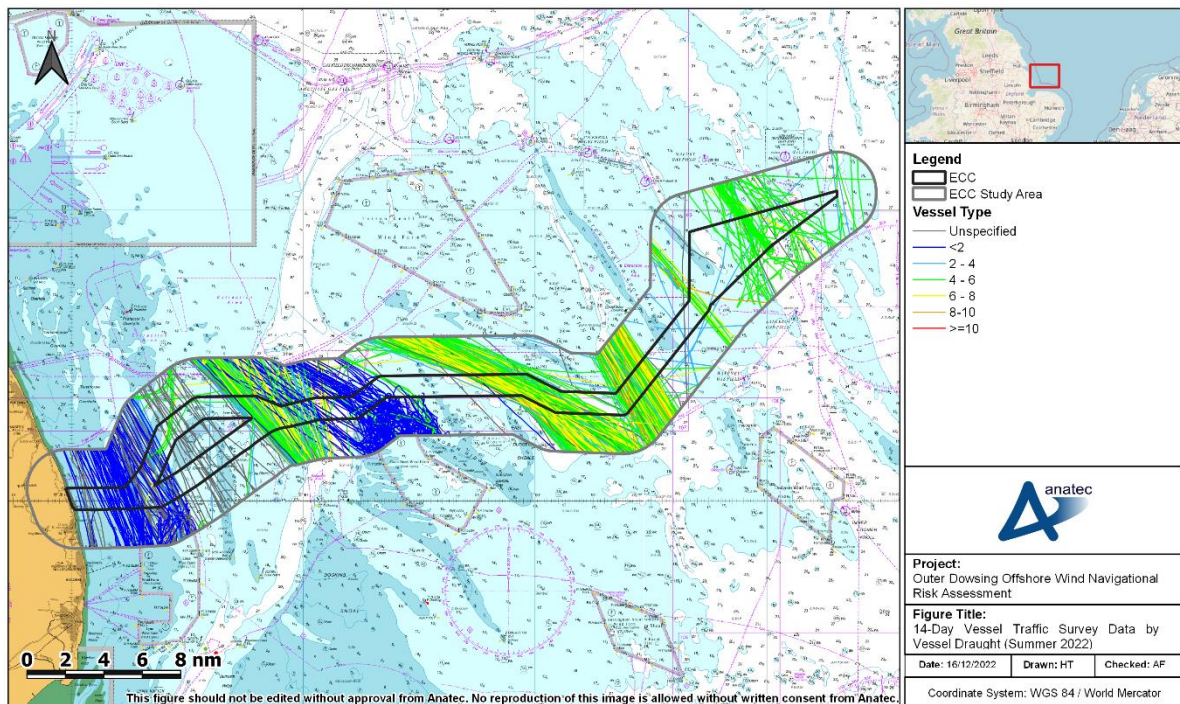


Figure 9.41 14-Day Offshore ECC Vessel Traffic Survey Data by Vessel Draught (Summer 2022)

283. The vessels with shallowest draughts (less than 2m) were generally observed to remain coastal, as well as operating in the north of the Race Bank.

9.3 Offshore Reactive Compensation Platform

284. A plot of the vessel tracks recorded during a 14-day ORCP search area winter survey period, colour-coded by vessel type and excluding any temporary traffic, is presented in Figure 9.42. Following this, Figure 9.43 presents the same data converted to a density heat map.

285. It is noted that as per Section 5.1, a second 14 day vessel traffic survey of the ORCP search area is planned post PEIR to bring the total up to 28 days.

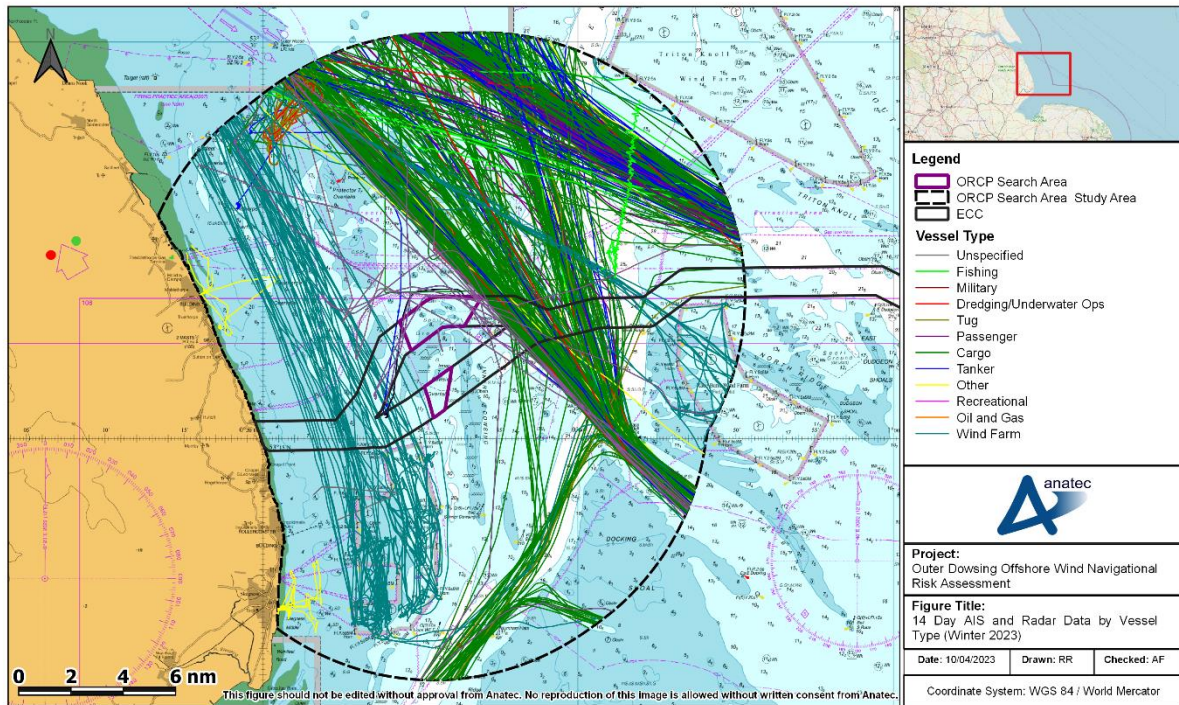


Figure 9.42 Vessel Traffic Survey Data by Vessel Type (14-Days, Winter 2023)

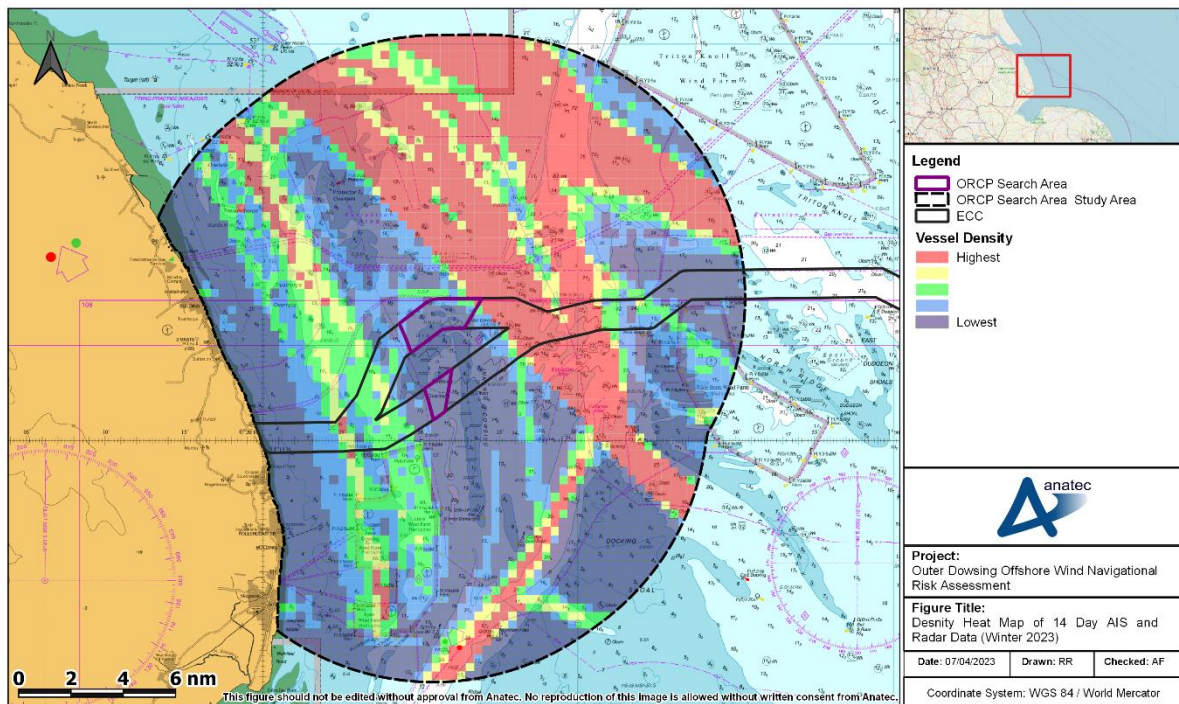


Figure 9.43 Vessel Traffic Density Heat Map (14-Days, Winter 2023)

9.3.1 Vessel Counts

286. The daily number of unique vessels recorded within the ORCP search area study area, as well as intersecting the ORCP search area, during the winter survey period is presented in Figure 9.44. Throughout the winter survey period, approximately 2% of vessel traffic recorded within the ORCP search area study area intersected the ORCP search area.

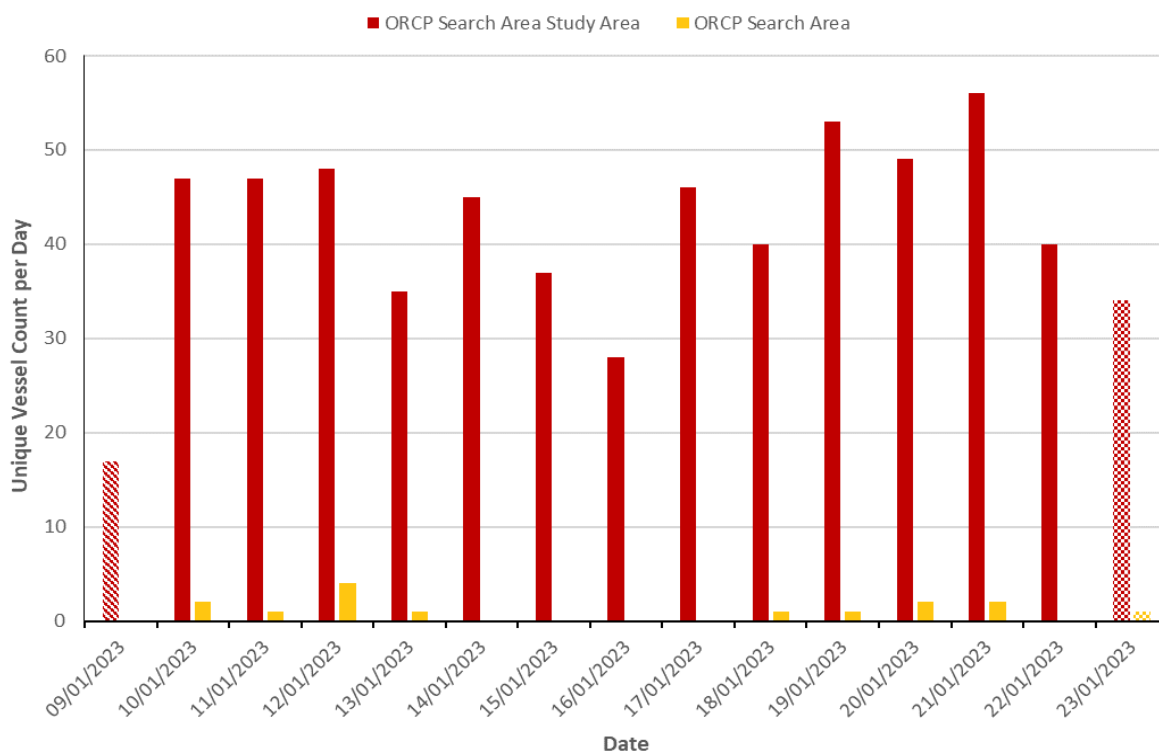


Figure 9.44 Daily Unique Vessel Counts Within the ORCP Search Area and ORCP Search Area Study Area (14-Days, Winter 2023)

287. For the 14-days analysis in the winter survey period, there was an average of 44 unique vessels recorded per day within the ORCP search area study area. An average of one vessel per day intersected the ORCP search area.
288. The busiest day recorded within the ORCP search area study area during the winter survey period was 21 January, on which 56 unique vessels were recorded. The busiest day recorded within the ORCP search area during the winter survey period was 12 January when four unique vessels were recorded.
289. The quietest full day recorded within the ORCP search area study area during the winter survey period was 16 January, on which 28 unique vessels were recorded. The

quietest full day recorded within the ORCP search area was 14, 15, 16, 17, and 22 January when no vessels were recorded within the ORCP search area.

9.3.2 Vessel Type

290. The percentage distribution of the main vessel types recorded within the ORCP search area study area, as well as intersecting the ORCP search area, during the winter survey period is presented in Figure 9.45.

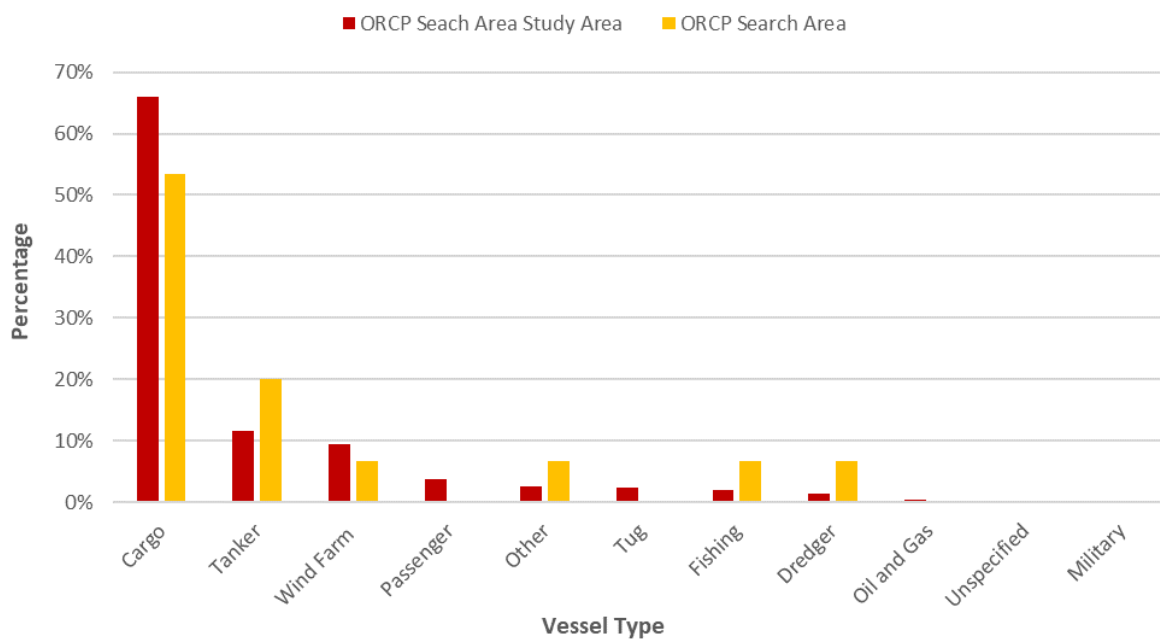


Figure 9.45 Vessel Type Distribution ORCP Search Area (14-Days, Winter 2023)

291. Throughout the winter survey period, the main vessel types recorded within the ORCP search area study area were cargo vessels (66%), tankers (12%), and windfarm vessels (9%). It is noted that no recreational vessels were recorded within the ORCP search area study area during the winter survey, but this can be expected due to the time of year the survey took place.

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

9.3.2.1 Cargo Vessels

293. Figure 9.46 presents a plot of cargo vessels, including commercial ferries, recorded within the ORCP search area study area during the 14-day winter survey period.

294. Throughout the winter survey period, an average of 28 unique cargo vessels per day were recorded within the ORCP search area study area. The most common cargo vessel sub-types present within the ORCP search area study area during the summer survey period were general cargo (54%), containerships (21%), and Ro-Ro (11%).

295. Cargo vessels were noted routing in the deeper waters to the east and avoiding the shallow banks surrounding the ORCP search area as well as routing around the pre-existing OWFs already in proximity to the area.
296. The regular cargo vessels operating within the ORCP search area study area included Ro-Ro vessels operated by DFDS Seaways, CLdN, Eckero Shipping, and Sea Cargo. Ro-Ro vessels are presented in Figure 9.47 for the 14-day winter survey period, colour-coded by vessel operator.

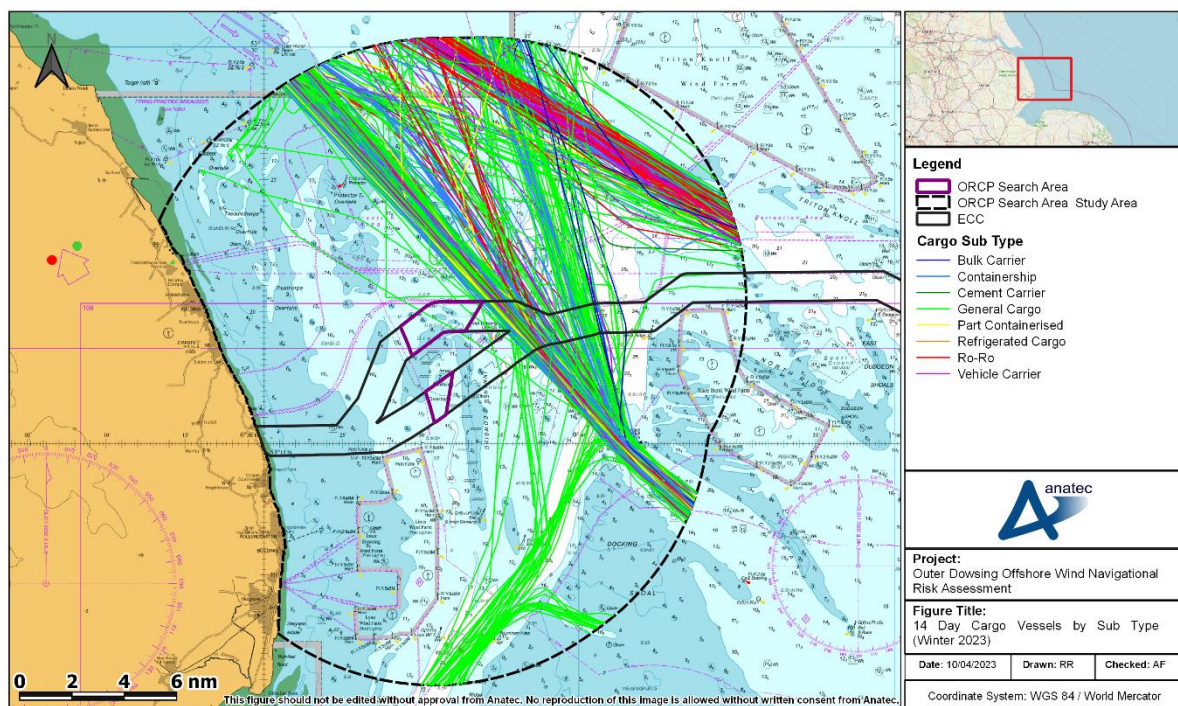


Figure 9.46 Cargo Vessels within ORCP Search Area Study Area by Sub Type (14-Days, Winter 2023)

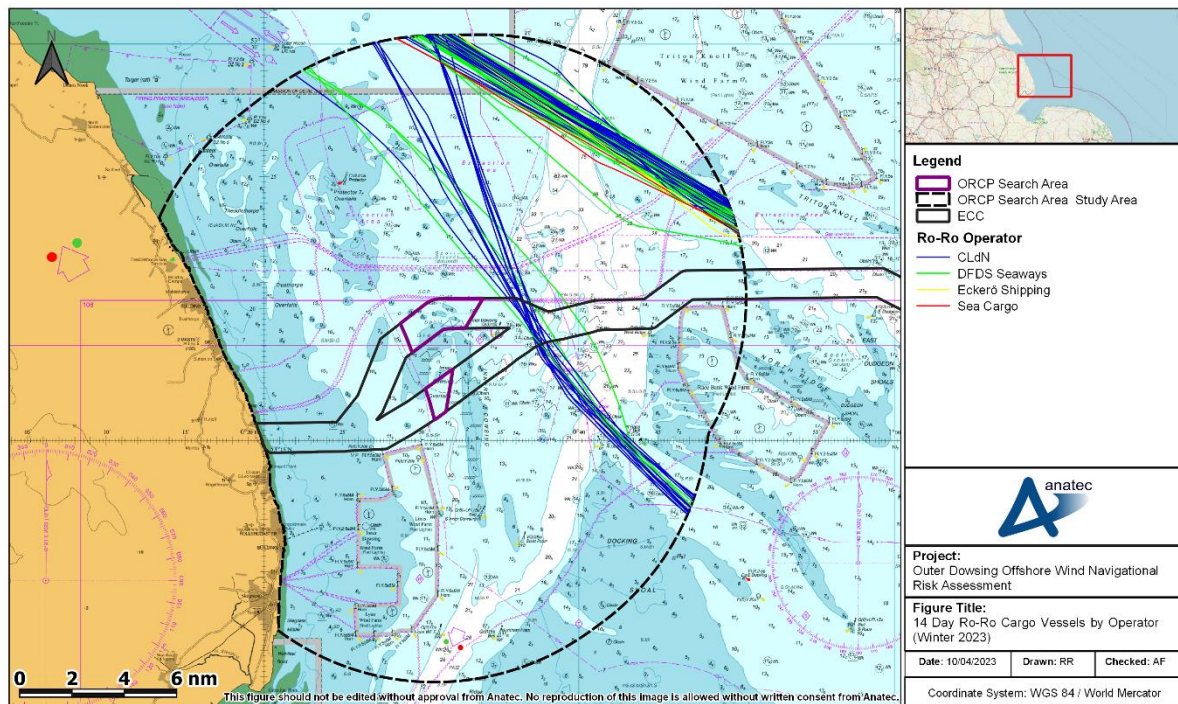


Figure 9.47 Ro-Ro Vessels within ORCP Search Area Study Area by Vessel Operator (14-Days, Winter 2023)

297. On average, three unique Ro-Ro vessels per day were recorded within the ORCP search area study area during the winter survey period. The most common Ro-Ro operators during the winter survey period were CLdN (52%) and DFDS Seaways (39%). CLdN vessels were on routes Killingholme (UK) – Zeebrugge (Belgium) as well as Killingholme (UK) – Rotterdam (the Netherlands). DFDS Seaways vessels were on routes Immingham (UK) – Cuxhaven (Germany) and Immingham (UK) – Vlaardingen (the Netherlands). No Ro-Ro vessel or route passed within the ORCP search area with all vessels noted to the east and north-east of the sites.

9.3.2.2 Tankers

298. Figure 9.48 presents a plot of tankers recorded within the ORCP search area study area during the 14-day winter survey period.

299. Throughout the winter survey period, an average of five unique tankers per day were recorded within the ORCP search area study area with the most common tanker sub-types being combined oil/chemical (42%), LPG (21%), product tankers (19%), and chemical tankers (18%).

300. Three unique instances of tankers anchoring in the shallower waters to the west of the ORCP search area, between the banks, was noted by two unique vessels. These vessels were routing to Immingham (UK) and passed to the immediate north of the

ORCP search area with some instances of intersecting the boundary corners before anchoring at the west.

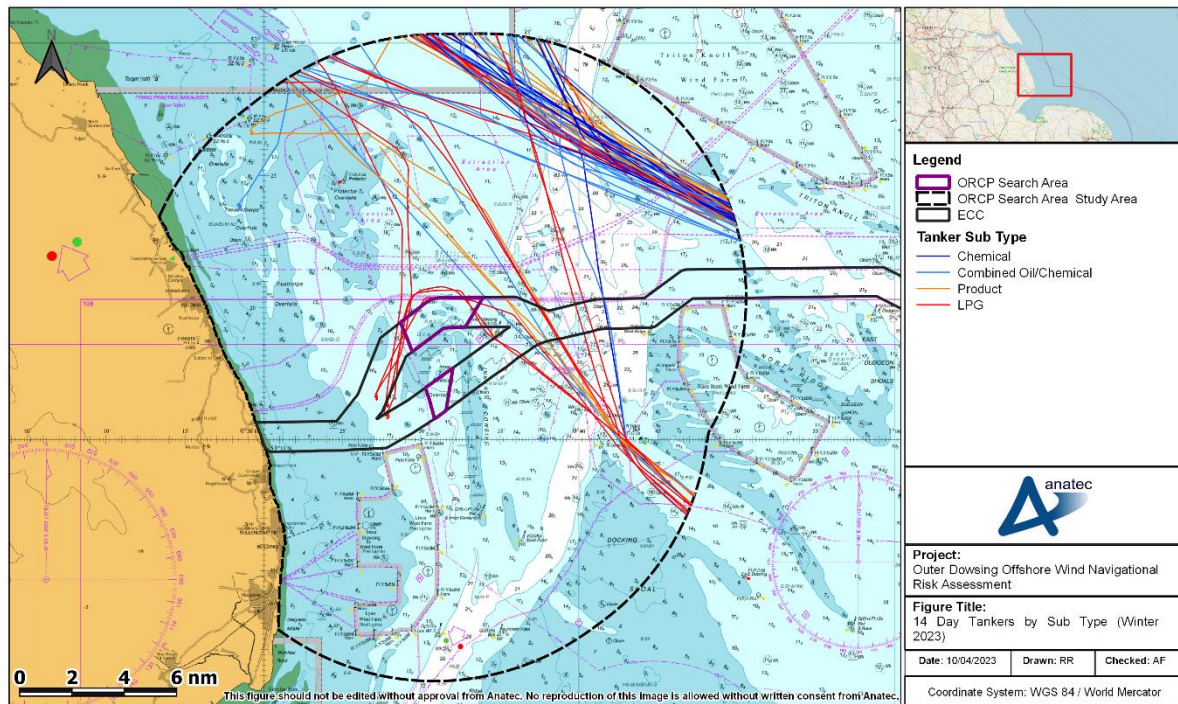


Figure 9.48 Tankers within the ORCP Search Area Study Area by Sub Type (14-Days, Winter 2023)

9.3.2.3 Passenger Vessels

301. Figure 9.49 presents a plot of passenger vessels recorded within the ORCP search area study area during the 14-day winter survey period. It is noted that all passenger vessels recorded within the ORCP search area study area were all RoPax.
302. An average of one to two unique RoPax vessels per day were recorded within the ORCP search area study area. No vessels were recorded routeing through the ORCP search area.
303. RoPax vessels were operated by StenaLine (65%) and P&O Ferries (35%). Roueting of RoPax during the winter period was noted between Killingholme (UK) – Hoek Van Holland (the Netherlands) for StenaLine vessels, and Hull (UK)– Rotterdam (the Netherlands) for P&O Ferries.

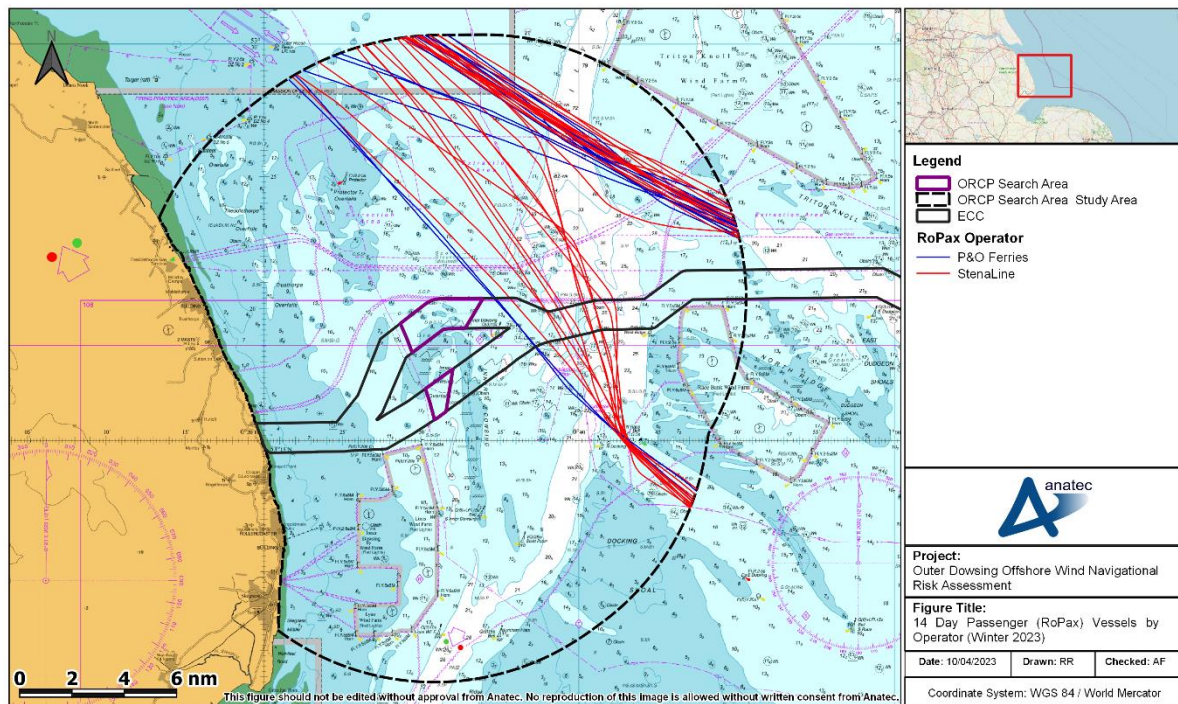


Figure 9.49 Passenger (RoPax) Vessels within the ORCP Search Area Study Area by Vessel Operator (14-Days, Winter 2023)

9.3.2.4 Windfarm Vessels

304. Figure 9.50 presents a plot of windfarm vessels recorded within the ORCP search area study area during the 14-day winter survey period.
305. Throughout the winter survey period, an average of four unique windfarm vessels per day were recorded within the ORCP search area study area.
306. Vessels were mostly associated with the Lincs, Lynn and Inner Dowsing OWFs in the south-west of the study area. Several vessels were also noted attending Race Bank OWF at the eastern extent of the ORCP search area study area. Vessels routing to/from OWFs were noted utilising Grimsby and Great Yarmouth ports.

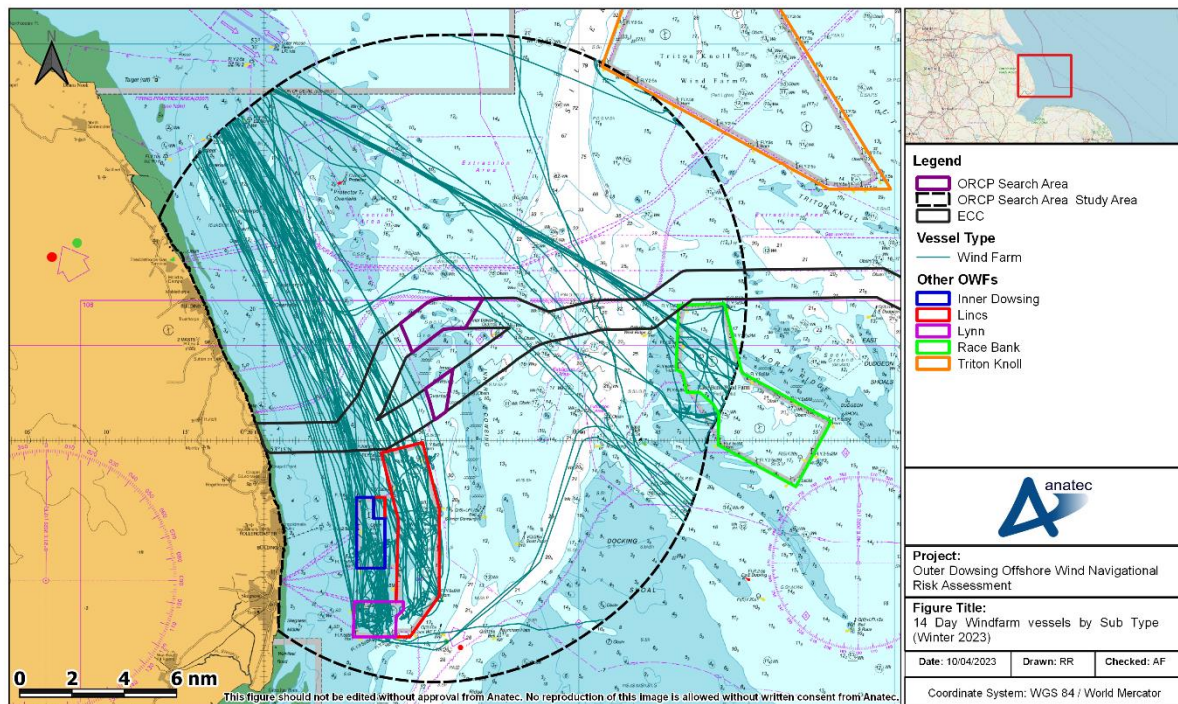


Figure 9.50 Windfarm Vessels within the ORCP Search Area Study Area (14-Days, Winter 2023)

9.3.2.5 Fishing Vessels

307. Figure 9.51 presents a plot of fishing vessels recorded within the ORCP search area study area during the 14-day winter survey period. Approximately 69% of fishing vessel tracks were recorded via AIS with the remaining 31% via Radar.
308. Throughout the winter survey period there was an average of one unique fishing vessel per day recorded within the ORCP search area study area. All fishing vessels were recorded on transit as opposed to being engaged in fishing activity, with most vessels to the north of the ORCP search area. Only one small fishing vessel, recorded via Radar, intersected the northern site of the ORCP search area.

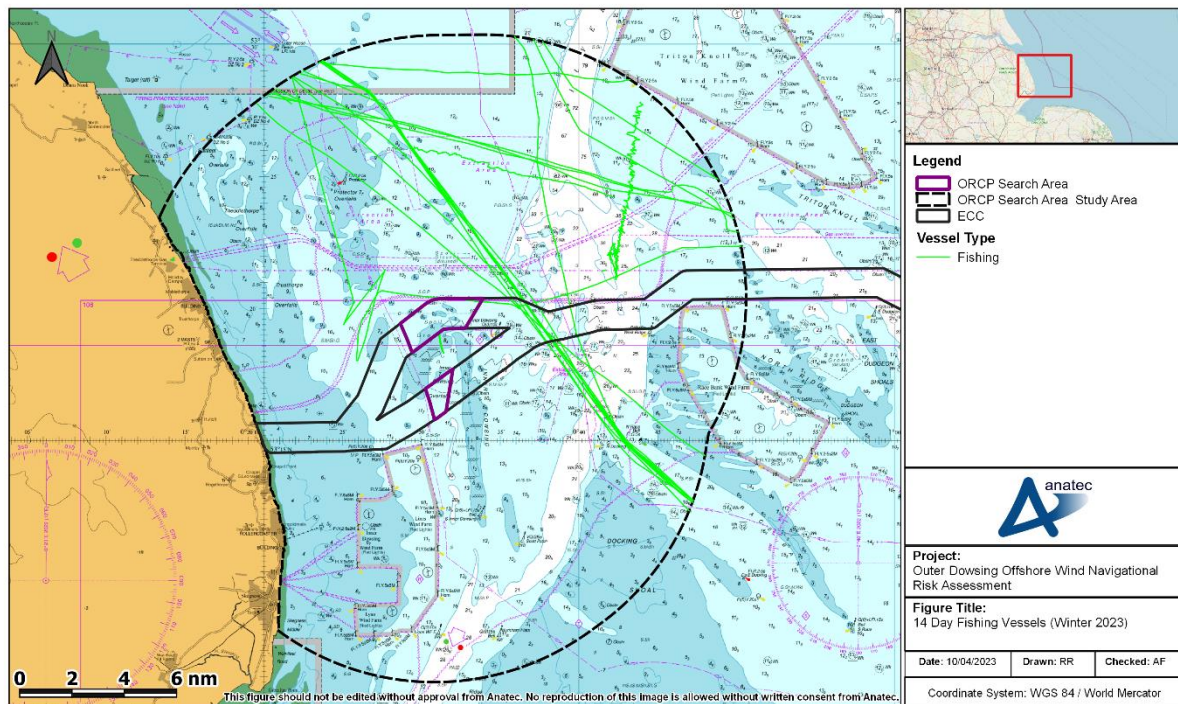


Figure 9.51 Fishing Vessels within the ORCP Search Area Study Area (14-Days, Winter 2023)

9.3.3 Vessel Size

9.3.3.1 Vessel Length

309. Vessel length information was available for over 99% of all vessels recorded within the ORCP search area study throughout the winter survey period. Of those vessels that had unspecified vessel lengths, all were recorded via Radar. Figure 9.52 illustrates the distribution of vessel length recorded throughout the survey period.

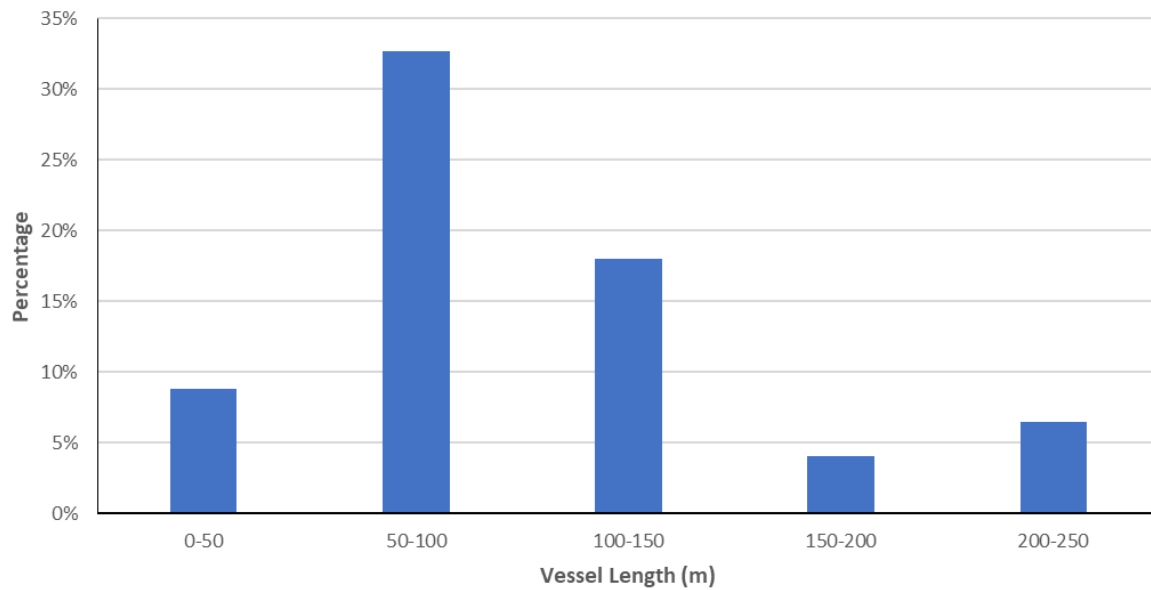


Figure 9.52 Vessel Length Distribution (14-Days, Winter 2023)

- 310. Excluding the proportion of vessels for which a length was not available, the average length of vessels within the ORCP search area study area throughout the winter survey period was 102m. The largest vessels recorded were two unique Ro-Ro vessels at 238m.
- 311. The vessel tracks recorded during the winter survey period, colour-coded by vessel length, are presented in Figure 9.53.

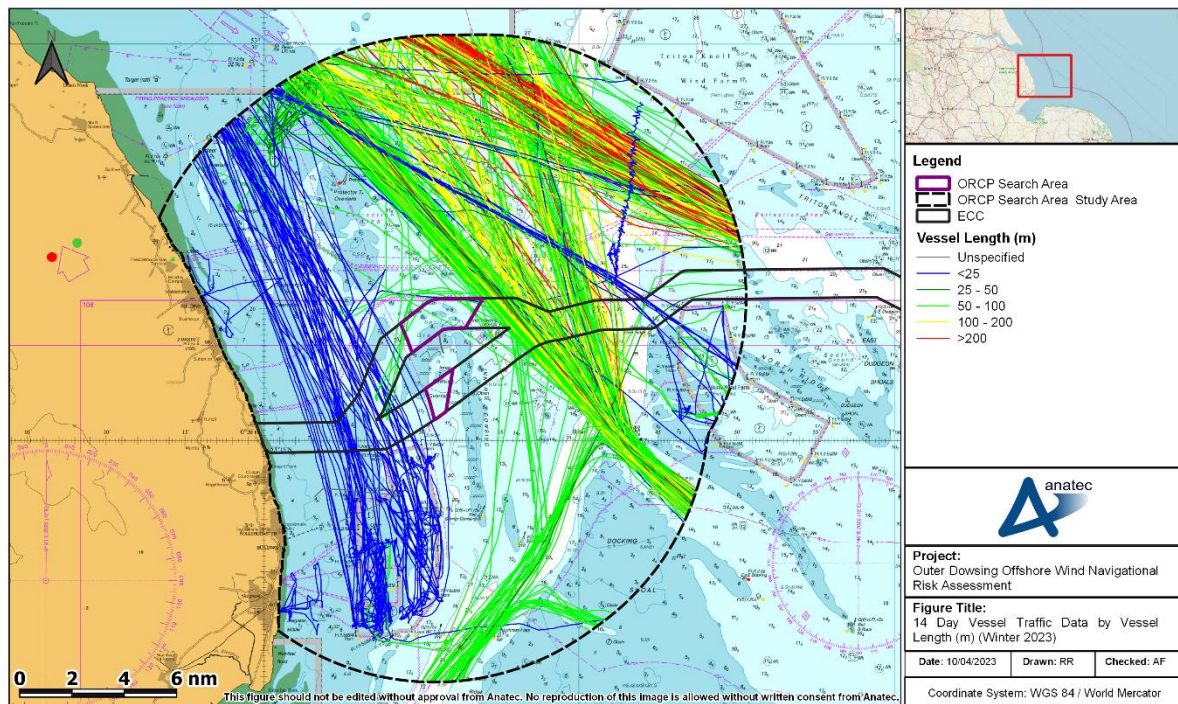


Figure 9.53 Vessel Traffic Survey Data by Vessel Length (14-Days, Winter 2023)

312. Vessels of greater lengths were primarily cargo vessels and passenger vessels (Ro-Ro and RoPax, respectively) noted to the north-east of the ORCP search area study area. Vessels of smaller lengths were typically windfarm vessels, fishing vessels, and inshore SAR vessels.

9.3.3.2 Vessel Draught

313. Vessel draught information was available for approximately 94% of all vessels recorded during the 14-day winter survey period. Of those vessels with unspecified vessel draughts, vessel types included windfarm, fishing, dredging/subsea operations, and 'other'. Figure 9.54 illustrates the distribution of vessel draught recorded throughout the survey period.

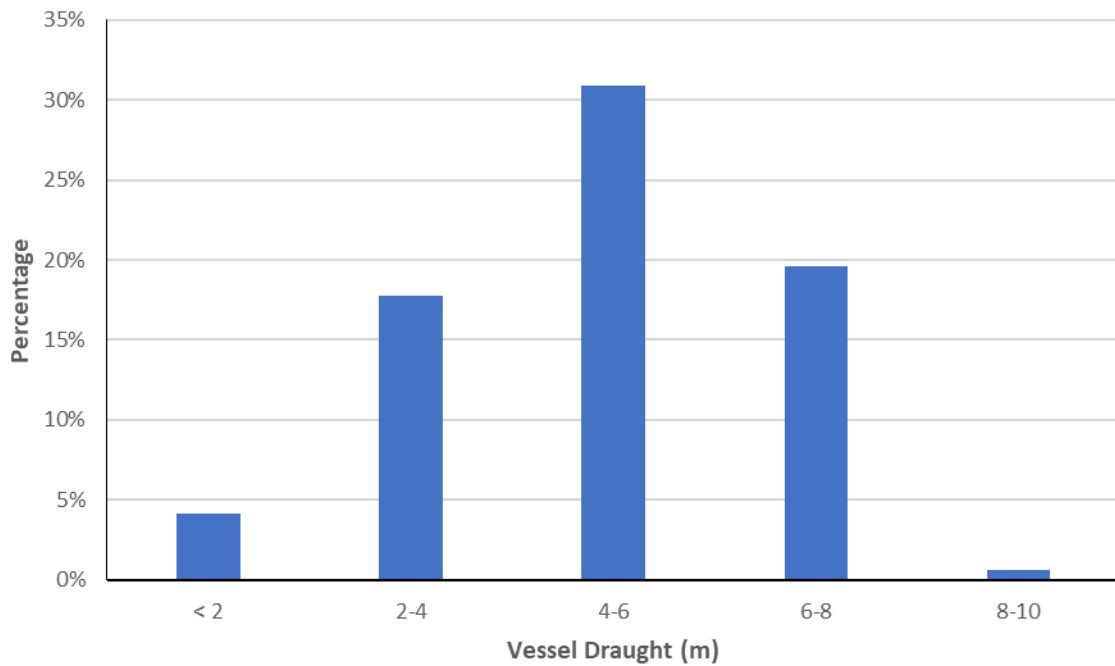


Figure 9.54 Vessel Draught Distribution within the ORCP Search Area Study Area (14-Days, Winter 2023)

- 314. Excluding the proportion of vessels for which a draught was not available, the average draught of vessels within the ORCP search area study area throughout the winter survey period was 4.7m. The largest vessel draught recorded was 9.6m for a general cargo vessel.
- 315. The vessel tracks recorded during the winter survey period, colour-coded by vessel draught, are presented in Figure 9.55.

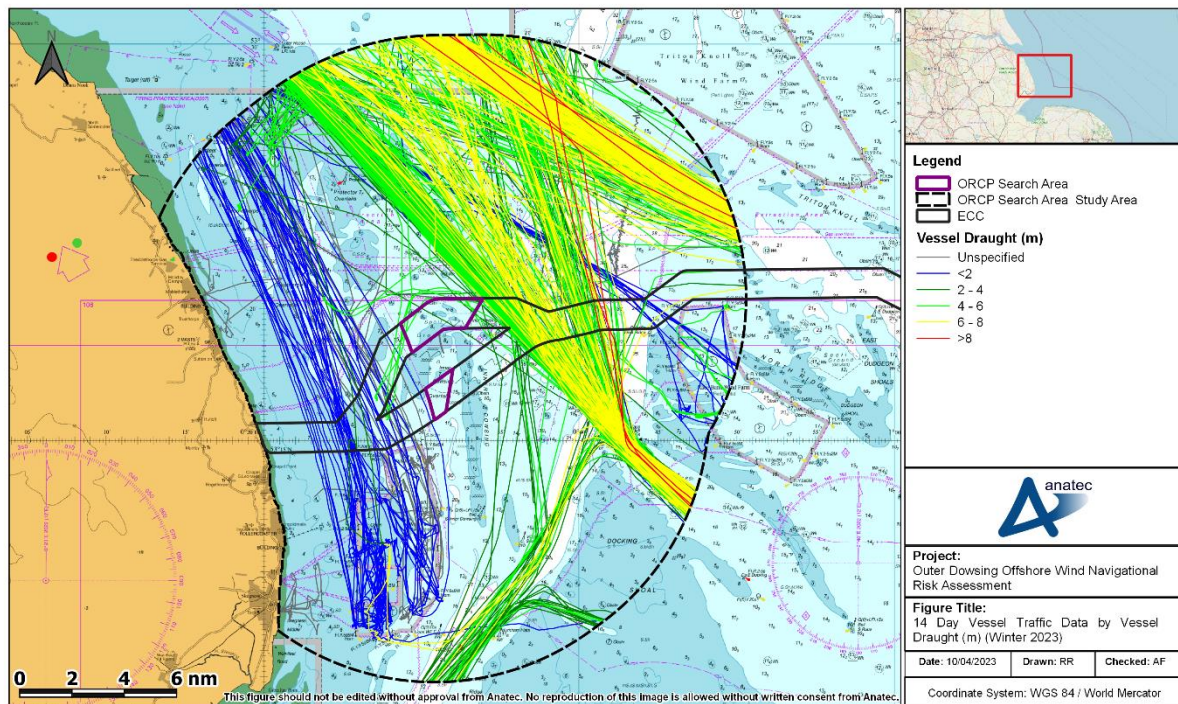


Figure 9.55 Vessel Traffic Survey Data by Vessel Draught (14-Days, Winter 2023)

316. Vessels with the largest draughts were primarily cargo vessels.. These vessels were recorded to the east and north-east of the ORCP search area.

9.4 Anchoring Activity

317. 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.

318. For this reason, those vessels which travelled at a speed of less than one knot (kt) for more than 30 minutes had their corresponding vessel tracks individually checked for patterns characteristic of anchoring activity.

319. No vessels were deemed to be an anchor within the shipping and navigation study area (i.e., within 10nm of the array area) on this basis.

320. The vessels deemed to be anchored within the offshore ECC study area (i.e., within 2nm of the Offshore ECC) are presented in Figure 9.56.

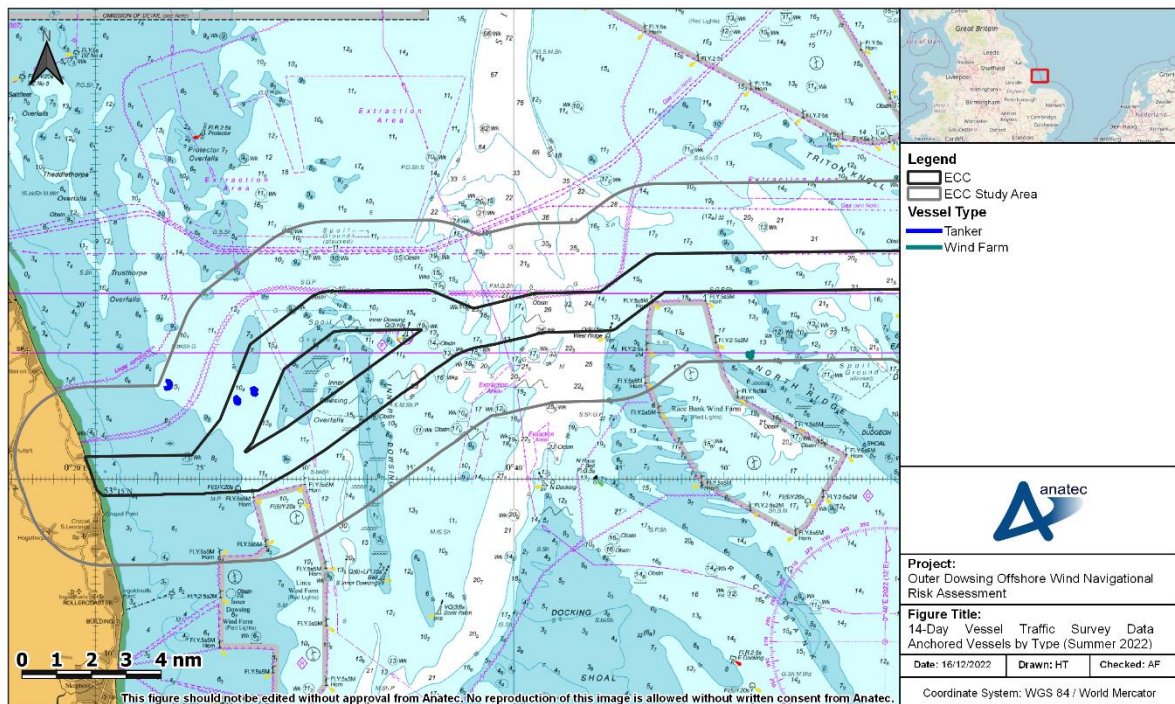


Figure 9.56 14-Day Vessel Traffic Survey Data Anchored Vessels by Type (Summer 2022)

- 321. One unique tanker and one windfarm vessel were recorded at anchor within the ECC study area. The tanker spent a total of seven-days at anchor whilst the windfarm vessel was anchored for a total of three-days.
- 322. The vessels deemed to be anchored within the ORCP search area study area (i.e., within 10nm of the ORCP search area) are presented in Figure 9.57.

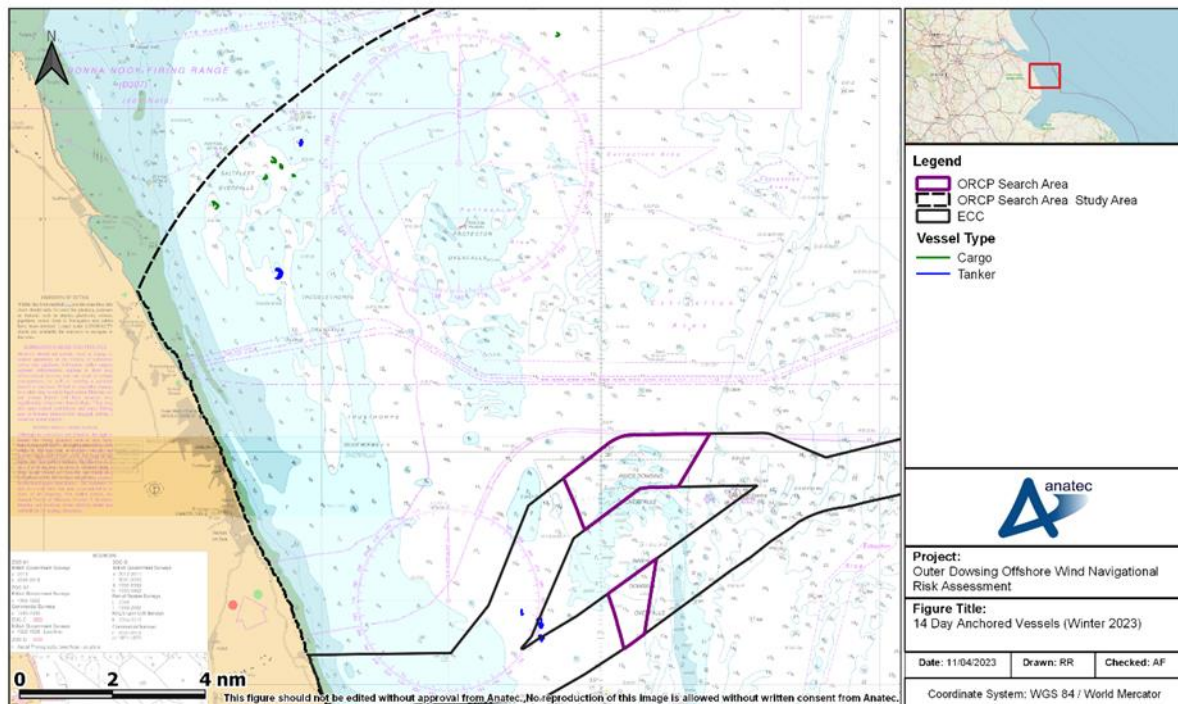


Figure 9.57 14-Day Vessel Traffic Survey Data Anchored by Vessel Type (Winter 2023)

323. There was 11 unique instances of anchoring recorded within the ORCP search area study area over the 14-day winter survey period. These instances of anchoring were recorded by six unique cargo vessels and four unique tankers, one of which anchored on two separate occasions. Most of these vessels at anchor were positioned at the north-west of the ORCP search area study area, just south of the Donna Nook firing practice area and west of the Humber Overfalls (area 493) marine aggregate dredging area. These vessels were likely waiting berth at Humber ports as implied by their AIS broadcast destinations.

10 Base Case Vessel Routeing

10.1 Definition of a Main Commercial Route

324. 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 in Figure 10.1.

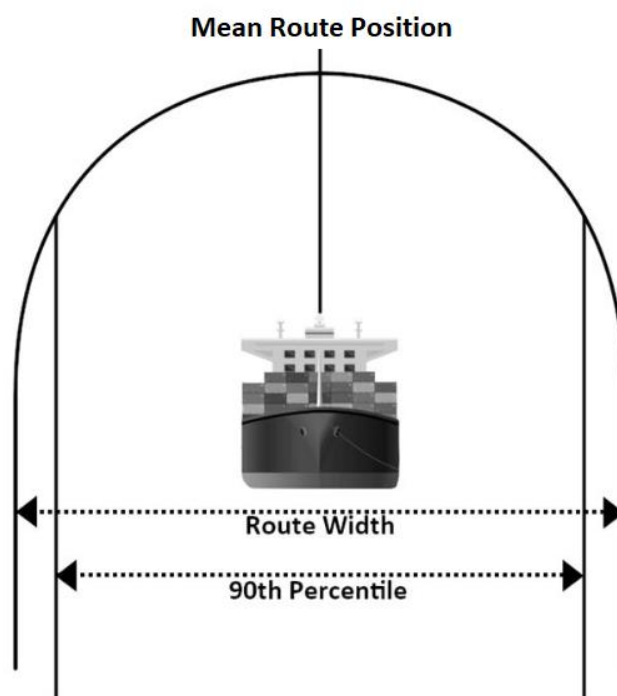


Figure 10.1 Illustration of Main Route Calculation

325. Appropriate routeing analysis will be undertaken for the ORCP post PEIR.

10.2 Pre Windfarm Main Commercial Routes

326. A total of 13 main commercial routes were identified from the vessel traffic survey data. These main commercial routes and corresponding 90th percentiles within the shipping and navigation study area are shown relative to the array area in Figure 10.2. Following this, a description of each route is provided in Table 10.1, including the average number of vessels per day, route terminus locations, and main vessel types. It is noted that the terminus points shown are based on the most common destinations transmitted via AIS by vessels on those routes.

327. To ensure all main commercial routes are captured, the long-term vessel traffic data has been used to validate the main commercial routes identified from the vessel traffic survey data. Lower use or seasonally based routes have still been captured within the modelling process via both the AIS data and Anatec’s ShipRoutes database (Anatec, 2022).

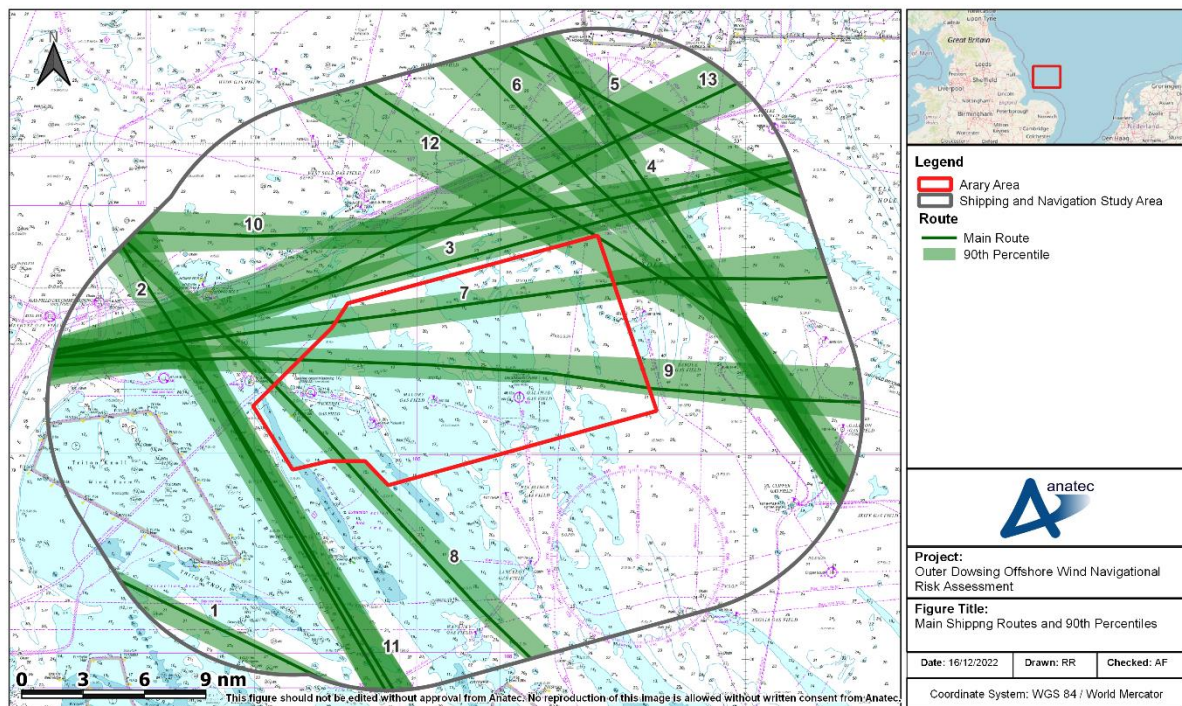


Figure 10.2 Main Commercial Routes and 90th Percentiles

Table 10.1 Description of Main Commercial Routes

Route No.	Average Vessels per Day	Description
1	16	Humber Ports – Rotterdam (The Netherlands). Primarily cargo vessels (59%) and tankers (29%). Includes P&O Ferries and Stena Line commercial ferry routes.
2	12	Tees – Rotterdam (The Netherlands). Primarily cargo vessels (53%) and tankers (34%). Used by DFDS Seaways commercial ferry operator (on the Newcastle-Amsterdam route) as an adverse weather route.
3	4	Humber Ports – Cuxhaven (Germany). Primarily cargo vessels (88%). Used by DFDS Seaways commercial ferry operator (on Immingham-Cuxhaven route).

Route No.	Average Vessels per Day	Description
4	2	Tees Port – Rotterdam (The Netherlands). Primarily cargo vessels (68%).
5	2	Newcastle – Amsterdam (The Netherlands). Primarily passenger vessels (79%). Used by DFDS Seaways commercial ferry operator (on the Newcastle-Amsterdam and Newcastle/North Shields-IJmuiden routes).
6	2	Tees – Rotterdam (The Netherlands). Primarily cargo vessels (49%) and tankers (41%).
7	1	Humber Ports – Cuxhaven (Germany). Primarily cargo vessels (88%).
8	1	Tees – Rotterdam (The Netherlands). Primarily cargo vessels (90%).
9	<1	Humber Ports – Bremerhaven/Hamburg (Germany). Primarily cargo vessels (90%).
10	<1	Humber Ports – Cuxhaven (Germany). Primarily cargo vessels (81%).
11	<1	Humber Ports – Rotterdam (The Netherlands). Primarily tankers (81%).
12	<1	Tees – Amsterdam (The Netherlands). Cargo vessels (35%), tankers (25%), passenger vessels (19%), and oil and gas vessels (19%). Used by DFDS Seaways commercial ferry operator (the Newcastle-Amsterdam route) as an adverse weather route.
13	<1	Humber Ports – Hornsea OWFs. Route used by construction, O&M vessels to the Hornsea offshore wind projects from the Humber.

11 Adverse Weather Vessel Traffic Movements

328. Some vessels and vessel operators may operate alternative routes during periods of adverse weather. This section focuses on vessel movements in adverse weather given the implications if 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 development or activities associated with the development.
329. Adverse weather includes wind, wave and tidal conditions as well as reduced visibility due to fog that can 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 will depend upon the actual stability parameters, hull geometry, vessel type, vessel size and speed.

11.1 Identification of Periods with Adverse Weather

330. Historical weather information provided by the Met Office (Met Office, 2022) has been used to identify periods of adverse weather during 2019 (the year covered by the long-term vessel traffic data) when routes in proximity to the Project could be considered most likely to be altered or cancelled. The key weather events identified are detailed in Table 11.1.

Table 11.1 Key Weather Events During 2021-2022 Relevant to the Project (Met Office)

Weather Event	Date(s)	Details
Storm Evert	29 to 30 July 2021	Strong and unusual winds for the time of year in southern England with wide gusts of over 40kt.
Storm Arwen	26 to 27 November 2021	Severe northerly winds tracking south with gusts over 60kt. Gusts of 85kt in Northumberland. This was one of the most powerful and damaging winter storms of the latest decade.
Storm Barra	7 to 8 December 2021	Deep Atlantic low pressure system which brought strong winds and heavy rain to UK with gusts up to 75kt.
Storm Malik	29 January 2022	Damaging north-westerly winds to Scotland and northeast England with gusts over 60kt and one of the most significant storms to affect the UK since 2015.
Storm Corrie	30 to 31 January 2022	Following on from Storm Malik, bringing further damaging winds with gusts reaching 80kt.
Storm Dudley	14 to 19 February 2022	Wet and windy weather for UK associated with a powerful jet stream with three consecutive storms in one week. Gusts over 60kt.

Weather Event	Date(s)	Details
Storm Eunice	18 to 21 February 2022	Wet and windy weather for UK associated with a powerful jet stream. The most severe and damaging storms to affect England and Wales since February 2014. Wind gusts over 70kt with a high of 106kt.
Storm Franklin	21 to 22 February 2022	Wet and windy weather for UK associated with a powerful jet stream with three consecutive storms in one week. Gusts over 60kt with persistent heavy rain.

11.2 Commercial Routeing Changes

331. The long-term vessel traffic data has been used to identify potential commercial routeing activity related to adverse weather conditions in proximity to the Project with the periods outlined in Table 11.1.
332. One instance of a vessel diverting from its usual route was recorded within the long-term dataset. This incident involved a DFDS Seaways-operated Ro-Ro vessel which tracked approximately 8nm south of its usual path during Storm Arwen, taking it into the shipping and navigation study area and 8nm northwest of the array area.
333. Additionally, as part of the Regular Operator consultation, Regular Operators identified from the 12-month AIS dataset (see Section 4.1 and Annex C) were asked “*whether the Project poses any safety concern to the routeing of your vessels, including any adverse weather routeing*”. The following relevant feedback arose from this consultation:
- Route 12 is used by DFDS Seaways vessels as an adverse weather route, however there is sufficient sea room to the north to accommodate the minor deviations required. DFDS indicated limited concern with this route during consultation.
 - DFDS indicated in relation to their Immingham to Cuxhaven routes that Route 7 is preferred under certain sea state conditions as using the typical routeing (Route 3) would require longer periods in port securing cargo i.e., there is a commercial impact.
 - Bore noted general concerns over adverse weather and stated masters would take additional care when transiting near or between windfarms in such conditions. In adverse conditions certain vessels may choose to pass offshore of the Outer Dowsing bank and therefore post windfarm such vessels would require to pass between Triton Knoll OWF and the array area, and therefore it was considered important that the existing width between the Outer Dowsing bank and Triton Knoll OWF was not reduced.

12 Navigation, Communication, and Position Fixing Equipment

334. 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.

12.1 Very High Frequency Communications (Including Digital Selective Calling)

335. In 2004, trials were undertaken at the North Hoyle OWF, located off the coast of North Wales. As part of these trials, tests were undertaken to evaluate the operational use of typical small vessel VHF transceivers (including Digital Selective Calling (DSC)) when operated close to WTGs.

336. The WTGs 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 WTGs, then it is reasonable to assume that larger vessels with higher powered and more efficient systems would also be unaffected.

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

338. Furthermore, as part of SAR trials carried out at the North Hoyle in 2005, radio checks were undertaken between the Sea King helicopter and both Holyhead and Liverpool coastguards. The aircraft was positioned offshore of the array area 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).

339. In addition to the North Hoyle trials, a desk-based study was undertaken for the Horns Rev 3 OWF 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).

340. 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.

12.2 Very High Frequency Direction Finding

341. 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 WTGs (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).

342. 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, the homer system operated as expected with no apparent degradation.
343. 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.

12.3 AIS

344. No significant issues with interference to AIS transmission from operational OWFs have been observed or reported to date. Such interference was also absent in the trials carried out at North Hoyle (MCA and QinetiQ, 2004).
345. 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.

12.4 Navigational Telex System

346. 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.
347. 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.
348. 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.
349. 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.

12.5 Global Positioning System

350. 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”*.
351. 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).
352. 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 OWFs to date.

12.6 Electromagnetic Interference

353. 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.
354. 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 Field (EMF) are minimised to ensure continued safe navigation.
355. 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.

12.6.1 Subsea Cables

356. The export and inter-array cables for the Project will be Alternating Current (AC). Studies indicate 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).

12.6.2 Wind Turbine Generators (WTGs)

357. MGN 654 (MCA, 2021) notes that small vessels with simple magnetic steering and hand bearing compasses should be wary of using these close to WTGs as with any structure in which there is a large amount of ferrous material (MCA and QinetiQ, 2004). 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.

12.6.3 Experience at Operational Windfarms

358. 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 OWFs.

12.7 Marine Radar

359. This section summarises the results of trials and studies undertaken in relation to Radar effects from OWFs in the UK. It is important to note that since the time of the trials and studies discussed, WTG technology has advanced significantly, most notably in terms of the size of WTGs available to be installed and utilised. The use of these larger WTGs allows for a greater spacing between WTGs 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.

12.7.1 Trials

360. 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 WTGs on the use and effectiveness of marine Radar.
361. In 2004 trials undertaken at North Hoyle (MCA, 2004) areas of concern were identified regarding the potential impact on marine- and shore-based Radar systems due to the large vertical extents of the WTGs (based on the technology at that time). This resulted in Radar responses strong enough to produce interfering side lobes and reflected echoes (often referred to as false targets or ghosts).
362. 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) and with large objects. Side lobe echoes form either an arc on the Radar screen similar to range rings, or a series of echoes forming a broken arc, as illustrated in Figure 12.1.

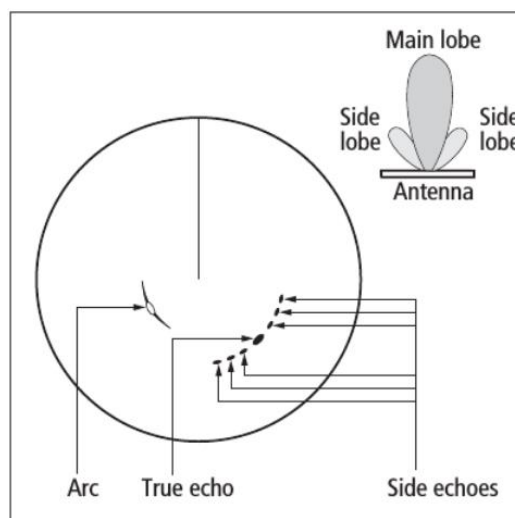


Figure 12.1 Illustration of Side Lobes on Radar Screen

363. Multiple reflected echoes are returned from a real target by reflection from some object in the Radar beam. Indirect echoes or ‘ghost’ images have the appearance of true echoes but are usually intermittent or poorly defined; such echoes appear at a false bearing and false range, as illustrated in Figure 12.2.

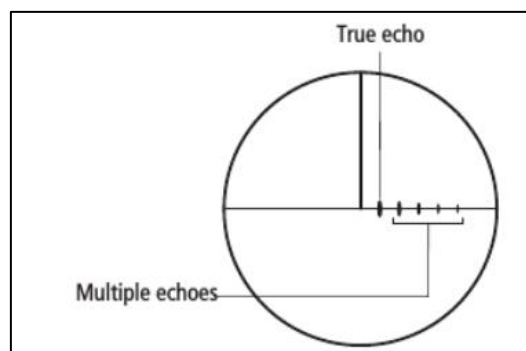


Figure 12.2 Illustration of Multiple Reflected Echoes on Radar Screen

364. 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 OWFs. However, as experience of effects associated with use of marine Radar in proximity to OWFs grew, the MCA refined their guidance, offering more flexibility within the more recent Shipping Route Templates, including the most recent contained within MGN 654 (MCA, 2021).
365. A second set of trials conducted at Kentish Flats OWF 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.

366. Theoretical modelling of the effects of the development of the proposed Atlantic Array OWF, 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 WTGs than that considered within the early trials⁴. 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 WTGs and safe navigation;
- Even in the worst case with Radar operator settings artificially set to be poor, there is significant clear space around each WTG that does not contain any multipath or side lobe ambiguities to ensure safe navigation and allow differentiation between false and real (both static and moving) targets;
- Overall, it was concluded that the amount of shadowing observed was very little (noting that the model considered lattice-type foundations which are sufficiently sparse to allow Radar energy to pass through);
- The lower the density of WTGs 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 WTGs 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 WTGs 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.

⁴ It is acknowledged that other theoretical analysis has been undertaken.

367. In summary, experience in UK waters has shown that mariners have become increasingly aware of any Radar effects as more OWFs 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”.
368. 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, 2008). The interference buffers presented in Table 12.1 are based on MGN 654 (MCA, 2021), MGN 371 (MCA, 2008), MGN 543 (MCA, 2016) and MGN 372 (MCA, 2022).

Table 12.1 Distances at which Impacts on Marine Radar Occur

Distance at Which Effect Occurs (nm)	Identified Effects
0.5	<ul style="list-style-type: none"> ▪ Intolerable impacts can be experienced. ▪ X-Band Radar interference is intolerable under 0.25nm. ▪ Vessels may generate multiple echoes on shore-based Radars under 0.45nm.
1.5	<ul style="list-style-type: none"> ▪ Under MGN 654, impacts on Radar are considered to be tolerable with mitigation between 0.5 and 3.5nm. ▪ S-band Radar interference starts at 1.5nm. ▪ Echoes develop at approximately 1.5nm, with progressive deterioration in the Radar display as the range closes. Where a main vessel route passes within this range considerable interference may be expected along a line of WTGs. ▪ The WTGs produce strong Radar echoes giving early warning of their presence. ▪ Target size of the WTG echo increases close to the WTG with a consequent degradation on both X and S-Band Radars.

369. As noted in Table 12.1, the onset range from the WTGs of false returns is approximately 1.5nm, with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of the Convention on International Regulations for Preventing Collisions at Sea (COLREGs) Rule 6 Safe Speed are particularly applicable and must be observed with due regard to the prevailing circumstances (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).

12.7.2 Experience from Operational Developments

370. The evidence from mariners operating in proximity to existing OWFs is that they quickly learn to adapt to any effects. Figure 12.3 presents the example of the Galloper and Greater Gabbard OWF, which are located in proximity to IMO routing 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 in Figure 12.3 are as per Table 12.1.

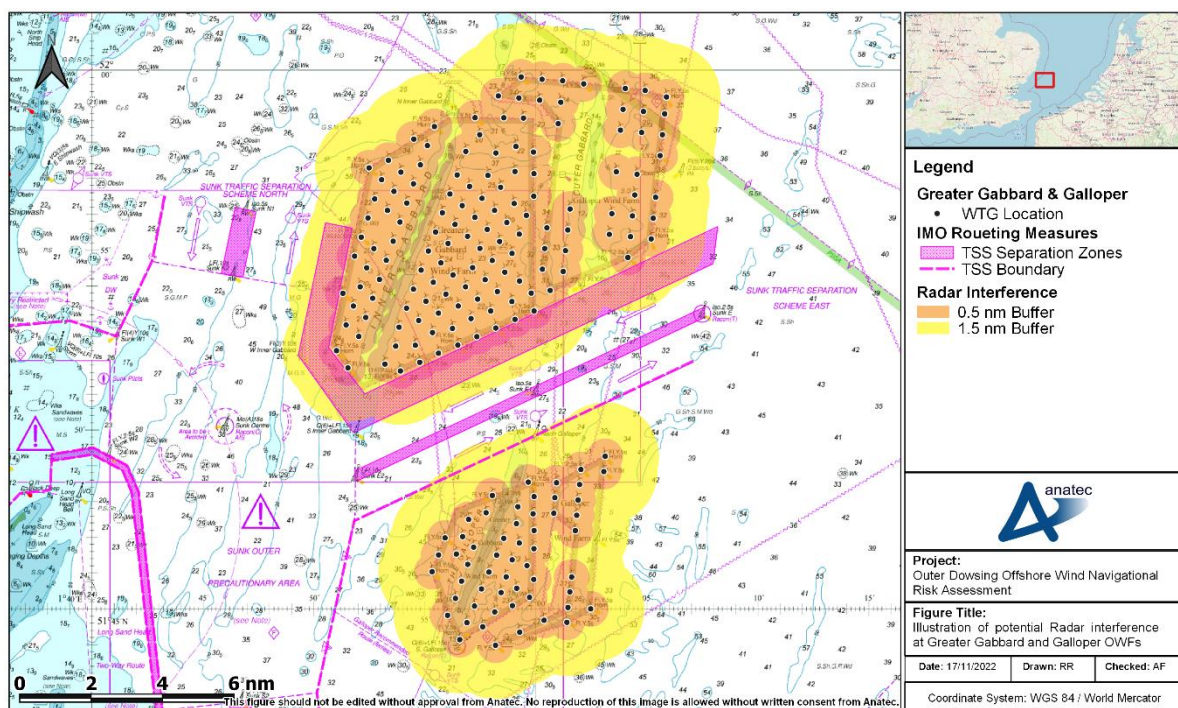


Figure 12.3 Illustration of Potential Radar Interference at Greater Gabbard and Galloper OWFs

371. As indicated by Figure 12.3, vessels utilising these 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 five vessels per day on average. However, to date, there have been no incidents recorded (including any related to Radar use) or concerns raised by other users.

372. 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 3% of the vessel traffic recorded within the shipping and navigation study area was under 15m LOA, although throughout the vessel

traffic surveys approximately 97% of vessel tracks were recorded on AIS, indicating a low level of AIS take-up among vessels for which AIS carriage is not mandatory.

373. 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 OWF.

12.7.3 Increased Radar Returns

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

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

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

12.7.4 Fixed Radar Antenna Use in Proximity to an Operational Windfarm

377. It is noted that there are multiple operational windfarms including Galloper that successfully operate fixed Radar antenna from locations on the periphery of the array. These antennas are able to provide accurate and useful information to onshore coordination centres.

12.7.5 Application to the Project

378. Upon development of the Project, some commercial vessels may pass within 1.5nm of structures within the array area and therefore may be subject to a minor level of Radar interference. Trials, modelling, and experience from existing developments note that any impact can be mitigated by adjustment of Radar controls.

379. Vessels passing within the array will be subject to a greater level of interference with impacts becoming more substantial in close proximity to WTGs. 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.

380. The final NRA will include assessment of a worst case layout for shipping and navigation. The associated assessment will include consideration of radar effects based on the interference buffers presented in Figure 12.3 and as per Table 12.1.
381. 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.

12.8 Sound Navigation Ranging System

382. No evidence has been found to date with regard to existing OWFs 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.

12.9 Noise

383. No evidence has been found to date with regard to existing OWFs to suggest that prescribed sound signals are in any way impacted by acoustic noise produced by the windfarm.

12.10 Summary of Potential Effects on Use

384. Based on the detailed technical assessment of the effects from the presence of the Project on navigation, communication, and position fixing equipment in the previous subsections, Table 12.2 summarises the assessment of frequency and consequence and the resulting risk for each component of this impact. On the basis of these findings, associated risks are screened out of the risk assessment undertaken in Section 17.

Table 12.2 Summary of Risks, Communication and Position Fixing Equipment

Topic	Frequency	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

13 Future Case Vessel Traffic

385. This section summarises the future case post windfarm routeing considered within the NRA at PEIR stage. The final NRA will additionally consider future case traffic growth scenarios within the modelling processes. The scenarios considered will include cases of 10% and 20% commercial traffic increases.

13.1 Methodology

386. It is not possible to consider all potential alternative routeing options for commercial traffic and therefore worst-case alternatives have been considered. Assumptions for re-routeing include:

- All alternative routes maintain a minimum mean distance of 1nm from offshore installations and existing OWF 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 sandbanks, AtoNs and known routeing preferences.

387. Annex 2 of MGN 654 defines a methodology for assessing passing distance from OWF boundaries (the Shipping Route Template) but states that it is “not a prescriptive tool but needs intelligent application”.

388. 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 of established OWFs (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 off established developments. Evidence also demonstrates that commercial vessels do not transit through arrays.

389. The NRA also aims to establish the MDS based on navigational safety parameters, and when considering this the most conservative realistic scenario for vessel routeing is considered to be when main commercial routes pass 1nm 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.

13.2 Post Windfarm Routeing

390. Each of the main routes identified (see Section 10.2) has been assessed for the potential to deviate considering the methodology set out in Section 13.1. A total of

five of the 13 main routes identified are expected to deviate on this basis. The post windfarm routeing is shown in Figure 13.1. Following this, a summary of the deviation magnitudes is provided in Table 13.1.

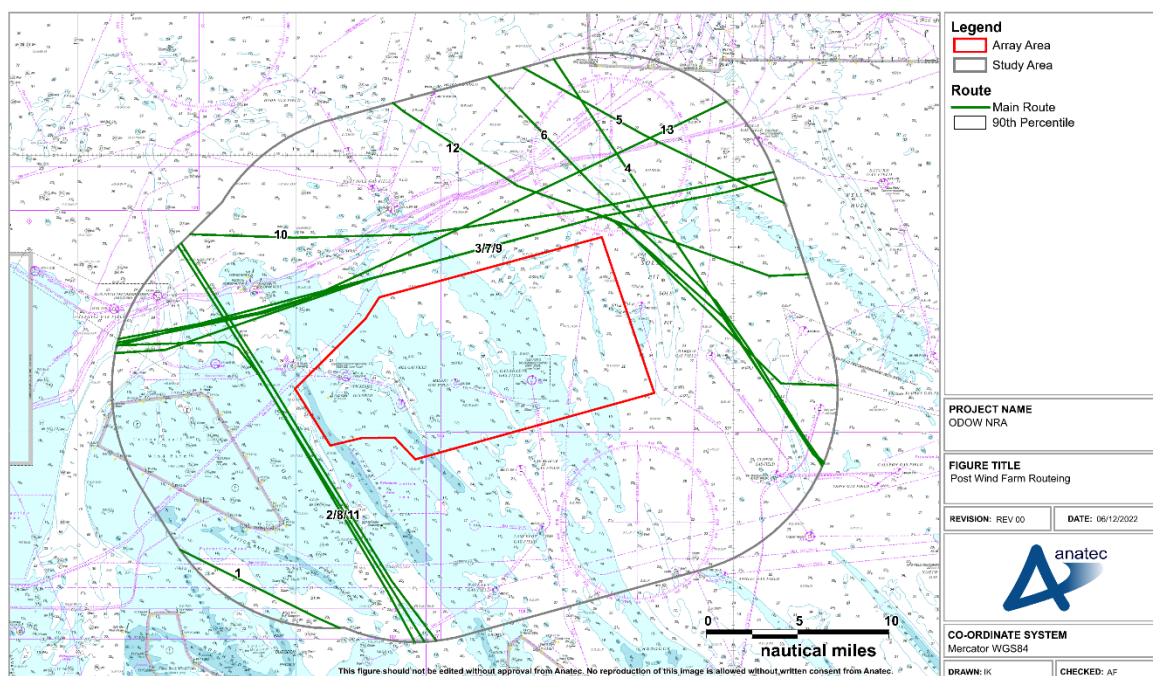


Figure 13.1 Post Windfarm Routeing

Table 13.1 Deviation Summary

Route	Vessels per Day	Distance pre Windfarm (nm)	Distance post Windfarm (nm)	Change (nm)	Percentage Change
1	16	174.3	174.3	0.00	0%
2	12	249.8	249.8	0.00	0%
3	4	286.9	286.9	0.01	0%
4	2	252.3	252.3	0.00	0%
5	2	267.8	267.8	0.00	0%
6	2	250.5	250.5	0.00	0%
7	1	289.1	290.3	1.21	0%
8	1	247.3	249.7	2.37	1%
9	<1	288.3	292.9	4.60	2%
10	<1	288.6	288.6	0.00	0%
11	<1	180.4	180.4	0.00	0%

Route	Vessels per Day	Distance pre Windfarm (nm)	Distance post Windfarm (nm)	Change (nm)	Percentage Change
12	<1	250.8	251.1	0.23	0%
13	<1	69.5	69.5	0.00	0%

391. The deviations of the five routes highlighted in Table 13.1 to are summarised as follows:

- **Route 3: four vessels per day.** Likely vessels will transit further north to increase passing distance from array area. Estimated journey distance increase of > 0.1nm.
- **Route 7: one vessel per day.** Intersects array area, vessels anticipated to pass to the north post windfarm. Estimated journey distance increase of 1.2nm.
- **Route 8: one vessel per day.** Intersects array area, vessels anticipated to pass to the west post windfarm. Estimated journey distance increase of 2.4nm.
- **Route 9: one vessel per day.** Intersects array area, vessels anticipated to pass to the north post windfarm. Estimated journey distance increase of 4.6nm.
- **Route 12: > 1 vessel per day.** Likely vessels will pass further north (a minor deviation) to increase passing distance from array area. Estimated journey distance increase of 0.2nm.

14 Cumulative and Transboundary Overview

392. Cumulative effects have been considered for activities in combination and cumulatively with the Project. This section provides an overview of the baseline used to inform the cumulative risk assessment, including the proposed developments screened into the cumulative risk assessment based on the criteria outlined in Section 3.3. Given the unique nature of shipping and navigation users the bespoke tiering system outlined in Section 3.3 has been applied.

393. The outputs of the cumulative risk assessment are then provided in Section 18.

14.1 Screened in Other Developments

394. The developments screened into the cumulative assessment based on the criteria provided in Section 3.3 are summarised in Table 14.1. A plot showing the locations of the developments relative to the array area is then shown in Figure 14.1, noting baseline developments have been shown for reference.

Table 14.1 Cumulative Tiering Summary

Development	Distance from Array Area (nm)	Status	Data Confidence	Interacts with Main Route	Tier
Dudgeon Extension	7.3	In examination	Medium	Yes	1
Sheringham Shoal Extension	14.1	In examination	Medium	Yes	1
Hornsea Four	19.7	In determination	Medium	Yes	1
Norfolk Vanguard West	45.2	Consented	High	Yes	1
Hornsea Three	45.4	Consented	High	Yes	1
Dogger Bank South	43.8	Scoped	Low	No	2

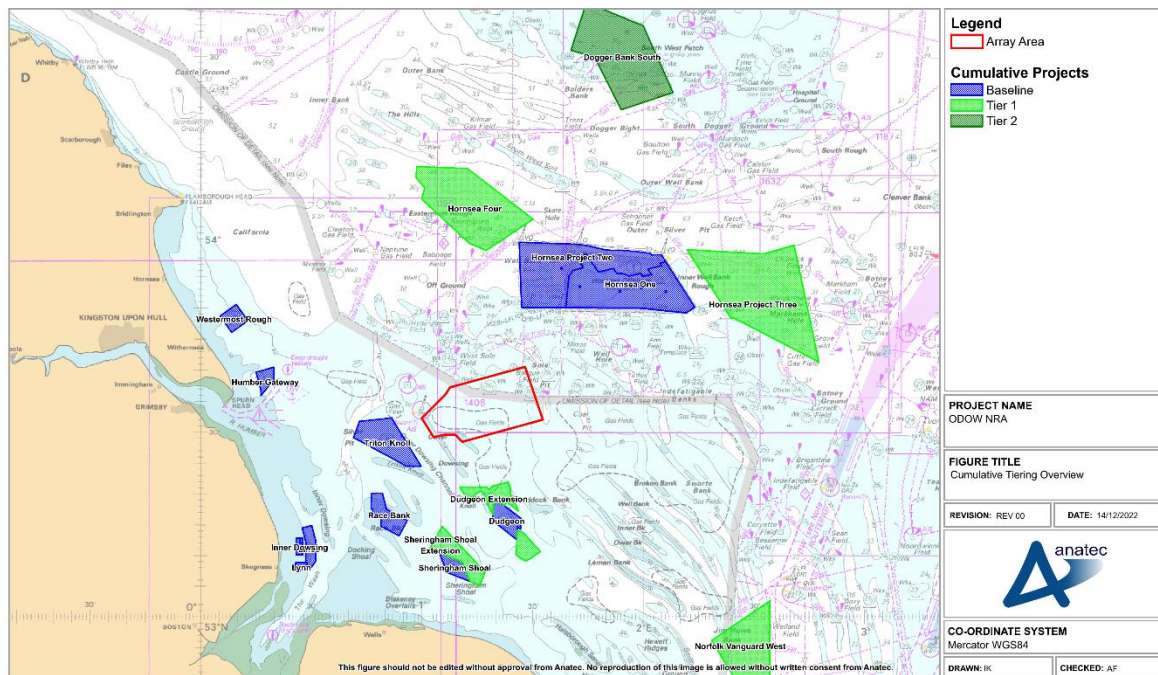


Figure 14.1 Cumulative Tiering Overview

395. The MCA noted during consultation (see Section 4.2.2) that it should be considered whether any of the Dutch windfarms north of the East Anglia projects may have an impact, though they added no impact was expected. These projects are all further than 50nm from the array area and are of low data confidence and as such have been screened out of detailed assessment. This will be revisited post PEIR.

14.2 Cumulative Routing Options

396. Each main route identified (see Section 10.2) has been assessed to determine any interactions with the screened in cumulative developments (see Section 14.1). The outputs of this assessment are summarised in Table 14.2.

Table 14.2 Potential Cumulative Routing Interactions with Cumulative Developments

Route No.	Average Vessels per Day	Description	Outer Dowsing	Hornsea Four	Hornsea Three	Dudgeon Extension	Sheringham Shoal Extension	Norfolk Vanguard West	Dogger Bank South
1	16	Humber Ports – Rotterdam (The Netherlands)				✓		✓	

Route No.	Average Vessels per Day	Description	Outer Dowsing	Hornsea Four	Hornsea Three	Dudgeon Extension	Sheringham Shoal Extension	Norfolk Vanguard West	Dogger Bank South
2	12	Tees – Rotterdam (The Netherlands)				✓			
3	4	Humber Ports – Cuxhaven (Germany)	✓		✓				
4	2	Tees Port – Rotterdam (The Netherlands)		✓				✓	
5	2	Newcastle – Amsterdam (The Netherlands)							
6	2	Tees – Rotterdam (The Netherlands)						✓	
7	1	Humber Ports – Cuxhaven (Germany)	✓		✓				
8	1	Tees – Rotterdam (The Netherlands)	✓			✓		✓	
9	<1	Humber Ports – Bremerhaven/Hamburg (Germany)	✓						
10	<1	Humber Ports – Cuxhaven (Germany)			✓				
11	<1	Humber Ports – Rotterdam (The Netherlands)				✓			
12	<1	Tees – Amsterdam (The Netherlands)	✓					✓	
13	<1	Humber Ports – Hornsea OWFs							

397. A total of five routes are likely to deviate as a result of the array area, namely Routes 3, 7, 8, 9 and 12. Based on the potential interactions with other screened in cumulative developments as shown in Table 14.2, the likely cumulative routing options for these five routes is summarised as follows:

- **Route 3:** vessels on this route are likely to undertake a minor deviation to the north of the array area to increase passing distance from the structures and will then pass south of Hornsea Three.
- **Route 7:** vessels on this route are likely to deviate to the north of the array area and will then pass south of Hornsea Three.
- **Route 8:** vessels are likely to pass west of the array area, in between the Dudgeon and Sheringham Shoal extensions, and south of Norfolk Vanguard West to access the DR1 Deep Water Route (DWR).
- **Route 9:** vessels may pass either north or south of the array area, no other interactions with cumulative developments have been identified
- **Route 12:** vessels are likely to utilise a minor deviation to the north to avoid the array area and pass north of Norfolk Vanguard West to access the DR1 DWR.

15 Collision and Allison Risk Modelling

398. To inform the risk assessment at PEIR stage, a quantitative assessment of vessel to vessel collision risk has been undertaken for both a pre windfarm and post windfarm scenario.

399. The final NRA will include additional modelling as follows:

- Baseline encounters assessment;
- Vessel to structure powered allision;
- Vessel to structure drifting allision; and
- Allision risk to fishing vessels navigating internally in the array area;
- Consequences assessment to estimate Potential Loss of Life (PLL) and pollution risk associated with the project; and
- Consideration of future case traffic increase scenarios of 10 and 20%.

15.1 Vessel to Vessel Collision

15.1.1 Pre Windfarm

400. Using the pre windfarm vessel routeing as input (see Section 10.2), Anatec's COLLRISK model has been run to estimate the existing vessel to vessel collision risk in proximity to the array area. The route positions and widths are based on the vessel traffic data sources considered (see Section 5).

401. A heat map based upon the geographical distribution of collision risk within a 0.5×0.5nm grid for the base case is presented in Figure 15.1.

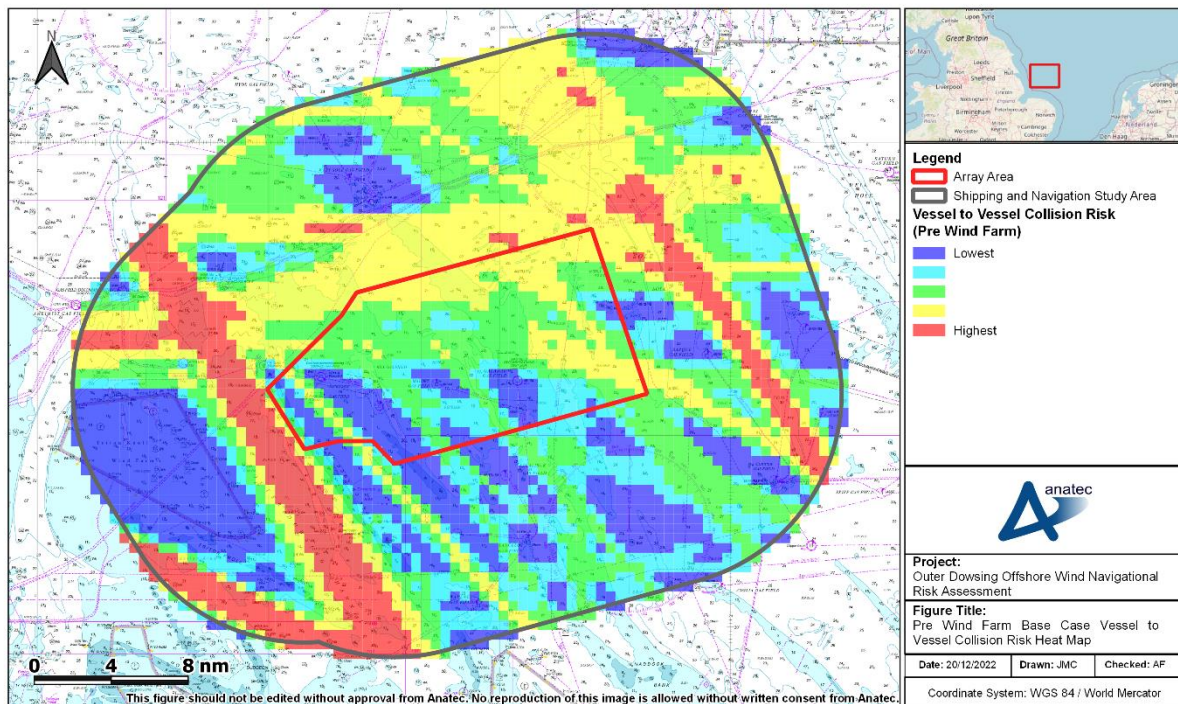


Figure 15.1 Pre windfarm vessel to vessel collision risk heat map within study area

402. The annual collision frequency pre windfarm was estimated to be 3.21×10^{-2} , corresponding to a return period of approximately one in 31 years. The highest risk areas generally correspond to the busiest main routes identified in Section 10.2.
403. 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, such as minor impacts. Other incident data, which includes minor incidents, is presented in Section 8.

15.1.2 Post Windfarm

404. Using the post windfarm routing as input (see Section 13.2), Anatec’s COLLRISK model has been run to estimate the anticipated vessel to vessel collision risk in proximity to the array area.
405. A heat map based upon the geographical distribution of collision risk within a 0.5×0.5 nm grid for the base case is presented in Figure 15.2.

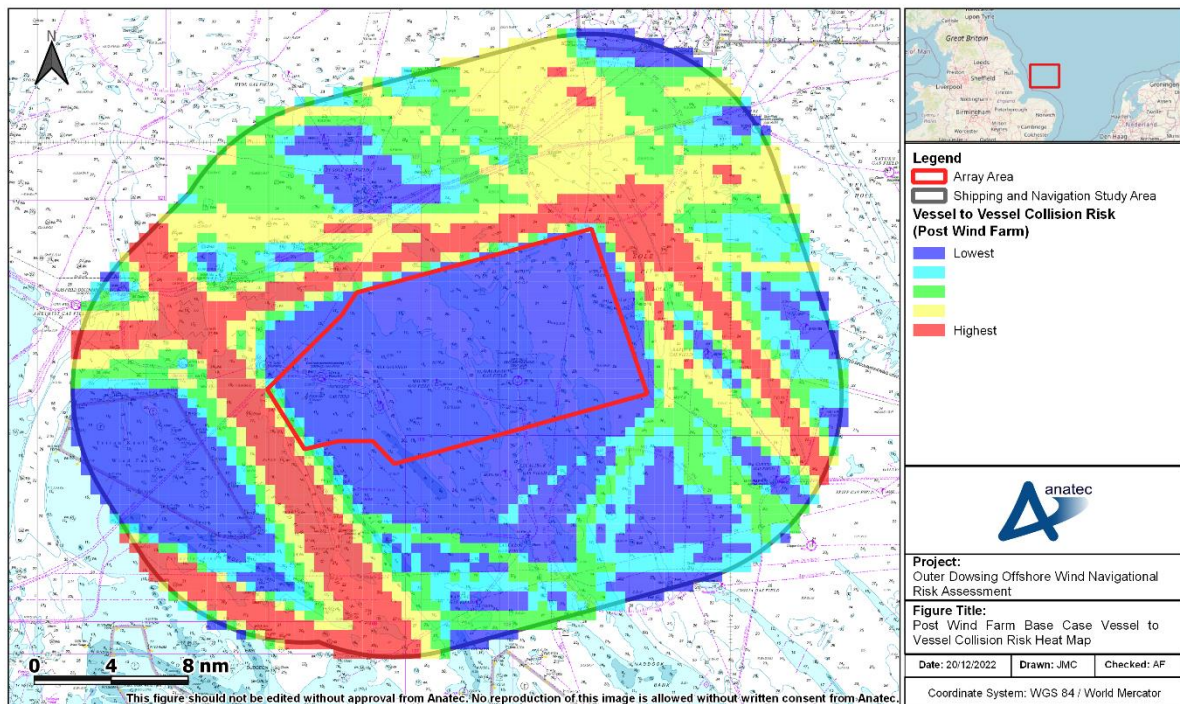


Figure 15.2 Post windfarm vessel to vessel collision risk heat map within study area

406. The annual collision frequency post windfarm was estimated to be 3.85×10^{-2} , corresponding to a return period of approximately one in 26 years. This represents a 19% increase in collision frequency compared to the pre windfarm base case result.
407. The greatest change in risk was observed to be on the west and north peripheries of the array area, reflective of the re-routing assumptions as per Section 13.2.

16 Embedded Mitigation Measures

408. 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. These measures have and will continue to evolve over the development process as the EIA progresses and in response to consultation including as part of the PEIR process.
409. The identified measures include good or standard practice and include actions that would be undertaken to meet existing legislation requirements. It has been assumed for the purposes of the FSA (see Section 17).
410. The identified measures are detailed in Table 16.1.

Table 16.1 Embedded mitigation measures relevant to shipping and navigation

Mitigation	Description	How Secured
Compliance with MGN 654	The Project will comply with MCA requirements under MGN 654 including its annexes.	DCO requirement / deemed Marine Licence (dML) conditions
Charting	Project infrastructure (including structures and subsea cables) will be charted.	DCO requirements or dML conditions.
Promulgation of information	Circulation of relevant project information including via all usual means (e.g., Kingfisher Bulletin, Notice to Mariners).	DCO requirements or dML conditions.
Buoyed construction area	Agreement of extent of buoyed construction area with Trinity House including buoy locations and types.	DCO requirements or dML conditions.
Application for safety zones	Application for safety zones around structures during construction and periods of major maintenance: <ul style="list-style-type: none"> ▪ 500m around structures where construction is ongoing; ▪ 50m around all structures prior to commissioning of the Project; and ▪ 500m around structures where major maintenance is ongoing. 	Electricity application procedures (Section 95 of Energy Act 2004).
Marine Coordination	Marine coordination and communication to manage project vessel movements.	XXX

Mitigation	Description	How Secured
Lighting and Marking	Lighting and marking in agreement with Trinity House, MCA, and Civil Aviation Authority (CAA), and in compliance with IALA G1162 (IALA, 2021).	DCO requirements or dML conditions.
Guard vessels	Use of guard vessels where identified as necessary via risk assessment.	MGN 654
Layout Design	Ongoing consultation with MCA and Trinity House in relation to layout design, including MMO sign off on final layout in consultation with the MCA and Trinity House.	DCO requirements or dML conditions.
Blade clearance	Blade clearance in line with RYA requirements and MGN 654 to ensure potential for recreational mast interaction with the blades is minimised.	MGN 654
Cable protection	Cable burial risk assessment process to determine required cable protection and monitoring requirements.	DCO requirements or dML conditions.

16.1 Marine Aids to Navigation

411. 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 G1162 (IALA, 2021) and MGN 654 (MCA, 2021).

16.1.1 Construction and Decommissioning Phases

412. 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. Surface piercing structures will be marked with temporary lighting.

16.1.2 Operation and Maintenance Phase

413. Marine marking during the O&M phase will be agreed in consultation with Trinity House once the final layout has been selected post consent. Likely requirements are given in the Sections 16.1.2.1 and 16.1.2.2

16.1.2.1 Marking of Individual Array Structures

414. As per IALA Guideline G1162, each surface structure within the array area will be painted yellow from the level of Highest Astronomical Tide (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.

415. 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 WTG. The light will be either hooded or baffled so as to avoid unnecessary light pollution or confusion with navigational marks.

16.1.2.2 Marking of Array

416. 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 G1162. As per the IALA guidance, and in consultation with Trinity House, it will be ensured that:

- All corner structures will be marked as an Significant Peripheral Structure (SPS) and where necessary to satisfy the spacing requirements between SPS under IALA G1162, additional periphery structures may also be marked as SPS;
- Structures designated as an SPS will exhibit a flashing yellow five second (flash yellow every five seconds) light of at least 5nm nominal range and omnidirectional fog signals as appropriate and where prescribed by Trinity House, and will be sounded when the visibility is 2nm or less;
- 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 WTG blades;
- All lights will be exhibited at least at night;
- 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 AtoNs;
- Aviation lighting will be as per CAA requirements; however, will likely be synchronised Morse “W” at the request of Trinity House; and

417. Consideration will also be given to the use of marking via AIS, or other electronic means (such as Radar Beacons (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.

16.2 Design Specifications Noted in Marine Guidance Note 654

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

16.3 Safety Zones

419. The Applicant intend to submit an application to the Department of Energy, Security, and Net Zero (DESNZ) post consent for safety zones during the construction and operational phases, with a separate application submitted for the decommissioning phase at a later date. The safety zones applied for will be determined as part of the application process, however it is expected that the following safety zones will be applied for noting that these are the industry standard:

- 500m around any structure where construction is ongoing, as denoted by the presence of a construction vessel;
- 50m around any structure where active construction is not ongoing prior to full commissioning of the windfarm; and
- 500m around any structure where major maintenance is ongoing during the operational phase, where major maintenance is as defined within the Electricity Regulations (2007).

17 Risk Assessment – In Isolation

420. This section provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to the Project, based on baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments. The hazards assessed are as follows:
- Displacement of vessels leading to increased collision risk between third-party vessels;
 - Restriction of adverse weather routeing;
 - Increased vessel-to-vessel collision risk between a third-party vessel and project vessel;
 - Increased vessel to structure collision risk (powered, drifting, and internal navigation);
 - Reduction of emergency response provision including SAR capability;
 - Reduction of under keel clearance; and
 - Increased anchor/gear interaction with subsea cables.
421. For each hazard, the full description of the hazard is provided in ***bold italicised*** text. This is followed by various subsections as appropriate to consider each component of the hazard, both for the array area and offshore ECC based on the MDS (see Section 6.5).
422. For each hazard, embedded mitigation measures which have been identified as relevant to reducing risk are listed, with full descriptions provided in Section 16. This is followed by statements defining the frequency of occurrence, severity of consequence, and subsequent significance of risk based on the methodology defined in Section 3.2.
423. The risk control log (see Section 19) summarises the risk assessment and a concluding risk statement for the PEIR stage is provided (see Section 21.7).

17.1 Displacement of vessels leading to increased collision risk between third party vessels

424. ***Construction or decommissioning activities and the presence of surface piercing structures within the array area may result in the displacement of vessels from pre-existing routes and activities. This displacement may result in an increased risk of a collision between third-party vessels.***
425. During the construction phase, the array area will be marked as a buoyed construction area. There will be no restriction on entry into the buoyed construction area other than through any active safety zones, noting the Cardinal Marks (buoys) do advise Mariners to avoid the area.

426. Experience at other OWF projects indicates that areas of active construction will generally be avoided by vessels observing the buoyed construction area, and therefore it is likely that the ongoing construction works will displace existing traffic from within the array area. The same scenario is likely during the decommissioning phase i.e., the array area will be marked as a buoyed decommissioning area, and it is likely that vessels will avoid the ongoing works.
427. During the operational phase, there would again be no restriction on transits into the array area assuming any active major maintenance safety zones are avoided.
428. During consultation, displacement was raised as a concern by vessel operators including DFDS and Stena (see Section 4.2.3). The potential for displacement leading to an increase in collision risk was also raised including by the MCA. This is discussed in more detail in paragraphs 17.1.1 and 17.1.2.

17.1.1 Commercial Vessels

17.1.1.1 Commercial Vessel Routing

429. Based on the deviations assessment (see Section 13.2), of the 13 of the main commercial routes identified, five are anticipated to deviate to avoid the structures within the array area. The deviations to these five routes are summarised as follows:
- **Route 3: four vessels per day.** Likely vessels will transit further north to increase passing distance from array area. Estimated journey distance increase of < 0.1nm.
 - **Route 7: one vessel per day.** Intersects array area, vessels anticipated to pass to the north post windfarm. Estimated journey distance increase of 1.2nm.
 - **Route 8: one vessel per day.** Intersects array area, vessels anticipated to pass to the west post windfarm. Estimated journey distance increase of 2.4nm.
 - **Route 9: one vessel per day.** Intersects array area, vessels anticipated to pass to the north post windfarm. Estimated journey distance increase of 4.6nm.
 - **Route 12: < 1 vessel per day.** Likely vessels will pass further north (a minor deviation) to increase passing distance from array area. Estimated journey distance increase of 0.2nm.
430. Baseline routing in the area is observed to be largely dictated by the numerous sand banks and the existing surface piercing infrastructure (both renewables and oil and gas). In the future case scenario routing of vessels deviating west of the array area will be dictated by the presence of the Outer Dowsing Bank merging with established routes. Vessels deviating to the north will likely pass between the array area and the platforms at the West Sole field, again on routes already established by other vessels.
431. The most likely consequences of vessel displacement will be increased journey times and distance for affected third-party vessels. This was highlighted by commercial ferry operators, DFDS and Stena during consultation. As a worst case, there may be disruption to existing schedules, particularly for the commercial ferry operators using

the region. However, given the size of the deviations anticipated and the ability to effectively passage plan, disruptions to schedule are expected to be minimal.

432. It is noted that there is likely to be some minor displacement associated with the ORCP search area, depending on the final location of the ORCP(s). This will be assessed further post PEIR.

17.1.1.2 Collision Risk

433. As per Section 8.6, historical incident data indicates that to date no collision incidents between third-party vessels have occurred directly as a result of a UK OWF. However, given vessels will be displaced (see Section 17.1), it is likely that there will be increased encounters and hence a potential for collision risk to also increase.
434. Based on the quantitative assessment of vessel to vessel collision risk (see Section 15.1), the return period of a vessel being involved in a collision pre windfarm was estimated at 31-years, reflective of the large traffic volumes in the area. This broadly aligns with the findings of the baseline incident assessment (see Section 8) which identified one collision incident occurring within the ten year period of RNLI data studied (with no collisions indicated from the twenty-years of MAIB data). The collision incident occurred 9nm east of the array area and involved an oil and gas vessel (the data did not specify the other vessel involved).
435. The corresponding post windfarm return period was estimated at 26-years which represents an increase of approximately 19%. The change in collision risk was observed to be primarily associated with routeing to the north and west of the array area.
436. In adverse weather including reduced visibility third-party vessels may experience limitations regarding visual identification of other third-party vessels, either when passing opposing sides of the buoyed construction / decommissioning areas (with partially constructed or deconstructed WTGS) and operational array area, or when navigating internally within the operational array area (small craft only). These limitations may increase the potential for an encounter. However, this will be mitigated by the application of the COLREGs (including Rule 6 Safe Speeds and Rule 19 Conduct of Vessels in Restricted Visibility) in adverse weather conditions.
437. 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.
438. 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. As a worst case (with very low frequency of occurrence) one or both of the vessels may experience 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). It is noted that the final NRA will include quantitative assessment of both PLL and pollution associated with the Project.

439. Vessel traffic monitoring will be undertaken throughout the construction phase to characterise changes to routeing patterns (see Section 20). These will be compared against the anticipated deviations determined in this NRA to allow a comprehensive review of the mitigation measures applied at the time.
440. It is noted that there is likely to be some minor displacement associated with the ORCP search area and hence changes in collision risk, depending on the final location of the ORCP(s). This will be assessed further post PEIR.

17.1.1.3 Commercial Vessel Third Party Activities

441. As shown via the vessel traffic assessment (see Section 9), dredging and oil and gas activities do take place in the vicinity. Of note is the Outer Dowsing extraction area (area 515/2) located near the south-western part of the array area, and various oil and gas platforms, including Malory which is within the array area and still active. Further assessment of third party activities is provided in Volume 1, Chapter 18: Infrastructure and Other Marine Users.
442. It was estimated that less than one marine aggregate dredger per week intersected the array area based on the long term AIS (see Section D.4.5). It is considered likely that these vessels would deviate around the array as opposed to transiting through. Feedback from Boskalis (a key marine aggregate dredger operator in the area) during the hazard workshop (see Section 4.2.5) was that any impact on marine aggregate dredging activity was likely to be minimal given the local dredging areas do not intersect the array area. The feedback indicated marine aggregate dredgers tend to transit from the south and as such significant deviations to vessel transits are also not expected.
443. Given the presence of oil and gas infrastructure within the array area, in particular Malory for which there are no known decommissioning plans, it will be necessary for oil and gas vessels to enter into the array area to access the infrastructure. Consultation is ongoing with the relevant oil and gas operators to ensure suitable access is maintained and as such the assessment will be updated post PEIR to account for these discussions.
444. Vessels to the Hornsea projects were observed to typically pass north of the array area and as such no impact is anticipated.
445. As for main commercial routes (see Section 17.1.1.1), the most likely consequence will be increased journey times and distances for affected third-party vessels.

17.1.1.4 Promulgation of Information and Passage planning

446. All vessels operating in the area expected to comply with national and international flag state regulations (including the COLREGs and SOLAS) and will have a raised level of awareness of construction and decommissioning activities given the promulgation of information relating to the Project. This includes the charting of the buoyed construction/decommissioning area on relevant nautical charts and the use of safety zones. The physical presence of the buoyed construction/decommissioning area itself will also serve to maximise awareness. Similarly, during the O&M phase infrastructure will be appropriately marked on relevant nautical charts and by that stage awareness of the array area will be high given its established presence over the construction phase.
447. All vessels proceeding to sea 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 and facilitate such passage planning.

17.1.2 Small Craft (Fishing and Recreational Vessels)

17.1.2.1 Small Craft Displacement

448. The vessel traffic survey data shows transits from recreational vessels and fishing vessels through the array area occur (noting the survey captured both AIS and non AIS traffic). This aligns with the findings of the long term AIS analysis (Annex D).
449. As for commercial vessels, there will be restriction on small craft entering the array area during any phase other than through active safety zones. However, based on experience at previously under construction OWFs, commercial fishing vessels and recreational vessels may choose not to navigate internally within the buoyed construction/decommissioning area. Therefore, some displacement of transits by small craft during the construction and decommissioning phases may occur.
450. For the O&M phase, based on experience at existing operational OWFs, it is anticipated that commercial fishing vessels and recreational vessels may choose to navigate internally within the array area, particularly in favourable weather conditions.
451. Feedback during the hazard workshop was that the area is commonly used by potters (i.e., vessels laying and hauling static gear pots) in particular (season dependent), and post windfarm use of the area is likely to depend on the final layout noting commercial impacts to fishing vessels are considered in Volume 1, Chapter 14: Commercial Fisheries. Recreational representation at the workshop indicated no

initial concerns, however noted that sailing vessels may be more likely to avoid the array area than motor cruisers.

452. The most likely consequence of small craft displacement is changes to vessel's existing routines but without any safety impact.

17.1.2.2 Collision Risk Involving Small Craft

453. As per Section 17.1.1.2, there is anticipated to be an increase in commercial vessel density and hence collision risk around the northern and western windfarm peripheries. Given recreational and fishing transits are known to occur in both these areas based on the vessel traffic survey data, there may be increased encounters between small craft and larger commercial vessels. It is noted that feedback during the hazard workshop was that recreational vessels would tend to avoid commercial vessel routing, however within this area recreational vessels do already transit with commercial vessels in the area between the Outer Dowsing Bank and Triton Knoll OWF.

454. In the event of a collision incident involving a small craft (with comparatively weaker structural integrity due to hull materials) compared to a larger commercial vessel, the likelihood of a worst case outcome (the small craft foundering with PLL and pollution) will be greater.

17.1.3 Embedded Mitigation Measures

455. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:
- Appropriate marking on Admiralty charts;
 - Promulgation of information;
 - Buoyed construction / decommissioning area;
 - Application for safety zones; and
 - Lighting and marking.

17.1.4 Significance of Risk

456. The frequency of occurrence, severity of consequence, and significance of risk due to vessel displacement is presented in Table 17.1 alongside the resulting significance of risk.

Table 17.1 Risk Rankings for displacement of vessels leading to increased collision risk between third party vessels

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction		Remote	Serious	Tolerable

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
O&M	Displacement with effects on schedule and collision incident occurs with vessel damage, PLL, and/or pollution.	Remote	Serious	Tolerable
Decommissioning		Remote	Serious	Tolerable

457. This impact will be re-assessed post PEIR once array area reduction has been applied.

17.2 Restriction of Adverse Weather Routeing

458. **The presence of the structures within the array area could restrict adverse weather routeing options in the study area.**

459. Adverse weather includes wind, wave, and tidal conditions as well as reduced visibility can hinder a vessel's normal route and/or speed of navigation. Adverse weather routes are defined as significant course adjustments to mitigate vessel movement in adverse weather conditions. When transiting in adverse weather conditions, a vessel is likely to encounter various kinds of weather and tidal phenomena, which may lead to severe roll motions, potentially causing damage to cargo, equipment and/or danger to persons on board. The sensitivity of a vessel to these phenomena will depend on the actual stability parameters, hull geometry, vessel type, vessel size and speed.

460. The presence of structures within or near to any adverse weather routes may prevent the route from being utilised during adverse conditions. Mitigations for vessels include adjusting their heading to position themselves 45° to the wind, altering or delaying sailing times, reducing speed and/or potentially cancelling journeys.

17.2.1 All Users

461. DFDS noted during consultation limited concern with the King Seaways and Princess Seaways adverse weather routeing, however stated that routeing between Immingham and Cuxhaven would be affected, with a route preferred for use during certain adverse conditions (Route 7 in Section 10.2) intersecting the array area. This route is used when sea conditions further north are such that the typically used Immingham to Cuxhaven route (Route 3 in Section 10.2) would require additional time in port to secure cargo i.e., there would be a commercial impact on DFDS if Route 7 could not be used.

462. Lighting and marking will be defined in consultation with Trinity House as required, and this will include consideration of requirements during periods of poor visibility (e.g., sound signals) to ensure the structures within the array area are detectable in

adverse conditions, noting the structures will also be charted. Under COLREGS (IMO, 1972), vessels are also required to take appropriate measures with regards to determining a safe speed, taking into account various factors including the state of visibility, the state of the wind, sea, and current as well as the proximity of navigational hazards.

463. The most likely consequences are considered to be displacement from existing adverse weather routeing options but with no safety risk. As a worst case, there may be effects on schedules with limited safety risk.

17.2.2 Embedded Mitigation Measures

464. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:

- Appropriate marking on Admiralty charts;
- Promulgation of information; and
- Lighting and marking.

17.2.3 Significance of Risk

465. The frequency of occurrence, severity of consequence, and significance of risk due to restriction of adverse weather routeing is presented in Table 17.2 alongside the resulting significance of risk.

Table 17.2 Risk rankings for restriction of adverse weather routeing

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction	Displacement from normal adverse weather preference with effects on schedule due to additional time in port and limited safety risks.	Remote	Serious	Tolerable
O&M		Remote	Serious	Tolerable
Decommissioning		Remote	Serious	Tolerable

466. This impact will be re-assessed post PEIR once the array area reduction has been applied.

17.3 Increased vessel-to-vessel collision risk between a third-party vessel and project vessel

467. *Increases in windfarm vessel activity associated with the Project could lead to increased collision rates in the area with third party vessels.*

468. The construction, operation, and decommissioning of the Project will necessitate the use of various types of vessels. These vessels will increase traffic volumes within the area, which may lead to an increase in collision risk to third party vessels.

17.3.1 In Isolation – All Users

469. During construction, it is estimated that up to 127 vessels could be used with a total of up to 3,051 return trips. It is likely that vessel numbers will be similar during the decommissioning phase. During the operational phase up to 2,216 annual trips are estimated. It is likely that some project vessels will be Restricted in Ability to Manoeuvre, noting that project vessels would likely be undertaking the associated activities within the array area or Offshore ECC.
470. From historical incident data, there have been two instances of third-party vessels colliding with a project vessel associated with a UK OWF. In both incidents moderate vessel damage was reported with no harm to persons. It is noted that the two incidents occurred in 2011 and 2012, and awareness of OWF developments and the application of the measures has improved or been refined considerably in the interim, with no further collision incidents reported since.
471. Project traffic movements will be managed via marine coordination for the purposes of ensuring any disruption to third party traffic is minimised. Details of the Project including in relation to vessels will be promulgated meaning areas where increased windfarm vessel traffic will be present are detailed to third party users maximising awareness.
472. Safety zones around structures where active construction/decommissioning and major maintenance works are ongoing will also be applied for to protect both third party and project vessels. Details of authorised safety zones will be promulgated in addition to details of the associated activities, meaning awareness for all third-party users will be maximised.
473. In periods of adverse visibility, third-party vessels may experience limitations regarding visual identification of any Project vessels entering or exiting the buoyed construction/decommissioning areas or array area. However, this will be mitigated by the application of the COLREGs (including Rule 6 Safe Speeds and Rule 19 Conduct of Vessels in Restricted Visibility) in adverse weather conditions and Project vessel compulsory AIS carriage.
474. The most likely consequences in the event of an encounter between a third-party and project vessel 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.
475. 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 (as

noted in incidents occurred to date, see Section 8.6). As a worst case, one of the vessels could founder with PLL and pollution, with this outcome more likely where one of the vessels is a small craft with comparatively weaker structural integrity given hull materials (e.g., fishing vessel, recreational vessel, or CTV).

17.3.2 Embedded Mitigation Measures

476. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:

- Appropriate marking on Admiralty charts;
- Promulgation of information;
- Buoyed construction / decommissioning area;
- Application for safety zones;
- Marine Coordination;
- Compliance of project vessels with the international marine regulations including COLREGs and SOLAS; and
- Guard vessel(s) as required by risk assessment.

17.3.3 Significance of Risk

477. The frequency of occurrence, severity of consequence, and significance of risk due to third party to project vessel collision is presented in Table 17.3 alongside the resulting significance of risk.

Table 17.3 Risk rankings for third party to project vessel collision

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction	Collision incident occurs with vessel damage, PLL, and/or pollution.	Extremely unlikely	Serious	Broadly acceptable
O&M		Extremely unlikely	Serious	Broadly acceptable
Decommissioning		Extremely unlikely	Serious	Broadly acceptable

17.4 Increased vessel to structure collision risk

478. **The structures within the array area will create collision risk to third party passing vessels under power.**

17.4.1 In Isolation – All Users

17.4.1.1 Powered Vessel to Structure Allision Risk

479. Full quantitative allision modelling including for vessels under power will be run post PEIR. On a preliminary basis, based on the post windfarm routeing (see Section 13.2) powered allision risk is likely to be greatest to the west and north peripheries given likely post windfarm traffic volumes in these areas. However, it is noted that the shallows of the Outer Dowsing Bank mean larger vessels would be likely to anchor or ground prior to making contact with the WTGs.
480. From historical incident data (see Section 8.6), there have been two instances of a third-party vessel alliding with an operational windfarm structure in the UK. These incidents both involved a fishing vessel, with a RNLI lifeboat attending on both occasions.
481. Vessels are expected to comply with national and international flag state regulations (including the COLREGs and SOLAS) and will be able to passage plan a route which minimises risk 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 on the structures will also assist in maximising awareness and project vessels will as required alert a vessel on a closing approach with a structure. During construction, the array area will be marked as a buoyed construction area, with temporary lighting used to mark individual structures. Pre commissioning safety zones of 50m will also be applied for. Similar mitigations are likely to be applied during the decommissioning phase.
482. 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, 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.
483. With considerations for lesson learned the most likely consequences are minor damage with the vessel involved able to resume passage and undertake a full inspection at the next port of call. As a worst case, the vessel may founder leading to PLL and pollution.
484. It is noted that there will be allision risk associated with the ORCP(s). This will be assessed further post PEIR.

17.4.1.2 Drifting Vessel to Structure Allision Risk

485. A drifting vessel scenario may 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. The final NRA will quantitatively model this scenario accounting for the local tidal conditions and wind direction probabilities.
486. From historical incident data, there have been no instances of a third-party vessel alliding with an operational windfarm structure in the UK whilst Not Under Command (NUC).
487. In circumstances where a vessel drifts towards a structure, there are actions which the vessel may take to prevent the drift incident developing into an allision situation. Powered vessels may be able to regain power prior to reaching the array area (i.e., by rectifying any fault). Failing this, the vessel's emergency response procedures would be implemented which may include an emergency anchoring event following a check of the relevant nautical charts to ensure the deployment of the anchor will not lead to other risks (such as anchor snagging on a subsea cable), or the use of thrusters (depending on availability and power supply).
488. Where the deployment of the anchor is not possible (e.g., for small craft), any project vessels on-site may be able to render assistance in liaison with the MCA and in line with SOLAS obligations (IMO, 1974). This response will be managed via the coastguard and marine coordination, and depends on the type and capability of vessels on site. This would be particularly relevant for sailing vessels relying on metocean conditions for propulsion, noting if the vessel becomes adrift in proximity to a structure there may be limited time to render assistance.
489. Should a drifting allision incident occur, the consequences will be similar to those outlined for a powered allision incident (see Section 17.4.1.1), including the determining factors. However, the speed at which the contact occurs is likely to be lower than for a powered allision.
490. It is noted that there will be drifting allision risk associated with the ORCP(s). This will be assessed further post PEIR.

17.4.1.3 Internal Vessel to Structure Allision Risk

491. As discussed in Section 17.1, commercial vessels are not anticipated to navigate internally within the array area and therefore the likelihood of an internal allision risk for commercial vessels is considered negligible. Vessels navigating within the array are most likely to be small craft (e.g., fishing, recreation). The final NRA will include quantitative modelling assessment of internal allision risk to fishing vessels.
492. 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 structures in the array area as required by Trinity House, MCA and CAA including MGN 654 compliant unique identification marking of structures in an easily identifiable pattern will assist with minimising the risk of a mariner becoming disoriented whilst navigating internally. The layout itself will be agreed with MCA and

Trinity House, noting that these discussions will include consideration of surface internal navigation.

493. For recreational vessels under sail navigating internally within the array area, there is also potential for effects such as wind shear, masking and turbulence to occur. From previous studies of offshore wind developments, it has been concluded that WTGs do reduce wind velocity downwind of a WTG (MCA, 2021) 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 raised by recreational users to date when operating in proximity to existing offshore wind developments.
494. An additional allision risk associated with the WTG blades applies for recreational vessels with a mast when navigating internally within the array area. However, the minimum blade tip clearance will align as a minimum with the minimum clearance the RYA recommend for minimising allision risk (RYA, 2019) and which is also noted in MGN 654.
495. As per Section 17.1.1.3, it will also be necessary for oil and gas vessels to enter into the array area to access the relevant oil and gas infrastructure, most notably the Malory platform which is still under active production. Suitable access within the layout will be discussed with the relevant operators.
496. Should an internal allision incident occur, the consequences will be similar to those outlined for a powered allision incident, including the determining factors (see Section 17.4.1.1). However, as with a drifting allision incident, the speed at which the contact occurs will likely be lower than for an external powered allision.

17.4.2 Embedded Mitigation Measures

497. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:
- Compliance with MGN 654 (MCA, 2021) and its annexes;
 - Appropriate marking on Admiralty charts;
 - Promulgation of information;
 - Buoyed construction / decommissioning area;
 - Application for safety zones;
 - Lighting and marking;
 - Blade clearance in excess of RYA and MCA requirements; and
 - Compliance of project vessels with the international marine regulations including COLREGs and SOLAS.

17.4.3 Significance of Risk

498. The frequency of occurrence, severity of consequence, and significance of risk due to vessel allision is presented in Table 17.4 alongside the resulting significance of risk.

Table 17.4 Risk rankings for vessel to structure allision risk

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction	Allision incident with the vessel foundering, leading to PLL, and/or pollution.	Extremely unlikely	Serious	Broadly acceptable
O&M		Extremely unlikely	Serious	Broadly acceptable
Decommissioning		Extremely unlikely	Serious	Broadly acceptable

17.5 Reduction of emergency response provision including SAR capability.

499. *The presence of structures within the array area and associated vessel activities may result in an increased likelihood of an incident occurring which requires an emergency response and may reduce access for surface and air SAR assets.*

17.5.1 Emergency Response Resources

500. During construction, it is estimated that up to 127 vessels could be used with a total of up to 3,051 return trips. It is likely that vessel numbers will be similar during the decommissioning phase. During the operational phase up to 2,216 annual trips are estimated. 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.

501. Based on the incident data studied, baseline incident rates are low in the area, reflective of the distance offshore. Additionally, based on the number of collision and allision incidents associated with UK OWFs reported to date (see Section 8.6), there is an average of one incident per 1,511 operational WTG years (as of December 2022). Therefore, the Project itself is not expected to result in a marked increase in the frequency of incidents requiring an emergency response.

502. Should an incident occur in proximity to the array area, it is likely that a project vessel would be well equipped to assist under SOLAS obligations (IMO, 1974) and in liaison with the MCA, potentially as the first responder. 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 OWFs as detailed in Section 8.7.

503. 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 a worst case, 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 considered highly unlikely.

17.5.2 Search and Rescue Access

504. The physical presence of surface piercing structures may restrict access for SAR responders, either due to the incident in question occurring within the array area or the array area obstructing the most effective path to an incident further offshore. This is more likely to be an issue in periods of adverse weather conditions, noting under such conditions it is likely that SAR helicopters would only enter into the array area from low altitude. The Applicant will ensure the associated layout design principles detailed in MGN 654 are applied in consultation with the MCA.
505. The assessment of SAR helicopter taskings data indicated that while taskings do occur in the area, the majority are rescue/recovery operations to the local oil and gas infrastructure as opposed to SAR operations (88% of the total were detailed as “Rescue/Recovery”).
506. The Applicant will agree an Emergency Response Co-operation Plan (ERCOP) with the MCA to ensure appropriate procedures are in place in the event of an emergency incident. A SAR Checklist will also be agreed to ensure any SAR mitigations required by the MCA are implemented for the Project.
507. The final layout and structure identification system will be agreed with both the MCA and Trinity House post consent, noting it will be MGN 654 compliant.
508. The most likely consequences in the event of a SAR operation is 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 layout, this is considered highly unlikely.

17.5.3 Embedded Mitigation Measures

509. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:
- Compliance with MGN 654 (MCA, 2021) and its annexes;
 - Marine Coordination;
 - Layout approval;
 - Compliance of project vessels with the international marine regulations including COLREGs and SOLAS; and
 - Guard vessel(s) as required by risk assessment.

17.5.4 Significance of Risk

510. The frequency of occurrence, severity of consequence, and significance of risk due to reduction of emergency response provision including SAR capability is presented in Table 17.5 alongside the resulting significance of risk.

Table 17.5 Risk rankings for reduction of emergency response provision including SAR capability

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction	Delay to a response request and inability to undertake an effective search leading to vessel damage, PLL, and pollution.	Extremely unlikely	Major	Tolerable
O&M		Extremely unlikely	Major	Tolerable
Decommissioning		Extremely unlikely	Major	Tolerable

17.6 Reduction of Under Keel Clearance

511. ***Any changes in under keel clearance as a result of the project could lead to a risk of under keel interaction to passing vessels.***

17.6.1 All Users

512. The use of external protection for the cables may be necessary if target burial depths cannot be met. This could lead to reductions in under keel clearance for passing vessels, and potential grounding/interaction risk. The need for and location of any external cable protection will be determined via the cable burial risk assessment which will be undertaken post consent.

513. The maximum height of external protection via rock berm is anticipated to be 3m, with potentially up to 25% of the export cable route requiring protection to be implemented.

17.6.2 As required under MGN 654 and as will be detailed within the DCO, the Applicant will consult with the MCA and Trinity House in any instances where water depths are reduced by more than 5% as a result of cable protection to determine whether additional mitigation is necessary to ensure the safety of passing vessels. 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).

514. The most likely consequence is a reduction in navigable depths but vessels are still able to transit over the area without contact being made. As a worst case, a vessel

may make contact with the cable protection potentially leading to foundering, PLL and/or pollution.

17.6.3 Embedded Mitigation Measures

515. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:

- Compliance with MGN 654 (MCA, 2021) and its annexes;
- Appropriate marking on Admiralty charts;
- Promulgation of information;
- Cable burial and protection including monitoring; and
- Guard vessel(s) as required by risk assessment.

17.6.4 Significance of Risk

516. The frequency of occurrence, severity of consequence, and significance of risk due to reduction of under keel clearance is presented in Table 17.6 alongside the resulting significance of risk.

Table 17.6 Risk rankings for reduction of under keel clearance

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
O&M	Vessel transits over and contacts the cable protection resulting in vessel damage, injury/fatality and/or pollution	Extremely unlikely	Serious	Broadly acceptable

17.7 Increased anchor/gear interaction risk with subsea cables.

517. ***The presence of subsea cables may result in an interaction risk with anchors or fishing gear.***

518. Scenarios that could lead to cable interaction include:

- Vessel dragging anchor over subsea cable following anchor failure;
- Vessel anchoring in an emergency over cable (e.g., to avoid drifting into a structure, or into an area of busy traffic);
- Vessel dropping anchor inadvertently (e.g., mechanical failure); or
- Negligent anchoring (e.g., use of out of date charts, neglecting to raise anchor when departing anchorage).

519. There is also a risk that deployed fishing gear may interact with subsea cables.

17.7.1 All Users – Vessel Anchors

520. The project may utilise up to 351km of inter array cables, 124km of interlink cables, and 515km of export cable. Burial will be the primary form of protection, with external protection used where identified as necessary via the cable burial risk assessment.

521. There are no charted anchorages in proximity to the Offshore ECC, however instances of anchoring activity were recorded in the nearshore area during the summer vessel traffic survey. In terms of the array area, anchoring activity within the study area was observed to be limited based on the 12 months analysis.

522. Burial depths and the need for any external protection will be determined via the cable burial risk assessment process. This will consider baseline vessel activity including in terms of anchored vessel locations, general traffic volumes, and vessel size and type to determine potential anchor sizes. Protection will also be monitored to ensure it remains an effective mitigation.

523. All cables will be charted on appropriate charts meaning mariners are aware of their presence. In any anchoring scenario, an interaction risk exists only where the anchoring occurs in proximity to a subsea cable and it is anticipated that the charting of infrastructure will inform any decision to anchor, as per Regulation 34 of SOLAS (IMO, 1974).

524. The most likely consequences in the event of a vessel anchoring over a subsea 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 cable. As a worst case, a snagging incident could occur to a small vessel with damaged caused to the anchor and/or the cable, compromising the stability of the vessel.

17.7.2 Fishing Vessels – Gear

525. As for vessel anchors, there is a risk that fishing gear may interact with subsea cables. It is the responsibility of the fishermen to dynamically risk assess whether it is safe to undertake fishing activities within the array area and to make a decision as to whether or not to fish. This decision will be informed by a number of factors, which will include the charted locations of subsea cables. Fishermen will similarly be required to take account of the charted presence of subsea cables within the Offshore ECC.

526. Active fishing activity is considered further in Volume 1, Chapter 14: Commercial Fisheries.

17.7.3 Embedded Mitigation Measures

527. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:

- Compliance with MGN 654 (MCA, 2021) and its annexes;
- Appropriate marking on Admiralty charts;
- Promulgation of information;
- Buoyed construction/decommissioning area;
- Cable burial and protection including monitoring; and
- Guard vessel(s) as required by risk assessment.

17.7.4 Significance of Risk

528. The frequency of occurrence, severity of consequence, and significance of risk due to potential anchor/gear interaction risk is presented in Table 17.7 alongside the resulting significance of risk.

Table 17.7 Risk rankings for increased anchor / gear interaction risk with subsea cables.

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
O&M	Damaged caused to the or loss of anchor/gear and/or the cable, leading to compromised stability of the vessel.	Extremely unlikely	Moderate	Broadly acceptable

18 Cumulative Risk Assessment

529. The following hazards have been assessed on a cumulative basis. Hazards associated with under keel clearance and subsea cable interaction have been screened out of the cumulative assessment given they are localised to the area around individual cables.

- Cumulative Displacement of vessels leading to increased collision risk between third party vessels;
- Cumulative Restrictions of Adverse Weather Routeing;
- Cumulative Increased vessel-to-vessel collision risk between a third-party vessel and project vessel;
- Cumulative increased vessel to structure collision risk; and
- Cumulative reduction of emergency response provision including SAR capability.

18.1 Cumulative Displacement of vessels leading to increased collision risk between third party vessels

530. ***Construction or decommissioning activities and the presence of surface piercing structures within the array area in combination with other cumulative developments may result in the displacement of vessels from pre-existing routes and activities. This displacement may result in an increased cumulative risk of a collision between third-party vessels.***

18.1.1 All Users

18.1.1.1 Tier 1

531. Cumulative displacement was raised as a key concern by DFDS during consultation, in particular associated with cumulative effects of the Project and Hornsea Three on routeing between Immingham and Cuxhaven. Input from DFDS was that the associated vessels will likely go north of the array area and south of Hornsea Three leading to increased transit distance and time on a cumulative basis. There is considered to be suitable sea room to safely accommodate this routeing (noting that the vessels will also need to account for local oil and gas infrastructure) however there will be a commercial impact.

532. For vessels anticipated to pass west of the array area (i.e., between the Outer Dowsing bank and Triton Knoll OWF), there may be cumulative displacement and collision risk associated with the Dudgeon and Sheringham Shoal Extensions to the south. However based on the post windfarm routeing assessment this is not expected to represent a large increase in traffic volume when compared against baseline numbers already using these routes.

533. Certain main routes were observed to interact with both the array area and Norfolk Vanguard West. Vessels on routes interacting with Norfolk Vanguard West may deviate into the DR1 DWR, however this is likely regardless of the presence of the Project.

18.1.1.2 Tier 2

534. No main routes identified in the study area interact with Dogger Bank South, and as such there is not considered to be an associated cumulative hazard.

18.1.2 Embedded Mitigation Measures

535. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:

- Appropriate marking on Admiralty charts;
- Promulgation of information;
- Buoyed construction/decommissioning area;
- Application for safety zones; and
- Lighting and marking.

18.1.3 Significance of Risk

536. The frequency of occurrence, severity of consequence, and significance of risk due to cumulative vessel displacement leading to collision risk is presented in Table 18.1 alongside the resulting significance of risk.

Table 18.1 Cumulative risk rankings for displacement of vessels leading to increased collision risk between third party vessels

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction	Cumulative displacement with effects on schedule and collision incident occurs with vessel damage, PLL, and/or pollution.	Remote	Serious	Tolerable
O&M		Remote	Serious	Tolerable
Decommissioning		Remote	Serious	Tolerable

537. This impact will be re-assessed post PEIR once array area reduction has been applied.

18.2 Cumulative Restrictions of Adverse Weather Routeing

538. *The presence of the structures within the array area in combination with other cumulative developments could restrict adverse weather routeing options in the study area.*

18.2.1 All Users

18.2.1.1 Tier 1

539. As discussed in Section 11, DFDS indicated during consultation the key concern in relation to adverse weather was in relation to Route 7 between Immingham and Cuxhaven given if the associated vessels deviate north of the array area, there will be a need for increased time in port to secure cargo under certain sea conditions i.e., a commercial impact. The cumulative impact of Hornsea Three will mean there is an additional commercial impact given these vessels would also require increased transit times and distances to deviate north of the array area and south of Hornsea Three. However, there is considered to be sufficient sea space available to accommodate adverse weather transits in terms of navigational safety.
540. DFDS indicated limited concerns with adverse weather transits for the Newcastle to Amsterdam routeing.

18.2.1.2 Tier 2

541. No adverse weather routeing identified in the study area interacts with Dogger Bank South, and as such there is not considered to be an associated cumulative hazard.

18.2.2 Embedded Mitigation Measures

542. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:
- Appropriate marking on Admiralty charts;
 - Promulgation of information; and
 - Lighting and marking.

18.2.3 Significance of Risk

543. The frequency of occurrence, severity of consequence, and significance of risk due to cumulative restriction of adverse weather routeing is presented in Table 18.2 alongside the resulting significance of risk.

Table 18.2 Cumulative risk rankings for restriction of adverse weather routeing

Phase	Worst Consequences	Case	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction	Displacement from normal adverse weather preference with effects on schedule due to additional time in port and limited safety risks.		Remote	Serious	Tolerable
O&M			Remote	Serious	Tolerable
Decommissioning			Remote	Serious	Tolerable

544. This impact will be re-assessed post PEIR once array area reduction has been applied.

18.3 Cumulative Increased vessel-to-vessel collision risk between a third-party vessel and project vessel

545. *Cumulative increases in windfarm vessel activity associated with the Project including combination with other cumulative developments could lead to increased cumulative collision rates in the area with third party vessels.*

18.3.1 All Users

18.3.1.1 Tier 1

546. Vessels routeing to the existing Hornsea projects were identified within the study area transiting from the Humber. It is anticipated that similar routeing may be used for vessels associated with Hornsea Three and Four. Depending on origin port there may also be increased windfarm vessel presence associated with other Tier 1 projects.

547. All windfarm developments are expected to be implementing appropriate vessel management procedures including via marine coordination to ensure any disruption to third party traffic is minimised. It is also expected that all developers will apply for standard safety zones. All project vessels regardless of developer will also be required to comply with COLREGS which will manage encounter situations.

18.3.1.2 Tier 2

548. Any cumulative impact associated with Dogger Bank South will depend on origin port of the project vessels. However, the same mitigations as for Tier 1 developments (see Section 18.3.1.1) would apply to any project vessel transits through the area.

18.3.2 Embedded Mitigation Measures

549. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:

- Appropriate marking on Admiralty charts;
- Promulgation of information;
- Buoyed construction/decommissioning area;
- Application for safety zones;
- Marine Coordination;
- Compliance of project vessels with the international marine regulations including COLREGs and SOLAS; and
- Guard vessel(s) as required by risk assessment.

18.3.3 Significance of Risk

550. The frequency of occurrence, severity of consequence, and significance of risk due to cumulative third party to project vessel collision is presented in Table 18.3 alongside the resulting significance of risk.

Table 18.3 Cumulative risk rankings for third party to project vessel collision

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction	Collision incident occurs with vessel damage, PLL, and/or pollution.	Extremely unlikely	Serious	Broadly acceptable
O&M		Extremely unlikely	Serious	Broadly acceptable
Decommissioning		Extremely unlikely	Serious	Broadly acceptable

18.4 Cumulative increased vessel to structure allision risk

551. *The structures within the array area will create cumulative allision risk to third party passing vessels in combination with other cumulative developments.*

18.4.1 All Users

18.4.1.1 Tier 1

552. Allision risk will be localised to individual areas around developments, and there is considered to be sufficient sea space between the array area and Tier 1 developments to mitigate cumulative allision risk.

553. All developments will be required to implement lighting and marking in agreement with Trinity House and in line with IALA G1162 (IALA, 2021) and chart structure locations on appropriate nautical charts to ensure the structure positions are clear to passing mariners.

18.4.1.2 Tier 2

554. There is not considered to be a notable increase in cumulative allision risk associated with Dogger Bank South based on its distance from the array area, noting that the same mitigations discussed for Tier 1 developments (Section 18.4.1.1) would apply.

18.4.2 Embedded Mitigation Measures

555. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:

- Compliance with MGN 654 (MCA, 2021) and its annexes;

- Appropriate marking on Admiralty charts;
- Promulgation of information;
- Buoyed construction/decommissioning area;
- Application for safety zones;
- Lighting and marking;
- Blade clearance in excess of RYA and MCA requirements; and
- Compliance of project vessels with the international marine regulations including COLREGs and SOLAS.

18.4.3 Significance of Risk

556. The frequency of occurrence, severity of consequence, and significance of risk due to cumulative vessel allision risk is presented in Table 18.4 alongside the resulting significance of risk.

Table 18.4 Cumulative risk rankings for vessel to structure allision risk

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction	Allision incident with the vessel foundering, leading to PLL, and/or pollution.	Extremely unlikely	Serious	Broadly acceptable
O&M		Extremely unlikely	Serious	Broadly acceptable
Decommissioning		Extremely unlikely	Serious	Broadly acceptable

18.5 Cumulative reduction of emergency response provision including SAR capability.

557. *The presence of structures within the array area and associated vessel activities may result in a cumulative increased likelihood of an incident occurring which requires an emergency response and may reduce access for surface and air SAR assets.*

18.5.1 All Users

18.5.1.1 Tier 1

558. Given generally low baseline incident rates and noting historical incident data indicates limited vessel based incidents associated with windfarms, it is considered unlikely that there will be a notable increase in incidents on a cumulative basis. Furthermore, there will be additional vessel based resources that would be available at other projects which may be able to assist in the event of an incident occurring in the area (depending on the nature of the incident) through the ERCoP.

559. All developers will be required to comply with MGN 654 in terms of developments of an ERCoP, agreements of a SAR checklist, and approval of the layout by MCA in terms of SAR access.

18.5.1.2 Tier 2

560. Dogger Bank South is considered analogous to Tier 1 developments (see Section 18.5.1.1) with regards to this hazard.

18.5.2 Embedded Mitigation Measures

561. Embedded mitigation measures identified as relevant to reducing the significance of risk are as follows:

- Compliance with MGN 654 (MCA, 2021) and its annexes;
- Marine Coordination;
- Layout approval;
- Compliance of project vessels with the international marine regulations including COLREGs and SOLAS; and
- Guard vessel(s) as required by risk assessment.

18.5.3 Significance of Risk

562. The frequency of occurrence, severity of consequence, and significance of risk due to cumulative reduction of emergency response provision including SAR capability is presented in Table 18.5 alongside the resulting significance of risk.

Table 18.5 Cumulative risk rankings for reduction of emergency response provision including SAR capability

Phase	Worst Case Consequences	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction	Delay to a response request and inability to undertake an effective search leading to vessel damage, PLL, and pollution.	Extremely unlikely	Major	Tolerable
O&M		Extremely unlikely	Major	Tolerable
Decommissioning		Extremely unlikely	Major	Tolerable

19 Risk Control Log

563. Table 19.1 presents a summary of the assessment of shipping and navigation hazards scoped into the risk assessment. This includes the proposed embedded mitigation measures, frequency of occurrence, severity of consequence and significance of risk, for each hazard assessed.

Table 19.1 Risk control log

Project Phase	Hazard	Mitigation Measure	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Construction	Displacement of Vessels leading increased Third Party to Third Party Vessel Collision	<ul style="list-style-type: none"> ▪ Promulgation of Information ▪ Appropriate Admiralty Chart Marking ▪ Buoyed Construction Area ▪ Application for Safety Zones ▪ Lighting and marking 	Remote	Serious	Tolerable
	Restriction of Adverse Weather Roueting	<ul style="list-style-type: none"> ▪ Promulgation of Information ▪ Appropriate Admiralty Chart Marking ▪ Lighting and marking 	Remote	Serious	Tolerable
	Third-party to Project Vessel	<ul style="list-style-type: none"> ▪ Promulgation of Information ▪ Appropriate Admiralty Chart Marking ▪ Buoyed Construction Area ▪ Application for Safety Zones ▪ Marine Coordination ▪ Compliance with international marine regulations ▪ Guard vessels if required 	Extremely Unlikely	Serious	Broadly Acceptable

Project A4700

Client GTR4 Limited

Title Outer Dowsing Offshore Wind Navigational Risk Assessment

Project Phase	Hazard	Mitigation Measure	Frequency of Occurrence	Severity of Consequence	Significance of Risk
	Vessel to Structure Allision	<ul style="list-style-type: none">Promulgation of InformationCompliance with MGN 654Appropriate Admiralty Chart MarkingBuoyed Construction AreaApplication for Safety ZonesLighting and markingCompliance with international marine regulationsBlade clearance in excess of RYA and MCA requirements	Extremely Unlikely	Serious	Broadly Acceptable
	Reduction of Emergency Response Provision	<ul style="list-style-type: none">Compliance with MGN 654Marine coordinationLayout approvalCompliance with international marine regulationsGuard vessel if required	Extremely Unlikely	Major	Tolerable
Operations and Maintenance	Displacement of Vessels leading increased Third Party to Third Party Vessel Collision	<ul style="list-style-type: none">Promulgation of InformationAppropriate Admiralty Chart MarkingLighting and markingMarine coordination	Remote	Serious	Tolerable
	Restriction of Adverse Weather Roueting	<ul style="list-style-type: none">Promulgation of InformationAppropriate Admiralty Chart MarkingLighting and marking	Remote	Serious	Tolerable

Project A4700

Client GTR4 Limited

Title Outer Dowsing Offshore Wind Navigational Risk Assessment

Project Phase	Hazard	Mitigation Measure	Frequency of Occurrence	Severity of Consequence	Significance of Risk
	Third-party to Project Vessel	<ul style="list-style-type: none">Promulgation of InformationAppropriate Admiralty Chart MarkingApplication for Safety ZonesMarine CoordinationCompliance with international marine regulationsGuard vessels if required	Extremely Unlikely	Serious	Broadly Acceptable
	Vessel to Structure Allision	<ul style="list-style-type: none">Promulgation of InformationCompliance with MGN 654Appropriate Admiralty Chart MarkingBuoyed Construction AreaApplication for Safety ZonesLighting and markingCompliance with international marine regulationsBlade clearance in excess of RYA and MCA requirements	Extremely Unlikely	Serious	Broadly Acceptable
	Under Keel Clearance	<ul style="list-style-type: none">Promulgation of InformationAppropriate Admiralty Chart MarkingCompliance with MGN 654Cable burial and protection including monitoringGuard vessel if required	Extremely Unlikely	Moderate	Broadly Acceptable

Project A4700

Client GTR4 Limited

Title Outer Dowsing Offshore Wind Navigational Risk Assessment

Project Phase	Hazard	Mitigation Measure	Frequency of Occurrence	Severity of Consequence	Significance of Risk
	Increased anchor / gear interaction risk with subsea cables	<ul style="list-style-type: none">Promulgation of InformationAppropriate Admiralty Chart MarkingCompliance with MGN 654Cable burial and protection including monitoringGuard vessel if required	Extremely Unlikely	Moderate	Broadly Acceptable
	Reduction of Emergency Response Provision	<ul style="list-style-type: none">Compliance with MGN 654Marine coordinationLayout approvalCompliance with international marine regulationsGuard vessel if required	Extremely Unlikely	Major	Tolerable
Decommissioning	Displacement of Vessels leading increased Third Party to Third Party Vessel Collision	<ul style="list-style-type: none">Promulgation of InformationAppropriate Admiralty Chart MarkingBuoyed Decommissioning AreaApplication for Safety ZonesLighting and markingMarine coordination	Remote	Serious	Tolerable
	Restriction of Adverse Weather Roueting	<ul style="list-style-type: none">Promulgation of InformationAppropriate Admiralty Chart MarkingLighting and marking	Remote	Serious	Tolerable

Project A4700

Client GTR4 Limited

Title Outer Dowsing Offshore Wind Navigational Risk Assessment

Project Phase	Hazard	Mitigation Measure	Frequency of Occurrence	Severity of Consequence	Significance of Risk
	Third-party to Project Vessel	<ul style="list-style-type: none">Promulgation of InformationAppropriate Admiralty Chart MarkingBuoyed Decommissioning AreaApplication for Safety ZonesMarine CoordinationCompliance with international marine regulationsGuard vessels if required	Extremely Unlikely	Serious	Broadly Acceptable
	Vessel to Structure Allision	<ul style="list-style-type: none">Promulgation of InformationCompliance with MGN 654Appropriate Admiralty Chart MarkingBuoyed Construction AreaApplication for Safety ZonesLighting and markingCompliance with international marine regulationsBlade clearance in excess of RYA and MCA requirements	Extremely Unlikely	Serious	Broadly Acceptable
	Reduction of Emergency Response Provision	<ul style="list-style-type: none">Compliance with MGN 654Marine coordinationLayout approvalCompliance with international marine regulationsGuard vessel if required	Extremely Unlikely	Major	Tolerable

Project A4700

Client GTR4 Limited

Title Outer Dowsing Offshore Wind Navigational Risk Assessment

Project Phase	Hazard	Mitigation Measure	Frequency of Occurrence	Severity of Consequence	Significance of Risk
Cumulative	Cumulative Displacement of vessels leading to increased collision risk between third party vessels	<ul style="list-style-type: none">▪ Appropriate marking on Admiralty charts;▪ Promulgation of information;▪ Buoyed construction/decommissioning area;▪ Application for safety zones; and▪ Lighting and marking.	Remote	Serious	Tolerable
	Cumulative Restrictions of Adverse Weather Routeing	<ul style="list-style-type: none">▪ Appropriate marking on Admiralty charts;▪ Promulgation of information; and▪ Lighting and marking.	Remote	Serious	Tolerable
	Cumulative Increased vessel-to-vessel collision risk between a third-party vessel and project vessel	<ul style="list-style-type: none">▪ Appropriate marking on Admiralty charts;▪ Promulgation of information;▪ Buoyed construction/decommissioning area;▪ Application for safety zones;▪ Marine Coordination;▪ Compliance of project vessels with the international marine regulations including COLREGs and SOLAS; and▪ Guard vessel(s) as required by risk assessment.	Extremely unlikely	Serious	Broadly acceptable

Project A4700

Client GTR4 Limited

Title Outer Dowsing Offshore Wind Navigational Risk Assessment

Project Phase	Hazard	Mitigation Measure	Frequency of Occurrence	Severity of Consequence	Significance of Risk
	Cumulative increased vessel to structure allision risk	<ul style="list-style-type: none">Compliance with MGN 654 (MCA, 2021) and its annexes;Appropriate marking on Admiralty charts;Promulgation of information;Buoyed construction/decommissioning area;Application for safety zones;Lighting and marking;Blade clearance in excess of RYA and MCA requirements; andCompliance of project vessels with the international marine regulations including COLREGs and SOLAS.	Extremely unlikely	Serious	Broadly acceptable
	Cumulative reduction of emergency response provision including SAR capability	<ul style="list-style-type: none">Compliance with MGN 654 (MCA, 2021) and its annexes;Marine Coordination;Layout approval;Compliance of project vessels with the international marine regulations including COLREGs and SOLAS; andGuard vessel(s) as required by risk assessment.	Extremely unlikely	Major	Tolerable

20 Through Life Safety Management

564. Quality, Health, Safety and Environment (QHSE) documentation including a Safety Management System (SMS) will be in place and continually updated throughout the development process. Table 20.1 provides an overview of various QHSE documentation and how it will be maintained and reviewed with reference, where required, to specific marine documentation.
565. 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.

Table 20.1 Summary of QHSE Documentation

Documentation	Details
Incident reporting	An incident report will be completed following any incidents, including near misses. A review will then be undertaken to determine any possible need for operational changes. Where appropriate, the designated person (noted within the ERCoP) should inform the MCA of any exercise or incidents including any implications on emergency response, with the MCA invited to participate in debriefs.
Review of documentation	The Project will be responsible for reviewing and updating all documentation including the risk assessments, ERCoP, safety management system and, if required, will convene a review panel of stakeholders to quantify risk. A review of potential risks and response procedures will be undertaken annually.
Inspection of resources	All vessels, facilities and equipment necessary for marine operations will be subject to appropriate inspection and testing to determine fitness for purpose and availability in relation to their performance standards, including AtoNs relative to the performance standards specified by Trinity House.
Audit of performance	Audits will be undertaken periodically to evaluate the efficiency of the marine safety documentation and possible corrective actions should be undertaken in accordance with standard procedures with audit results and reviews brought to the attention of responsible personnel.
Safety management system	An integrated safety management system will be established to ensure the safety and environmental impact of activities undertaken are ALARP. This includes the use of remote monitoring and switching for AtoNs to ensure that a quick fix for a faulty light can be instigated, thus ensuring IALA availability requirements are satisfied.
Future monitoring of vessel traffic	The Development Consent Order (DCO) is expected to include the requirement for construction traffic monitoring by AIS, including continual collection of data from a suitable location. An assessment of a minimum of 28-days and comparison against the results of the vessel traffic analysis (see Section 9) and anticipated future case routing (see Section 13) will be submitted to the MCA annually throughout the construction phase and is likely to continue through the first year of the O&M phase to ensure measures implemented are effective.

Documentation	Details
Cable monitoring	The subsea cables will be subject to periodic inspection post construction to monitor cable burial depths and protection. If exposed cables or ineffective cable protection measures are identified, these would be promulgated to relevant sea users including via notifications to mariners and Kingfisher Bulletins and if there was deemed to be an immediate risk additional temporary measures may be deployed until such time as the risk is permanently mitigated.
Hydrographic surveys	As required by MGN 654, detailed and accurate hydrographic surveys will be undertaken periodically at intervals agreed with the MCA.
Decommissioning plan	A decommissioning plan will be developed. For shipping and navigation, this will include consideration of the scenario where upon decommissioning and completion of removal operations, an obstruction is left on-site which is considered a danger to safe navigation and has not been possible to remove.

21 Summary

21.1 Consultation

566. 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 (both statutory and non-statutory), outreach to Regular Operators of the area, recreational outreach, and a Hazard Workshop process.

21.2 Existing Environment

567. Triton Knoll, which was fully commissioned in January 2022, is approximately 4nm to the west of the array area with Hornsea Project Two, which was fully commissioned in November 2022, approximately 9nm to the northeast. Several other OWFs are in proximity to the wider Project area.

568. Two TCE marine aggregate dredging areas are within proximity to the array area, areas Outer Dowsing 515/1 and 515/2 with the latter just 0.6nm from the southwest of the array area.

569. The closest port or harbour to the array area is Wells Harbour, 32nm south of the array area on the Norfolk coast and the closes commercial port, the Port of Immingham at the entrance to the Humber, 38nm northwest (24nm from Offshore ECC). Pilotage services and anchorage areas are provided within the vicinity to the Humber.

570. Within the array area are four oil and gas platforms with the Pickerill A and B partially decommissioned (topsides removed), Galahad pending decommissioning, and the Malory operational. Surrounding the array area as many other oil and gas fields and associated platforms, with an additional 15 structures within the shipping and navigation study area. These gas fields being Clipper, Barque, Audrey, Galleon, Waveney, Lancelot, Excalibur, Amethyst, West Sole, Hoton, and Mimas.

571. There are six charted pipelines from offshore assets to shore in proximity to the array area with pipeline bundles and pipelines between assets also present. Two pipelines intersect the Offshore ECC, south of the array area.

572. The closest subsea cables to the Project are the export cables for Hornsea Project One and Two which pass through the s and intersect the shipping and navigation study area, approximately 2.4nm north of the array. Subsea cables for Triton Knoll intersect the Offshore ECC along its northern boundary.

573. There are 93 charted wrecks or obstructions within the shipping and navigation study area with only five present within the array area.

574. There are two areas of spoil ground in close proximity to the Offshore ECC. One spoil ground intersects the Offshore ECC approximately 6nm offshore with the other area, although disused, 1.4nm south of the Offshore ECC.

21.3 Maritime Incidents

575. From SAR helicopter taskings data between 2015 and 2022 there was an average of six incidents per year within the shipping and navigation study, the majority of these being "Rescue/Recovery" (88%), Nine taskings took place within the array area itself. There was an average of three incidents per year within the ECC study area, the majority of these also being "Rescue/Recovery" (60%). Two taskings took place within the Offshore ECC. The closest SAR helicopter base is located at Humberside Airport.
576. From RNLI incident data recorded between 2010 and 2019 there was an average of two incidents per year within the shipping and navigation study area with one incident recorded within the array area. The most common incident types recorded were "Machinery Failure" (28%) and "Flooding/Foundering" (17%). The most common casualty types recorded were fishing vessels (39%) and "Oil and Gas Rig/Support" (22%). An average of six to seven incidents per year were recorded within the ECC study area with the majority occurring off the coast and ten within the Offshore ECC. The most common incident types recorded were "Person in Danger" (31%) and "Unspecified" (22%). The most common casualty types recorded were "Person in danger" (41%) and "Other (non-vessel based)" (23%). The most common RNLI base stations recorded for lifeboat launches for incidents in the ECC study area were Skegness (56%) and Mablethorpe (37%).
577. From MAIB incident data recorded between 2010 and 2019 there was on average one incident per year within the shipping and navigation study area and an average of one incident was recorded every two years in the ECC study area. Throughout the 10-year period, no incidents occurred within the array area or within the Offshore ECC. The most common incident types were the same within each study area "Accident to Person" (31% for shipping and navigation and 40% for ECC) and "Flooding/Floundering" (23% and 40%). The main vessel types involved in incidents were "other commercial" vessels (63% and 80%) for both study areas.

21.4 Vessel Traffic Movements

578. From 14-days of vessel traffic survey data recorded in August 2022 (summer) within the shipping and navigation study area, there was an average of between 64 and 65 unique vessels per day with an average of ten unique vessels per day were recorded intersecting the array area. The main vessel types recorded within the shipping and navigation study area were cargo vessels (43%), tankers (17%) and oil and gas vessels (11%).

579. During the summer survey period an average of 58 unique vessels per day were recorded within the ECC study area with an average of 55 unique vessels per day were recorded intersecting the Offshore ECC. The main vessel types recorded within the ECC study area were cargo vessels (50%), tankers (16%) and windfarm vessels (14%).
580. A total of 13 main commercial routes were identified from the vessel traffic survey data. The highest use main commercial route was between Ports within the Humber and to Rotterdam, The Netherlands with an average of 16 unique vessels per day. This route was also used by commercial ferries. Several other routes were identified in and out of the Humber including routes to and from ports in The Netherlands and Germany.

21.5 Future Case Vessel Traffic

581. An indicative 10% and 20% increase in vessel traffic associated with commercial vessels has been considered for the future case scenario at this stage.
582. Deviations could be required for five out of the 13 main commercial routes identified, with the level of deviation varying between less than 0.1nm increase for a route between Humber Ports and Cuxhaven, Germany, and a 4.6nm increase for a route between Humber Ports and Bremerhaven/Hamburg, Germany.

21.6 Collision Risk Modelling

583. The annual collision frequency pre windfarm was estimated to be 3.21×10^{-2} , corresponding to a return period of approximately one in 31 years. This rose to 3.85×10^{-2} post windfarm which represents an increase of approximately 19%.
584. Additional modelling scenarios will be run as part of the final NRA (see Section 21.8).

21.7 Risk Statement at PEIR

585. The final NRA will include a risk statement based on the assessment undertaken on the refined array area. A risk assessment has been undertaken at PEIR stage and all hazards were found to be at most tolerable, however it is considered necessary to assess the refined array area before a final ALARP statement can be made.

21.8 Next Steps

586. Although this NRA does primarily address 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 and compliant NRA is submitted at the ES stage. These include:

- Additional consultation with shipping and navigation stakeholders including via the Section 42 process;
- Incorporation of the RYA Coastal Atlas of Recreational Boating (RYA, 2019);
- Additional quantitative modelling of allision risk and baseline encounters;
- Development of a detailed methodology for future case vessel traffic scenarios;
- Consequences assessment based on the outputs of the collision and allision risk modelling;
- Further assessment of EMF depending on transmission options in ES design; and
- Assessment of ORCP and accommodation platform if included in ES design.

587. The completion of these additional steps will allow further inputs to be considered within the risk assessment post PEIR, ensuring that the significance of risk determined for each hazard at the ES stage is based on fully comprehensive inputs. This will account for any changes made in project design, including the planned reduction array area size from 500km² to 300km².

21.9 Points for Stakeholder Consideration at Section 42

588. For the purposes of informing the NRA submitted at the ES stage, the Applicant requests any feedback from stakeholders as part of their Section 42 consultation response on the following points in particular:

- Do you have any feedback on the array area boundaries from a shipping and navigation perspective?
- Do you have any feedback on appropriate future case traffic values to inform the future case scenario assessment post PEIR (currently intended that 10% and 20% scenarios will be run)?
- Are there any other projects of particular concern on a cumulative basis in relation to the Project?
- Would you view a dedicated stakeholder meeting with your organisation post PEIR as being of benefit?
- Whether you have any information around decommissioning plans for oil and gas assets in the area?
- If you feel unable to adequately respond to these points at this stage then please advise what additional information is required to allow you to do so.

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Annex A Marine Guidance Note 654 Checklist

589. 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.
590. 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 (or PEIR) is given.

Table A.1 MGN 654 Checklist for main document

Issue	Compliance	Comments
<p>Site and Installation Coordinates. Developers 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.</p>		
<p>Traffic Survey. Includes:</p>		
All vessel types.	✓	<p>Section 9: Vessel Traffic Movements All vessel types are considered with specific breakdowns by vessel type given within the study area.</p>
At least 28 days duration, within either 12 or 24 months prior to submission of the ES.	✓	<p>Section 5: Data Sources The PEIR NRA is based on 28 days of vessel traffic survey data collected during 2022.</p>
Multiple data sources.	✓	<p>Section 5: Data Sources The vessel traffic survey data includes AIS, Radar and visual observations to maximise coverage of vessels not broadcasting on AIS. Long-term vessel traffic data recorded on AIS have also been considered.</p>
Seasonal variations.	✓	<p>Section 5: Data Sources The PEIR NRA is based primarily on 28 days of vessel traffic survey data collected during summer / winter 2022.</p> <p>Annex D: Long-Term Vessel Traffic Movements To assist with the assessment of seasonal variation a long-term AIS dataset covering 12 months in April 2021-March 2022 has also been assessed.</p>
MCA consultation.	✓	<p>Section 4: Consultation The MCA has been consulted as part of the NRA process including through the Hazard Workshop.</p>

Issue	Compliance	Comments
GLA consultation.	✓	Section 4: Consultation Trinity House has been consulted as part of the NRA process including through the Hazard Workshop.
UK CoS.	✓	Section 4: Consultation The UK CoS has been consulted as part of the NRA process including through the Hazard Workshop.
Recreational and fishing vessel organisations consultation.	✓	Section 4: Consultation The RYA, CA and NFFO were all invited to input into the NRA process including through the Hazard Workshop.
Port and navigation authorities consultation, as appropriate.	✓	Section 4: Consultation ABP Humber have been consulted as part of the NRA process including 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 9: Vessel Traffic Movements Vessel traffic data in proximity to the Project has been analysed. Section 17: Risk Assessment – In isolation The hazards due to the Project have been assessed. Section 18: Cumulative Risk Assessment The hazards due to the Project have been assessed on a cumulative basis.
ii. Numbers, types and sizes of vessels presently using such areas.	✓	Section 9: 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 7: Navigational Features Non-transit uses of the areas in proximity to the Project have been identified, including marine aggregate dredging, and anchoring. Section 9: Vessel Traffic Movements Non-transit users were identified in the vessel traffic survey data and included fishing vessels engaged in fishing activities, marine aggregate dredgers engaged in dredging activities, oil and gas activity and anchoring activities.
iv. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✓	Section 10: 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 There are no IMO routeing measures in proximity to the array area as per Section 7.10.

Issue	Compliance	Comments
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	✓	Section 7: Navigational Features There are no IMO routeing measures in proximity to the array area as per Section 7.10.
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 Section 7.2 identifies port approaches in proximity to the Project and Section 7.4 identifies anchorage areas in proximity to the Project.
viii. Whether the site lies within the jurisdiction of a port and/or navigation authority.	✓	Section 7: Navigational Features Section 7.2 identifies the locations of ports in proximity to the Project.
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	Section 9: 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 practice areas in proximity to the Project as per Section 7.11.
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 Section 7.3 identifies the marine aggregate dredging areas in proximity to the Project and Section 7.8 identifies the charted wrecks in proximity to the Project. Section 14: Cumulative and Transboundary Overview Considers other developments in proximity to the Project cumulatively.
xii. Proximity of the site to existing or proposed OREI developments, in cooperation with other relevant developers, within each round of lease awards.	✓	Section 7: Navigational Features Section 7.1 Identifies other baseline OWF developments in proximity to the Project. Section 14: 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 7.9 Identifies spoil and dumping grounds in proximity to the Project.
xiv. Proximity of the site to AtoNs and/or VTS in or adjacent to the area and any impact thereon.	✓	Section 7: Navigational Features Section 7.2 identifies VTS areas in proximity to the Project and Section 7.5 identifies AtoNs in proximity to the Project.

Issue	Compliance	Comments
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 15: Collision and Allision Risk Modelling Provides quantification of collision risk resulting from the Project including pinch (or choke) points in proximity to the array area.
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 8: Emergency Response and Incident Overview Historical vessel incident data published by DfT (Section 8.1), RNLI (Section 8.2) and MAIB (Section 8.5) in proximity to the Project has been considered alongside historical OWF incident data throughout the UK (Section 8.6).
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area.	✓	Section 9: 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 13: Future Case Vessel Traffic A methodology for post windfarm routeing is outlined and includes a minimum distance of 1nm from offshore installations and existing OWF boundaries.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	Section 14: Future Case Vessel Traffic Section 14.2 assesses cumulative routeing. Noted that the distance between the array area and the Hornsea projects is considered large enough that no "corridor" is created (in excess of 9nm), and the gap between the array area and Triton Knoll OWF is already established via presence of the Outer Dowsing Shoal.
OREI Structures. The following should be determined:		

Issue	Compliance	Comments
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 17: Risk Assessment – In Isolation The hazards due to the Project have been 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.
b. Clearances of fixed or floating WTG blades above the sea surface are not less than 22m (above Mean High Water Springs (MHWS) for fixed). Floating WTG allow for degrees of motion.	✓	Section 6: Project Description Relevant to Shipping and Navigation Section 6 outlines the shipping and navigation MDS for WTGs 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 MDS for subsea cables including the cable burial specifications.
d. Whether structures block or hinder the view of other vessels or other navigational features.	✓	Section 17: Risk Assessment – In Isolation The hazards due to the Project have been assessed for each phase and include consideration of the potential for vessels navigating in proximity to structures to be visually obscured.
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 6.1 outlines the shipping and navigation project description for the PEIR and includes the range of existing water depths. Section 9: Vessel Traffic Movements Vessel traffic data in proximity to the Project has been analysed including vessel draught. Section 15: Collision and Allision Risk Modelling Provides quantification of collision risk. The final NRA will include allision modelling which will include account of 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 15: Collision and Allision Risk Modelling Provides quantification of collision risk. The final NRA will include allision modelling which will include account of tidal conditions.

Issue	Compliance	Comments
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.	✓	
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 15: Collision and Allision Risk Modelling Provides quantification of collision risk. The final NRA will include allision modelling which will include account of 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 15: Collision and Allision Risk Modelling Provides quantification of collision risk. The final NRA will include allision modelling which will include account of tidal conditions.
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 windfarm area or adjacent to the area.	✓	Section 17 : Risk Assessment – In Isolation The hazards due to the Project have been assessed for each phase and include 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 9: Vessel Traffic Movements Vessel traffic data in proximity to the Project has been analysed including recreational vessels. Section 11: Adverse Weather Routeing Section 11.2 identifies alternative vessel routeing in proximity to the Project in adverse weather. Section 17: Risk Assessment – In Isolation The hazards due to the Project have been assessed for each phase and include consideration of adverse weather routeing.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	Section 17: Risk Assessment – In Isolation The hazards due to the Project have been assessed for each phase and include consideration of internal allision risk for vessels under sail.

Issue	Compliance	Comments
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.	✓	<p>Section 15: Collision and Allision Risk Modelling Provides quantification of collision risk. The final NRA will include allision modelling which will include account of tidal conditions.</p> <p>Section 17: Risk Assessment – In Isolation The hazards due to the Project have been assessed for each phase and include consideration of drifting allision risk.</p>
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:		
a. Navigation within or close to the site would be safe:		
i. For all vessels.	✓	<p>Section 4: Consultation Section 4.2.3 outlines Regular Operator consultation undertaken following the vessel traffic surveys.</p> <p>Section 11: Adverse Weather Routeing Section 11.2 identifies alternative vessel routeing in proximity to the Project in adverse weather.</p> <p>Section 15: Collision and Allision Risk Modelling Provides quantification of collision risk. The final NRA will include allision modelling which will include account of tidal conditions.</p> <p>Section 17: Risk Assessment – In Isolation The hazards due to the Project have been assessed for each phase and include consideration of internal allision risk.</p>
ii. For specified vessel types, operations and/or sizes.		
iii. In all directions or areas.		
iv. In specified directions or areas.		
v. In specified tidal, weather or other conditions.		
b. Navigation in and/or near the site should be prohibited or restricted:		
i. For specified vessel types, operations and/or sizes.	✓	<p>Section 12: Navigation, Communication and Position Fixing Equipment Assesses potential hazards on navigation of the different communications and position fixing devices used in and around OWFs.</p>
ii. In respect of specific activities.	✓	
iii. In all areas or directions.	✓	<p>Section 13: Future Case Vessel Traffic</p>
iv. In specified areas or directions.	✓	

Issue	Compliance	Comments
v. In specified tidal or weather conditions.	✓	A methodology for post windfarm routeing is outlined and includes a minimum distance of 1nm from offshore installations and existing OWF boundaries, i.e., it is assumed that commercial vessels will avoid the array area. Section 17: Risk Assessment – In Isolation The hazards due to the Project have been assessed for each phase and include consideration of vessel displacement.
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.	✓	Section 17: Risk Assessment – In Isolation The hazards due to the Project have been assessed for each phase and include consideration of vessel displacement and emergency response capability.
d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered.	✓	Section 13: Future Case Vessel Traffic A methodology for post windfarm routeing is outlined and includes consideration of the Shipping Route Template.
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 developers and operators.		
a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI.	✓	Section 16: 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.
b. The MCA's guidance document <i>Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response</i> (MCA, 2021) for the design, equipment and operation requirements will be followed.	✓	Section 2: Guidance and Legislation Outlines the guidance and legislation used within the NRA including Annex 5 of MGN 654. Section 16: 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.

Issue	Compliance	Comments
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 16: 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 20: 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.	✓	
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 12: 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 12: Navigation, Communication and Position Fixing Equipment
ii. Vessel to shore.	✓	

Issue	Compliance	Comments
iii. VTS Radar to vessel.	✓	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.
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 12: 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 12: 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 12: 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.

Risk mitigation measures recommended for OREI during construction, operation 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 developer'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 16: 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 16: 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 16: 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.

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
v. Provision of AtoNs as determined by the GLA.	✓	Section 16: 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 16: Embedded Mitigation Measures Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards. Includes MGN 654 compliance and therefore agreement of a SAR checklist with the MCA. Section 20: Through life safety management Confirms that monitoring of the site will be undertaken in line with standard DCO/dML traffic monitoring condition approach.
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of Safety Zones.	✓	Section 16: 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.
ix. Creation of an ERCoP with the MCA's SAR Branch for the construction phase onwards.	✓	Section 16: 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 include the provision of an ERCoP.
x. Use of guard vessels, where appropriate.	✓	Section 16: 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 Describes all offshore elements of the Project including all infrastructure (surface and sub-sea) within the array area and offshore export cable corridor.
xiii. Design of OREI structures to minimise risk to contacting vessels or craft.	✓	There is no additional risk posed to craft compared to previous OWFs and so no additional measures are identified.

Issue	Compliance	Comments
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	<p>Section 16: Embedded Mitigation Measures Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards.</p> <p>Section 20: Through life safety management Outlines how QHSE documentation will be maintained and reviewed.</p>

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.	✓	<p>Section 17: Risk Assessment – In Isolation The risk assessment provides a risk claim at PEIR stage for a range of hazards based on a number of inputs including (but not limited to) baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments.</p>
Description of the marine environment.	✓	<p>Section 7: Navigational Features Relevant navigational features in proximity to the Project have been described including (but not limited to) other OWF developments, marine aggregate dredging areas, ports, harbours and related facilities, charted anchorage areas, AtoNs, sub-sea cables, oil and gas infrastructure, and charted wrecks.</p> <p>Section 14: Cumulative and Transboundary Overview Potential future developments have been screened in to 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 OWFs, oil and gas infrastructure and marine aggregate dredging areas.</p>
SAR overview and assessment.	✓	<p>Section 8: 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 HMCG stations.</p> <p>17: Risk Assessment – In Isolation The risk assessment includes an assessment of how activities associated with the Project may restrict emergency response capability of existing resources.</p>
Description of the OREI development and how it changes the marine environment.	✓	<p>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</p>

Item	Compliance	Comments
		<p>description of the PEIR boundary, array area and export cable corridor infrastructure, construction phase programme and indicative vessel and helicopter numbers during the construction and O&M phases.</p> <p>Section 13: Future Case Vessel Traffic Worst case alternative routeing for commercial traffic has been considered.</p>
Analysis of the marine traffic, including base case and future traffic densities and types.	✓	<p>Section 9: Vessel Traffic Movements Vessel traffic data in proximity to the Project has been analysed and includes vessel density and breakdowns of vessel type.</p> <p>Section 13: Future Case Vessel Traffic Worst case alternative routeing for commercial traffic has been considered. The final NRA will include traffic growth scenarios.</p>
<p>Status of the hazard log:</p> <ul style="list-style-type: none"> ▪ Hazard identification; ▪ Risk assessment; ▪ Influences on level of risk; ▪ Tolerability of risk; and ▪ Risk matrix. 	✓	<p>Section 3: Navigational Risk Assessment Methodology A tolerability matrix has been defined to determine the tolerability (significance) of risks.</p> <p>Annex B: Hazard Log The complete hazard log is presented and includes a description of the hazards considered, possible causes, consequences (most likely and worst case) and relevant embedded mitigation measures. Using this information, each hazard is then ranked in terms of frequency of occurrence and severity of consequence to give a tolerability (significance) level.</p>
<p>NRA:</p> <ul style="list-style-type: none"> ▪ Appropriate risk assessment; ▪ MCA acceptance for assessment techniques and tools; ▪ Demonstration of results; and ▪ Limitations. 	✓	<p>Section 2: Guidance and Legislation MGN 654 and the IMO's FSA guidelines are the primary guidance documents used for the assessment.</p> <p>Section 15: Collision and Allision Risk Modelling Provides quantification of collision risk with the results outlined numerically and graphically, where appropriate. The final NRA will include quantitative assessment of allision risk.</p>
Risk control log	✓	<p>Section 19: Risk Control Log Provides the risk control log which summarises the assessment of shipping and navigation hazards scoped into the risk assessment. This includes the proposed embedded mitigation measures, frequency of occurrence, severity of consequence and significance of risk, per hazard.</p>

Annex B Hazard Log

591. As per Section 4.2.4, a Hazard Workshop was held for the Project on 10 November 2022. Following the workshop, a Hazard Log was drafted and distributed to attendees for agreement.
592. The Hazard Log was based on the discussions held and captured the following:
- Relevant impacts;
 - Embedded mitigations;
 - Possible causes;
 - Frequency and consequence;
 - Risk; and
 - Any relevant additional mitigations discussed at the workshop.
593. The Hazard Log is shown below.

User	Isolation / Cumulative	Project Component(s)	Phase (C/O/D)	Embedded Mitigation Measures (Full Descriptions Provided in Separate Sheet)	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences					Worst Case Consequences	Realistic Worst Case Consequences					Further Mitigation Required	Additional Comments				
							Consequences						Risk	Consequences						Risk			
							Frequency	People	Environment	Property	Business			Average Consequence	Frequency	People	Environment				Property	Business	Average Consequence
Displacement from Routing with Potential for Collision																							
Commercial vessels (exc. oil and gas)	Isolation	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Presence of buoyed construction/ decommissioning area Construction/ decommissioning vessels which are RAM 	Displacement with effects on schedule but no safety risks	5	1	1	1	2	1.3	Tolerable	Displacement with effects on schedule and collision event occurs involving vessel damage, injury to person and/or pollution	2	3	3	4	4	3.5	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%	No initial concerns at port level, however additional consultation will be undertaken at E5.
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Maintenance vessels which are RAM 	Displacement with effects on schedule but no safety risks	5	1	1	1	2	1.3	Tolerable	Displacement with effects on schedule and collision event occurs involving vessel damage, injury to person and/or pollution	2	3	3	4	4	3.5	Broadly Acceptable		
	Cumulative	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Simultaneous buoyed construction/ decommissioning areas for Construction vessels which are RAM 	Displacement with effects on schedule but no safety risks	5	1	1	1	3	1.5	Tolerable	Displacement with effects on schedule and collision event occurs involving vessel damage, injury to person and/or pollution	2	3	3	4	5	3.8	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%	
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Maintenance vessels which are RAM 	Displacement with effects on schedule but no safety risks	5	1	1	1	3	1.5	Tolerable	Displacement with effects on schedule and collision event occurs involving vessel damage, injury to person and/or pollution	1	3	3	4	5	3.8	Broadly Acceptable		
Oil and gas vessels	Isolation	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Presence of buoyed construction/ decommissioning area Construction/ decommissioning vessels which are RAM 	Displacement from historic access routes to platforms but no safety risks	5	1	1	1	2	1.3	Tolerable	Displacement from historic access routes and collision event occurs involving vessel damage, injury to person and/or pollution	2	3	3	4	4	3.5	Broadly Acceptable	Consultation with oil and gas operators	
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Maintenance vessels which are RAM 	Displacement from historic access routes to platforms but no safety risks	5	1	1	1	2	1.3	Tolerable	Displacement from historic access routes and collision event occurs involving vessel damage, injury to person and/or pollution	2	3	3	4	4	3.5	Broadly Acceptable		
	Cumulative	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Simultaneous buoyed construction/ decommissioning areas Construction vessels which are RAM 	Displacement from historic access routes to platforms but no safety risks	5	1	1	1	3	1.5	Tolerable	Displacement from historic access routes and collision event occurs involving vessel damage, injury to person and/or pollution	2	3	3	4	5	3.8	Broadly Acceptable	Consultation with oil and gas operators	
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Maintenance vessels which are RAM 	Displacement from historic access routes to platforms but no safety risks	5	1	1	1	3	1.5	Tolerable	Displacement from historic access routes and collision event occurs involving vessel damage, injury to person and/or pollution	1	3	3	4	5	3.8	Broadly Acceptable		

Commercial fishing vessels in transit	Isolation	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Presence of buoyed construction/ decommissioning area Construction/ decommissioning vessels which are RAM 	Displacement with effects on routine but no safety risks	1	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on routine and collision event occurs involving vessel damage, injury to person and/or pollution	1	4	2	3	3	3.0	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%.
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Maintenance vessels which are RAM 	1	1	1	1	1	1.0	Broadly Acceptable	1		4	2	3	3	3.0	Broadly Acceptable		
Cumulative	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Simultaneous buoyed construction/ decommissioning areas Construction vessels which are RAM 	Displacement with effects on routine but no safety risks	3	1	1	1	2	1.3	Broadly Acceptable	Displacement with effects on routine and collision event occurs involving vessel damage, injury to person and/or pollution	2	4	2	3	3	3.0	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%.	
		O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Maintenance vessels which are RAM 	3	1	1	1	2	1.3	Broadly Acceptable	2		4	2	3	3	3.0	Broadly Acceptable			
Recreational vessels (2.5 to 24m length)	Isolation	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Presence of buoyed construction/ decommissioning area Construction/ decommissioning vessels which are RAM 	Displacement with effects on routine but no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on routine and collision event occurs involving vessel damage, injury to person and/or pollution	1	4	1	2	3	2.5	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%.
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Maintenance vessels which are RAM 	2	1	1	1	1	1.0	Broadly Acceptable	1		4	1	2	3	2.5	Broadly Acceptable		
Cumulative	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Simultaneous buoyed construction/ decommissioning areas Construction vessels which are RAM 	Displacement with effects on routine but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Displacement with effects on routine and collision event occurs involving vessel damage, injury to person and/or pollution	2	4	1	2	3	2.5	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%.	
		O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Maintenance vessels which are RAM 	3	1	1	1	1	1.0	Broadly Acceptable	2		4	1	2	3	2.5	Broadly Acceptable			

Displacement from Adverse Weather Routing

Commercial vessels	Isolation	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Presence of buoyed construction/ decommissioning area Adverse weather Construction/ decommissioning vessels which are RAM 	Displacement from normal adverse weather preference with no effects on schedule and no safety risks	5	1	1	1	1	1.0	Tolerable	Displacement from normal adverse weather preference with effects on schedule due to additional time in port and limited safety risks.	2	3	3	4	3	3.3	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%.	
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Adverse weather Maintenance vessels which are RAM 	5	1	1	1	1	1.0	Tolerable	2		3	3	4	3	3.3	Broadly Acceptable			
	Cumulative	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Simultaneous buoyed construction/ decommissioning areas for Adverse weather Construction vessels which are RAM 	Displacement from normal adverse weather preference with no effects on schedule and no safety risks	5	1	1	1	3	1.5	Tolerable	Displacement from normal adverse weather preference with effects on schedule due to additional time in port with limited safety risks.	2	3	3	4	5	3.8	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%.	Noted that key concern was cumulative effects associated with Hornsea Three
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Adverse weather Maintenance vessels which are RAM 	5	1	1	1	3	1.5	Tolerable	2		3	3	4	5	3.8	Broadly Acceptable			
Commercial fishing vessels in transit	Isolation	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Presence of buoyed construction/ decommissioning area Adverse weather Construction/ decommissioning vessels which are RAM 	Displacement from normal adverse weather preference with no safety risks	1	1	1	1	1	1.0	Broadly Acceptable	Displacement from normal adverse weather preference with limited safety risks	1	4	2	3	3	3.0	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%.	
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Adverse weather Maintenance vessels which are RAM 	1	1	1	1	1	1.0	Broadly Acceptable	1		4	2	3	3	3.0	Broadly Acceptable			
	Cumulative	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Simultaneous buoyed construction/ decommissioning areas Adverse weather Construction vessels which are RAM 	Displacement from normal adverse weather preference with no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Displacement from normal adverse weather preference with limited safety risks	2	4	2	3	3	3.0	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%.	
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Adverse weather Maintenance vessels which are RAM 	3	1	1	1	1	1.0	Broadly Acceptable	2		4	2	3	3	3.0	Broadly Acceptable			

Recreational vessels (2.5 to 24m length)	Isolation	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Presence of buoyed construction/ decommissioning area Adverse weather Construction/ decommissioning vessels which are RAM 	Displacement from normal adverse weather preference with no safety risks	1	1	1	1	1	1.0	Broadly Acceptable	Displacement from normal adverse weather preference with limited safety risks	1	4	1	2	3	2.5	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%.
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Adverse weather Maintenance vessels which are RAM 		1	1	1	1	1	1.0	Broadly Acceptable		1	4	1	2	3	2.5	Broadly Acceptable	
	Cumulative	Array area	C/D	<ul style="list-style-type: none"> Application for safety zones Buoyed construction/ decommissioning area Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information Traffic Monitoring 	<ul style="list-style-type: none"> Simultaneous buoyed construction/ decommissioning areas Adverse weather Construction vessels which are RAM 	Displacement from normal adverse weather preference with no safety risks	2	1	1	1	1	1.0	Broadly Acceptable	Displacement from normal adverse weather preference with limited safety risks	2	4	1	2	3	2.5	Broadly Acceptable	Post PEIR anticipated that site will be reduced by approx. 40%.
			O	<ul style="list-style-type: none"> Application for safety zones (major maintenance only) Charting of infrastructure Compliance with MGN 654 Guard vessels Pollution planning Promulgation of information 	<ul style="list-style-type: none"> Presence of surface structures Adverse weather Maintenance vessels which are RAM 		2	1	1	1	1	1.0	Broadly Acceptable		2	4	1	2	3	2.5	Broadly Acceptable	
Collision Risk (Third-Party with Project Vessel in Transit)																						
Commercial vessels	Isolation	Array Area	C/D	<ul style="list-style-type: none"> Application for safety zones Charting of infrastructure Guard vessels Marine coordination for Project vessels Pollution planning Project vessel compliance with international marine regulations (COLREGs) 	<ul style="list-style-type: none"> Project vessels in transit Lack of third-party awareness 	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	2	3	3	4	4	3.5	Broadly Acceptable	
			O	<ul style="list-style-type: none"> Pollution planning Project vessel compliance with international marine regulations (COLREGs) 			2	1	1	1	1	1.0	Broadly Acceptable			1	3	3	4	4	3.5	Broadly Acceptable
	Cumulative	Array Area	C/D	<ul style="list-style-type: none"> Application for safety zones Charting of infrastructure Guard vessels Marine coordination for Project vessels Pollution planning 	<ul style="list-style-type: none"> Project vessels in transit Lack of third-party awareness Simultaneous installation from same or similar ports 	Increased encounters resulting in increased alertness but no safety risks	4	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	3	3	3	4	4	3.5	Tolerable	
			O	<ul style="list-style-type: none"> Project vessel compliance with international marine regulations (COLREGs) Promulgation of information 	<ul style="list-style-type: none"> Project vessels in transit Lack of third-party awareness Simultaneous operation from same or similar ports 		3	1	1	1	1	1.0	Broadly Acceptable			2	3	3	4	4	3.5	Broadly Acceptable
Commercial fishing vessels in transit	Isolation	Array Area	C/D	<ul style="list-style-type: none"> Application for safety zones Charting of infrastructure Guard vessels Marine coordination for Project vessels Pollution planning Project vessel compliance with international marine regulations (COLREGs) Promulgation of information 	<ul style="list-style-type: none"> Project vessels in transit Lack of third-party awareness 	Increased encounters resulting in increased alertness but no safety risks	1	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	1	4	2	3	2	2.8	Broadly Acceptable	
			O	<ul style="list-style-type: none"> Pollution planning Project vessel compliance with international marine regulations (COLREGs) Promulgation of information 			1	1	1	1	1	1.0	Broadly Acceptable			1	4	2	3	2	2.8	Broadly Acceptable
	Cumulative	Array Area	C/D	<ul style="list-style-type: none"> Application for safety zones Charting of infrastructure Guard vessels Marine coordination for Project vessels 	<ul style="list-style-type: none"> Project vessels in transit Lack of third-party awareness Simultaneous installation from same or similar ports 	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person	2	4	2	3	2	2.8	Broadly Acceptable	

			O	<ul style="list-style-type: none"> • Pollution planning • Project vessel compliance with international marine regulations (COLREGS) • Promulgation of information 	<ul style="list-style-type: none"> • Project vessels in transit • Lack of third-party awareness • Simultaneous operation from same or similar ports 	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	1	4	2	3	2	2.8	Broadly Acceptable
Recreational vessels (2.5 to 24m length)	Isolation	Array area	C/D	<ul style="list-style-type: none"> • Application for safety zones • Charting of infrastructure • Guard vessels • Marine coordination for Project vessels 	<ul style="list-style-type: none"> • Project vessels in transit • Lack of third-party awareness 	Increased encounters resulting in increased alertness but no safety risks	1	1	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	1	4	1	2	2	2.3	Broadly Acceptable
			O	<ul style="list-style-type: none"> • Pollution planning • Project vessel compliance with international marine regulations (COLREGS) • Promulgation of information 		Increased encounters resulting in increased alertness but no safety risks	1	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	1	4	1	2	2	2.3	Broadly Acceptable	
	Cumulative	Array area	C/D	<ul style="list-style-type: none"> • Application for safety zones • Charting of infrastructure • Guard vessels • Marine coordination for Project vessels 	<ul style="list-style-type: none"> • Project vessels in transit • Lack of third-party awareness • Simultaneous installation from same or similar ports 	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	2	4	1	2	2	2.3	Broadly Acceptable
			O	<ul style="list-style-type: none"> • Pollution planning • Project vessel compliance with international marine regulations (COLREGS) • Promulgation of information 	<ul style="list-style-type: none"> • Project vessels in transit • Lack of third-party awareness • Simultaneous operation from same or similar ports 	Increased encounters resulting in increased alertness but no safety risks	3	1	1	1	1	1	1.0	Broadly Acceptable	Collision event occurs involving vessel damage, injury to person and/or pollution	1	4	1	2	2	2.3	Broadly Acceptable
Allision Risk (Powered, Drifting or Internal)																						
Commercial vessels	Isolation	Array area	O	<ul style="list-style-type: none"> • Application for safety zones (major maintenance only) • Charting of infrastructure • Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels 	<ul style="list-style-type: none"> • Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure 	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	4	1	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, injury to person and/or pollution	2	3	3	4	4	3.5	Broadly Acceptable
	Cumulative			<ul style="list-style-type: none"> • Pollution planning • Project vessel compliance with international marine regulations (SOLAS) • Promulgation of information 	<ul style="list-style-type: none"> • Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure 	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	4	1	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, injury to person and/or pollution	2	3	3	4	4	3.5	Broadly Acceptable
Commercial fishing vessels in transit	Isolation	Array area	O	<ul style="list-style-type: none"> • Application for safety zones (major maintenance only) • Charting of infrastructure • Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels 	<ul style="list-style-type: none"> • Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure 	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	2	1	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, injury to person and/or pollution	3	4	2	3	2	2.8	Broadly Acceptable
	Cumulative			<ul style="list-style-type: none"> • Pollution planning • Project vessel compliance with international marine regulations (SOLAS) • Promulgation of information 	<ul style="list-style-type: none"> • Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure 	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	3	1	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, injury to person and/or pollution	4	4	2	3	2	2.8	Tolerable
Recreational vessels (2.5 to 24m length)	Isolation	Array area	O	<ul style="list-style-type: none"> • Application for safety zones (major maintenance only) • Charting of infrastructure • Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels 	<ul style="list-style-type: none"> • Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure 	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	1	1	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, injury to person and/or pollution	2	4	1	2	2	2.3	Broadly Acceptable
	Cumulative			<ul style="list-style-type: none"> • Minimum blade tip clearance • Pollution planning • Project vessel compliance with international marine regulations (SOLAS) • Promulgation of information 	<ul style="list-style-type: none"> • Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure 	Vessel passes at an unsafe distance resulting in a need to make a late adjustment to course/speed	2	1	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs involving vessel damage, injury to person and/or pollution	3	4	1	2	2	2.3	Broadly Acceptable
Interference with Marine Navigation, Communication and Position Fixing Equipment																						

All vessels	Isolation	Array area	O	<ul style="list-style-type: none"> Compliance with MGN 654 	<ul style="list-style-type: none"> Human error relating to adjustment of Radar controls Presence of surface structures 	Structures have no effect upon the Radar, communications and navigation equipment on a vessel	4	1	1	1	1	1.0	Broadly Acceptable	Minor level of Radar interference due to the structures	3	1	1	1	1	1.0	Broadly Acceptable		
Reduction in Emergency Response Capability																							
Emergency responders	Isolation	Array area	C/D	<ul style="list-style-type: none"> Compliance with MGN 654 Lighting and marking Marine coordination for Project vessels Pollution planning 	<ul style="list-style-type: none"> Under construction array does not facilitate responder access Limited resource capability Adverse weather 	Delay to emergency response request	2	1	1	1	2	1.3	Broadly Acceptable	Delay to response request leading to injury to person or loss of life	1	4	5	5	5	4.8	Tolerable		
			O	<ul style="list-style-type: none"> Project vessel compliance with international marine regulations (SOLAS) 	<ul style="list-style-type: none"> Array does not facilitate responder access Limited resource capability Adverse weather 		2	1	1	1	2	1.3	Broadly Acceptable		1	4	5	5	4.8	Tolerable			
	Cumulative	Array area	C/D	<ul style="list-style-type: none"> Compliance with MGN 654 Lighting and marking Marine coordination for Project vessels Pollution planning 	<ul style="list-style-type: none"> Simultaneous buoyed construction/decommissioning areas Under construction array does not facilitate responder access Limited resource capability Adverse weather 	Delay to emergency response request	3	1	1	1	3	1.5	Broadly Acceptable	Delay to response request leading to injury or loss of life	2	4	5	5	5	4.8	Tolerable		
			O	<ul style="list-style-type: none"> Project vessel compliance with international marine regulations (SOLAS) 	<ul style="list-style-type: none"> Simultaneous operation Array does not facilitate responder access Limited resource capability Adverse weather 		3	1	1	1	3	1.5	Broadly Acceptable		2	4	5	5	5	4.8	Tolerable		

Annex C Regular Operator Consultation

594. As part of the consultation process for the Project, regular operators identified as potentially being of relevance based on the vessel traffic survey data were contacted to request comment on the Project. 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: 8th September 2022

Opportunity to Participate in Consultation Relating to Shipping and Navigation for the Proposed Outer Dowsing Offshore Wind Farm

Dear Stakeholder,

As you may be aware, the Outer Dowsing offshore wind farm is proposed to be a 1.5 gigawatt project located approximately 54 kilometres off the Lincolnshire coast. It is being developed as a joint venture between TotalEnergies and Corio Generation. Further information about the Project can be found [here](#).

Following a Scoping Report submitted to the Planning Inspectorate in August 2022 (see [here](#)), the Project has commenced drafting of the Preliminary Environmental Information Report (PEIR) including the Navigational Risk Assessment (NRA). The outputs of this process will feed into the subsequent Environmental Statement (ES) which will include any relevant NRA updates following the PEIR outputs.

The site covers an area of approximately 145 nm², and is located approximately 4nm to the east of the operational Triton Knoll offshore wind farm. An overview of the current site boundary is provided in Figure 1. The figure includes the Offshore Export Cable Corridor (ECC) Area of Search for reference.

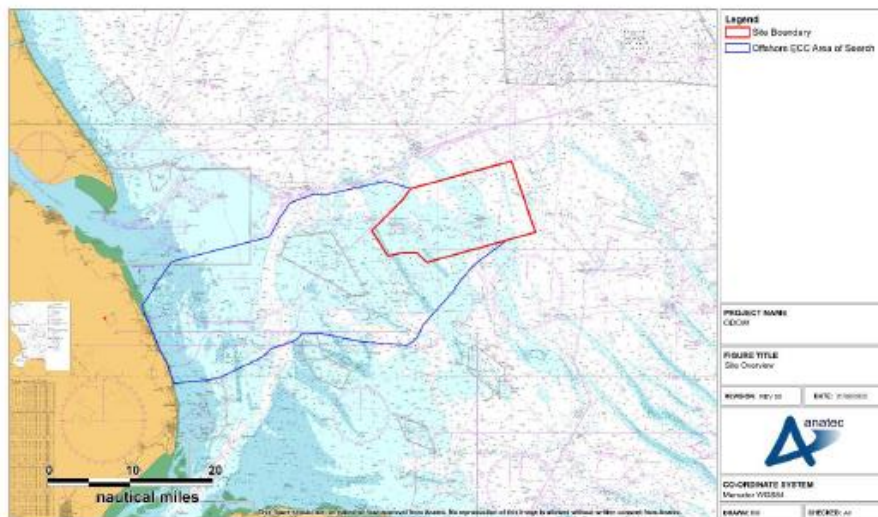


Figure 1 Overview of the Site Boundary

Anatec has been contracted to provide technical support on shipping and navigation during the consenting process, and to coordinate consultation with relevant stakeholders. As part of the NRA

process, Anatec has undertaken an assessment of 12 months of AIS data covering the period from April 2021 to March 2022 to identify regular commercial operators. This exercise has identified your organisation as a regular operator within or in proximity to the site boundary.

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 on the following:

1. Whether the Project is likely to impact the routeing of any specific vessels and/or routes.
2. Whether the Project poses any safety concern to the routeing of your vessels, including any adverse weather routeing.
3. Whether the cumulative scenario (i.e., other potential wind farm projects) affects your responses to the previous questions.
4. Whether you would choose to make passage internally through the site boundary and associated structures.

Additionally, we would like to invite you to attend a Hazard Workshop for the Project. Further details can be provided if this is of interest.

We would appreciate if any responses are provided via email to [REDACTED] by the 23rd September 2022, as well as an indication of whether you are interested in attending the Hazard Workshop noted above. In the meantime I would be grateful if you could confirm receipt of this letter for our records.

Please do not hesitate to get in touch should you have any queries or require any further information.

Yours sincerely,

[REDACTED]
Risk Analyst
Anatec Ltd.

Annex D Long-Term Vessel Traffic Movements

D.1 Introduction

595. This appendix assesses the additional long-term vessel traffic data for the project. The NRA and Volume 1, Chapter 15: Shipping and Navigation of the PEIR consider 14-days of AIS, Radar and visual observation data as the primary vessel traffic data source. The final NRA will incorporate a second 14 day survey to bring the total up to 28 days. However, it should be considered that studying a 28-day period in isolation may exclude certain activities or periods of pertinence to shipping and navigation.
596. Therefore, in line with good practice assessment procedures, this NRA has also considered a longer term dataset covering 12-months from the 1st April 2021 to the 31st March 2022 to ensure a comprehensive characterisation of vessel traffic movements can be established including the capture of any seasonal variation.
597. This approach (i.e., the use of both short- and long-term data) has been agreed with the MCA and Trinity House.

D.2 Methodology

D.2.1 Study Area

598. This appendix has assessed the long-term vessel traffic data within the same shipping and navigation study area introduced in Section 3.4.

D.2.2 Date Period and Temporary Vessel Traffic

599. The long-term vessel traffic data was collected from coastal AIS receivers for the 12-month between the 1st April 2021 to the 31st March 2022. The percentage uptime⁶ per month for the AIS receivers that the AIS data has used within this report was analysed. The uptime for the receivers was estimated at 99%.
600. As per the vessel traffic surveys, a number of vessel tracks recorded during the data period were classified as temporary (non-routine) and have been excluded from the characterisation of the vessel traffic baseline, including vessels associated with Hornsea Project Two which was still under construction at the time of data collection.

D.2.3 AIS Carriage

601. General limitations associated with the use of AIS data (for example carriage requirements) are discussed in full within Section 5.4.1.

⁶ The time period when AIS data was being received by the receiver

D.3 Long-Term Vessel Traffic Movements

602. A plot of the vessel tracks recorded within the shipping and navigation study area during the data period, colour-coded by vessel type and excluding temporary traffic, is presented in Figure D.1.

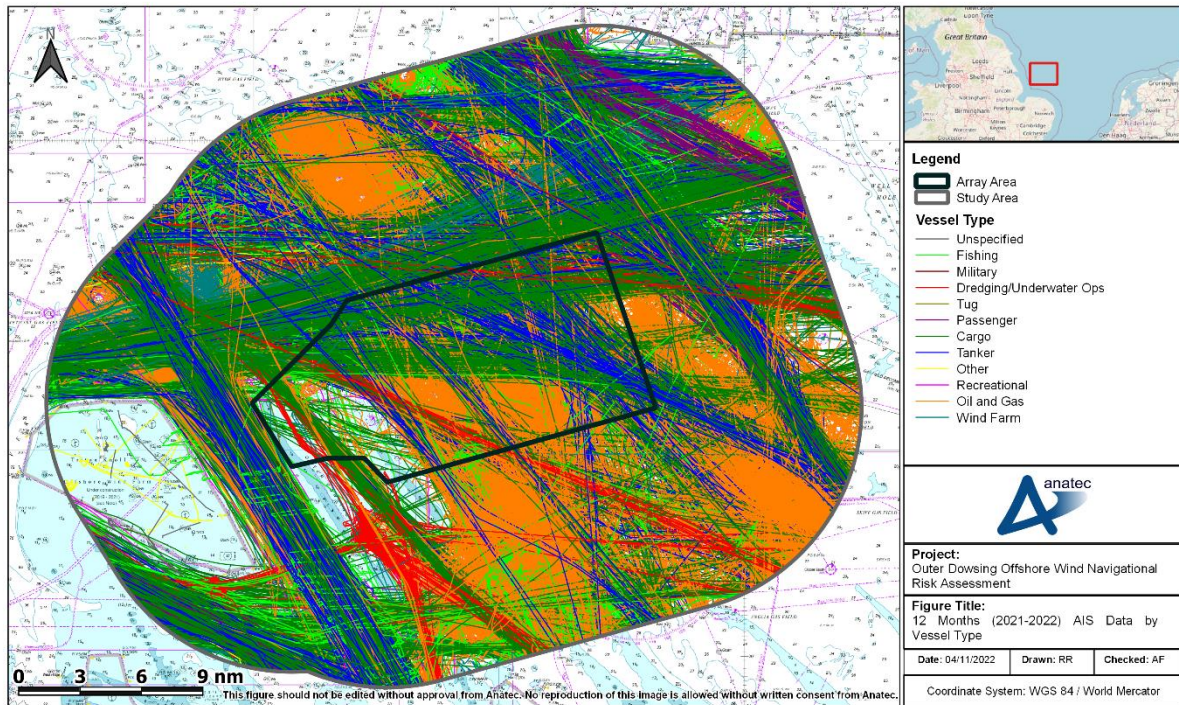


Figure D.1 Long-term Vessel Traffic Data by Vessel Type (12-Months, 2021-2022)

D.3.2 Vessel Count

603. The average daily number of vessels within the shipping and navigation study area for each month of the 12-month data periods are presented in Table D.1.

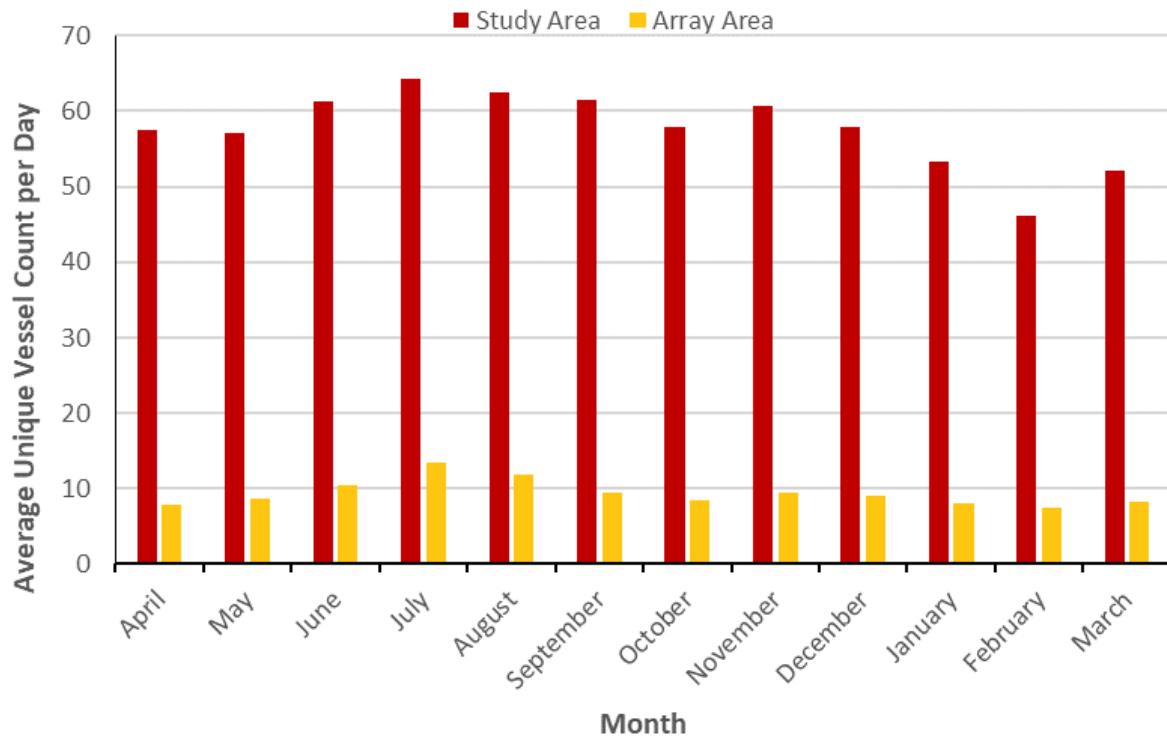


Table D.1 Long-Term Daily Counts by Month Within the Shipping and Navigation Study Area and Array Area (12-Months, 2021-2022)

604. The busiest month recorded within the shipping and navigation study area was July with approximately 64 unique vessels per day, noting the average for the entire data period was 58 unique vessels per day. The quietest month was February with approximately 46 unique vessels per day recorded. Overall, there was not considered to be notable fluctuation in traffic volumes over the data period within the shipping and navigation study area.
605. In total, approximately 16% of all vessels recorded within the shipping and navigation study area during the data periods intersected the array area.

D.3.3 Vessel Type

606. The distribution of the main vessel types recorded during the data period are presented in Figure D.2. Vessel types accounting for less than 1% of the overall activity during the data period (including military vessels, High Speed Crafts, and recreational vessels) have been incorporated into the 'other' vessel category.

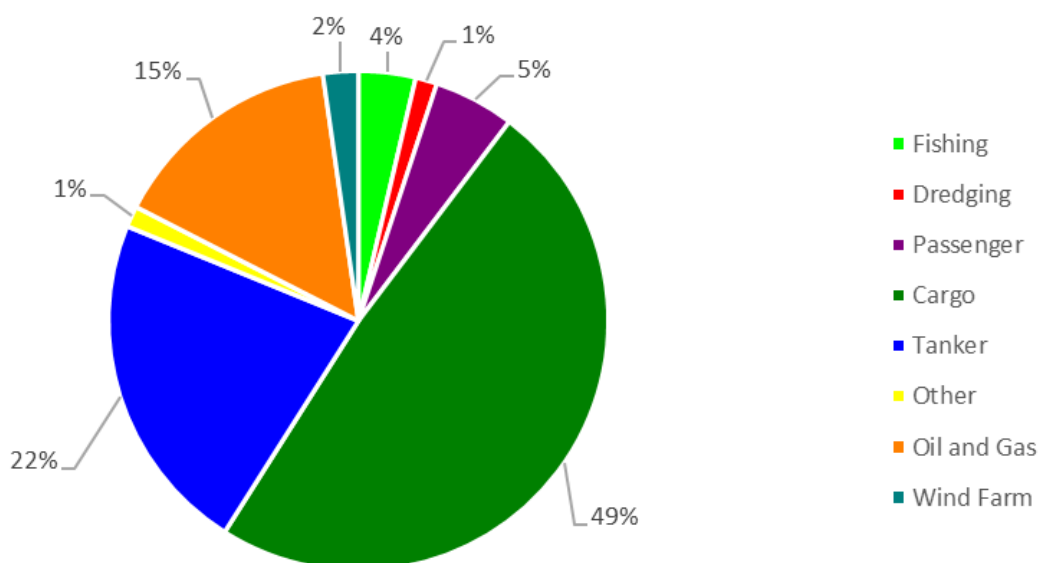


Figure D.2 Main Vessel Types Distribution (12-months, 2021-2022)

607. The most common vessel type recorded was cargo vessels, accounting for approximately 49% of all traffic recorded within the shipping and navigation study area during the data period. Other common vessel types included tankers (22%), oil and gas vessels (15%), passenger vessels (5%), and fishing vessels (4%).

D.4 Site Specific Analysis

D.4.1 Commercial Vessels

608. The commercial vessels (in this instance relating to cargo vessels, tankers, and passenger vessels) recorded within the shipping and navigation study area during the data period are presented in Figure D.3.

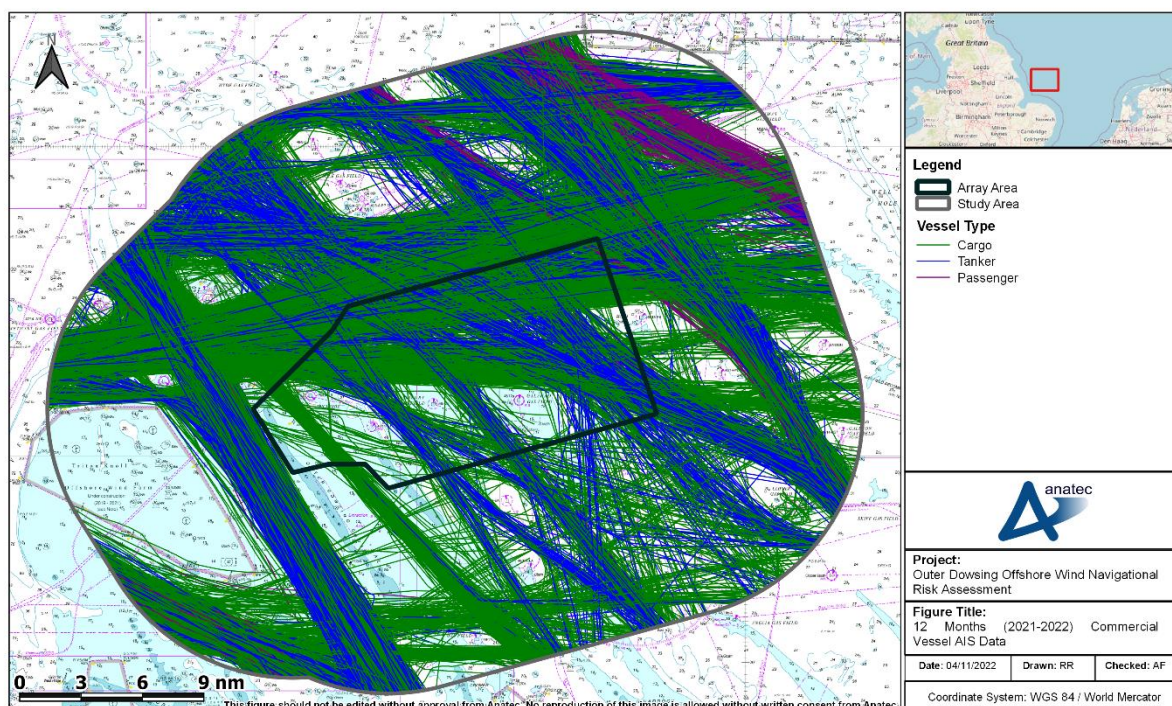


Figure D.3 Commercial Vessels Within the Shipping and Navigation Study Area by Vessel Type (12-months, 2021-2022)

609. An average of 44 unique commercial vessels per day were recorded within the shipping and navigation study area during the data period.
610. The cargo vessels and tankers recorded were noted on well-defined routes through the site boundary both in a northwest-southeast and east-west orientation with these primarily comprising the main commercial routes that have been identified from the vessel traffic survey data (see Section 10.2). Cargo vessels and tankers were on routes primarily between ports on the Humber and Tees (UK), and mainland Europe ports such as Rotterdam (the Netherlands), Zeebrugge (Belgium), and Cuxhaven (Germany).
611. Additionally, passenger routes were observed primarily between Tyne (UK) and Ijmuiden (the Netherlands) operated by Stena Line and P&O Ferries; and between Hull (UK) and Rotterdam operated by DFDS Seaways. Other routes included alternate adverse weather passage for the route between Ijmuiden and Tyne.
612. The number of unique cargo, tanker, and passenger vessels recorded per day for each month within the shipping and navigation study area and array area itself are presented in Figure D.4, and Figure D.5 respectively.

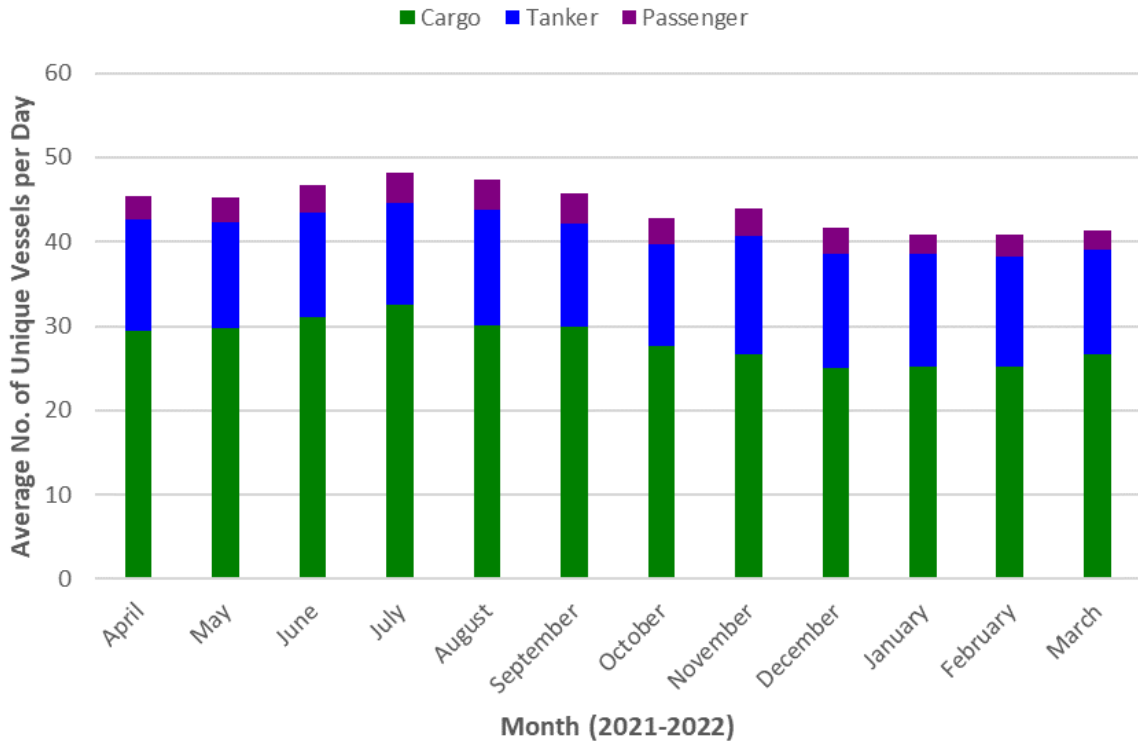


Figure D.4 Long-Term Average Daily Counts by Month Per Type Within the Shipping and Navigation Study Area (12-Months, 2021-2022)

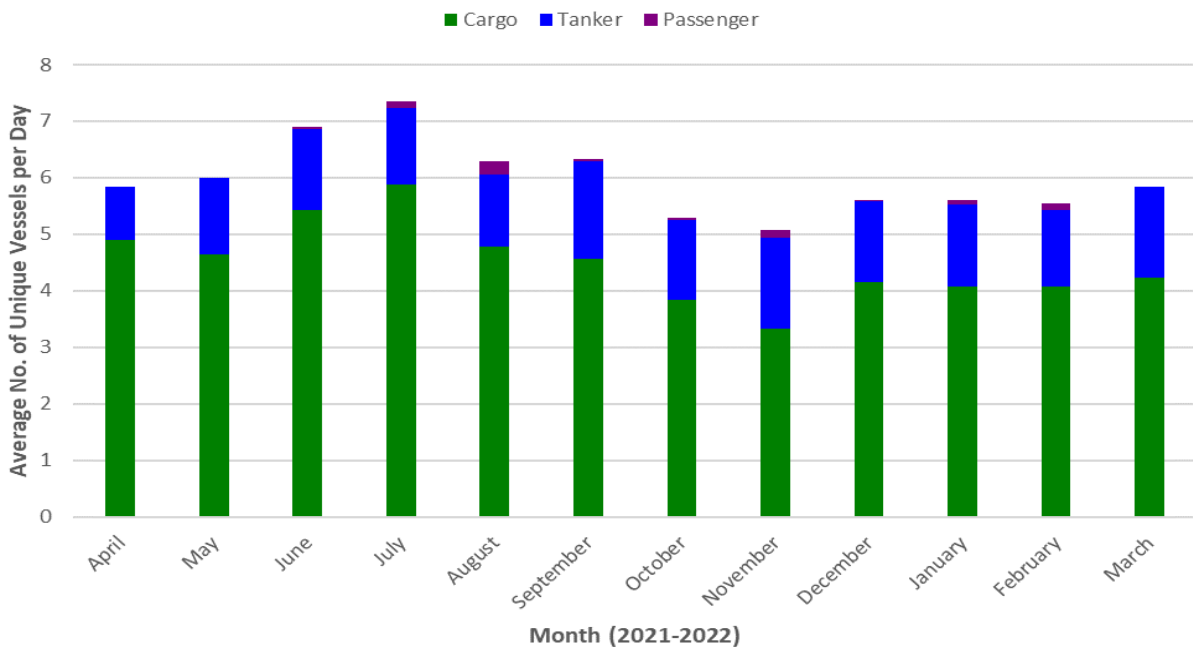


Figure D.5 Long-Term Average Daily Counts by Month Per Type Within Array Area (12-Months, 2021-2022)

613. On average throughout the data period there was 28 unique cargo vessels, 13 unique tankers, and 3 unique passenger vessels per day. Approximately 14% of commercial vessels were recorded intersecting the array area, the majority being cargo vessels.
614. Cargo vessels showed some seasonal variation, albeit minimal, with slightly higher vessel numbers being recorded in summer months. The busiest month within the shipping and navigation study area was July with an average of 32 unique cargo vessels per day. The quietest month for cargo vessels was December with 25 unique cargo vessels per day.
615. Tankers similarly showed minimal seasonal variation with the busiest month within the shipping and navigation study area being November with an average of 14 unique tankers per day. The quietest month for tankers was July with approximately 12 unique tankers per day.
616. Passenger vessels similarly showed some seasonal variation, albeit minimal, with slightly higher vessel numbers being recorded in summer months also. The busiest month within the shipping and navigation study area was August with an average of between three and four unique passenger vessels per day. The quietest month was March with an average of two unique passenger vessels per day.
617. In total, of all commercial vessels recorded within the shipping and navigation study area, 16% of cargo vessels, 11% of tanker, and 2% of passenger vessels intersected the array area during the data period.
618. Table D.2 presents a summary of the average number of vessels within the shipping and navigation study area and array area during the busiest month, quietest month, and the average throughout the full data period.

Table D.2 Quietest Month, Busiest Month, and Overall Average Daily Count for Commercial Vessels (2021-2022)

Vessel Type	Study Area			Array Area		
	Quietest	Busiest	Average	Quietest	Busiest	Average
Passenger	2	4	3	0	<1	<1
Cargo	25	32	28	3	6	4
Tanker	12	14	13	1	2	1

619. In summary, the most common type of commercial vessel recorded withing the shipping and navigation study area was cargo vessels. Cargo vessels and passenger vessels showed little seasonal variation with slightly higher numbers recorded in summer months whilst tanker activity was consistent throughout the data period.

D.4.2 Oil and Gas Vessels

620. Vessel tracks of oil and gas vessels recorded within the shipping and navigation study area during the data period were analysed for activity, with vessels likely to be on station or engaged in O&M activities, as opposed to in transit, separated. The oil and gas vessel tracks are colour-coded by likely vessel activity and presented in Figure D.6.

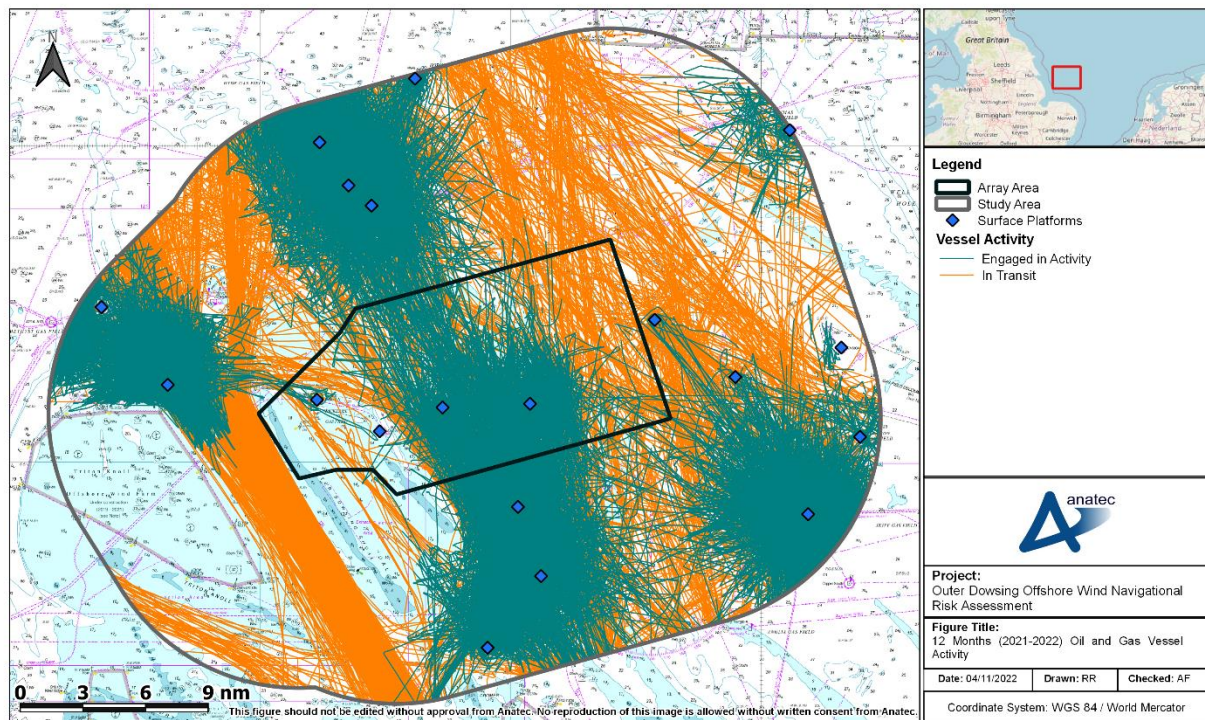


Figure D.6 Oil and Gas Vessels Within the Shipping and Navigation Study Area by Vessel Activity (12-Months, 2021-2022)

621. An average of nine unique oil and gas vessels per day were recorded within the shipping and navigation study area during the data period with a total of 28% of all oil and gas vessels recorded intersecting the array area.
622. The oil and gas vessels recorded were noted routing through the site boundary with a well-defined route, passing in a northwest-southeast orientation to the west of the array, on one of the main commercial routes that have been identified from the vessel traffic survey data (see Section 10.2). Transits to/from ports and harbours that were noted on this route included Great Yarmouth, Lowestoft, and oil and gas fields including York, Villages, Breagh, Tolmount, and Ravenssprun as well as jack-up rigs Maersk Resolve, Noble Sam Hartley, and Erda. Oil and gas vessels in transit accounted for approximately 41% of all oil and gas vessels with those vessels likely to be engaged in activity at a platform or in O&M activity equated to 58%.

623. Vessels engaged in activity within the shipping and navigation study area during the data period were noted at platforms within the gas fields surrounding the array area. These fields being Clipper, Barque, Galleon, Amethyst, West Sole, Malory, and Excalibur.

D.4.3 Fishing Vessels

624. The fishing vessels recorded within the shipping and navigation study area during the data period are presented in Figure D.7. It should be considered that as this assessment was via AIS only, it is likely to under-represent actual fishing vessels within the area (see Section 5.4.1).

625. Analysis of vessel speed and movement was undertaken to determine the likely status of fishing vessel behaviour within the shipping and navigation study area (i.e., actively fishing or in transit). The results of this assessment are colour-coded by fishing vessel behaviour and illustrated in Figure D.7. It is noted that the same vessel may be represented multiple times if it changed behaviour whilst in the shipping and navigation study area. Following this, the average number of fishing vessels engaged in fishing and exclusively transiting per day for each month within the shipping and navigation study area are summarised in Figure D.8.

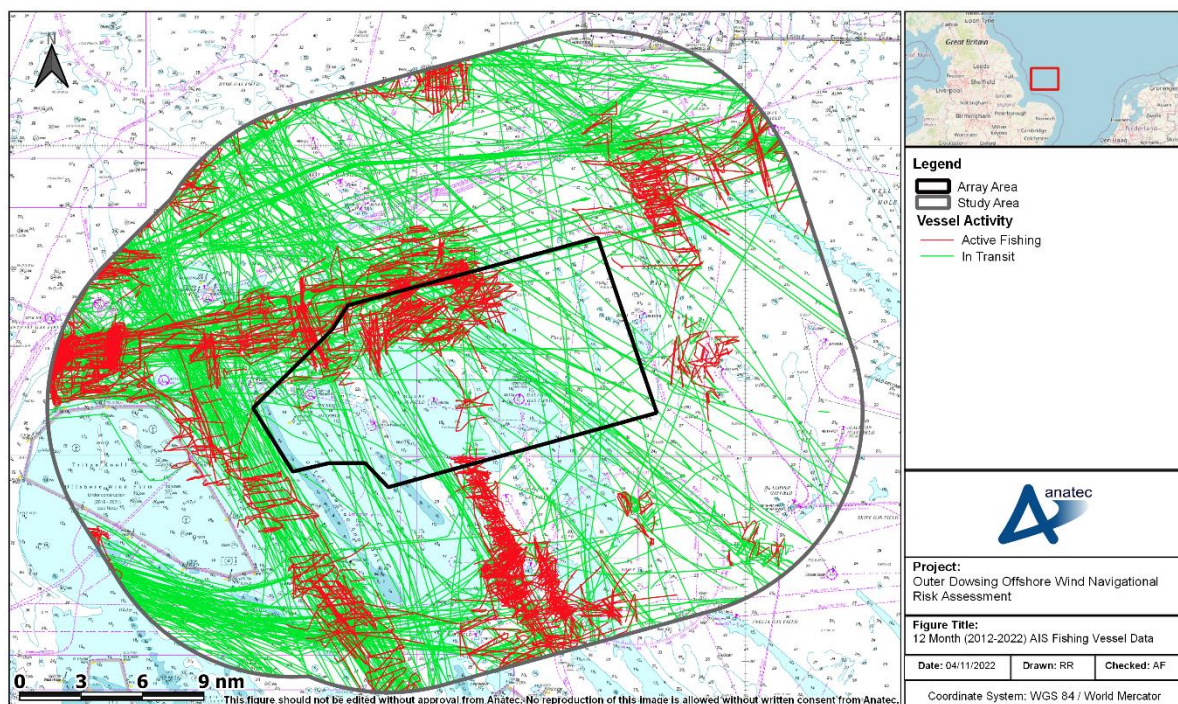


Figure D.7 Fishing Vessels Within the Shipping and Navigation Study Area by Vessel Activity (12-Months, 2021-2022)

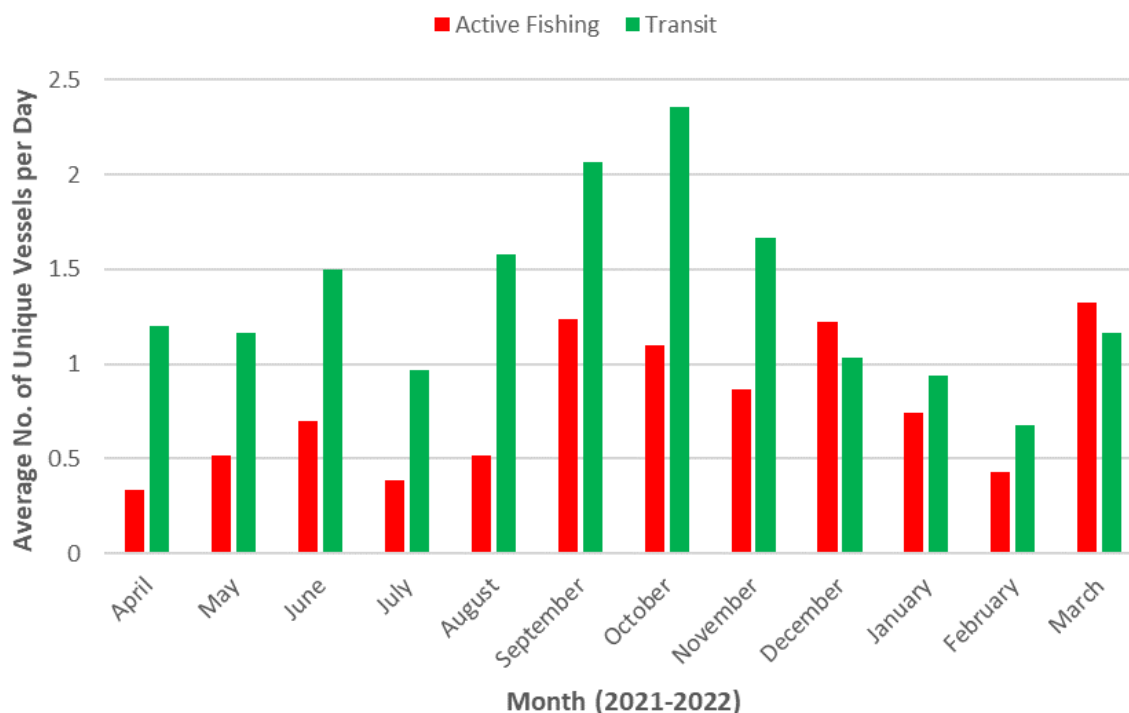


Figure D.8 Unique Fishing Vessels by Vessel Activity

626. An average of two unique fishing vessels per day were recorded within the shipping and navigation study area during the data period with 64% of vessels likely to be in transit with the other 36% engaged in likely fishing activity.
627. Fishing activity was recorded throughout the shipping and navigation study area with a high density noted to and within the north of the array area as well as within the south of the shipping and navigation study area. Overall, fishing levels peaked in October, but this was not the same trend for vessels engaged in active fishing with the highest levels of active fishing activity recorded in March.
628. Of all fishing vessels recorded within the shipping and navigation study area during the data period, irrespective of activity, 20% were recorded intersecting the array area.

D.4.4 Windfarm Vessels

629. The windfarm vessels recorded within the shipping and navigation study area during the data period, along with the surrounding developments, are presented in Figure D.9.

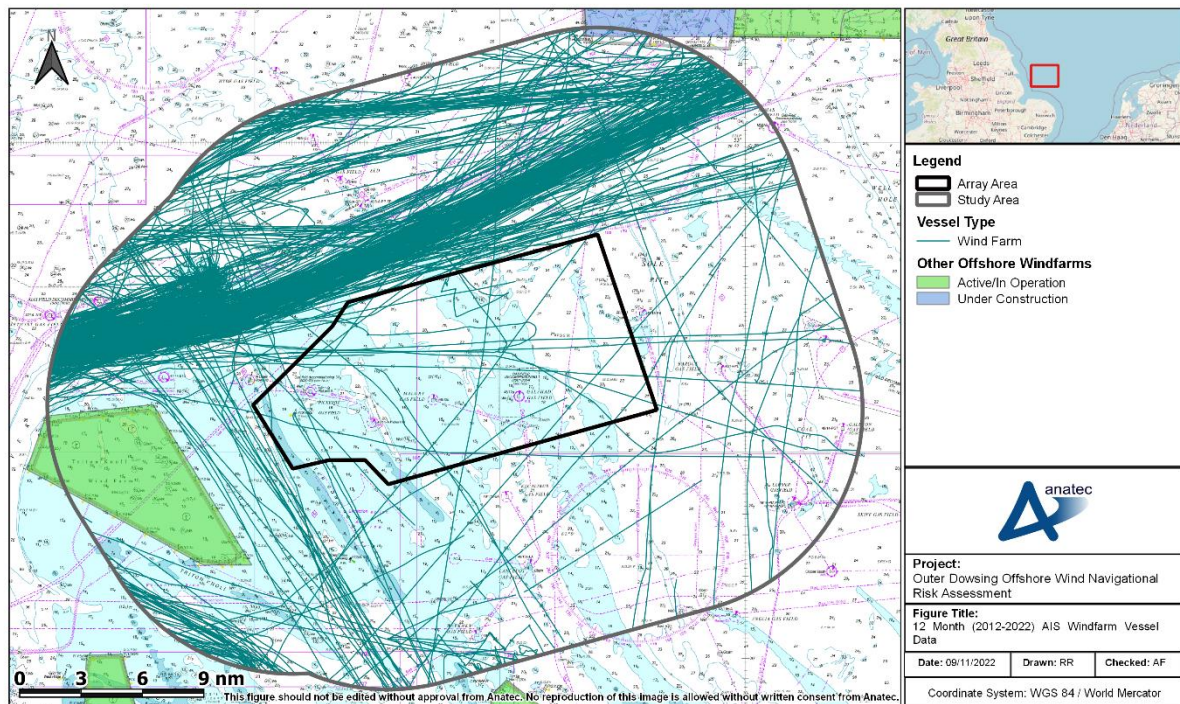


Figure D.9 Windfarm Vessels Within the Shipping and Navigation Study Area (12-Months, 2021-2022)

- 630. An average of one unique windfarm vessel per day was recorded within the shipping and navigation study area during the data period. The majority of windfarm vessels recorded were associated with the O&M of Hornsea Project One, with others associated with the Dudgeon, Race Bank, and Sheringham OWFs.
- 631. A total of 5% of all windfarm vessels recorded within the shipping and navigation study area during the data period were recorded intersecting the array area.

D.4.5 Marine Aggregate Dredging/ Subsea Operations

- 632. The marine aggregate dredging/subsea operations vessels recorded within the shipping and navigation study area during the data period are presented in Figure D.10.

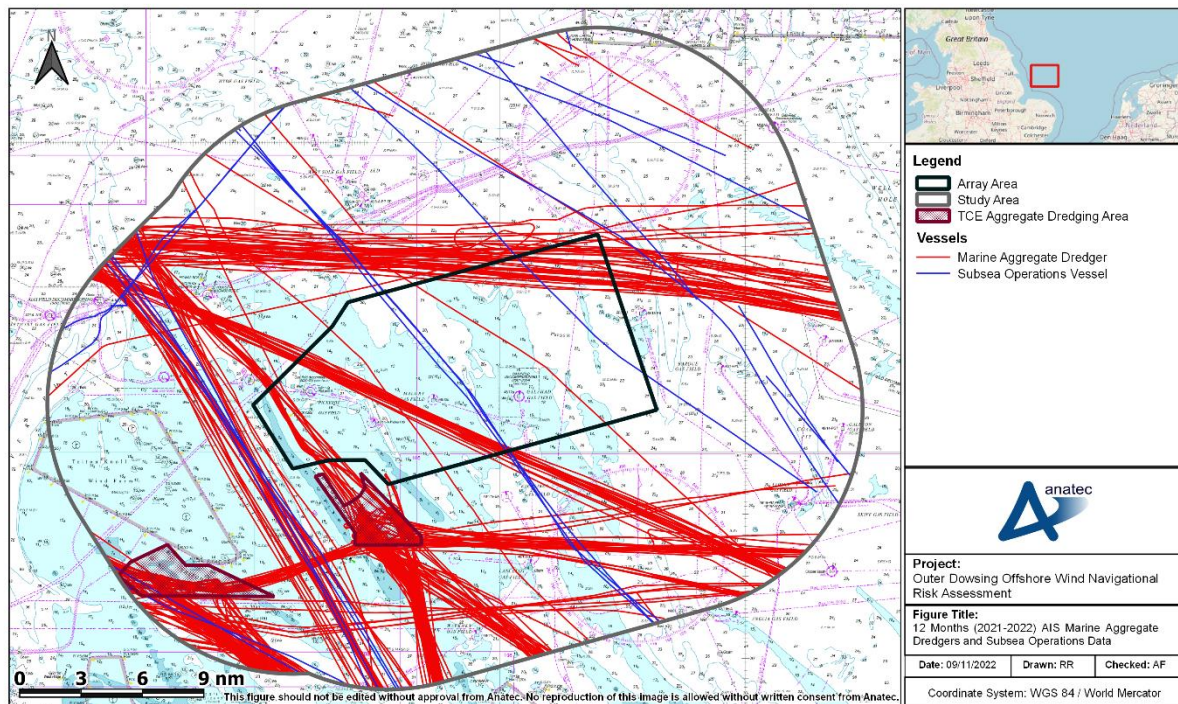


Figure D.10 Marine Aggregate Dredgers/ Subsea Operation Vessels Within the Shipping and Navigation Study Area (12-Months, 2021-2022)

- 633. An average of one unique dredging/subsea operations vessel per day was recorded within the shipping and navigation study area during the data period. Marine aggregate dredgers were predominately recorded transiting to the two Outer Dowsing aggregate dredging area to the southwest of the array area. Other vessels were transiting to dredging areas in proximity to the Humber as well as on routes to various locations in Belgium and the Netherlands, such as Oostende, Zeebrugge, Ijmuiden, and Harlingen.
- 634. Subsea operation vessels included cable laying and pipe burial vessels with common destinations including Middlesbrough and Grimsby, UK, and Rotterdam, the Netherlands.
- 635. A total of 24% of all dredging/subsea operation vessels recorded within the shipping and navigation study area during the data period were recorded intersecting the array area

D.4.6 Recreational Vessels

- 636. The recreational vessels recorded within the shipping and navigation study area during the data period are presented in Figure D.11.

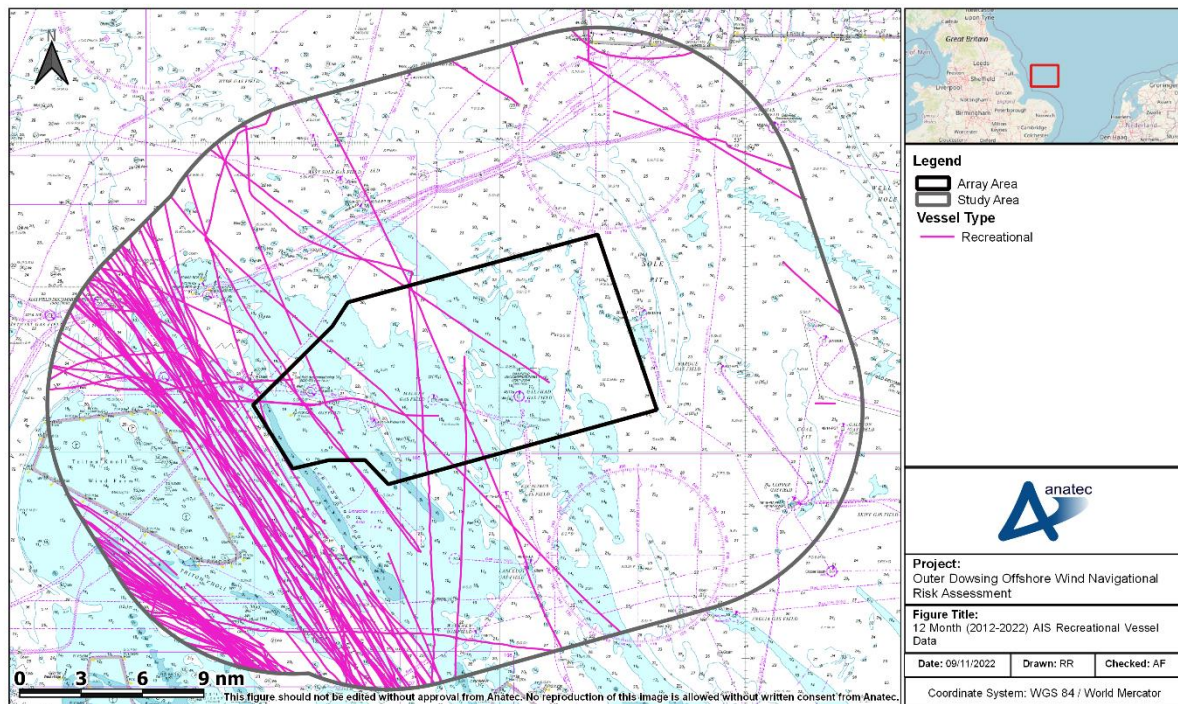


Figure D.11 Recreational Vessels Within the Shipping and Navigation Study Area (12-Months, 2021-2022)

637. An average of less than one unique recreational vessel per day was recorded within the shipping and navigation study area during the data period. Recreational vessels were recorded mostly on the west of the array area, in the shallower waters closer to the shore. Vessels also made use of the navigational corridors on routes on a northwest-southeast bearing split east and west of Triton Knoll OWF. Recreational vessels charted a high degree of seasonality with approximately 79% of vessels being recorded in the four-month period between 1st May 2021 and 31st August 2021.
638. A total of 12% of all recreational vessels recorded within the shipping and navigation study area during the data period were recorded intersecting the array area

D.4.7 Anchored Vessels

639. Speed analysis was performed on the 12-months of data to identify vessels at anchor within the shipping and navigation study area. This analysis has identified likely anchored vessels as those transiting at <1 knot (kt) for a period of 30 minutes or longer. Based on this, vessel behaviour patterns, and navigational status broadcast through AIS, the vessels identified as likely being at anchor within the shipping and navigation study area during the survey period are colour-coded by vessel type and presented in Figure D.12.

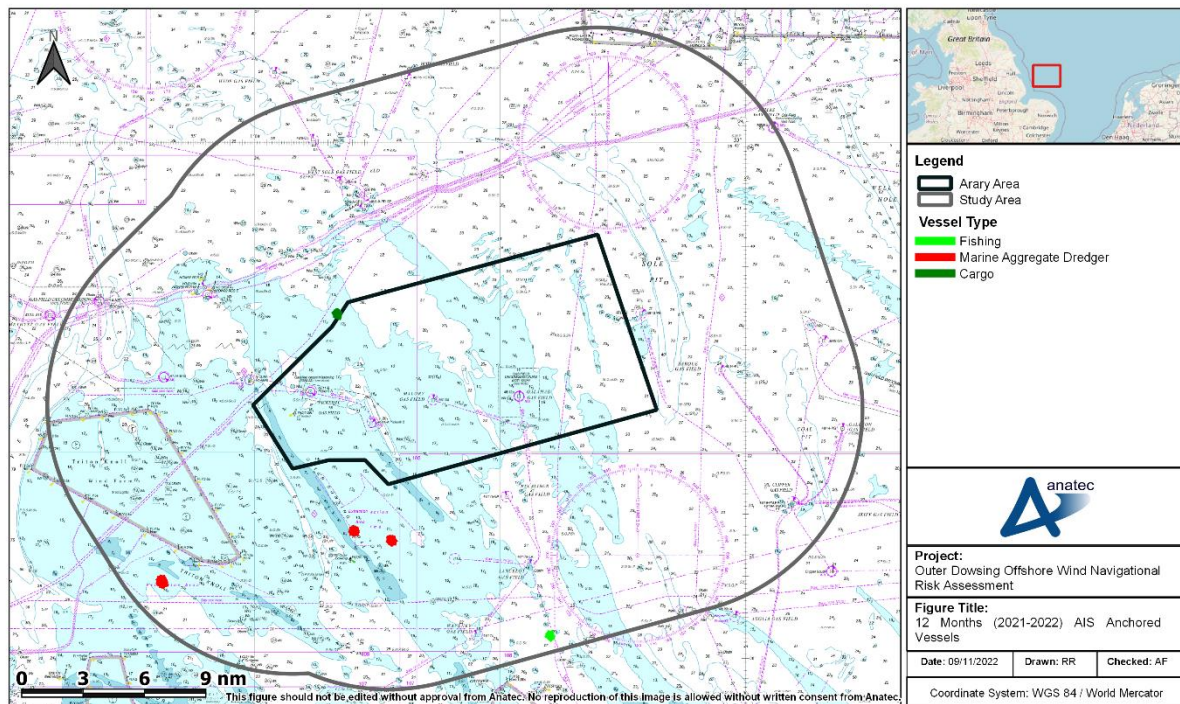


Figure D.12 Anchored Vessels Within the Shipping and Navigation Study Area (12-Months, 2021-2022)

640. In total, there was five separate instances of vessels anchoring within the shipping and navigation study area during the data period. This low value is expected for anchoring vessels due to water depths and distance offshore. The vessels at anchor within the shipping and navigation study area were in depths between approximately 11m and 20m below CD. The marine aggregate dredgers that are at anchor are all present within the Outer Dowsing aggregate dredging areas and all three unique vessel anchor occurrences extended over the course of two separate days with the longest time at anchor for any vessel recorded was 40 hours. The cargo vessel and fishing vessel were at anchor for 7.25 hours and 3.7 hours, respectively.

D.5 Survey Data Comparison

641. A comparison of the average number of each main vessel type analysed in the previous sections recorded throughout the 2021-2022 data period against the average number of each vessel type recorded throughout the two vessel traffic surveys are presented in Table D.3.

Table D.3 Comparison of the Number of each Main Vessel Type Detected During 2021-2022 and the Vessel Traffic Survey Data

Vessel type	Long-term AIS data			Summer survey
	Busiest month	Quietest month	Average vessels per day	Average vessels per day
Cargo vessels	July	Dec	28	27
Tankers	Nov	July	13	11
Passenger vessels	Aug	Mar	3	5
Marine aggregate dredgers	Feb	Aug	1	1
Oil and Gas vessels	Dec	Mar	9	9
Windfarm vessels	Nov	Feb	1	6
Recreational vessels	July	Feb/Dec	1	1
Fishing vessels	Oct	Feb	2	2

642. The only notable difference between the long term AIS and the summer vessel traffic survey was the number of windfarm vessels, which were notable higher during the summer survey than the long term AIS. This is likely due to a number of factors notably including changes in status of local windfarms and seasonal variation in windfarm traffic (vessel numbers likely to be lower during winter conditions).