MachairWind Offshore Windfarm

Appendix 13.1 Navigational Risk Assessment

MachairWind Offshore Windfarm Navigational Risk Assessment

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Abbreviations Table

Abbreviation	Definition
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ALB	All-Weather Lifeboat
ARPA	Automatic Radar Plotting Aid
ATBA	Area to be Avoided
BSU	Bundesstelle für Seeunfalluntersuchung
BWEA	British Wind Energy Association
CA	Cruising Association
CAA	Civil Aviation Authority
CBA	Cost Benefit Analysis
CCTV	Closed Circuit Television
CD	Chart Datum
CHIRP	Confidential Human Factors Incident Reporting Programme
CMAL	Caledonian Maritime Assets Ltd
COLREGs	Convention on International Regulations for Preventing Collisions at Sea
CTV	Crew Transfer Vessel
DC	Direct Current
DF	Direction Finding
DfT	Department for Transport
DSC	Digital Selective Calling
DSLP	Development Specification and Layout Plan
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
ERCoP	Emergency Response Co-operation Plan
ESRI	Environmental Systems Research Institute
ETRS89	European Terrestrial Reference System 1989
FSA	Formal Safety Assessment
GIS	Geographical Information System
GLA	General Lighthouse Authority

Abbreviation	Definition
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
HAT	Highest Astronomical Tide
HDD	Horizontal Directional Drilling
HMCG	His Majesty's Coastguard
HSEQ	Health, Safety, Environment, and Quality
HVDC	High Voltage Direct Current
IALA	International Organization for Marine Aids to Navigation
IHO	International Hydrographic Organization
ILB	Inshore Lifeboat
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
JRCC	Joint Rescue Coordination Centre
kHz	Kilohertz
km	Kilometre
km^2	Square Kilometre
kt	Knot
LMP	Lighting and Marking Plan
LOA	Length Overall
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MEPC	Marine Environment Protection Committee
MetOcean	Meteorological and Oceanic
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MPCP	Marine Pollution Contingency Plan
MRCC	Maritime Rescue Coordination Centre
MSC	Maritime Safety Committee
MSI	Maritime Safety Information
MW	Megawatt
µT	Microtesla

Abbreviation	Definition
NAVTEX	Navigational Telex
NLB	Northern Lighthouse Board
nm	Nautical Mile
nm^2	Square Nautical Mile
NMPi	National Marine Plan Interactive
NRA	Navigational Risk Assessment
NSP	Navigational Safety Plan
O&M	Operation and Maintenance
OfTDA	Offshore Transmission Development Area
OnTDA	Onshore Transmission Development Area
OREI	Offshore Renewable Energy Installation
OSP	Offshore Substation Platform
PDE	Project Design Envelope
PLL	Potential Loss of Life
PNT	Positioning, Navigation and Timing
Racon	Radar Beacon
Radar	Radio Detection and Ranging
RAM	Restricted in Ability to Manoeuvre
REZ	Renewable Energy Zone
RIB	Rigid-hulled Inflatable Boat
RNLI	Royal National Lifeboat Institution
RoPax	Roll-on/Roll-off Passenger
RoRo	Roll-on/Roll-off Cargo
RYA	Royal Yachting Association
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SFF	Scottish Fishermen's Federation
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea
SONAR	Sound Navigation Ranging
SOV	Service Operations Vessel
SPS	Significant Peripheral Structure
TSS	Traffic Separation Scheme
UK	United Kingdom

Abbreviation	Definition
UKHO	United Kingdom Hydrographic Office
US	United States
VHF	Very High Frequency
VMP	Vessel Management Plan
VMS	Vessel Monitoring System
VTS	Vessel Traffic Service
WDA	Windfarm Development Area
WGS84	World Geodetic System 1984
WTG	Wind Turbine Generator

1 Introduction

1.1 Background

1. Anatec was commissioned by Haskoning on behalf of MachairWind Limited (The Applicant) to undertake a Navigational Risk Assessment (NRA) for the MachairWind Offshore Windfarm, hereafter referred to as the 'Project'.

2. This NRA presents information on the Wind Turbine Generators (WTG), Offshore Substation Platforms (OSP) and associated fixed foundations and scour protection, inter-array cables, OSP link cables, the portion of the offshore export cable located within the Windfarm Development Area (WDA) and associated cable protection offshore components of the Project (hereafter the ''WDA infrastructure"). The WDA infrastructure is considered relative to the existing and estimated future navigational activity and forms a supporting study to **Chapter 13 Shipping and Navigation** of the Environmental Impact Assessment (EIA) Report (EIAR).

3. Due to the delay in the confirmation of the Projects grid connection location (see **Chapter 1 Introduction**) this NRA considers the WDA and existing environment (within an inclusive 10 nautical mile (nm) buffer of the WDA) only. As noted in **Chapter 1 Introduction**, the hazards associated with the Offshore Export Cable Corridor (ECC) and Onshore Transmission Development Area (OnTDA) will be assessed in individual EIARs, which will be submitted separately in accordance with the relevant EIA Regulations.

1.2 Navigational Risk Assessment

4. EIA is a process which identifies the environmental effects of a project, both adverse and beneficial. An important requirement of the EIA for offshore projects is the NRA. Following the Maritime and Coastguard Agency's (MCA) Marine Guidance Note (MGN) 654 (MCA, 2021), this NRA includes:

- Outline of methodology applied in the NRA including relevant guidance;
- Summary of consultation undertaken with shipping and navigation stakeholders;
- Lessons learnt from previous offshore windfarm developments;
- Summary of the Project Design Envelope (PDE) parameters relevant to shipping and navigation;
- Overview of existing environment including:
    - Navigational features;
    - Meteorological and oceanographic (MetOcean) conditions;
    - Emergency response resources;
    - Historical maritime incidents; and
    - Vessel traffic movements.
- Implications for marine navigation and communication equipment;
- Cumulative and transboundary overview;
- Overview of anticipated future case vessel traffic;

- Assessment of navigation risk pre and post construction of the Project including collision and allision risk modelling;
- Hazard identification for further assessment in **Section 18**;
- Identification of embedded mitigation measures; and
- Completion of the MGN 654 Checklist (See **Appendix A**).

5. Potential hazards have been considered for each phase of the Project as follows:

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

2 Guidance and Legislation

2.1 Legislation

6. An EIAR is required to support the application for the Section 36 consent for the Project. The MCA require that, as part of the EIA, an NRA is undertaken to "inform the shipping and navigation chapter of the EIA Report" (MCA, 2021).

2.2 Primary Guidance

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

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

8. MGN 654 highlights issues that shall be considered when assessing the potential effect on navigational safety from offshore renewable energy developments proposed in UK internal waters, territorial sea or Renewable Energy Zones (REZ).

9. MGN 654 includes several annexes including the Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI) which the MCA require to be used as a template for preparing NRAs. The methodology 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**). In both **Chapter 13 Shipping and Navigation** of the EIAR and the NRA, the base and future case levels of risk have been identified as well as the mitigation measures required to ensure the future case remains broadly acceptable, or tolerable with mitigation.

2.3 Other Guidance

10. Other guidance documents used during the assessment include:

- MGN 372 Amendment 1 (Merchant and Fishing) Offshore Renewable Energy Installations (OREI): Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA, 2022);
- International Organization for Marine Aids to Navigation (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, 2021);
- IALA Guidance G1162 The Marking of Offshore Man-Made Structures (IALA, 2022);
- IALA Guidance G1185 Enhancing the Safety and Efficiency of Navigation around Offshore Renewable Energy Installations (IALA, 2024); and

- The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy (RYA, 2019(a)).

2.4 Lessons Learned

11. There is considerable benefit for the Project in the sharing of lessons learned within the offshore industry. The NRA, and in particular the risk assessment undertaken in **Section 18** and **Chapter 13 Shipping and Navigation**, includes general consideration for lessons learnt and expert opinion from previous offshore windfarm 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

12. A shipping and navigation user can only be affected by a hazard if there is a pathway through which a hazard can be transmitted between the source activity (cause) and the user. In cases where a user is exposed to a hazard, the overall severity of consequence 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;
- Outputs of the Hazard Workshop;
- Level of stakeholder concern;
- Time and/or distance of any deviation;
- Number of transits of specific vessel and/or vessel type; and
- Lessons learnt from existing offshore developments.

13. With regards to commercial fishing vessels, the methodology and assessment consider hazards to commercial fishing vessels in transit. A separate methodology and assessment have been applied in **Chapter 12 Commercial Fisheries** to consider hazards to commercial fishing vessels related to commercial fishing activity (rather than commercial fishing vessels in transit).

3.2 Formal Safety Assessment Process

14. The IMO FSA process (IMO, 2018) (the FSA process) as approved by the IMO in 2018 under Maritime Safety Committee (MSC) – Marine Environment Protection Committee (MEPC).2/circ. 12/Rev.2 has been applied to the risk assessment in **Section 18**.

15. The FSA process is a structured and systematic methodology based upon risk analysis and Cost Benefit Analysis (CBA) (if applicable) to reduce risks to As Low as Reasonably Practicable (ALARP). There are five basic steps within this process as illustrated in **Figure 3.1** and summarised in the following list:

- Step 1 – identification of hazards (a list is produced of hazards prioritised by risk level specific to the problem under review);
- Step 2 – risk analysis (investigation of the causes and initiating events and consequences of the more important hazards identified in Step 1);
- Step 3 – risk control options (identification of measures to control and reduce the identified hazards);
- Step 4 – CBA (identification and comparison of the 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 (IMO, 2018)

16. A key tool used when undertaking an NRA is the Hazard Workshop which ensures that all risks are identified and qualified in agreement with relevant consultees prior to assessment within the EIA. Risks (and the determined qualification) are recorded via the hazard log which is presented in full in **Appendix B**.

17. **Table 3.1** and **Table 3.2** identify how the severity of consequence and the frequency of occurrence has been defined within the hazard log, respectively.

Table 3.1 Severity of Consequence Ranking Definitions

Rank	Description	Definition			
		People	Property	Environment	Business
1	Negligible	No perceptible risk	No perceptible risk	No perceptible risk	No perceptible risk
2	Minor	Slight injury(ies)	Minor damage to property, i.e. superficial damage	Tier 1 local assistance required	Minor reputational risks – limited to users

Rank	Description	Definition			
		People	Property	Environment	Business
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 risk to operations	Tier 2 regional assistance required	National reputational risks
5	Major	More than one fatality	Total loss of property	Tier 3 national assistance required	International reputational risks

Table 3.2 Frequency of Occurrence Ranking Definitions

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

18. An aggregate of the severity of consequence (**Table 3.1**) and frequency of occurrence (**Table 3.2**) provide the level of risk for each hazard; the method for undertaking this aggregation is through use of a tolerability matrix, as presented in **Table 3.3**. The risk of a hazard is defined as Broadly Acceptable (low risk), Tolerable (intermediate risk), or Unacceptable (high risk).

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

20. Outputs of the hazard log have been used as evidence to support and refine the assessment undertaken in **Chapter 13 Shipping and Navigation** and **Section 18**.

Table 3.3 Tolerability Matrix and Risk Rankings

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

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

3.3 Methodology for Cumulative Risk Assessment

21. The hazards identified in the FSA are also assessed for cumulative risks with other projects and proposed developments within the cumulative risk assessment. Given the varying type, status and location of developments, different scenarios have been considered in the cumulative risk assessment, which allocates developments into the scenarios depending upon the following criterion:

- Development status;
- Distance from the Project;
- Level of interaction with baseline traffic relevant to the Project;
- Level of concern raised during consultation; and
- Data confidence.

22. It is noted that given the unique nature of shipping and navigation, the tiering system applied in the NRA differs from that assumed in the overarching EIAR (see **Chapter 5 EIA Methodology**).

23. The scenarios and associated level of assessment undertaken for each, are summarised in **Table 3.4**. A detailed qualitative and quantitative (where applicable) approach to the cumulative risk assessment has been applied for each scenario.

24. The maximum distance within which developments are considered for the cumulative risk assessment is 50 nm from the WDA on the basis that there is not considered to be a direct pathway between the Project and any development beyond 50 nm from the WDA. This distance is standard within NRAs and provides a good overview of cumulative traffic patterns.

25. An aggregate of the criterion can determine the relevant scenario(s) for each development. For example, if a development is located within 50 nm of the WDA but does not impact a main commercial route passing within 1 nm of the WDA and has low data confidence it may still be screened out of the cumulative risk assessment.

26. Projects meeting the assessment criteria are detailed in **Section 15**.

Table 3.4 Cumulative Development Screening Summary

Tier	Minimum Development Status	Criterion	Data Confidence Level	Level of Cumulative Risk Assessment
1	Consented or under determination	▪ May impact a main commercial route passing within 1 nm of the WDA. *Offshore Windfarms:* ▪ Up to 50 nm from the WDA. *Subsea cables:* ▪ Up to 2 nm from the WDA. *Other* ▪ Tidal development within 10 nm.	High or medium	Quantitative cumulative re-routeing of main commercial routes
2	Scoped	▪ May impact a main commercial route passing within 1 nm of the WDA. *Offshore Windfarms:* ▪ Up to 50 nm from the WDA; or *Subsea cables:* ▪ Between 2 nm and 5 nm from the WDA. *Other:* ▪ Tidal development within 10 nm.	High or medium	Qualitative cumulative re-routeing of main commercial routes

Tier	Minimum Development Status	Criterion	Data Confidence Level	Level of Cumulative Risk Assessment
3	Pre-scoping	▪ Does not impact a main commercial route passing within 1 nm of the WDA. *Offshore Windfarms:* ▪ Up to 50 nm from the WDA. *Subsea cables:* ▪ Further than 5 nm from the WDA. *Other:* ▪ Tidal array up to 20 nm from the WDA. ▪ Aid to Navigation maintenance up to 10 nm from the WDA.	Low	Qualitative assumptions of routeing only

3.4 Study Area

27. A 10 nm buffer has been applied around the WDA (hereafter the ‘shipping and navigation study area’) as shown in **Figure 3.2**. This study area has been defined to provide local context to the analysis of risks by obtaining vessel traffic movements within, and in proximity to, the Project. A 10 nm study area has been used within the majority of UK offshore windfarm NRAs and is suitable for collection of Radio Detection and Ranging (Radar) data.

28. This study area has been presented to stakeholders including in the Scoping Report and at the Hazard Workshop and was considered sufficient to characterise the shipping and navigation baseline.

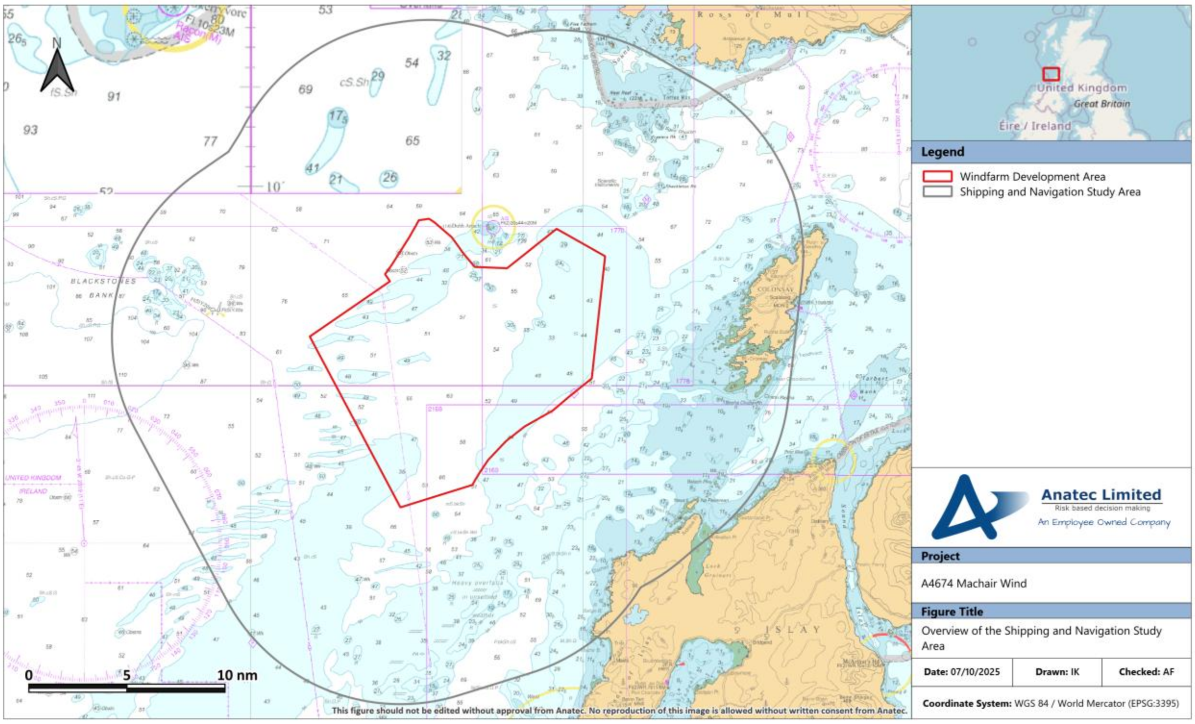

Figure 3.2 Overview of the Shipping and Navigation Study Area

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;
- Northern Lighthouse Board (NLB);
- UK Chamber of Shipping;
- Port of Glensanda; and
- DFDS Seaways.

30. Additional stakeholders were consulted during the Hazard Workshop, as included within **Section 4.3**.

31. As well as consulting with the organisations outlined above, 34 Regular Operators were identified from the vessel traffic surveys and long-term vessel traffic data and were provided with an overview of the Project with subsequent opportunity to provide feedback and to attend the Hazard Workshop. Specific questions were included to aid Regular Operators wishing to make a response, including in relation to changes in routeing or adverse weather routeing. The Regular Operator letter is presented in full in **Appendix D**.

32. The full list of Regular Operators identified and subsequently contacted is provided below:

- Aasen Shipping;
- Altera Infrastructure Norway;
- Aquaship;
- Arklow Shipping;
- Bakkafrost FSV;
- Brise Bereederungs;
- Calmac Ferries;
- Charles M Willie & Co Shipping;
- DFDS Seaways;
- EMS Shipmanagement;
- Faversham Ships;
- Fred Olsen Cruise Lines;
- Harren Ship Management;
- Harren Tanker Management;
- Hurtigruten Coastal;
- Intrada Ship Management;
- Lighthouse Ship Management;
- Mol LNG Ship Management;
- Myklebusthaug Management;
- Navigare Shipping;
- Norwest Ship Management;
- Ocean Star Shipping;
- OSM Maritime;
- Salen Ship Management;
- Sarfo Denizcilik ve Ticaret;
- SMT Shipping Poland;
- Solvtrans Management;
- Synergy Maritime;
- Tarbit Tankers Services;
- Ulvan Personal;
- V Ships;
- Wijnne & Barends Cargadoors;
- Wilhelmsen Ship Management; and
- Wilson.

33. Of the Regular Operators consulted with, CalMac Ferries, attended the Hazard Workshop. Aside from the additional consultation undertaken with CalMac Ferries and DFDS Seaways, no other Regular Operator provided feedback on the Project.

4.2 Consultation Responses

34. The key issues raised including via dedicated meetings, the Scoping Opinion, Regular Operator outreach and the Hazard Workshop, are summarised in **Table 4.1**.

Table 4.1 Summary of Key Points Raised During Consultation

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
MCA	Scoping response	The MCA noted that the EIA Report should supply detail on the possible impact on navigational issues for both commercial and recreational craft, specifically: ▪ 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.	▪ Collision risk and the likely squeeze of small craft into the routes of larger commercial vessels have been assessed within **Section 18.1** and **Section 18.2**. ▪ Navigational safety has been assessed throughout **Section 18**. ▪ Visual intrusion and noise, as well as the effect on small craft navigational/communication equipment and marking and lighting of site have been assessed within **Section 13**. ▪ Risk management and emergency response have been assessed within **Section 18.4**. ▪ The risk to drifting recreational craft in adverse weather or tidal conditions has been assessed within **Section 18.1**.
		Attention needs to be paid to routeing, particularly in heavy weather so that vessels can continue to make safe passage without large-scale deviations.	Adverse weather routeing has been assessed within **Section 12.**
		If an HVDC [High Voltage Direct Current] transmission cable is used, a study should be undertaken to establish the electromagnetic deviation, affecting ship compasses and other navigating systems, of the high voltage cable route to the satisfaction of the MCA. On receipt of the study, the MCA reserves the right to request a deviation survey of the cable route post installation.	Electromagnetic Field (EMF) impacts on vessels in the vicinity to cables which will be Direct Current (DC) are assessed within **Section 13.6**.
		The likely cumulative and in combination effects on shipping routes should be considered for this project.	Cumulative developments have been screened based on criteria described in **Section 3.3**. As per **Section 15**, the Dubh Artach lighthouse refurbishment works have been screened into the cumulative risk assessment in **Section 19**.

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
		We recommend the applicant consult with NLB regarding closing off the Dubh Artach lighthouse and consider impacts on local aids to navigation as a risk within the EIAR and NRA.	As per **Section 4**, NLB have been consulted with regarding the Dubh Artach lighthouse. As per **Section 6.1**, site refinements have been made to facilitate NLB access requirements. Impacts on the lighthouse as an AToN have been assessed in **Section 18**.
		An NRA will need to be submitted in accordance with MGN 654. The NRA should be accompanied by a detailed MGN 654 Checklist.	This NRA has been submitted, with associated MGN 654 checklist included in **Appendix A**.
		We note that the MGN 654 compliant data will be presented within the NRA.	As per the email dated 05 February 2025, MCA were content with the suitability of the vessel traffic data presented within the NRA.
		Once the location for the new HVDC switching station in South Ayrshire has been identified, the Applicant will progress separate consent applications for the OfTDA [Offshore Transmission Development Area] and OnTDA. Each consent application and associated assessments will take account of the wider Project. If an HVDC transmission cable is used, a study should be undertaken to establish the electromagnetic deviation, affecting ship compasses and other navigating systems, of the high voltage cable route to the satisfaction of the MCA. On receipt of the study, the MCA reserves the right to request a deviation survey of the cable route post installation.	As noted in **Section 1.1**, the assessment of potential effects on all receptors associated with the Offshore ECC and OnTDA will be presented in individual EIARs, which will be submitted separately in accordance with the relevant EIA Regulations. EMF impacts on vessels in the vicinity to cables which will be DC are assessed within **Section 13**.
		We understand that a Cumulative Effects Assessment will be carried out in a tiered system of appraisal as detailed in the Scoping report. As highlighted, the proximity to other offshore windfarms and infrastructure will need to be fully considered, with an appropriate assessment of the distances between OREI boundaries and shipping routes as per MGN 654. Attention must be paid to the traffic to ensure the established shipping routes within the area can continue safely without unacceptable deviations.	Cumulative developments have been screened based on criteria described in **Section 3.3**. A Cumulative Effects Assessment has been undertaken in **Section 19**, which considers the distance between other infrastructure and vessel traffic in the area.

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
		Attention should be paid to cabling routes and where appropriate burial depth for which a 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 Horizontal Directional Drilling (HDD) location.	As per **Section 6.3** and **Section 17**, any cable protection will be compliant with MGN 654, including in relation to underkeel clearance. The Burial Protection Index study and anchor penetration study will be captured as part of the Cable Burial Risk Assessment (CBRA) process (an embedded mitigation measure included in **Section 17**) as required.
		The Development Specification and Layout Plan (DSLP) will require MCA approval prior to construction. Any additional navigation safety and/or Search and Rescue (SAR) requirements, as per MGN 654 Annex 5, will be agreed at the approval stage.	The DSLP and compliance with MGN 654 are included as mitigation in the NRA, with the creation of an Emergency Response Co-operation Plan (ERCoP) also included (as per **Section 17**).
		Particular consideration will need to be given to the implications of the site size and location on SAR resources and ERCoPs. Due consideration should be given to the use of appropriate mitigation as outlined in MGN 654 Annex 5 and a SAR checklist will also need to be completed.	A SAR checklist is required under MGN 654, which will be adhered to as per **Section 17**.
		MGN 654 Annex 4 requires that hydrographic surveys should fulfil the requirements of the International Hydrographic Organization (IHO) Order 1a standard.	As per **Section 17**, there will be full MGN 654 compliance including in relation to hydrographic surveys.
		Impacts on safe access to ports should be included as a potential impact of the project, applicable during construction, O&M, and decommissioning phases.	The potential for reduced access to local ports and harbours has been included within the risk assessment in **Section 18**.
MD-LOT	Scoping response	Marine Accident Investigation Branch (MAIB) data included in the EIA should cover a 20-year period to fully assess trends and historic incidents.	A total of 20 years of MAIB incident data has been assessed within **Section 9.5**.
		Each of the possible impacts on navigational issues outlined in the MCA representation should be addressed within the EIA.	Each of the potential impacts to shipping and navigation have been assessed within the risk assessment in **Section 18**.

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
		A Navigational Risk Assessment in accordance with MGN 654 will be required, accompanied by a detailed MGN 654 checklist.	As per **Section 1.1**, this NRA has been submitted as an appendix to the MachairWind EIA.
		MCA representation must be fully addressed within the EIA and a SAR checklist must be completed by the Developer in consultation with the MCA.	This table sets out where MCA consultation outputs including from scoping have been addressed.
		A cumulative risk assessment between neighbouring offshore renewable project boundaries and nearby routeing must be enacted in line with MGN Standard 654 in the EIA.	The potential for cumulative and transboundary effects is assessed in **Section 15**.
		Impacts on navigational safety relating to the Dubh Artach and Skerryvore lighthouse refurbishment work must be fully addressed in the EIA.	Cumulative impacts to Navigational safety relating to the Dubh Artach refurbishment works have been included in the cumulative screening as per **Section 15**.
		It is advised that transboundary effects are considered within the EIA report.	Transboundary effects are assessed within **Chapter 13 Shipping and Navigation**.
		Traffic surveys should be supported by a 12-month AIS analysis for consideration.	12 months of AIS data have been considered within the long-term vessel traffic assessment in **Appendix E**.
		The inclusion of possible port locations into the EIA Report for consideration is requested.	Noting that further technical and commercial due diligence will be undertaken post-consent before a decision is made as to the final ports used for the Project, the most likely to be used during each stage are considered within the risk assessment in **Section 18**.
		The Scottish Ministers advise that Marine Accident Investigation Branch data included in the EIA Report should cover a 20-year period to fully assess trends and historic incidents.	A total of 20 years of MAIB incident data has been assessed within **Section 9.5**.
		The Scottish Ministers highlight the SFF [Scottish Fishermen's Federation] representation relating to WTG spatial footprint for consideration [which is as follows]:	Shipping and navigation hazards are assessed within **Section 18**, which considers worst-case WTG dimensions (as listed in **Section 6**).

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
		"Our primary concern is the spatial footprint of the WTGs foundation, therefore, SFF would propose to the Applicant to use the monopile design (which has lesser spatial footprint)."	
		The RYA representation around loss of station, failure of Aids to Navigation marking the devices and delays around sharing of information is highlighted, which should be fully addressed in the EIA Report.	This table sets out where RYA consultation outputs including from scoping have been addressed for each of the points raised.
		The Developer will be required to submit a Navigational Risk Assessment in accordance with MGN 654, accompanied by a detailed MGN 654 checklist.	An NRA has been submitted, with associated MGN 654 checklist included in **Appendix A**.
		Hydrographic surveys should fulfil the requirements set out in Annex 4 of MGN 654.	As per **Section 17**, there will be full MGN 654 compliance including in relation to hydrographic surveys.
		The MCA and NLB representations regarding the Design Specification and Layout Plan, Navigational Safety Plan and Lighting and Marking Plan should be addressed by the Developer in the EIA Report.	The DSLP and compliance with MGN 654 are included as mitigation, with the creation of an ERCoP also included (as per **Section 17**). As per **Section 17**, an NSP and LMP are included as embedded mitigation.
		An assessment of the distances between the neighbouring offshore renewable project boundaries and shipping routes in line with MGN Standard 654 must be addressed in the EIA Report.	Cumulative developments have been screened based on criteria described in **Section 3.3**. A Cumulative Effects Assessment has been undertaken in **Section 19**, which considers the distance between other infrastructure and vessel traffic in the area.
		The Scottish Ministers highlight the representation from the MCA, NLB, RYA and UKCoS regarding the Dubh Artach and Skerryvore lighthouse refurbishment work and general navigational safety and advise that this should be fully addressed in the EIA Report.	Cumulative impacts to Navigational safety relating to the Dubh Artach refurbishment works have been included in the cumulative screening as per **Section 15.1**.

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
		The Scottish Ministers note the representation from UKCoS which welcomes a study area of 50 nautical miles but adds that this must address transboundary effects and advise that this is considered within the EIA Report.	Transboundary effects are assessed within **Chapter 13 Shipping and Navigation**.
		The Scottish Ministers direct the Developer to the representation from the RYA and advise that the additional documentation highlighted should be considered when assessing the impact on shipping and navigation from the Proposed Development.	As per **Section 5**, the Marine Recreation and Tourism Survey maps are considered as a data source. The data sources used during the EIA process were presented during the Hazard Workshops, with no concerns raised. As per the RYA Scoping response, Northern Ireland recreational representatives were also invited to attend.
NLB	Scoping response	NLB are scheduled to conduct major refurbishment projects on both the Dubh Artach and Skerryvore lighthouses, from 2027 through until 2032, and these works will utilise a large number of helicopter flights and ship visits to this area. These operations may coincide with the construction phase of the Project, and the need to define the safe limits for aviation and vessel operations in this area for both projects should be considered at an early stage.	As per **Section 6.1**, following consultation site refinements have been made in line with NLB requirements. NLB have confirmed they are content with the WDA following the refinement.
UK Chamber of Shipping	Scoping response	The scoping report proposes a deviation to a distinct north-south cargo route, which is a matter of concern. This deviation may result in increased steaming distances, additional operational costs, and movement into more constrained inshore waters, raising safety risks for commercial and recreational vessels.	Deviations to the route in question are identified in **Section 14.5**, with risks resulting from the route deviation assessed within **Section 18**. As per **Section 6.1**, site refinements have been made to reduce impacts on this route.
		The EIA should include: ▪ A full 12-month AIS dataset analysis to ensure seasonal variations in vessel activity are captured. ▪ At least 20 years of MAIB data to provide a comprehensive historical perspective on navigational risks.	12 months of AIS data have been considered within the long-term vessel traffic assessment in **Appendix E**. A total of 20 years of MAIB incident data has been assessed within **Section 9.5**. As per **Section 6.1**, the WDA has been refined to remove the potential for an isolated structure at the southern extent.

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
		▪ An assessment of the navigational risks posed by isolated structures at the southern tip of the WDA, including their potential impact on vessel operations.	
		Transboundary effects must also be assessed, with the potential for offshore developments in Northern Ireland and the Republic of Ireland to have significant implications for shipping routes	The potential for cumulative and transboundary effects is assessed in **Section 15**.
		Emergency anchoring and refuge options for vessels should be assessed, particularly in poor weather conditions or during incidents near the WDA. Coordination with the MCA and other maritime authorities should be demonstrated to ensure robust incident response procedures are in place.	Anchoring and safe haven optionality is described within **Section 12.4**. Emergency anchoring has been discussed within the risk assessment in **Section 18.**
		The potential impacts on existing aids to navigation (including lighthouses) and outline mitigation measures to maintain their functionality should be assessed, with adjustments to the eastern Routeing and Licensing Boundary (RLB) explored to better accommodate shipping receptors and reduce navigational constraints.	As per **Section 6.1**, site refinements have been made, with the NLB expressing content on the updates (see 25 September 2025 entries). Further discussion with NLB regarding the lighting arrangements will take place post-consent, including within the Lighting and Marking Plan (LMP) process (as described in **Section 17**).
		The UK Chamber of Shipping and other stakeholders such as the Cruising Association (CA) and identified Regular Operators should be included in ongoing consultation.	As per **Section 4**, the UK Chamber of Shipping, CA, and Regular Operators in the area have been engaged with, and were invited to the Hazard Workshops.
RYA Scotland	Scoping response	Appropriate ports which could likely be used during each of the phases should be listed in the EIA.	Although the ports to be used are unknown at this stage, the most likely to be used during each stage are considered within the risk assessment in **Section 18**.
		Only about a quarter of recreational vessels passing through the WDA transmit an AIS signal.	As per **Section 5.2**, dedicated vessel traffic surveys have captured traffic within the shipping and navigation study area using Radar as well as AIS.

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
		The WDA is on the direct route from Ireland to the west of Mull, through the Passage of Tiree to the north or to the Western Isles. Circumventing the WDA would add considerably to the length of the voyage. Smaller boats from the Clyde will tend to pass east of Islay and Colonsay to avoid the area proposed for the Project due to its reputation for rough seas.	Impacts on recreational has been assessed within the risk assessment in **Section 18**. In summary, it is considered likely that recreational vessels on this route will be able to pass through the WDA unrestricted when considering the mitigations in place.
		Failure of aids to navigation, as well as obscuration of key aids to navigation, should be included as potential hazards.	The distance between structures associated with the Project and the Dubh Artach lighthouse has been increased since Scoping (see **Section 4**), with minimum distance between the WDA and the lighthouse now 2 nm. Impacts on the lighthouse have been assessed in **Section 13.10**. Further discussion with NLB regarding aids to navigation contingencies will take place post-consent, including within the outline LMP and Aids to Navigation Plan processes (as described in **Section 17**).
		The proposed export corridor route should be presented.	The Offshore ECC at this stage is presented in **Section 15.2**.
		Although cable laying is not normally an issue for recreational boaters, the busy area off the Mull of Kintyre is characterised by strong currents and there is a Traffic Separation Scheme [TSS] not far offshore, which recreational boaters need to avoid.	Potential for additional factors in recreational vessel impacts from the Offshore ECC are assessed in **Section 19**.
		RYA Scotland and the Cruising Association would both like to contribute to the Navigational Risk Assessment. The developers also consult the Irish Cruising Club and Sail Ireland as many Irish boats pass through the area.	As per **Section 4**, RYA Scotland and the CA were both consulted with during the NRA process, and Northern Ireland recreational representatives were also invited to attend the Hazard Workshops.
		The maps of the 2015 Marine Recreation and Tourism Survey are available on NMPi [National Marine Plan Interactive]. These are probably an underestimate of the current amount of recreational traffic given the encouragement to sail in these waters given by, for example, the MalinWaters project.	As per **Section 5**, the Marine Recreation and Tourism Survey maps are considered as a data source. The data sources used during the EIA process were presented during the Hazard Workshops, with no concerns raised. As per the above item,

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
			Northern Ireland recreational representatives were also invited to attend.
Argyll and Bute Council	Scoping response	NLB, Argyll and Bute Harbour Authority, and CMAL [Caledonian Maritime Assets Ltd] should be consulted with.	As per **Section 4**, all stakeholders listed have been provided with the opportunity to comment. As per **Chapter 13 Shipping and Navigation**, the Applicant met with CMAL in October 2022 to introduce the Project and answer any initial queries.
		Confirmed content with legislation, policy and guidance followed; study area used for Shipping and Navigation; embedded mitigation measures; and identified potential impacts.	Acknowledged.
MCA	Meeting – 11 October 2023	The planned winter and summer survey dates, as well as the intention of using a 12-month AIS dataset to assess long-term vessel traffic, are suitable for use.	Suitability of the dates considered are acknowledged within **Section 5.2**.
MCA	Email - 05 February 2025	"MCA can confirm that on this occasion it is content with the following datasets being used to inform the project EIA, in the event that submission occurs in Q2 2026: • 14 days of AIS & Radar (December 2023); • 14 days of AIS & Radar (August 2024); • Six days of AIS & Radar (January 2025); and • 12 months of AIS (January 2025)."	Acknowledged within **Section 5.2**. These datasets have been used to inform **Chapter 13 Shipping and Navigation** and this NRA.
NLB	Meeting – 30 April 2025	Slinging operations at Dubh Artach lighthouse require a vessel and helicopter. The vessel requires 360° access around the lighthouse to account for different positioning in certain weather conditions and is positioned a maximum of 1 nm from the lighthouse (closer for helicopter lifting operations). The safety zone around the vessel will need to be 1 nm to allow for helicopter operations, meaning slinging operations will require a 2 nm 360° clearance around the lighthouse.	Acknowledged within **Section 6.1**, with site reductions made to accommodate. NLB have confirmed they are content.
Local fisher	Local Hazard Workshop – 11 June 2025	Vessel Monitoring System (VMS) data shown in the meeting does not fully represent the Islay fishing fleet as no fishing vessels located in Islay are over 15 metres (m).	In addition to AIS and VMS data, radar and visual observations have been considered within the primary vessel traffic datasets (see **Section 5.2**).

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
Local fisher		Minimum structure separation distance would likely be sufficient for both transiting and fishing operations dependent on conditions.	Acknowledged within the risk assessment in **Section 18**.
Local fisher		For six months of the year the local fishers undertake fishing operations every day.	Acknowledged within the vessel traffic baseline (see **Section 10.2.3**).
Clyde Fishermen's Association		The Project should consider the layout in relation to helicopter SAR operations.	As per the mitigations presented in **Section 17**, it will be ensured post-consent that the layout options will comply with MGN 654, including ease of access/mobility for helicopters and further consultation to take place prior to final layout signoff.
NLB		All lighting requirements for the Project need to follow stringent and established lighting and marking protocols.	As noted within the mitigation measures (see **Section 17**), lighting and marking of the WDA will be in agreement with NLB and in line with IALA O139 (IALA, 2021) and G1162 (IALA, 2022).
MCA	Mainland Hazard Workshop – 02 July 2025	The searoom to the east requires further consideration, with further assessment required for corridor calculations.	Site refinements have been made (see **Section 6.1**), with the MCA expressing contentment on the updates (see 25 September 2025 entries).
		No cumulative effects are expected from the Malin Sea and Malin Head offshore windfarms.	Acknowledged within **Section 15**.
		Reduced access to local ports should be included within the hazard log.	Reduction of access to local ports and harbours has been included within the hazard log in **Appendix B** and assessed in **Section 18**.
RYA Scotland		The possibility of buoys losing station and creating a hazard should be investigated.	As will be included within the LMP, buoyage to be deployed will be placed after consultation with NLB. Buoys which will be in place will use tracking devices, with recovery plans to be

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
			implemented within the LMP. Impacts of construction buoyage losing station have been assessed within **Section 18**.
		Recreational vessels may find it more difficult to view the lighthouse than other vessel types due to the relatively low height of recreational craft.	As per **Section 6.1**, site reductions in the north have been made to increase the distance between the Dubh Artach lighthouse and WTG for the Project.
		The recreational vessel tracks in the survey data and long-term data are as would be expected. Any vessels transiting from the Clyde are likely to go further east than the WDA.	Acknowledged within the future case picture for recreational vessel traffic (**Section 14.2**).
		Those sailing in area will likely be competent sailors due to the local conditions.	Acknowledged within the risk assessment in **Section 18**.
		Incidences of larger vessels displaying as Restricted in Ability to Manoeuvre (RAM) have been observed due to shallow water depths. If this happens with Project vessels, it will constrict searoom even further.	Potential for RAM Project vessels to restrict searoom has been addressed within the risk assessment in **Section 18**.
UK Chamber of Shipping		There is concern over the distance between the WDA and the coast to the east, with cargo vessels routeing north-south potentially required to deviate here. This will likely impact fishing vessels further inshore.	The WDA has been refined as per **Section 6.1** to allow for greater sea room.
CalMac Ferries		CalMac vessels only undertake 1-2 transits in the area per year, as most transits are further east. These vessels would transit inshore if required to deviate, as vessel Masters are comfortable at close to 1 nm from WTGs on larger vessels. This depends on the ports used by the Project.	CalMac vessel routeing patterns have been acknowledged within the risk assessment in **Section 18**.
		In periods of inclement weather, vessels sheltering further inshore may impact on CalMac vessel routeing.	Potential impact on deviating CalMac vessels in periods of adverse weather has been acknowledged within the risk assessment in **Section 18**.
SWFPA		Whether fishing vessels will continue to transit within the WDA depends on the orientation and size of the WTGs, as well as the vessel Master's discretion.	Acknowledged within the risk assessment in **Section 18**.

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
		If jacket foundations are used, they are typically towed by barges and present the greatest risk to damaging static fishing gear. There should be defined transit lanes, consideration of sheltered areas for larger vessels, and the Project's Vessel Management Plan (VMP) to be available on all Project vessels so vessel personnel are aware of appropriate procedures.	Associated content on vessel transit corridors and shelter areas is a standard inclusion requirement for VMP consent conditions. A VMP is included as embedded mitigation as per **Section 17**. This will be promulgated to all vessel Masters on project vessels noting that abiding by the requirements of the Convention on International Regulations for Preventing Collisions at Sea (COLREGs) and the International Convention for the Safety of Life at Sea (SOLAS) will remain the navigational priorities at all times.
		In the event of a potential drifting allision, a fishing vessel Master would prioritise deploying anchor as quickly as possible, with primary concern on the allision as opposed to cable snagging.	Considered within the risk assessment in **Section 18**.
DFDS	Meeting – 07 July 2025	DFDS concerns are primarily commercial, although there are navigational concerns dependent on weather conditions. The decision of a vessel Master to transit inshore or offshore of the WDA would be dependent on weather conditions such as visibility and sea state, with vessels likely to transit inshore of the WDA during normal conditions. During periods of adverse weather, vessels will instead transit offshore to the west of the Project's WDA.	Likelihood of DFDS vessels to deviate offshore of the WDA during adverse weather highlighted in **Section 12.3**. DFDS have confirmed they are content with the WDA post refinement.
		DFDS preference would be for the northeastern section of the WDA boundary to be refined so it is located further offshore from Colonsay. It would be preferable also for the northeastern section of the WDA boundary to be adjusted in a southwestern direction which would result in fewer necessary turns	As per **Section 6.1**, the northeast of the WDA has been refined with straighter edges. DFDS have confirmed they are content with the WDA post refinement.
NLB	Meeting – 07 July 2025	The distinction between the Project's WTG lighting arrangements and the Dubh Artach lighthouse lighting characteristics should be considered, with 3D reference visualisations of the Dubh Artach lighthouse requested to demonstrate the presence of the WTGs in relation to the lighthouse.	NLB were provided with 3D reference visuals of the Dubh Artach lighthouse in relation to the WDA infrastructure. As per email on 06 January 2026, NLB are content that impacts on the lighthouse as a significant Aid to Navigation in the area can be mitigated through discussions as part of the LMP.

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
		NLB has a preference for defined i.e., straight line edge boundaries and reducing the presence of isolated WTGs.	Site reductions have been made to further define the WDA boundary and reduce potential for isolated structures, as per **Section 6.1**.
Port of Glensanda	Meeting – 14 July 2025	Vessels transiting to Glensanda typically route through the Sound of Mull when arriving from Europe. All vessels routeing to Glensanda are of sufficient draught to pass through the Sound of Mull. Glensanda receives approximately a hundred larger vessels per year.	Acknowledged within the risk assessment in **Section 18**.
		The searoom between Colonsay and the eastern boundary of the WDA is likely sufficient for vessels transiting to Glensanda.	Suitability of vessels to transit between the WDA and the coast has been acknowledged within the risk assessment in **Section 18**.
DFDS	Meeting – 10 September 2025	The DFDS route runs in a fixed line of service on a weekly schedule which would need to be amended, resulting in the need for an extra vessel with subsequent large cost.	Acknowledged within the risk assessment in **Section 18**.
		DFDS are appreciative of the refined RLB.	Acknowledged within discussions of the site refinement undertaken in **Section 6.1**.
NLB and MCA	Meeting – 25 September 2025	Content with the site refinement made, and appreciative of the further detail presented on searoom available to the east of the WDA as well as vessel numbers/sizes post-site refinement.	Acknowledged within **Section 6.1** and **Section 12.1**
		Suggested consulting with the Port of Glensanda on local water depths in the inshore area.	As per the item on 29 January 2026 in this table, the Port of Glensanda have been consulted regarding local water depths and did not raise any concerns following consultation with the Yeoman vessels.
UK Chamber of Shipping		Content with the site refinement made.	Noted.

Stakeholder	Form of Correspondence	Point Raised	Response and Where Addressed in the NRA
UK Chamber of Shipping	Email – 12 December 2025	Chamber of Shipping confirmed that DFDS are content with the WDA boundary as it has been amended.	Noted.
Port of Glensanda	Meeting – 16 December 2025	Confirmed content with the WDA.	Considered within the risk assessment in **Section 18**.
NLB	Email – 06 January 2026	NLB are content that any impact on the Dubh Artach lighthouse as a significant Aid to Navigation in the area can be mitigated through discussions as part of the project LMP.	Addressed within the risk assessment in **Section 18**.
Port of Glensanda	Email – 29 January 2026	No concerns were raised by vessel Masters on Yeoman-operated craft regarding the water depths in proximity to the WDA.	Addressed within the future case vessel traffic in **Section 14**.
MCA	Email – 10 March 2026	MCA are content with the updated shipping and navigation Study Area used in the NRA.	Noted, the agreed study area has been utilised.
NLB	Email – 10 March 2026	NLB are content with the updated shipping and navigation Study Area used in the NRA.	Noted, the agreed study area has been utilised.

4.3 Hazard Workshops

35. A key element of the consultation phase were the Hazard Workshops, meetings of local and national marine stakeholders to identify and discuss potential shipping and navigation hazards. These included a local Hazard Workshop on Islay, involving predominantly small-craft users such as fishers, and a mainland Hazard Workshop in Edinburgh for all others. Using the information gathered from the Hazard Workshops, a Hazard Log was produced for use as input into the risk assessment undertaken in **Section 18**. This ensured that expert opinion and local knowledge was incorporated into the risk assessment and that the hazard log was site-specific.

36. Stakeholders invited to attend the Hazard Workshops included various fishing representatives at both a local and national level, recreational representatives at both a local and national level (including the CA and RYA Scotland/RYA Northern Ireland), port/harbours authorities (including Argyll and Bute Harbour Authority), and Regular Operators identified as using the area, including CalMac Ferries and DFDS.

37. The local Hazard Workshop was held on Islay on 11 June 2025 and was attended by seven local fishers.

38. The mainland Hazard Workshop was held in Edinburgh on 02 July 2025. The following organisations attended at least one of the Hazard Workshops:

- CalMac Ferries;
- Clyde Fishermen's Association;
- MCA;
- NLB;
- Royal Highland Yacht Club;
- RYA Scotland (also representing the Cruising Association);
- Scottish Fishermen's Federation (SFF);
- Southwest Coast Regional Inshore Fisheries Group (SWCRIFG);
- Scottish White Fish Producers Association (SWFPA); and
- UK Chamber of Shipping.

4.4 Hazard Workshop Process and Hazard Log

39. During the Hazard Workshops, 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.

40. Following the Hazard Workshops, the risks associated with the identified hazards were ranked in the hazard log based upon the discussions held during the workshops, 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 and their feedback incorporated into the NRA.

41. The hazard log has been used to inform the risk assessment from **Section 18** and is provided in full in **Appendix B**.

5 Data Sources

42. 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

43. The main data sources used in assessing the shipping and navigation baseline relative to the Project are outlined in **Table 5.1**.

Table 5.1 Data Sources Used to Inform the Shipping and Navigation Baseline

Data	Source(s)	Purpose
Vessel traffic	Winter vessel traffic data consisting of AIS, Radar, and visual observations for the shipping and navigation study area (14 days, 01 December to 16 December 2023) recorded from a dedicated survey vessel on-site.	Characterising vessel traffic movements within and in proximity to the Project in line with MGN 654 (MCA, 2021) requirements.
	Summer vessel traffic data consisting of AIS, Radar, and visual observations for the shipping and navigation study area (14 days, 16 August to 31 August 2024) recorded from a dedicated survey vessel on-site.	
	Winter vessel traffic data consisting of AIS, Radar, and visual observations for the shipping and navigation study area (six days, 20 January to 30 January 2025) recorded from a dedicated survey vessel on-site.	Secondary source for characterising vessel traffic movements within and in proximity to the Project.
	Long-term AIS data for the shipping and navigation study area (12 months, March 2024 to February 2025) recorded from terrestrial and satellite receivers.	
	Anatec's ShipRoutes database (2025).	
	Scottish Marine Recreation and Tourism Survey 2015 (Scottish Government, 2015)	
Maritime incidents	MAIB marine accidents database (2005 to 2024).	Review of maritime incidents within and in proximity to the Project.
	Royal National Lifeboat Institution (RNLI) incident data (2015 to 2024).	
	Department for Transport (DfT) UK civilian SAR helicopter taskings (April 2015 to March 2025).	
Navigational features	Admiralty charts 2635, 2723, and 2724 (United Kingdom Hydrographic Office (UKHO), 2025).	Characterising navigational features within and in proximity to the Project.

Data	Source(s)	Purpose
	Admiralty Sailing Directions South-West Coast of Scotland Pilot NP66A (UKHO, 2023).	
Weather	Wind direction data from the Machair Floating Lidar device.	Characterising weather conditions within and in proximity to the Project.
	Significant wave height data from Copernicus North Sea Waves.	
	Tidal data from IFREMER ResourceCode modelled dataset.	
	Visibility data from Admiralty Sailing Directions South-West Coast of Scotland Pilot NP66A (UKHO, 2023).	

5.2 Vessel Traffic Surveys

44. The vessel traffic surveys were undertaken using methodology agreed with the MCA. Two 14-day AIS, Radar, and visual observation surveys undertaken in winter 2023 (01 December to 16 December 2023) and summer 2024 (16 August to 31 August 2024) have been considered within the baseline for a total of 28 full days. A further six days of survey data was collected in January 2025, noting the data collection period was limited due to adverse weather on the west coast during this time. The survey area used for shipping and navigation (the 'shipping and navigation survey area') is the same area as used for the shipping and navigation study area, and so is hereafter referred to as such. Over the vessel traffic surveys, approximately 5% of vessel traffic was recorded using Radar, with the remaining 95% recorded using AIS.

45. A long-term dataset (March 2024 to February 2025) is described within **Section 5.3** and has been used as validation in **Appendix E**.

46. The MCA confirmed during consultation (see **Section 4**) that these datasets will be suitable to inform the NRA assuming a Q2 2026 submission. The vessel traffic survey datasets are assessed in full in **Section 10**.

47. A number of vessel tracks recorded during the survey periods were classified as temporary (non-routine), such as those of the survey vessel and a vessel undertaking maintenance works on metocean equipment. These have therefore been excluded from the analysis; as were vessels which remained moored at the Port of Scalasaig (to avoid skewing the analysis).

5.3 Long-term Vessel Traffic Data

48. Long-term vessel traffic data consisting of AIS covering 12 months between 01 March 2024 and 28 February 2025 was collected from terrestrial and satellite receivers. Taking into account the distance offshore of the WDA, the long-term vessel traffic

data is considered to be comprehensive for the shipping and navigation study area. The assessment of this dataset allowed seasonal variations to be captured.

49. This dataset is assessed in full in **Appendix E**.

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 01 July 2002 and fishing vessels over 15 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 15 m LOA and recreational craft) were recorded, where possible, on the Automatic Radar Plotting Aid (ARPA) on board the survey vessel. A proportion of smaller vessels also carry AIS voluntarily, typically utilising a Class B AIS device.

52. Throughout the winter 2023 survey, approximately 92% of vessel tracks were recorded via AIS with the remainder recorded via Radar. Throughout the summer 2024 survey, approximately 98% of vessel tracks were recorded via AIS with the remainder recorded via Radar.

5.4.2 Historical Incident Data

53. Although all UK commercial vessels are required to report accidents to the MAIB, this is not mandatory for non-UK vessels unless they are in a UK port, within 12 nm of territorial waters, or carrying passengers to a UK port. There are also no requirements for a non-commercial recreational craft to report accidents to the MAIB.

54. The 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 UKHO Charts

55. The UKHO Admiralty Charts are updated periodically, and therefore the information shown may not reflect the real-time features within the region with total accuracy. For aids to navigation, only those charted and considered key to establishing the shipping and navigation baseline are shown.

56. During consultation, input has been sought from relevant stakeholders regarding the navigational features baseline. Navigational features are based upon the most

recently available UKHO Admiralty Charts and Sailing Directions at the time of writing.

6 Project Description Relevant to Shipping and Navigation

57. The NRA reflects the PDE which is detailed in full in **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

58. The WDA is located approximately 6.7 nm west of Colonsay, and 8.1 nm northwest of Islay. The total area covered by the WDA is approximately 131 square nautical miles (nm^2), with water depths ranging between 21 m and 79 m below CD.

59. The WTGs and OSPs will be located within the WDA, inclusive of blade overfly. The key coordinates defining the boundary of the WDA are illustrated in **Figure 3.2** and provided in **Table 6.1** using World Geodetic System 1984 (WGS84).

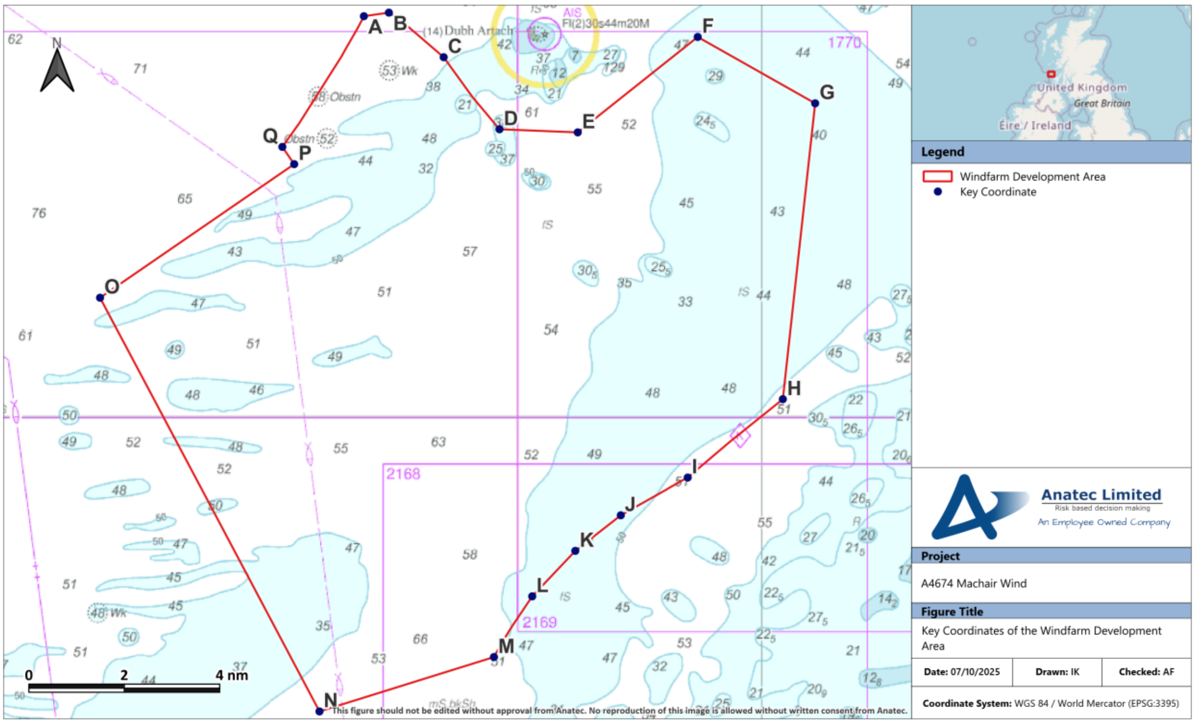

Figure 6.1 Key Coordinates of the WDA

Table 6.1 Key Coordinates of the WDA

Point	Latitude	Longitude
A	56° 08′ 18.64″ N	006° 44′ 48.36″ W
B	56° 08′ 23.10″ N	006° 43′ 52.52″ W
C	56° 07′ 27.53″ N	006° 41′ 50.11″ W
D	56° 05′ 57.67″ N	006° 39′ 45.51″ W

Point	Latitude	Longitude
E	56° 05′ 53.76″ N	006° 36′ 50.65″ W
F	56° 07′ 52.77″ N	006° 32′ 22.65″ W
G	56° 06′ 30.00″ N	006° 28′ 00.29″ W
H	56° 00′ 20.47″ N	006° 29′ 12.45″ W
I	55° 58′ 42.38″ N	006° 32′ 45.01″ W
J	55° 57′ 55.14″ N	006° 35′ 14.46″ W
K	55° 57′ 10.58″ N	006° 36′ 56.10″ W
L	55° 56′ 13.61″ N	006° 38′ 32.33″ W
M	55° 54′ 57.52″ N	006° 39′ 57.88″ W
N	55° 53′ 49.29″ N	006° 46′ 27.58″ W
O	56° 02′ 27.29″ N	006° 54′ 37.76″ W
P	56° 05′ 14.11″ N	006° 47′ 24.05″ W
Q	56° 05′ 35.63″ N	006° 47′ 50.56″ W

60. It is noted that the WDA represents a change from that considered at Scoping, i.e., the EIA Scoping WDA Boundary, with updates made following stakeholder feedback (see **Section 4**). The WDA changes are presented in **Figure 6.2**.

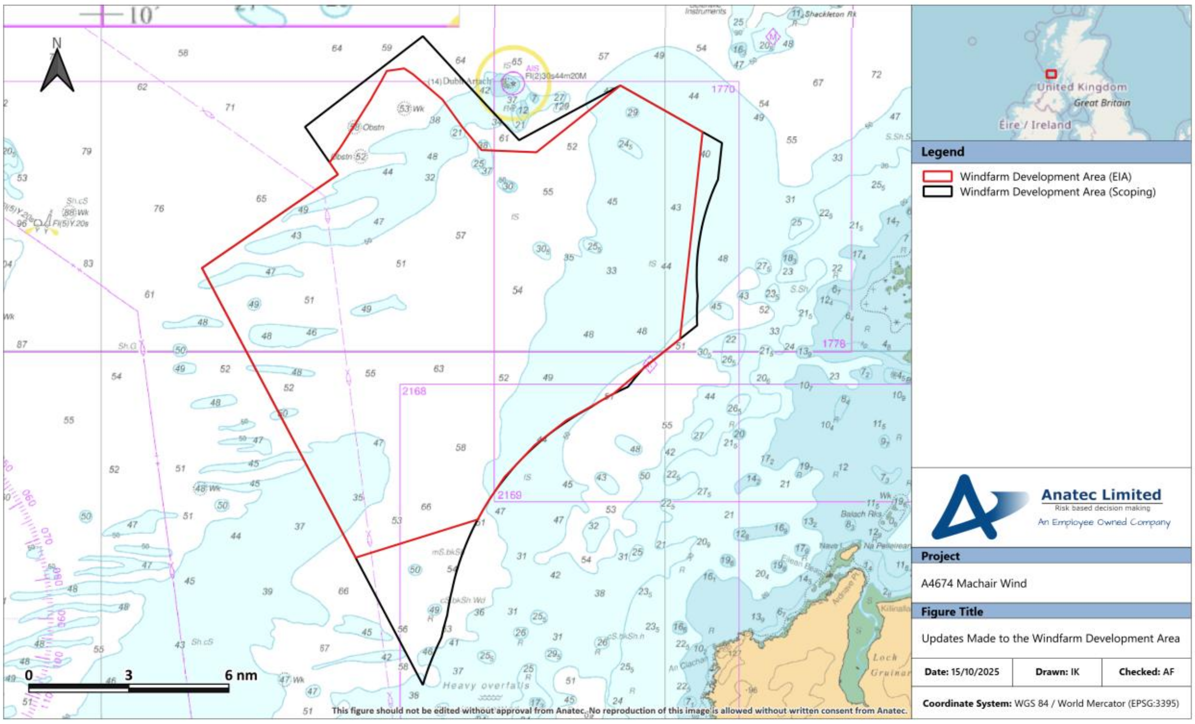

Figure 6.2 Updates Made to the WDA

61. The key changes relate to the northern, eastern, and southern extents of the WDA.

62. Primary concerns on the northern extent of the EIA Scoping WDA Boundary related to the ability of NLB to access the Dubh Artach lighthouse. It was requested during consultation that a 2 nm setback be provided between the WDA and the lighthouse. A reduction of the northern extent of the WDA was therefore provided to allow a 2 nm buffer of clear searoom between the two.

63. The inshore area of the EIA Scoping WDA Boundary was raised by multiple stakeholders, with the impact on routeing for regularly scheduled DFDS vessels (see **Section 11.2**), and general inshore navigation cited. Inshore searoom has therefore been increased via a reduction in the eastern boundary.

64. The Chamber of Shipping noted during consultation that there was potential for isolated WDA infrastructure at the southern extremity of the EIA Scoping WDA Boundary. This periphery has since been reduced to a straight-line edge, which will allow for the accommodation of multiple WTGs.

6.2 Surface Infrastructure

6.2.1 Indicative WDA Layout

65. Up to 144 WTGs and two OSPs may be installed within the WDA.

66. Although the final locations of infrastructure have not yet been defined, an indicative layout option has been considered in this NRA which represents the realistic worst-case scenario for shipping and navigation from an allision and collision modelling perspective (noting the layout is used as input into the modelling in **Section 15**). This layout is considered in the risk assessment in **Section 18**. The minimum centre-to-centre spacing between WTGs within the PDE is 944 m.

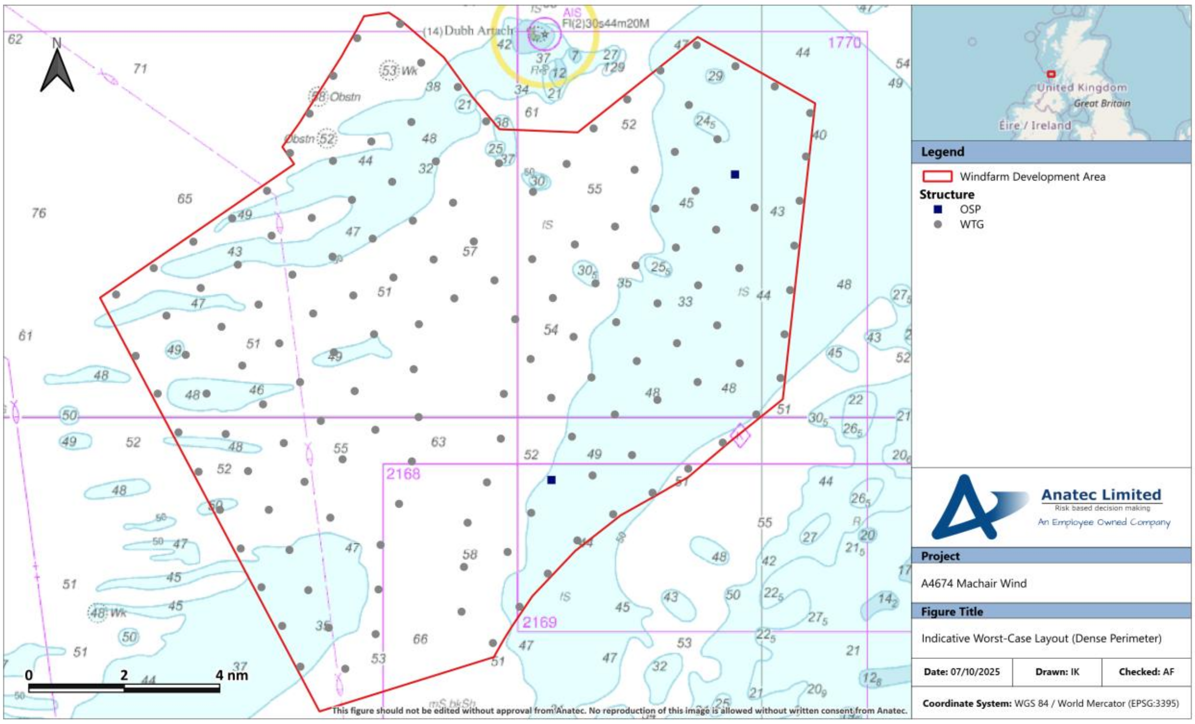

Figure 6.3 Indicative Worst-case Layout

67. The final layout defined post consent will be agreed with the MCA and NLB and will apply the layout principles included in MGN 654 (MCA, 2021).

6.2.2 Wind Turbine Generators

68. The Maximum Design Scenario (MDS) for the WTGs within the indicative layouts is for a maximum rotor diameter of 236 m and a maximum blade tip height of 275.72 m above Highest Astronomical Tide (HAT).

69. Jacket foundations have been considered as MDS for shipping and navigation as these foundation types provide the maximum structure dimension for which a vessel could come into contact, therefore maximising potential exposure for passing/adrift vessels. The MDS for the WTGs, assuming use of jacket foundations, are provided in **Table 6.2**

Table 6.2 Shipping and Navigation MDS for WTGs

Parameter	MDS
Number	144
Foundation type	Jacket
Dimensions	37 m x 35 m
Minimum air gap (above HAT)	31.97 m
Minimum blade tip height (above Mean High Water Springs (MHWS))	29 m
Maximum rotor diameter	236 m

6.2.3 Offshore Substation Platforms

70. Up to two OSPs may be installed within the WDA, with topside dimensions of 125 m x 120 m.

6.3 Subsea Infrastructure

6.3.1 Inter-array Cables

71. The inter-array cables (IACs) will be fully installed within the WDA to connect individual WTGs to each other and to the OSPs and will all carry Alternating Current (AC). Up to 309 nm (572 kilometres (km)) of IACs will be required, with the final length dependent on the final layout.

6.3.2 Offshore Export Cables

72. Although a separate consent will be sought for the offshore ECC, the relevant portion of infrastructure located within the WDA is assessed within this document. Up to 108 nm (200 km) of the total length of the offshore export cables will be located within the WDA itself. These will carry DC.

6.3.3 OSP Link Cables

73. If more than one OSP is required, then these will be linked to each other by OSP link cables. These will be located fully within the WDA. Assuming their necessity as a worst-case, up to 147 nm (272 km) of OSP link cables will be required. These could carry either AC or DC at this stage.

6.3.4 Cable Burial and Protection

74. Where cable burial is not possible, alternative cable protection methods may be deployed which will be determined within the CBRA. There will be a maximum cable protection height of 3 m and maximum cable protection width of 13 m.

6.4 Vessel Numbers

6.4.1 Construction Phase

75. The construction phase will last for up to five years, with the earliest any construction works at the WDA would start assumed to be in 2030. Up to 5,700 return trips by construction vessels may be made throughout the construction phase, broken down as summarised in **Table 6.3** (noting that numbers are indicative and assumed to be an MDS for shipping and navigation). A maximum of 117 vessels will be on-site at any one time during construction.

Table 6.3 Maximum Vessel Numbers per Construction Activity

Activity	Vessel Type	Number of Vessels	Round Trips
Foundation Installation	Dredging vessel	6	30
	Tugs and barges storage and transport	16	1100
	Jack-up vessel	3	300
	Dynamic Position Heavy Lift Vessel	5	525
	Support vessels	8	500
WTG installation	Jack-up vessel	5	300
	Dynamic Position Heavy Lift Vessel	2	200
	Accommodation vessel	3	40
	Windfarm service vessel	3	30
OSP installation	Support vessels	3	400
	Installation vessel	2	100
	Tug with accommodation barge	2	100
	Supply vessel	2	50
	Support vessels	3	500
Cable installation	IAC laying vessel	2	107
	Accommodation vessel	3	42
	Installation support vessel	3	32
	Trenching support vessel	2	21
	Crew Transfer Vessel (CTV)	3	204
	Rock Fall pipe vessel	2	32
	Light construction vessel	2	161

Activity	Vessel Type	Number of Vessels	Round Trips
	Export offshore cable laying vessel	2	107
	Export cable nearshore laying vessel	2	50
	Export cable support vessel	2	161
	Export cable pre-trenching/backfilling vessel	2	43
	Export cable - cable jetting vessel	2	43
	Export Cable - Survey Vessel	2	161
	Export Cable - Multi Cat vessel	3	139
	Export Cable - Rock Fall Pipe Vessel	2	32
	Workboat	20	190
Total		**117**	**5,700**

6.4.2 Operations and Maintenance Phase

76. An indicative 600 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

77. 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

78. The MDS for each shipping and navigation hazard is provided in **Table 6.4** and is based on the parameters described in the previous subsections.

Table 6.4 MDS by Hazard for Shipping and Navigation

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
Increased vessel to vessel collision risk resulting from displacement (third-party to third-party)	Construction/ decommissioning	▪ Maximum extent of buoyed construction area assuming full build out of the WDA. ▪ 144 WTGs and two OSPs within the WDA. ▪ Structure locations as per **Figure 6.3**. ▪ Construction phase of up to five years. ▪ 500 m safety zones around structures where active construction is ongoing, 50 m safety zones otherwise. ▪ 309 nm (572 km) of inter-array cables. ▪ 108 nm (200 km) of the offshore export cables within the WDA. ▪ 147 nm (272 km) of OSP link cables.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel displacement and subsequent collision risk involving third-party vessels.
	O&M	▪ Maximum extent of the WDA. ▪ 144 WTGs and two OSPs within the WDA. ▪ Structure locations as per **Figure 6.3**. ▪ Operational phase of up to 35 years. ▪ 500 m safety zones around major maintenance. ▪ 309 nm (572 km) of inter-array cables. ▪ 108 nm (200 km) of the offshore export cables within the WDA. ▪ 147 nm (272 km) of OSP link cables.	
Increased vessel to vessel collision risk (third-party to project vessel)	Construction/ decommissioning	▪ Maximum extent of buoyed construction area assuming full build out of the WDA. ▪ 144 WTGs and two OSPs within the WDA. ▪ Structure locations as per **Figure 6.3**. ▪ Construction phase of up to five years. ▪ Up to 1,140 return trips per year from project vessels, with up to 117 project vessels on site at any one time. ▪ 108 nm (200 km) of the offshore export cables within the WDA. ▪ 147 nm (272 km) of OSP link cables.	Largest possible extent of infrastructure, greatest number of simultaneous vessel activities and greatest duration resulting in the maximum spatial and temporal effect on vessel-to-vessel collision risk involving a third-party vessel and a project vessel.

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
	O&M	▪ Maximum extent of the WDA. ▪ 144 WTGs and two OSPs within the WDA. ▪ Structure locations as per **Figure 6.3**. ▪ Operational phase of up to 35 years. ▪ Up to 600 return trips per year from project vessels. ▪ 108 nm (200 km) of the offshore export cables within the WDA. ▪ 147 nm (272 km) of OSP link cables.	
Vessel to structure allision risk	Construction/ decommissioning	▪ Maximum extent of buoyed construction area assuming full build out of the WDA. ▪ 144 WTGs and two OSPs within the WDA. ▪ Structure locations as per **Figure 6.3**. ▪ Construction phase of up to five years. ▪ 500 m safety zones around structures where active construction is ongoing, 50 m safety zones otherwise. ▪ WTG jacket leg dimensions of 37 m x 35 m at sea surface. ▪ OSP topside dimensions of 125 m x 120 m. ▪ Minimum WTG spacing of 944 m.	Largest possible extent of surface infrastructure, greatest number of surface structures and greatest duration resulting in the maximum spatial and temporal effect on vessel to structure allision risk.
	O&M	▪ Maximum extent of the WDA. ▪ 144 WTGs and two OSPs within the WDA. ▪ Structure locations as per **Figure 6.3**. ▪ Operational phase of up to 35 years. ▪ 500 m safety zones around major maintenance. ▪ WTG jacket leg dimensions of 37 m x 35 m at sea surface. ▪ OSP topside dimensions of 125 m x 120 m. ▪ Minimum WTG spacing of 944 m.	
	Construction/ decommissioning	▪ Maximum extent of buoyed construction area assuming full build out of the WDA.	Greatest number of simultaneous vessel activities resulting in the

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
Reduced access to local ports and harbours		▪ Up to 1,140 return trips per year from project vessels, with up to 117 project vessels on site at any one time.	maximum spatial and temporal effect on access to local ports and harbours.
	O&M	▪ Maximum extent of the WDA. ▪ Up to 600 return trips per year from project vessels.	
Reduction of under keel clearance as a result of subsea infrastructure	O&M	▪ Maximum extent of the WDA. ▪ 144 WTGs and two OSPs within the WDA. ▪ Operational phase of up to 35 years. ▪ 309 nm (572 km) of IACs. ▪ Maximum protection height of 3 m.. ▪ No inter-array crossings. ▪ 108 nm (200 km) of offshore export cables within the WDA. ▪ 147 nm (272 km) of OSP link cables.	Maximum length of subsea cable and maximum extent of protection leading to greatest under keel interaction risk.
Anchor interaction with subsea cables	O&M	▪ Maximum extent of the WDA. ▪ 144 WTGs and two OSPs within the WDA. ▪ Operational phase of up to 35 years. ▪ 309 nm (572 km) of IACs. ▪ Maximum IAC protection height of 3 m, with 0.1% of the IACs requiring protection. ▪ No inter-array crossings. ▪ 108 nm (200 km) of offshore export cables within the WDA. ▪ 147 nm (272 km) of OSP link cables. ▪ Minimum target burial depth for inter-array cables of 0.3 m, and 1 m for the OSP link and export cables.	Largest possible extent of subsea infrastructure and greatest duration resulting in the maximum spatial and temporal effect on anchor or fishing gear interaction with subsea cables.
Reduction of SAR capability	Construction/ decommissioning	▪ Maximum extent of buoyed construction area assuming full build out of the WDA. ▪ 144 WTGs and two OSPs within the WDA. ▪ Structure locations as per **Figure 6.3**.	Largest possible extent, greatest number of surface structures, greatest number of simultaneous vessel

Potential Hazard	Phase(s)	MDS for Shipping and Navigation	Justification
		▪ Construction phase of up to five years. ▪ 500 m safety zones around structures where active construction is ongoing, 50 m safety zones otherwise.	activities and greatest duration resulting in the maximum spatial and temporal effect on emergency response capability.
	O&M	▪ Maximum extent of the WDA. ▪ 144 WTGs and two OSPs within the WDA. ▪ Structure locations as per **Figure 6.3**. ▪ Operational phase of up to 35 years. ▪ Minimum WTG spacing of 944 m ▪ Up to 600 return trips per year from project vessels.	

7 Navigational Features

79. The navigational features identified in proximity to the WDA are presented in **Figure 7.1**.

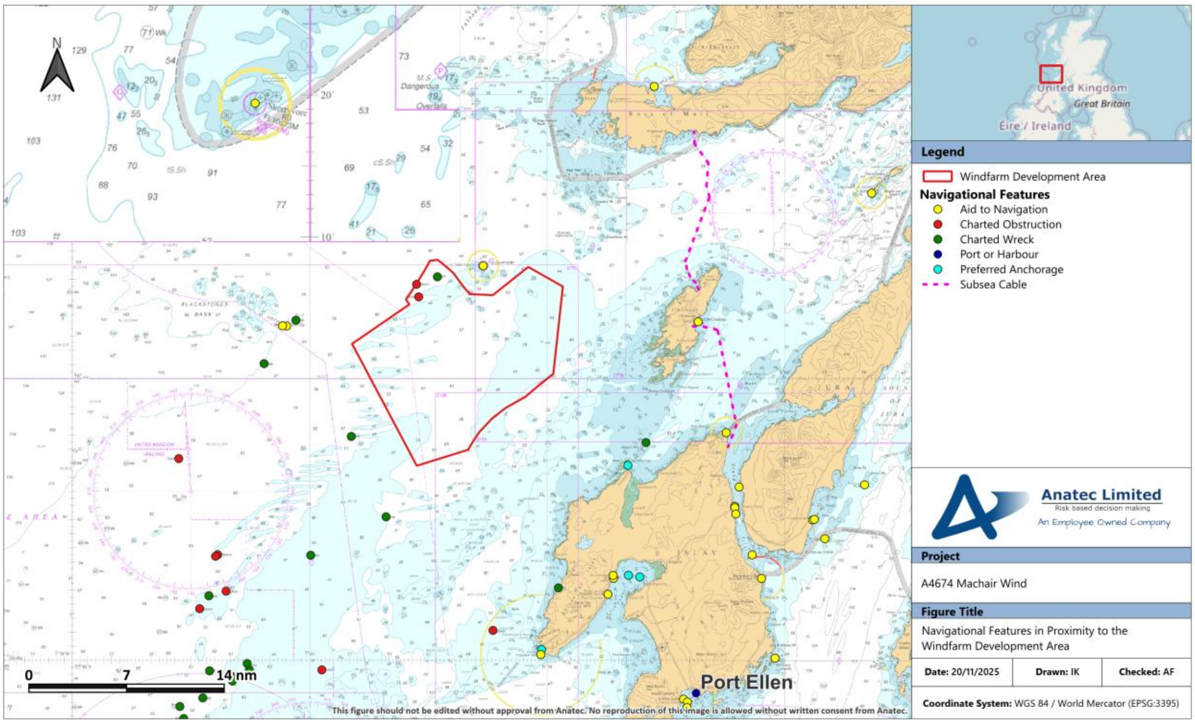

Figure 7.1 Navigational Features in Proximity to the WDA

7.1 Key Aids to Navigation

80. The Dubh Artach lighthouse is of importance to navigation in the area, and is located in proximity to the northern portion of the WDA approximately 2 nm from the boundary following site refinement (see **Section 6.1**). The aid to navigation on the lighthouse is at a height of 44 m, flashes twice every 30s, and has a range of 20 nm. Other notable key aids to navigation in the vicinity of the WDA include two buoys approximately 5 nm to the west (one of which is a special mark), and a pillar buoy equipped with AIS approximately 9 nm to the southeast.

7.2 Wrecks and Obstructions

81. One charted wreck is located within the WDA, in the north. This lies at a depth of 53 m below CD. Two charted obstructions are noted within the WDA, again within its northern portion. These are at a depth of 52 m and 58 m below CD. Not all wrecks are charted; further details of non-charted wrecks are provided in **Chapter 14 Offshore Archaeology and Cultural Heritage**.

7.3 Anchorages

82. A single preferred anchorage location is in proximity to the WDA, approximately 8.5 nm to the southeast at the entrance to Loch Gruinart (inshore of Nave Island). In addition, two preferred anchorages are in the bay within the west of Islay, approximately 14.5 nm southeast of the WDA.

7.4 Subsea Cables

83. Two subsea cables connect to the Island of Colonsay (inshore of the WDA), with one connecting to the Isle of Mull to the north (8.8 nm east of the WDA) and the other connecting to Islay to the south (9.3 nm east).

7.5 Ports and Harbours

84. The closest port or harbour to the Project is Port Ellen on Islay, located approximately 24 nm to the southeast of the WDA, though it lies on the southern side of the island. A ferry terminal is present at Scalascaig, on the eastern side of Colonsay, approximately 9.6 nm east of the WDA. The Port of Glensanda is an important hub in the area located approximately 40 nm to the northeast of the WDA and, as per consultation (**Section 4**) and vessel traffic routeing observed (**Section 11.2**), serves as the origin and terminus port for bulk carriers related to the proximal quarry. For reference, the port limits for Glensanda are shown in relation to the WDA in **Figure 7.2**.

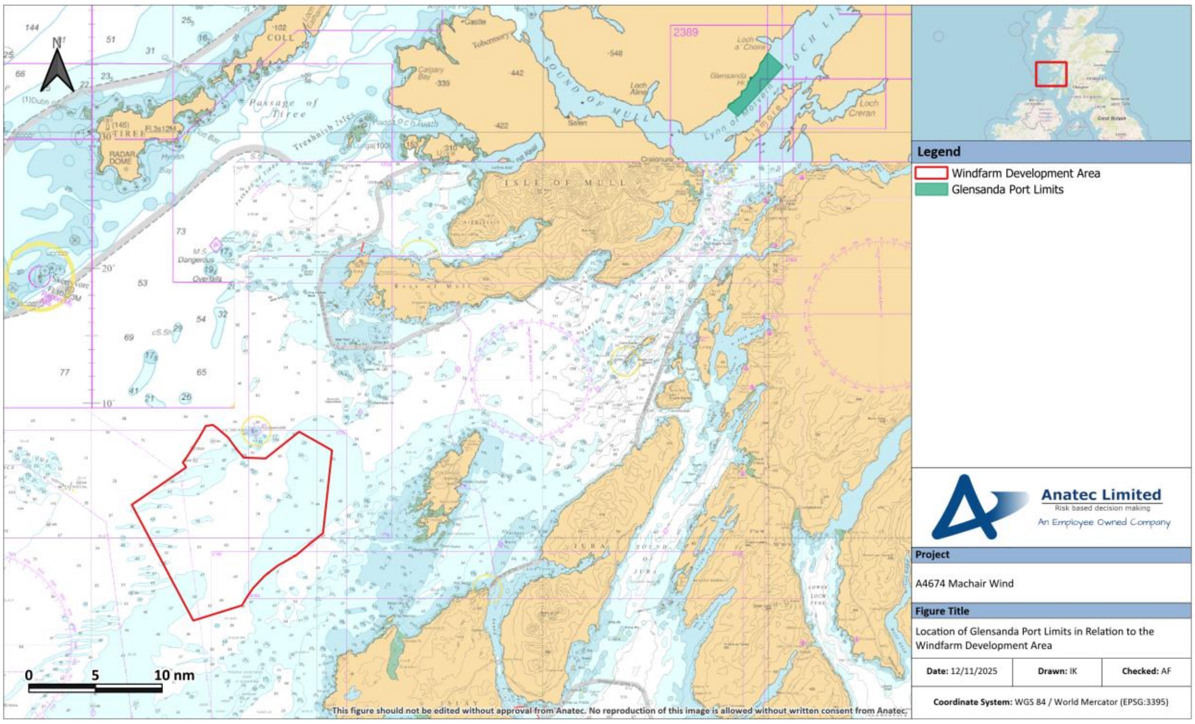

Figure 7.2 Location of Glensanda Port Limits in Relation to the WDA

7.6 Military Practice Areas

85. The WDA is located within Ministry of Defence (MoD) practice areas X5543 and X5626, noting that these are not presented within relevant navigational features figures to improve visual clarity. Admiralty charts of the area state that "no restrictions are placed on the right to transit the firing practice areas at any time, and these operate a clear range procedure (i.e., firing only takes place when the area is considered to be clear of all shipping)".

8 Meteorological Ocean Data

86. This section presents MetOcean statistics local to the Project. The data presented in this section has been used as input to the collision and allision risk modelling (**Section 15**).

8.1 Wind

87. The proportion of the wind direction within each 30-degree interval for a location in the WDA is presented in **Figure 8.1** in the form of a wind rose. It can be seen that wind is predominately from the southwest.

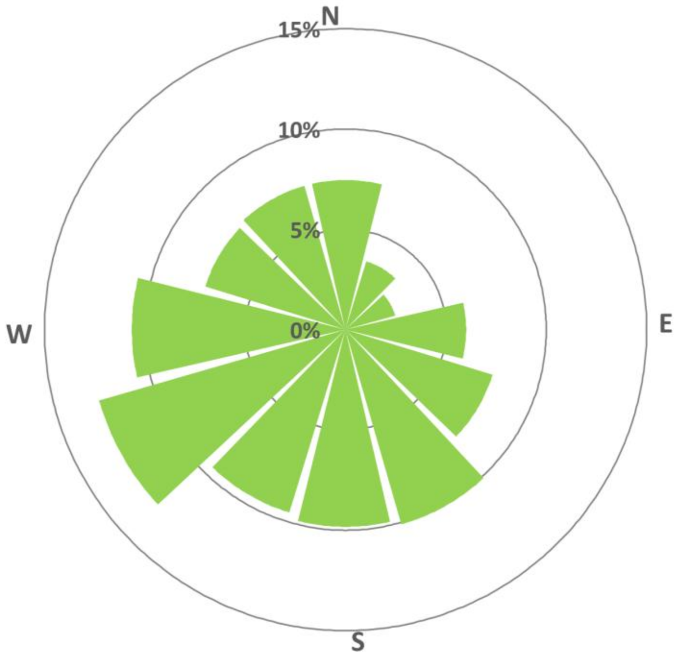

Figure 8.1 Wind Direction Distribution

8.2 Wave

88. The proportion of the sea state (significant wave height) within each of three defined ranges, using output from Copernicus North Sea Waves (validated with onsite measurements), is presented in **Table 3.1**.

Table 8.1 Sea State Probability

Sea State (Significant Wave Height)	Proportion (%)
Calm (<1 m)	16.37
Moderate (1–5 m)	79.53
Severe (> 5 m)	4.10

8.3 Visibility

89. It is assumed that the proportion of poor visibility (defined as the proportion of a year where the visibility can be expected to be less than 1 km) is 2%. This is based upon information available within Admiralty Sailing Directions south-west Coast of Scotland Pilot NP66A (UKHO, 2023).

8.4 Tide

90. Tidal data to be used as input to the collision and allision modelling is based upon surface tidal current data from IFREMER ResourceCode modelled dataset for the period 01/01/1994 – 31/12/2020. **Table 8.2** presents the peak flood and ebb direction and speed values at four locations in proximity to the WDA.

Table 8.2 Tidal Data

Position WGS84 D.DDD		Flood		Ebb	
Latitude	Longitude	Direction (°)	Speed (knots (kt))	Direction (°)	Speed (kt)
55.971	-6.625	170	1.57	350	1.57
55.991	-6.528	180	1.19	0	1.19
56.011	-6.601	160	1.40	340	1.40
56.008	-6.687	160	1.54	340	1.54

91. Based upon the available data, no impacts are expected at high water that would not also be expected at low water, and vice versa. The infrastructure associated with the Project is not expected to have any additional impact on the existing tidal streams in relation to their effect on existing shipping and navigation users.

9 Emergency Response and Incident Overview

92. This section summarises the existing SAR resources in the region, as well as issues considered in relation the Project.

9.1 Search and Rescue Helicopters

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

94. The SAR helicopter service is currently operated out of ten base locations around the UK, with the closest to the WDA located at Prestwick, approximately 71 nm to the southeast. The Prestwick base operates two Agusta Westland AW189 helicopters. The location of the SAR helicopter bases in proximity to the Project are presented in **Figure 9.1**.

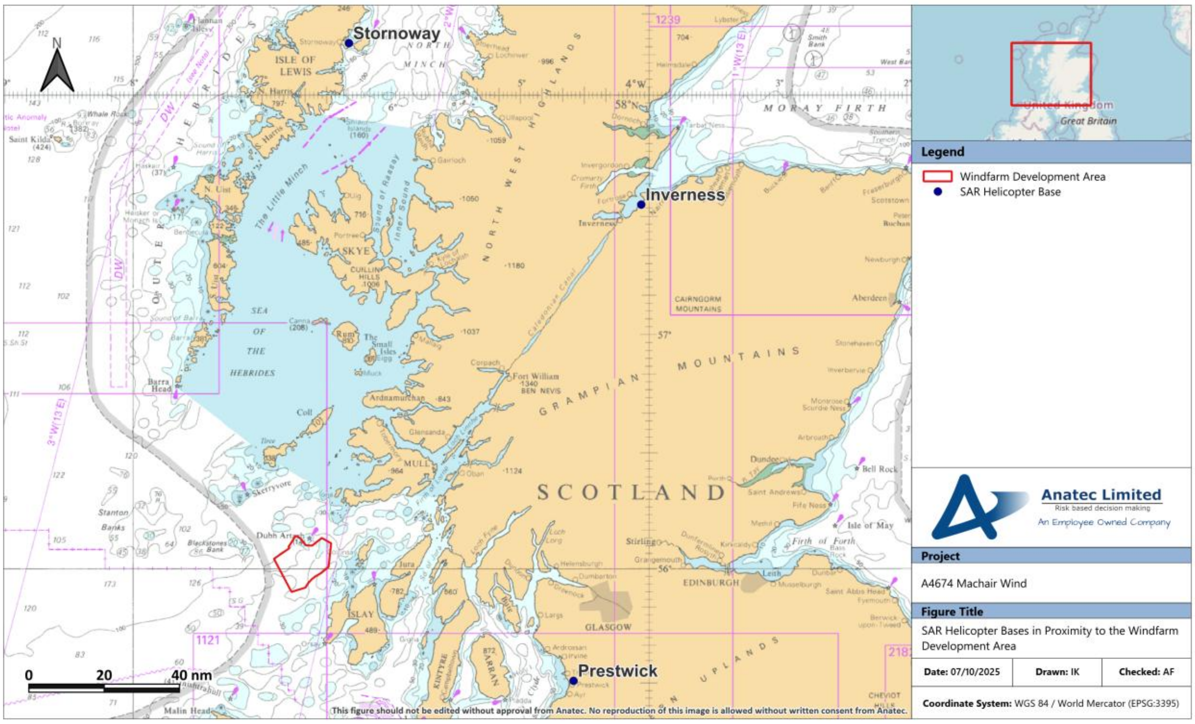

Figure 9.1 SAR Helicopter Bases in Proximity to the WDA

95. 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 2025. The location of SAR helicopter taskings within the shipping and navigation study area are colour-coded by tasking type and presented in **Figure 9.2**.

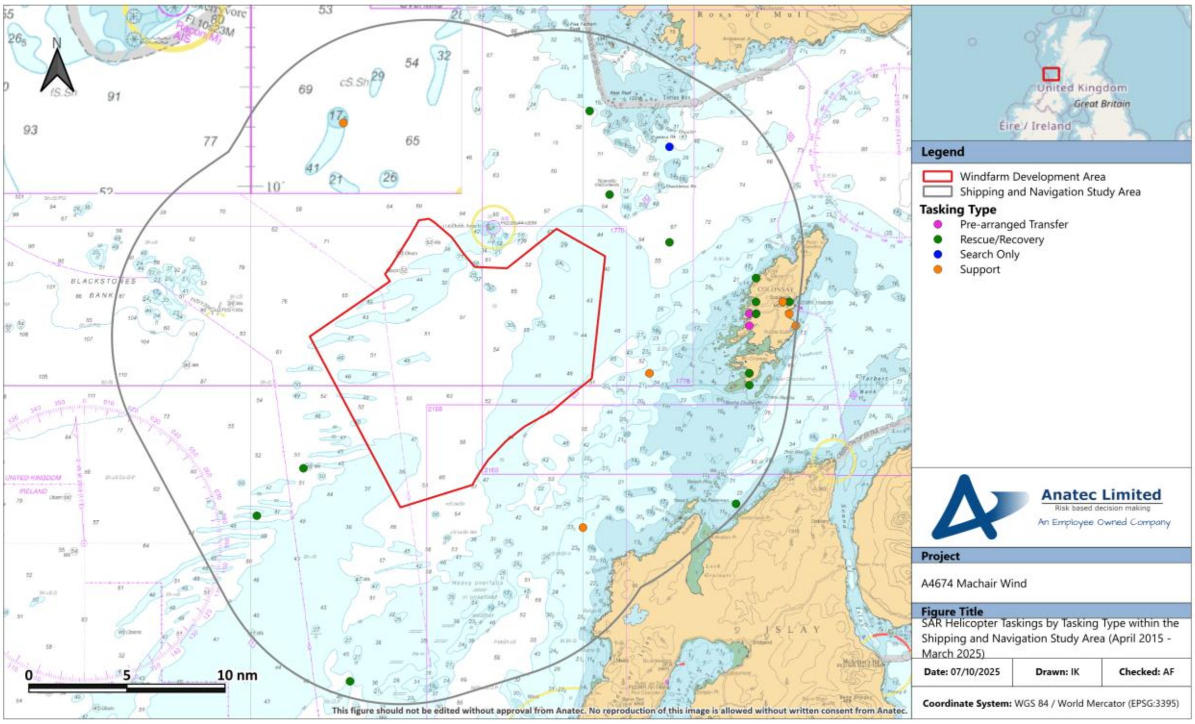

Figure 9.2 SAR Helicopter Taskings by Tasking Type within the shipping and navigation study area (April 2015 - March 2025)

96. There were a total of 25 unique SAR helicopter taskings undertaken for incidents within the shipping and navigation study area between April 2015 and March 2025, corresponding to an average of two to three taskings per year. The majority of these taskings were 'rescue/recovery' (60%), with 'support' taskings (28%) also frequently noted. The taskings primarily related to incidents on Colonsay, with few recorded offshore of the WDA.

9.2 Royal National Lifeboat Institution

97. The RNLI is organised into six regions, with the relevant region for the Project being 'Scotland'. 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).

98. The location of RNLI stations in proximity to the WDA are presented in **Figure 9.3**.

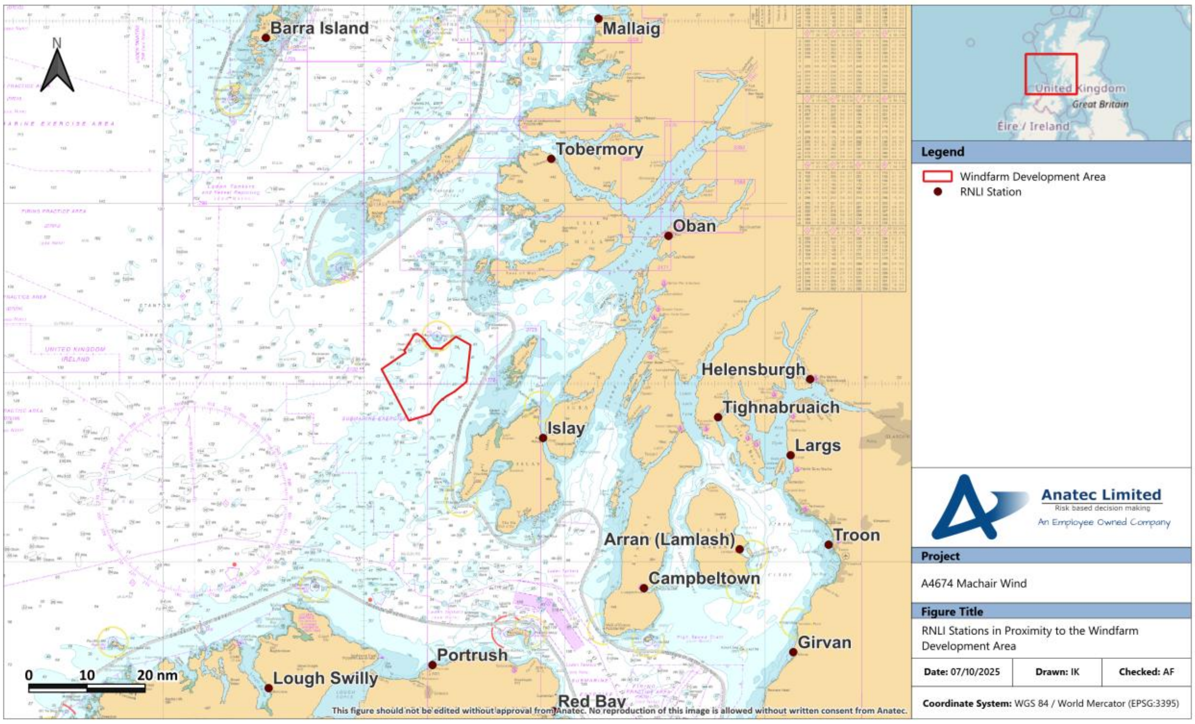

Figure 9.3 RNLI Stations in Proximity to the WDA

99. The closest RNLI station to the WDA is on Islay, approximately 16 nm to the southwest. This station contains an ALB. Given that the RNLI have an operational limit of 100 nm, it is anticipated that an incident occurring in proximity to the WDA could result in a response from an RNLI asset.

100. The incidents documented by the RNLI that occurred within the shipping and navigation study area during the ten-year period from 2015 to 2024 are colour-coded by incident type and presented in **Figure 9.4**. The same data is then colour-coded instead by casualty type and presented in **Figure 9.5**.

101. Incidents which were deemed as hoaxes or false alarms have been excluded from the analysis, with these comprising a single incidence of a false alarm approximately 8 nm southeast of the WDA.

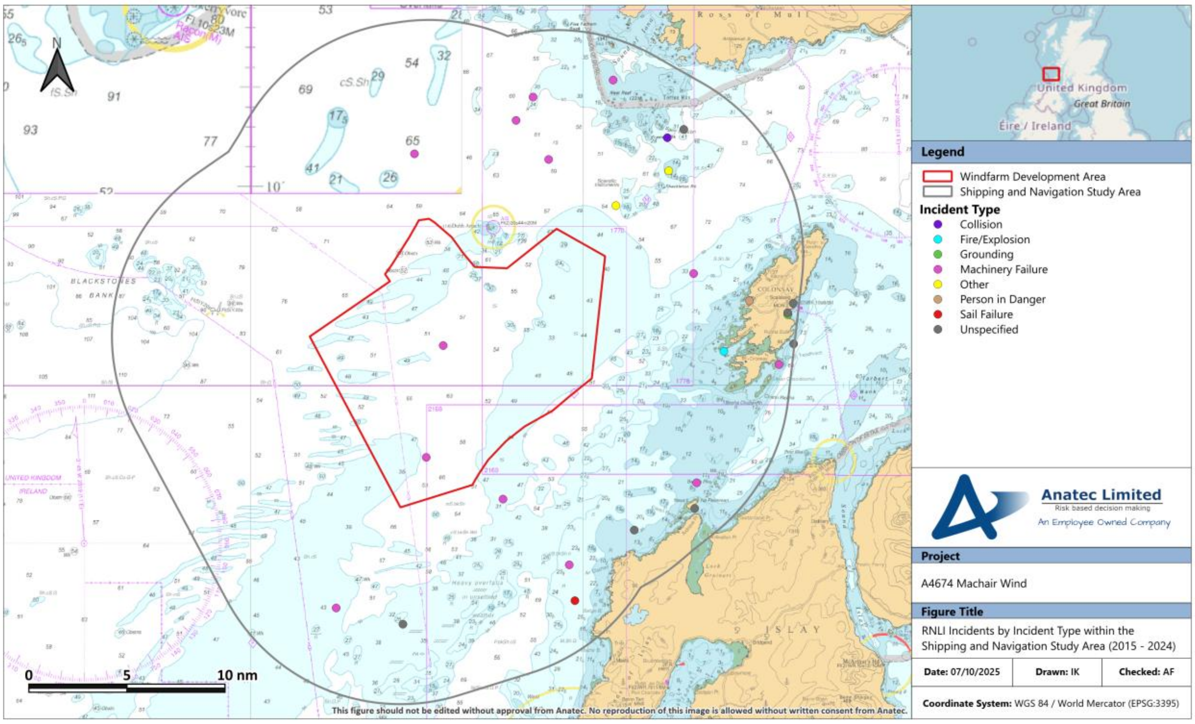

Figure 9.4 RNLI Incidents by Incident Type within the Shipping and Navigation Study Area (2015 - 2024)

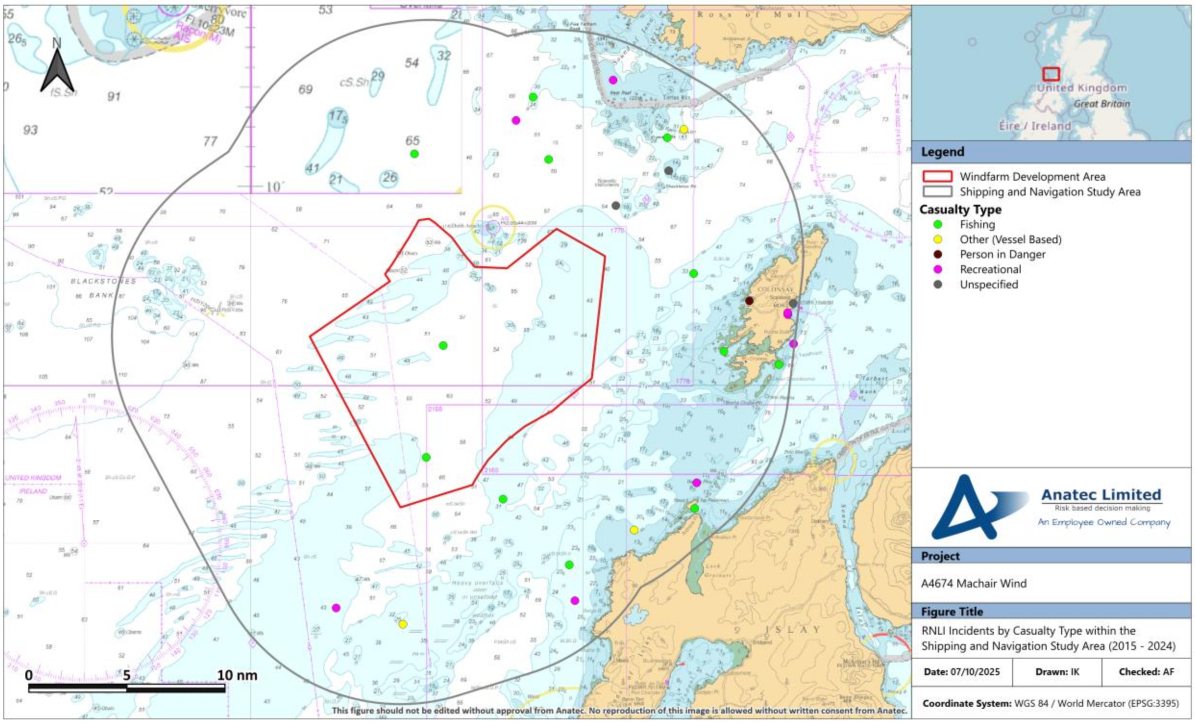

Figure 9.5 RNLI Incidents by Casualty Type within the Shipping and Navigation Study Area (2015 - 2024)

102. There were a total of 20 recorded RNLI responses to 20 unique incidents within the shipping and navigation study area from 2015 to 2024, corresponding to an average of two incidents per year. The majority of incidents were inshore of the WDA.

103. The majority of incident types within the shipping and navigation study area were 'machinery failure' (65%). Other than 'other' comprising two incidents, all other incident types recorded a single instance. The most frequently recorded casualty types within the shipping and navigation study area were fishing vessels (44%) and recreational vessels (30%). Two incidents were recorded within the WDA itself, both related to a fishing vessel undergoing machinery failure.

104. The majority of the incidents were responded to by the Islay RNLI station (74%), with the Oban station (22%) and the Tobermory station (one instance) also utilised.

9.3 Maritime Rescue Coordination Centres and Joint Rescue Coordination Centres

105. 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).

106. 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.

107. All of the MCA's operations, including SAR, are divided into 18 geographical regions. Area 17 – 'Kintyre to Mull, Isle of Arran and Inner Hebrides' – covers the area encompassing the Project. The closest MRCC is located at Belfast, approximately 82 nm south of the WDA, as illustrated in **Figure 9.6**.

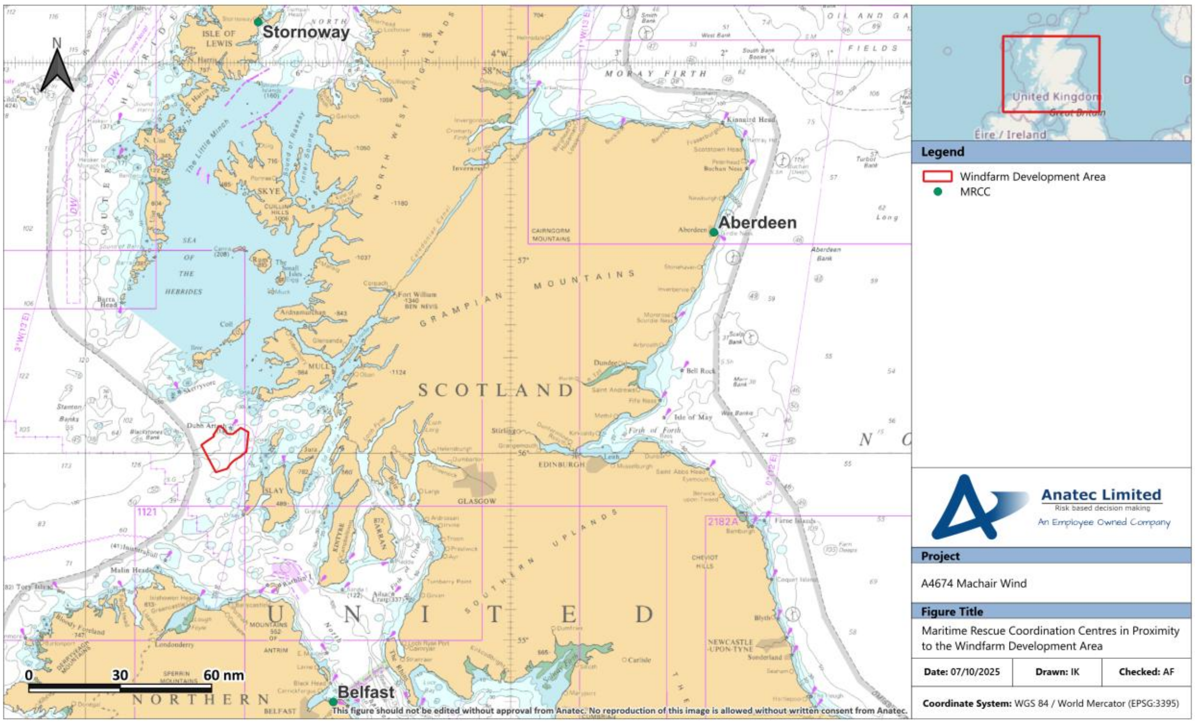

Figure 9.6 Maritime Rescue Coordination Centres in Proximity to the WDA

9.4 Global Maritime Distress and Safety System

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

109. There are four GMDSS sea areas, with the areas applicable to the UK shown in **Figure 9.7**. The WDA is located within sea area A1.

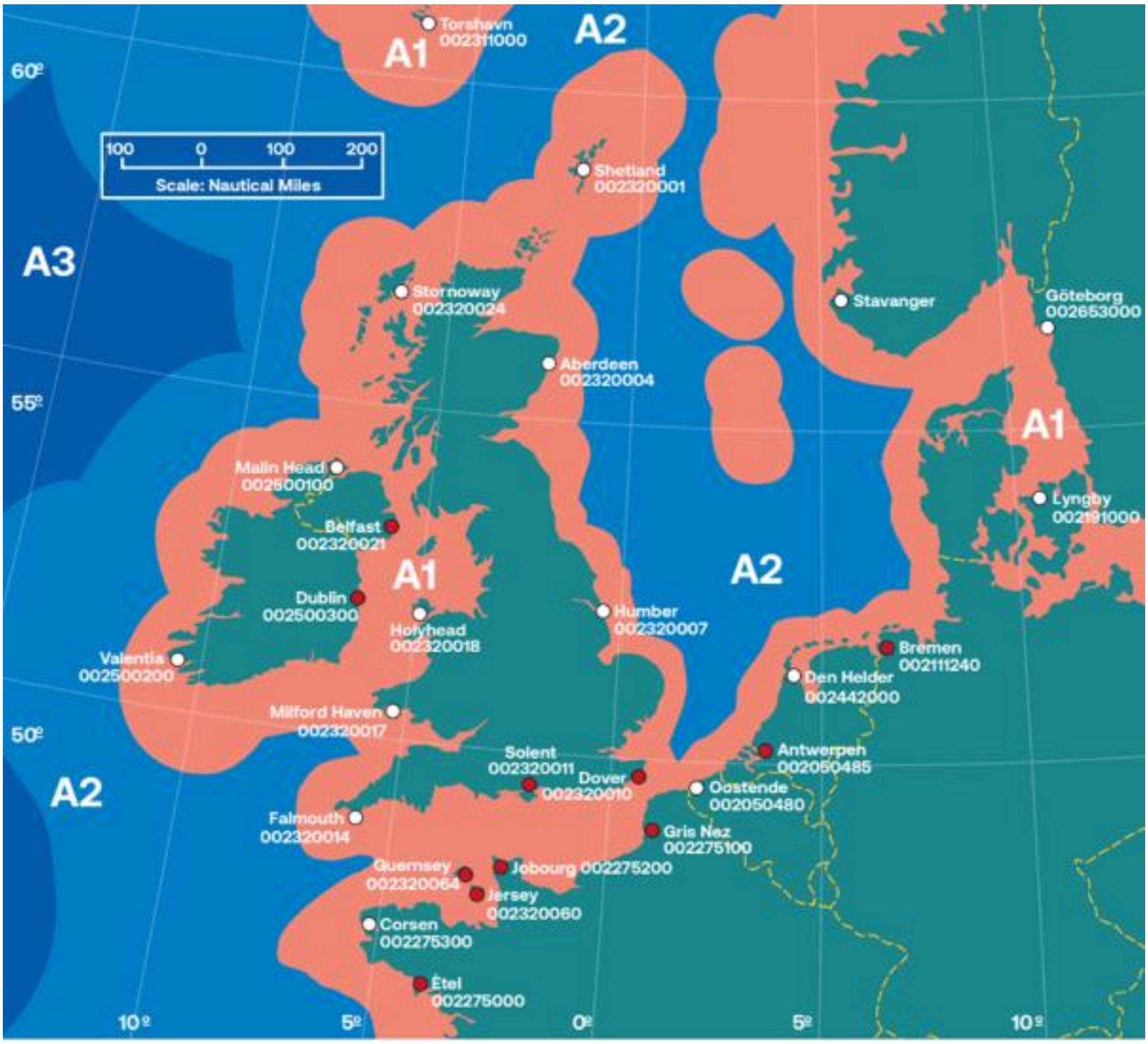

Figure 9.7 Global Maritime Distress and Safety System Sea Areas (MCA, 2021)

9.5 Marine Accident Investigation Branch

110. All UK flagged vessels and non-UK flagged vessels in UK territorial waters (extending to 12 nm from the coast), a UK port, or carrying passengers to a UK port, are required to report incidents to the MAIB. Data arising from these reports are assessed within this section, primarily covering the ten-year period between 2015 and 2024.

111. The incidents documented by the MAIB that occurred within the shipping and navigation study area during the ten-year period are colour-coded by incident type and presented in **Figure 9.8**. The same data is then colour-coded instead by vessel type and presented in **Figure 9.9**.

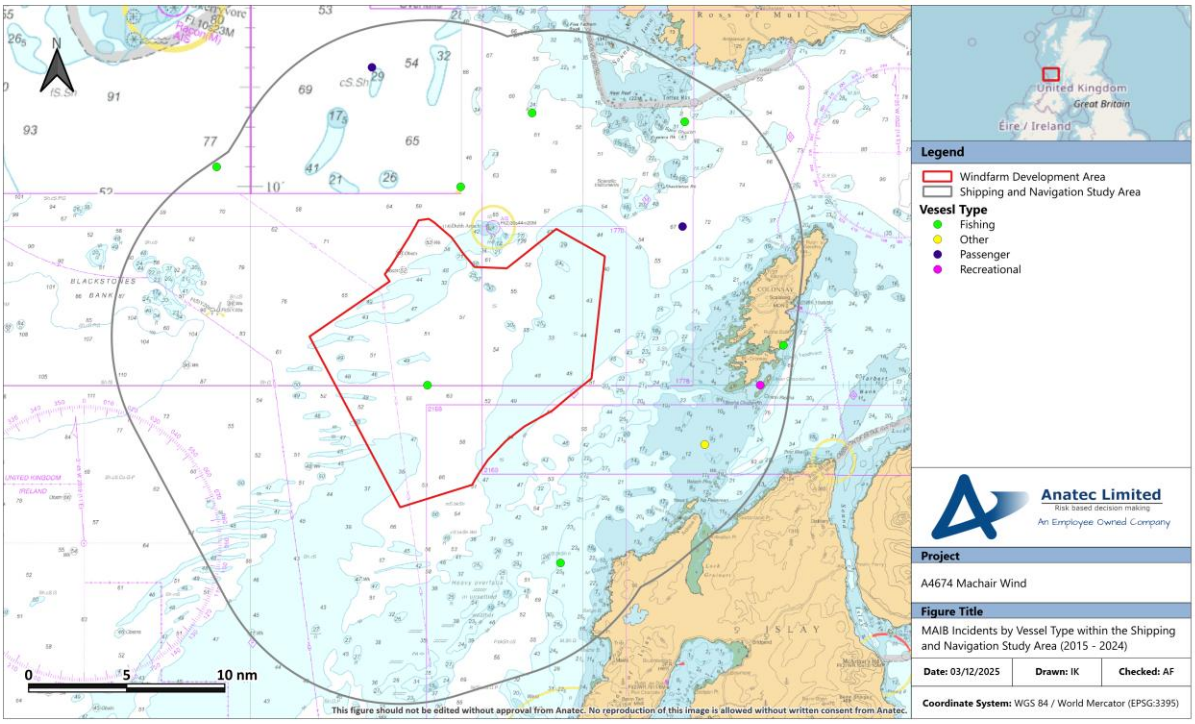

Figure 9.8 MAIB Incidents by Incident Type within the Shipping and Navigation Study Area (2015 - 2024)

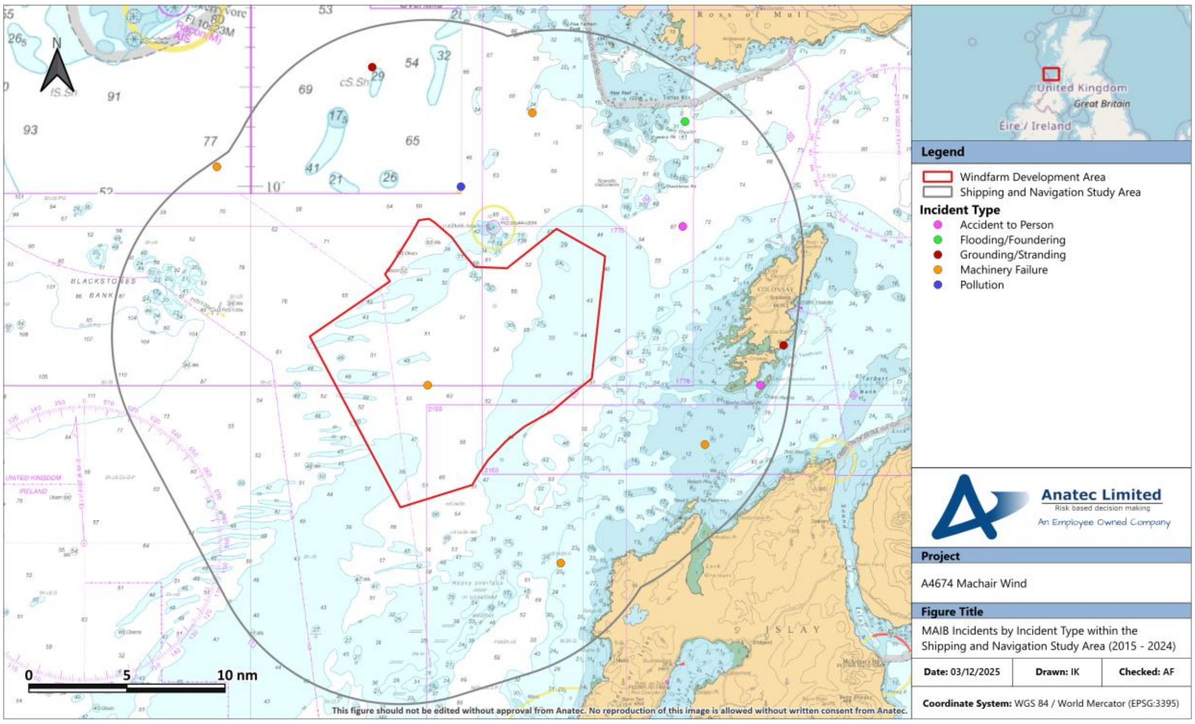

Figure 9.9 MAIB Incidents by Vessel Type within the Shipping and Navigation Study Area (2015 - 2024)

112. There were a total of 11 unique incidents recorded by the MAIB within the shipping and navigation study area from 2015 to 2024, corresponding to an average of one incident per year.

113. Of the incidents within the shipping and navigation study area, the most frequent incident type was ‘machinery failure’ (45%), with ‘accident to person’ and ‘grounding/stranding’ (18% each) also commonly noted. The majority of incidents involved fishing vessels (64%), with passenger vessels (18%) also frequently seen. One incident was recorded within the WDA itself, related to a fishing vessel undergoing machinery failure.

114. A review of older MAIB incident data within the shipping and navigation study area between 2005 and 2014 indicates that the number of incidents has decreased in proximity to the WDA, with a total of 15 incidents within the shipping and navigation study area recorded. Three incidents occurred within the WDA itself – a person overboard a fishing vessel, a fishing vessel with machinery failure, and a recreational vessel collision (noting that no further details on this collision, including the second vessel involved, are available). The MAIB incidents recorded within the shipping and navigation study area from 2005 to 2014 are colour-coded by incident type and presented in **Figure 9.10**.

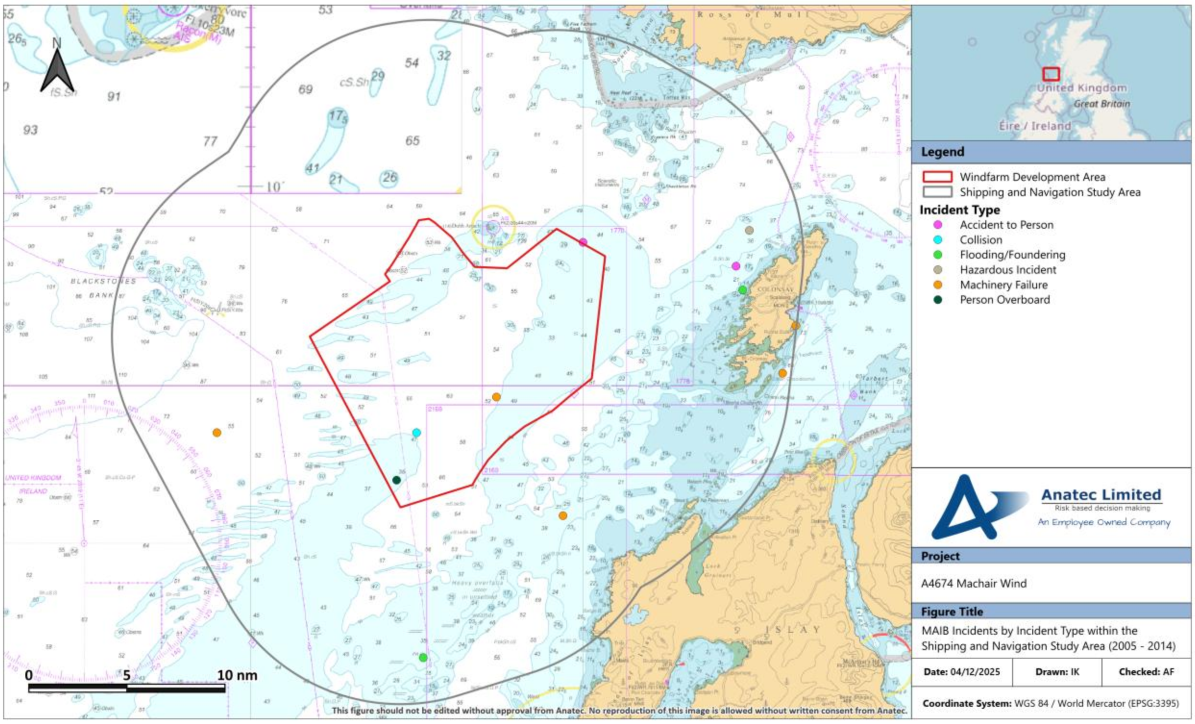

Figure 9.10 MAIB Incidents by Incident Type within the Shipping and Navigation Study Area (2005 - 2014)

9.6 Historical Offshore Windfarm Incidents

9.6.1 Incidents Involving UK Offshore Windfarm Developments

115. As of February 2026, there are 44 operational[1] offshore windfarms in the UK, ranging from North Hoyle (fully commissioned in 2003) to Moray West (fully commissioned in 2025). Between them these developments encompass approximately 28,463 fully operational WTG years.

116. MAIB incident data has been used to collate a list of reported historical collision and allision incidents involving UK offshore windfarm developments[2], which is summarised in **Table 9.1**. Other sources have also been used to produce this list including the UK Confidential Human Factors Incident Reporting Programme (CHIRP) for Aviation and Maritime, International Marine Contractors Association (IMCA), and basic web searches.

Table 9.1 Summary of Historical Collision and Allision Incidents Involving UK Offshore Windfarm Developments

Incident vessel	Incident type	Date	Description of incident	Vessel damage*	Harm to persons	Source
Project	Allision	07 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	08 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

[1] For shipping and navigation purposes offshore windfarms are considered operational only once the construction buoyage has been removed.

[2] Includes only those incidents reported explicitly as collisions or allisions to an accident investigation branch or anonymous reporting service. Unconfirmed incidents have not been considered.

Incident vessel	Incident type	Date	Description of incident	Vessel damage*	Harm to persons	Source
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	02 June 2012	CTV allision with flotel. Nine persons safely evacuated and transferred to nearby vessel before being brought back into 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 port unassisted with no water ingress but some structural damage sustained.	Moderate	Injury	MAIB
Project	Allision	01 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 following human error (autopilot). Lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)

Incident vessel	Incident type	Date	Description of incident	Vessel damage*	Harm to persons	Source
Project	Allision	14 February 2019	Survey vessel contacted with WTG jacket whilst autopilot was engaged.	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
Project	Allision	February 2021	The deckhand engineer fell asleep whilst supposed to be on watch, resulting in a CTV making contact with a WTG at low speed.	None	None	MAIB
Project	Allision	12 April 2021	An allision occurred with a WTG resulting in a passenger suffering a chest injury and was attended to by paramedics upon the vessel's return to port.	None	Injury	MAIB
Project	Allision	May 2021	A CTV was drifting towards the WTG it was tied off to. The Master started the engines but was with insufficient time to avoid contact. Upon returning to port the vessel began listing due to substantial water ingress.	Moderate	None	MAIB
Third-party	Allision	09 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)
Project	Allision	October 2022	A project vessel allided with the boat landing for a WTG causing a deformation to the port side midship area.	Minor	None	MAIB

Incident vessel	Incident type	Date	Description of incident	Vessel damage*	Harm to persons	Source
Project	Allision	November 2022	A high speed craft allided with a WTG whilst the vessel propulsion was in neutral resulting in damage to the starboard jet platform and bucket.	Minor	None	MAIB
Project	Allision - project vessel with WTG	April 2023	A supply vessel was drifting after deploying personnel to WTGs. The Master was reportedly distracted and failed to notice that the vessel was closing on a WTG. An allision occurred at 5 kt resulting in one crew member falling and suffering a rib fracture. No damage was caused to the vessel or the WTG and there was no pollution.	None	Injury	MAIB
Project	Allision - project vessel with WTG	November 2023	A trainee on a CTV misjudged the wind and current causing the vessel to drift sideways and make contact with a WTG resulting in a broken window but no reported injuries.	Minor	None	MAIB
Third-party	Allision – fishing vessel with WTG	January 2024	A stern trawler was navigating through an offshore windfarm when it collided with one of the WTGs. Cosmetic damage to the vessel was reported and it was able to make its own way back to port. No injuries were reported.	Minor	None	MAIB
Third-party	Allision – fishing vessel with WTG	April 2024	Whilst undertaking fishing operations a crew member made a navigational error resulting in turning towards an offshore windfarm, and subsequently an allision occurred. Minor damage to the bow and paint marks were sustained, with the vessel able to maintain their fishing operations and land their catch in a port. No injuries were reported.	Minor	None	MAIB

Incident vessel	Incident type	Date	Description of incident	Vessel damage*	Harm to persons	Source
Project	Allision - project vessel with WTG	19 September 2024	A Service Operations Vessel (SOV) allided with a WTG causing damage to the starboard side above the waterline and the helideck.	Minor	None	Web search (Maritime Executive, 2024)
Project	Collision – project vessel with survey vessel	19 September 2025	A CTV associated with an offshore windfarm was involved in a collision with an unmanned survey vessel whilst in the array. The CTV was reportedly holed but was able to head back to port under its own power, escorted by a lifeboat as a precaution.	Minor	None	Web search (Eastern Daily Press, 2025)

(*) As per incident reports

117. As of February 2026, there have been no third-party collisions directly as a result of the presence of an offshore windfarm in the UK. The only reported collision incidents in relation to a UK offshore windfarm involved a project vessel hitting a third-party vessel whilst in harbour, and a CTV colliding with an unmanned survey vessel.

118. As of February 2026, there have been 23 reported 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 1,238 WTG years per allision incident in the UK, noting that this is a conservative calculation given that only operational WTG hours have been included (whereas allision incidents counted included non-operational WTGs).

119. On an individual project basis, there has been an average of 0.024 allision incidents per operational offshore windfarm year, noting this is an average across the 22-year period since the first UK offshore windfarm became operational.

120. The presence of offshore windfarms and associated activities does increase the likelihood of an incident occurring based on consideration of existing datasets. This includes the Project given that it will represent new offshore infrastructure and activities. The analysis above incorporates only collision and allision incidents since these are more likely to result in notable consequences and are more comprehensively reported; they are also of primary interest to the NRA. The worst consequences reported for vessels involved in a collision or allision incident involving a UK offshore windfarm development has been flooding, with no life-threatening injuries to persons reported.

121. Other types of incidents (such as medical incidents) may also require emergency response and therefore the rates reported above should not be considered comprehensive for all emergency response incidents. An accident to person requiring medical attention (which may include emergency response) is considered the most likely type of incident that may occur at an offshore windfarm.

9.6.2 Incidents Involving Non-UK Offshore Windfarm Developments

122. It is acknowledged that collision and allision incidents involving non-UK offshore windfarm developments have also occurred. However, it is not possible to maintain a comprehensive list of such incidents.

123. One high profile non-UK incident which is noted is that involving a bulk carrier in January 2022 which broke its anchor chain during a storm in Dutch waters and collided with a nearby anchored vessel. The vessel began to take on water, leading to all crew members being evacuated by helicopter. The vessel then continued to drift towards shore including through an under construction offshore windfarm where it allided with a WTG foundation and a platform foundation before being taken under tow.

124. Additionally, during April 2023, a general cargo vessel allided with a WTG within the Godewind 1 Offshore Windfarm in the German North Sea, resulting in tearing of the starboard side of the bow leading to water ingress. The vessel made its own way to port. The WTG suffered minor damage. A report was published for this incident by the Bundesstelle für Seeunfalluntersuchung (BSU) in January 2025 (BSU, 2025).

9.6.3 Incidents Responded to by Vessels Associated with UK Offshore Windfarms

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

126. From news reports, basic web searches and experience at working with existing offshore windfarm developments, a list has been collated of historical incidents responded to by vessels associated with UK offshore windfarm developments, which is summarised in **Table 9.2**. The initial cause of these incidents is not related to the offshore windfarm in question.

Table 9.2 Historical Incidents Responded to by Vessels Associated with UK Offshore Windfarm Developments

Incident type	Date	Related development	Description of incident	Source
Capsize	21 June 2018	Walney	HM Coastguard issued mayday relay broadcast following trimaran capsize.	Web search (4C Offshore, 2018)

Incident type	Date	Related development	Description of incident	Source
			Support vessel for Walney arrived and recovered two persons from the water who were then winched onboard a Coastguard helicopter.	
Capsize	5 November 2018	Race Bank	Fishing vessel capsized resulting in two persons in the water. Vessel operating at the nearby Race Bank reported to have assisted with the rescue which also involved a Belgian military helicopter and the RNLI.	Web search (British Broadcasting Corporation, 2018)
Vessel in distress	15 May 2019	London Array	Yacht in difficulty 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	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	Fishing vessel suffered mechanical failure and launched flares. Guard vessel and SOV for Race Bank both immediately offered assistance until the MCA's arrival on-scene.	Internal daily progress report received by Anatec
Vessel in distress	13 December 2019	Race Bank	Passing vessel got into difficulty and guard vessel for Race Bank was requested to assist. The Coastguard later requested that the guard vessel tow the casualty vessel into port.	Internal daily progress report received by Anatec
Search	21 May 2020	Walney	Coastguard contacted guard vessel for Walney reporting red flare sighting at the offshore windfarm. Guard vessel proceeded to undertake search but did not find anything to report.	Internal daily progress report received by Anatec
Aircraft crash	15 June 2020	Hornsea Project One	United States (US) jet crashed into sea during routine flight. CTVs and SOVs for	Web search (4C Offshore, 2020)

Incident type	Date	Related development	Description of incident	Source
			Hornsea Project One joined the search for the missing pilot.	
Fire/ explosion	15 December 2020	Dudgeon	Fishing vessel experienced explosions on board with crew injured. SOV for Dudgeon deployed its Fast Rescue Boat and evacuated the casualty vessel.	Web search (Offshore WIND, 2020)
Person in danger	10 July 2021	Unknown (East Irish Sea)	Two swimmers were in difficulty against a rising tide near to Talacre beach. A RNLI lifeboat was launched but a commercial windfarm vessel recovered the swimmers from the water. They were then transferred to the lifeboat.	Web search (RNLI, 2021)
Drifting	17 July 2021	Neart na Gaoithe	Small dinghy with two children aboard drifted offshore due to strong winds. A guard vessel associated with Neart na Gaoithe was able to retrieve the children.	Web search (Edinburgh Evening News, 2021)
Allision	09 June 2022	Westermost Rough	Fishing vessel allided with a WTG at Westermost Rough. A supply vessel was among the responders as a RNLI lifeboat escorted the vessel under its own power to port.	MAIB
Vessel in distress	01 September 2022	Rampion	A recreational motorboat experienced power failure and anchored near Rampion. The anchor could then not be recovered and Coastguard assistance was requested. A CTV for Rampion responded and towed the vessel back to port.	MAIB
Machinery failure	01 December 2022	Unknown	A survey vessel suffered an engine failure and was towed back to port by a windfarm Rigid-hulled Inflatable Boat (RIB).	MAIB
Accident to Person	12 July 2024	Stromar	A deckhand on a fishing vessel became entangled in a creel rope and was pulled overboard. The vessel's crew alerted HM Coastguard and manoeuvred to attempt a rescue. The deckhand was recovered on board and attempts to revive were supported by a paramedic from a HM Coastguard helicopter, a RNLI lifeboat and crew from a nearby survey vessel for the Stromar Offshore Wind Farm. The deckhand could not be revived and was declared deceased.	BBC (2024)
Collision	10 March 2025	Humber Gateway	A cargo vessel collided with an anchored tanker approximately 14 nm east of the entrance to the Humber, resulting in	Web search (Grimsby Live) and AIS data

Incident type	Date	Related development	Description of incident	Source
			damage to both vessels and the presumed loss of a crew member onboard the cargo vessel. CTVs operating from Humber Gateway Offshore Wind Farm were able to provide assistance in recovering crew members, who had begun evacuating on lifeboats. From AIS data, it is clear that vessels from Westermost Rough also assisted with crew recovery.	

127. It is clear that the presence of offshore windfarms creates new emergency response resources which can be mobilised to attend a third-party incident in liaison with HM Coastguard. This includes the Project, with project vessel compliance with international marine regulations including the SOLAS (IMO, 1974) and pollution planning included as embedded mitigation measures (see **Section 17**). Additionally, an ERCoP will be completed post consent in consultation with the MCA.

10 Vessel Traffic Movements

128. The vessel tracks recorded during the 14-day winter survey period within the shipping and navigation study area, excluding temporary traffic, are colour-coded by vessel type and presented in **Figure 10.1**. Following this, the same data converted to a density heat map is presented in **Figure 10.2**.

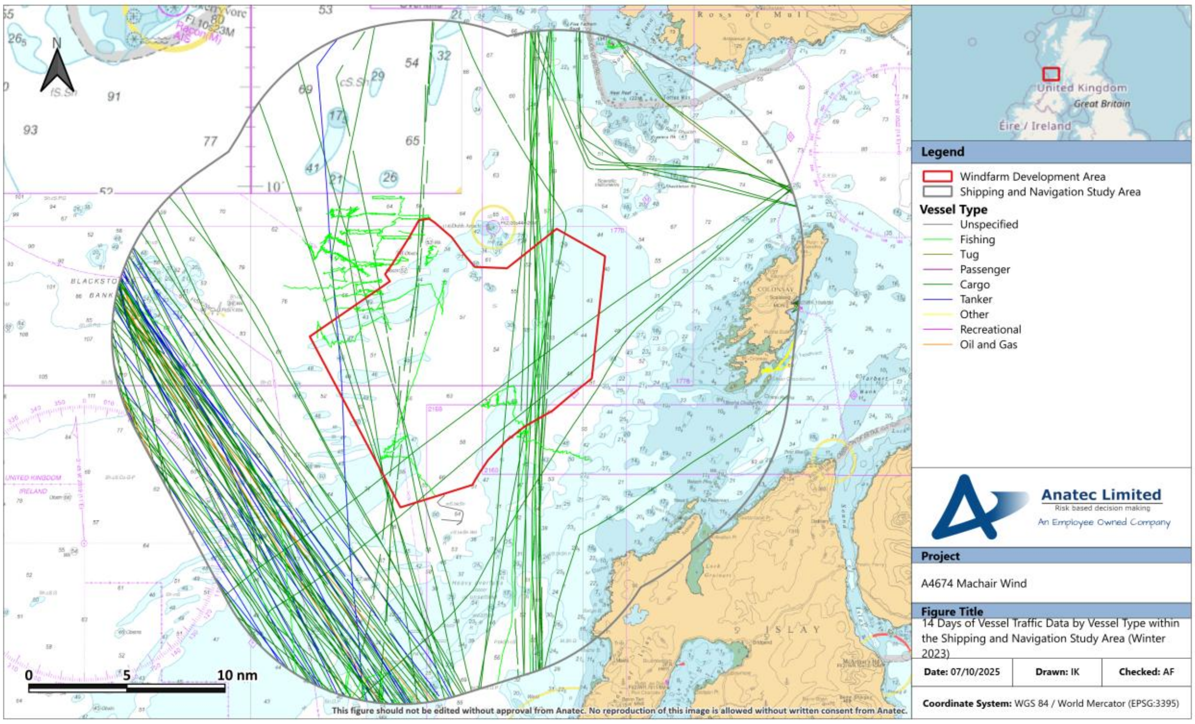

Figure 10.1 14 Days of Vessel Traffic Data by Vessel Type within the Shipping and Navigation Study Area (Winter 2023)

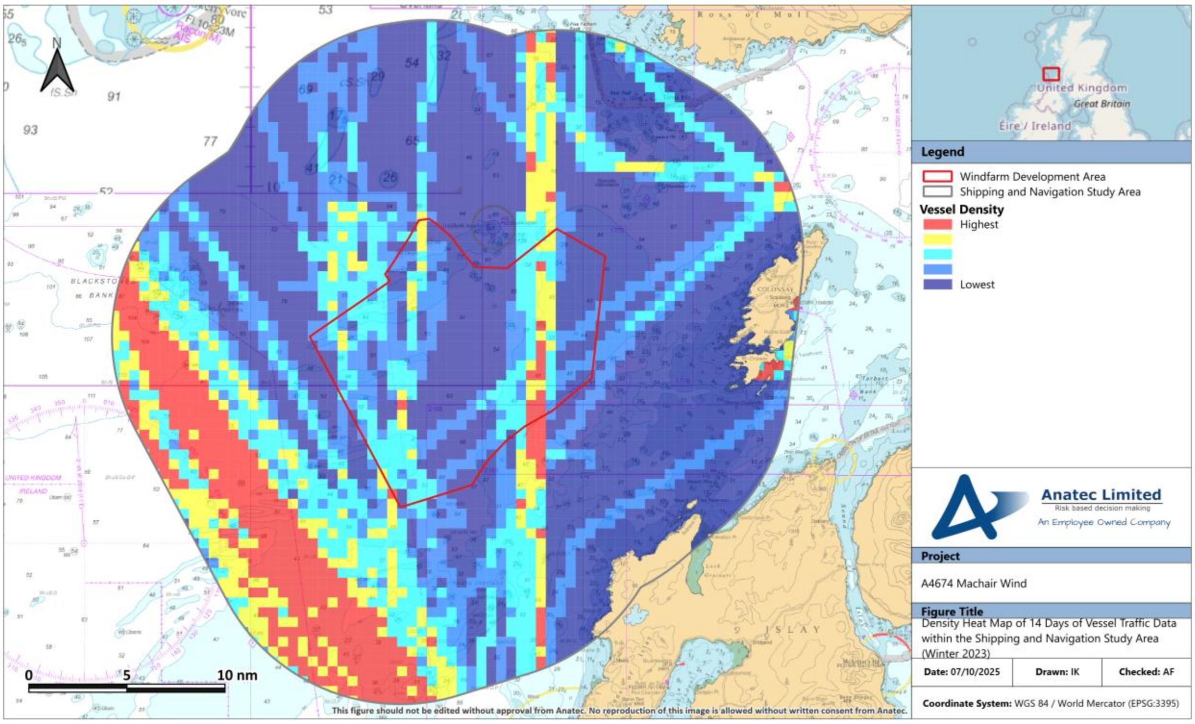

Figure 10.2 Density Heat Map of 14 Days of Vessel Traffic Data within the Shipping and Navigation Study Area (Winter 2023)

129. The vessel tracks recorded during the 14-day summer survey period within the shipping and navigation study area, excluding temporary traffic, are colour-coded by vessel type and presented in **Figure 10.3**. Following this, the same data converted to a density heat map is presented in **Figure 10.4**. The density ranges used in the summer survey data are those of the winter data, to allow direct comparison.

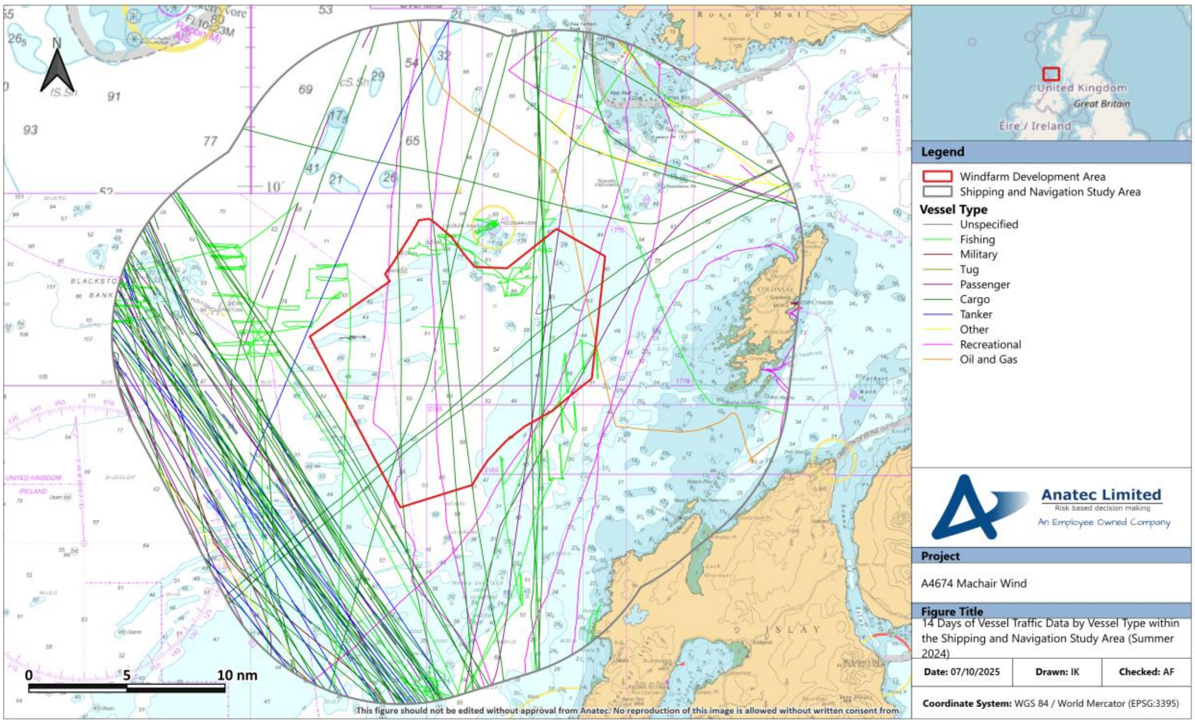

Figure 10.3 14 Days of Vessel Traffic Data by Vessel Type within the Shipping and Navigation Study Area (Summer 2024)

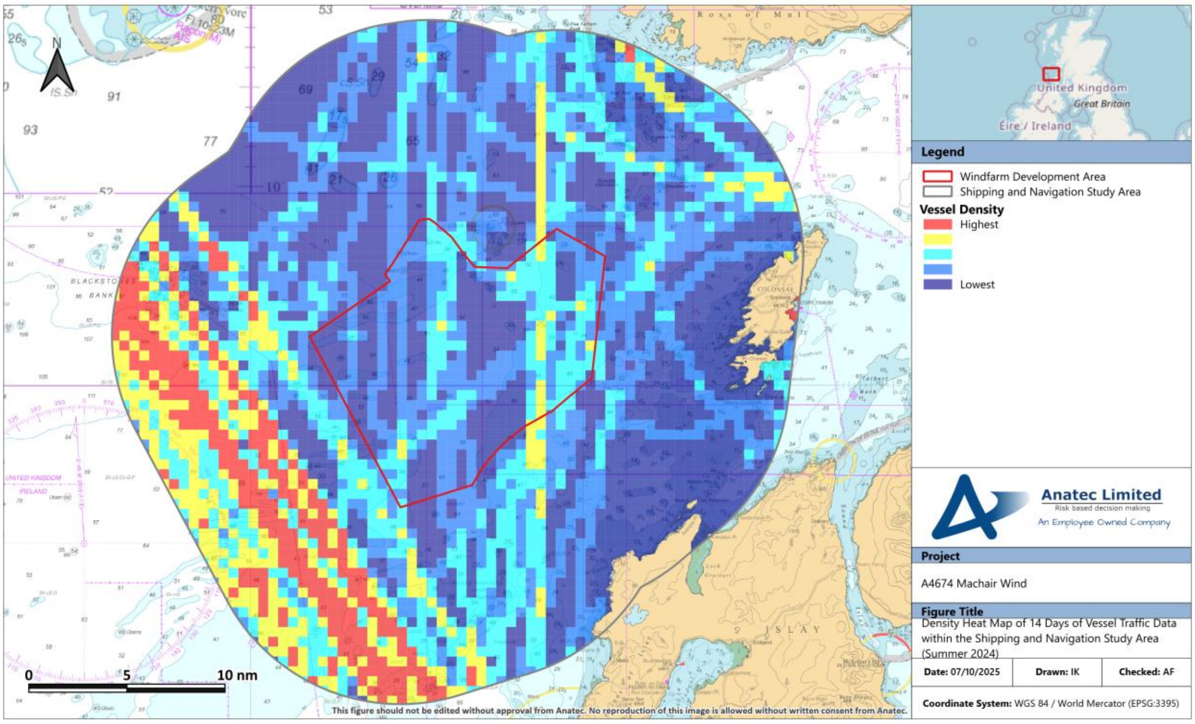

Figure 10.4 Density Heat Map of 14 Days of Vessel Traffic Data within the Shipping and Navigation Study Area (Summer 2024)

10.1 Vessel Count

130. The daily number of unique vessels recorded within the shipping and navigation study area, as well as intersecting the WDA, during the winter survey period is presented in **Figure 10.5**. Partial days are indicated through hatched shading. Throughout the winter survey period, approximately 23% of vessel traffic recorded within the shipping and navigation study area intersected the WDA.

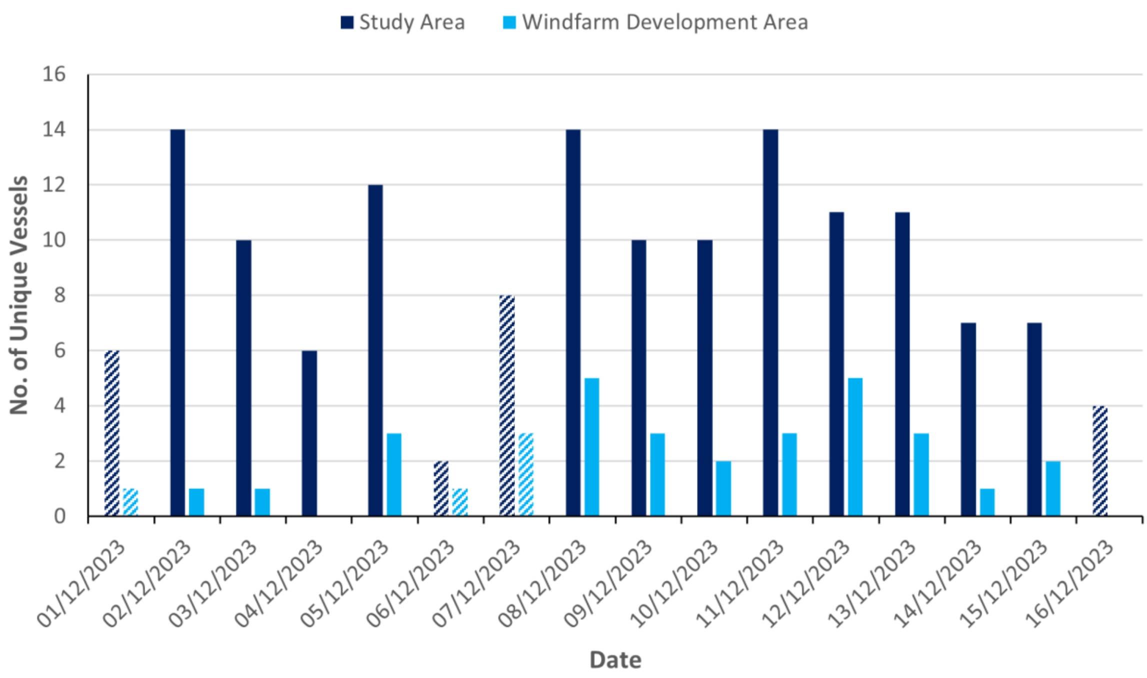

Figure 10.5 Unique Vessels per Day within the Shipping and Navigation Study Area and WDA (Winter 2023)

131. There was an average of ten to eleven unique vessels recorded per day within the shipping and navigation study area during the winter survey period. An average of two to three unique vessels per day intersected the WDA itself.

132. The busiest days recorded within the shipping and navigation study area during the winter survey period were 02, 08, and 11 December 2023, on which 14 unique vessels were recorded each. The busiest days within the WDA during the winter survey period were 08 and 12 December 2024, on which five unique vessels were recorded each.

133. The quietest full day recorded within the shipping and navigation study area during the winter survey period was 04 December 2023, on which six unique vessels were recorded. There were no vessels recorded within the WDA itself on the 04 December 2023.

134. The daily number of unique vessels recorded within the shipping and navigation study area, as well as intersecting the WDA, during the summer survey period is presented in **Figure 10.6**. Partial days are indicated through hatched shading. Throughout the summer survey period, approximately 17% of vessel traffic recorded within the shipping and navigation study area intersected the WDA.

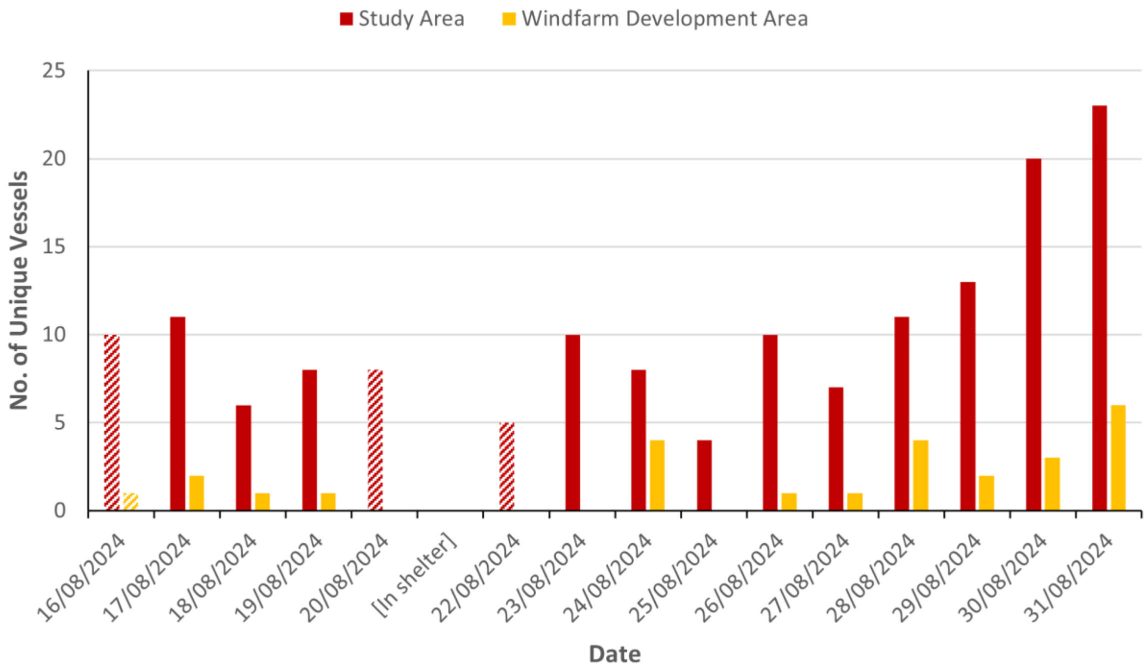

Figure 10.6 Unique Vessels per Day within the Shipping and Navigation Study Area and WDA (Summer 2023)

135. There was an average of 11 unique vessels recorded per day within the shipping and navigation study area during the summer survey period. An average of two unique vessels per day intersected the WDA itself.

136. The busiest day recorded within the shipping and navigation study area during the summer survey period was 31 August 2024, on which 23 unique vessels were recorded. The busiest day within the WDA during the summer survey period was also 31 August 2024, on which six unique vessels were recorded.

137. The quietest full day recorded within the shipping and navigation study area during the summer survey period was 25 August 2024, on which four unique vessels were recorded. There were no vessels recorded within the WDA itself on the 23 and 25 August 2024.

10.2 Vessel Type

138. The distribution of the main vessel types recorded passing within the shipping and navigation study area and WDA during the survey periods is presented in **Figure 10.7**.

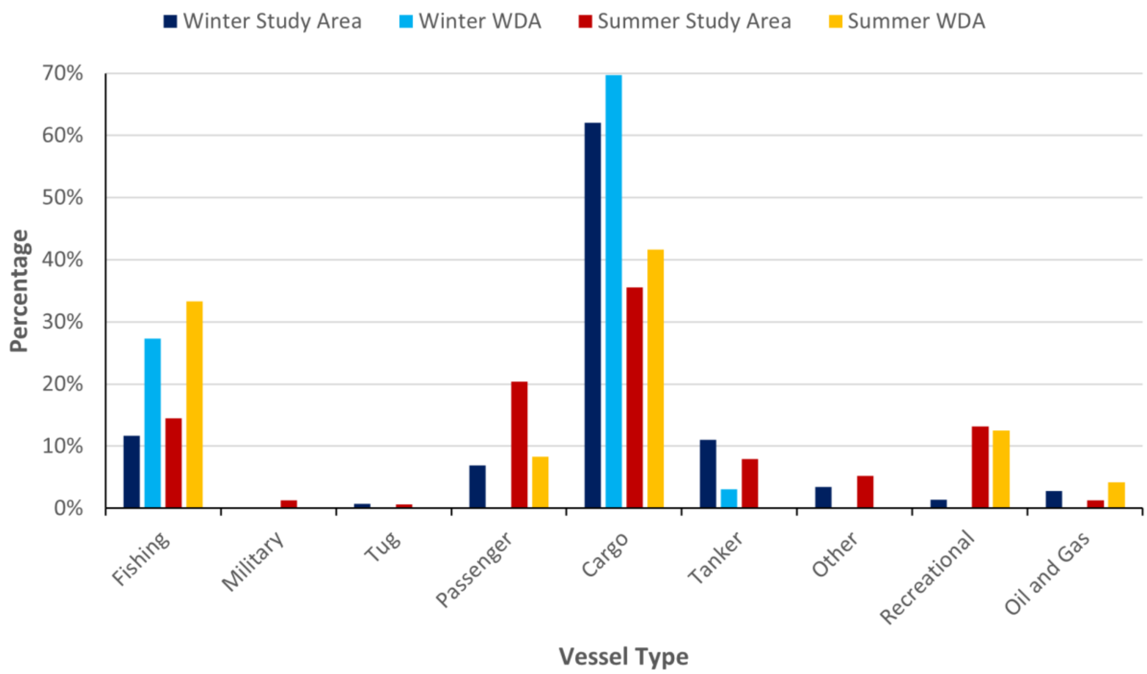

Figure 10.7 Vessel Type Distribution within the Shipping and Navigation Study Area and WDA (Winter 2023 and Summer 2024)

139. During the winter survey period, the main vessel types within the shipping and navigation study area were cargo vessels (62%), fishing vessels (12%), and tankers (11%). During the summer survey period, the main vessel types within the shipping and navigation study area were cargo vessels (36%), passenger vessels (20%), and fishing vessels (14%).

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

10.2.1 Cargo Vessels

141. The cargo vessels recorded within the shipping and navigation study area during the survey periods are presented in **Figure 10.8**.

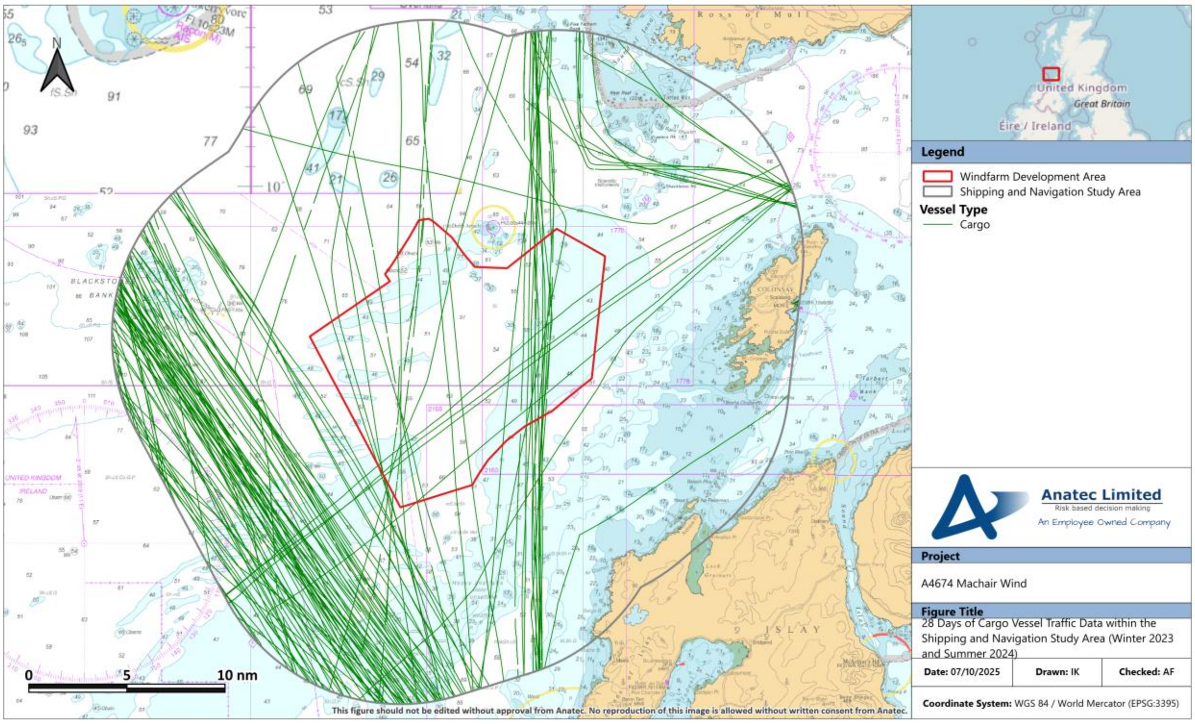

Figure 10.8 28 Days of Cargo Vessel Traffic Data within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

142. During the winter survey period, an average of six to seven cargo vessels per day were recorded within the shipping and navigation study area, with an average of one to two cargo vessels per day intersecting the WDA. During the summer survey period, an average of four cargo vessels per day were recorded within the shipping and navigation study area, with an average of one cargo vessel every one to two days intersecting the WDA.

143. The lower number of cargo vessels during summer within both the shipping and navigation study area and the WDA may indicate a preference for cargo vessels to pass further inshore in less favourable conditions. Adverse weather routeing is discussed further in **Section 12**.

144. Cargo vessels were noted primarily undertaking northwest-southeast routeing to the west of the WDA, with these destinations mainly involving Belfast, as well as Scandinavian and Icelandic ports. A cargo vessel route on a north/south bearing in the east of the WDA was also observed, with this including a vessel owned by Godby Shipping and chartered by DFDS Seaways on a circular passage between Skogn (Norway), Belfast (UK), and Greenock (UK).

145. Other vessels routeing inshore included those transiting to Glensanda and other UK west coast ports, as well as vessels associated with fish farms on the west coast of Scotland. No regularly scheduled Roll-on/Roll-off cargo (RoRo) vessel routeing was recorded.

10.2.2 Passenger Vessels

146. The passenger vessels recorded within the shipping and navigation study area during the survey periods are presented in **Figure 10.9**.

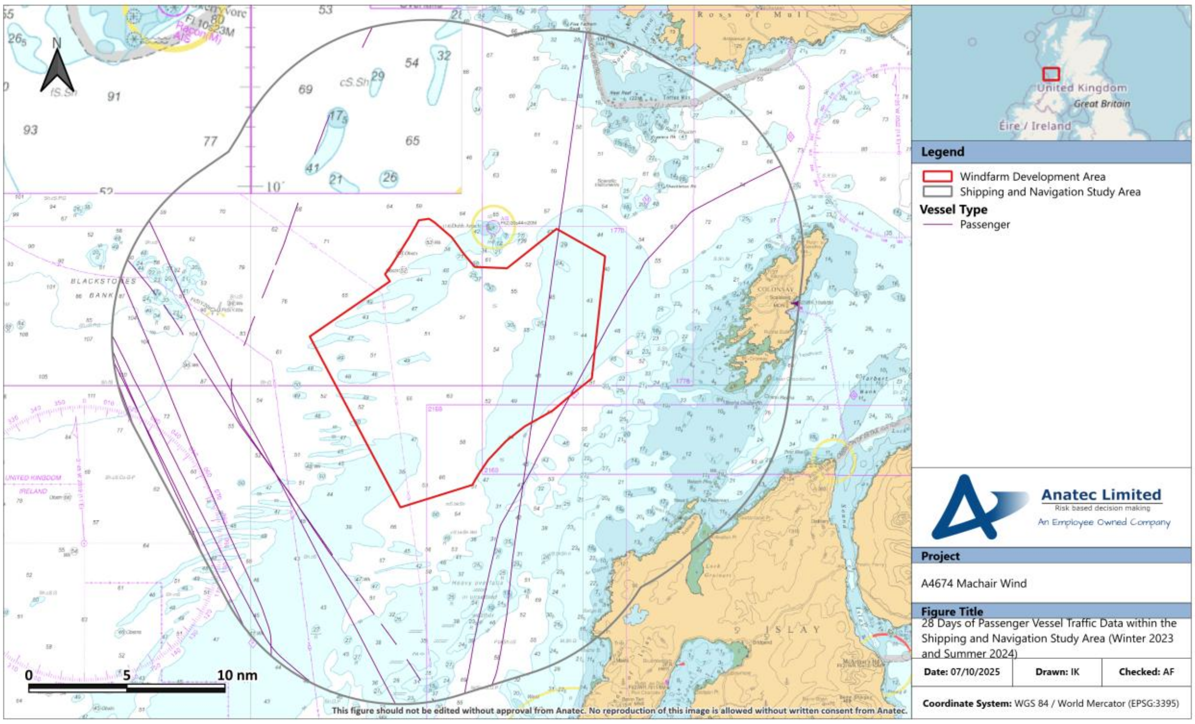

Figure 10.9 28 Days of Passenger Vessel Traffic Data within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

147. During the winter survey period, an average of one passenger vessel every one to two days was recorded within the shipping and navigation study area, with no passenger vessels recorded intersecting the WDA. During the summer survey period, an average of two passenger vessels per day were recorded within the shipping and navigation study area, with an average of one passenger vessel per week intersecting the WDA.

148. The vast majority of passenger vessel transits were contained to the eastern extremity of the shipping and navigation study area and involved regularly scheduled CalMac Roll-on/Roll-off passenger (RoPax) vessel routeing between Colonsay and Oban/Islay (UK). Due to the location of these transits, it is not expected that they will be impacted by the Project.

149. The passenger vessel tracks offshore of Colonsay were all cruise liner transits.

10.2.3 Fishing Vessels

10.2.3.1 AIS Vessel Traffic

150. The fishing vessels recorded within the shipping and navigation study area during the survey periods are colour-coded by average speed and presented in **Figure 10.10**. As a general rule, average speeds of less than 6 kt may indicate active fishing i.e., the possibility that gear is deployed.

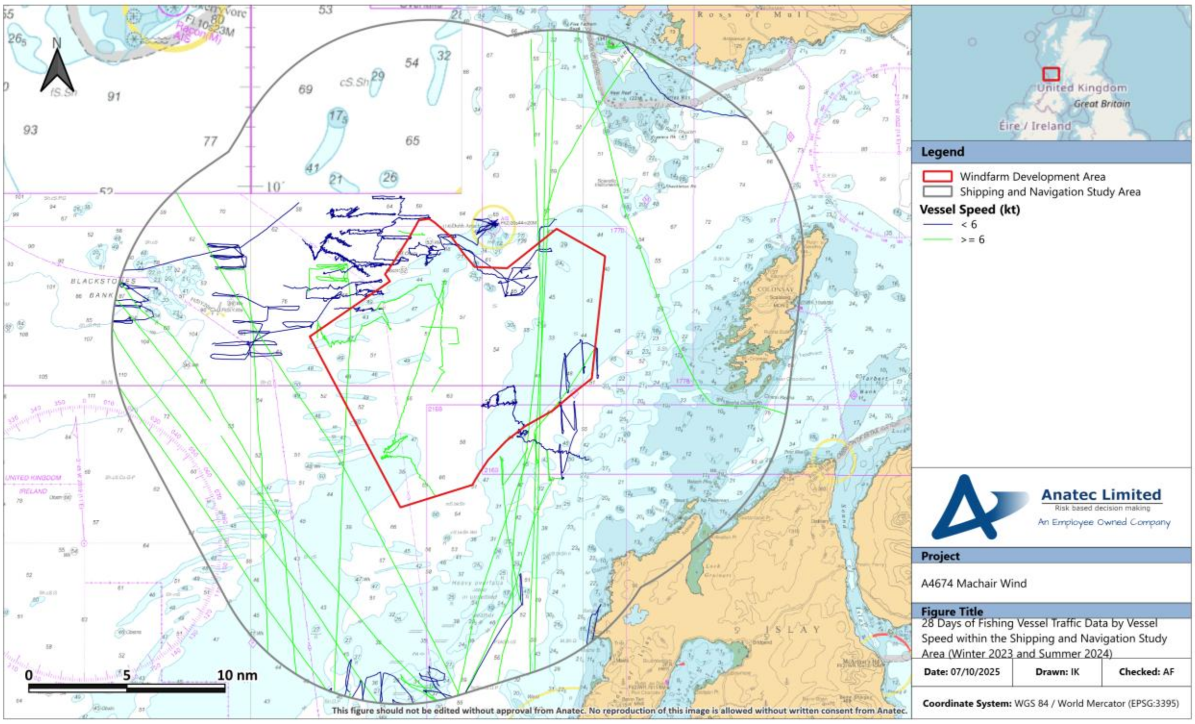

Figure 10.10 28 Days of Fishing Vessel Traffic Data by Vessel Speed within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

151. During the winter survey period, an average of one fishing vessel per day was recorded within the shipping and navigation study area, with an average of one fishing vessel every two days intersecting the WDA. During the summer survey period, an average of one to two fishing vessels per day were recorded within the shipping and navigation study area, with an average of one fishing vessel every one to two days intersecting the WDA. These values aligned with fishers during the local Hazard Workshop who noted that, for six months of the year, the local fishers undertake fishing operations every day.

152. Fishing vessels operating below 6 kt were observed primarily in the northwest of the shipping and navigation study area, with tracks also recorded to the south, as well within the southeast of the WDA.

10.2.3.2 Vessel Monitoring System

153. In addition to the vessel traffic survey data, Vessel Monitoring System (VMS) data can supplement the AIS assessment of fishing activity within and around the Project. VMS data recorded within the shipping and navigation study area throughout 2024 were converted to a density heat map and presented in **Figure 10.11**.

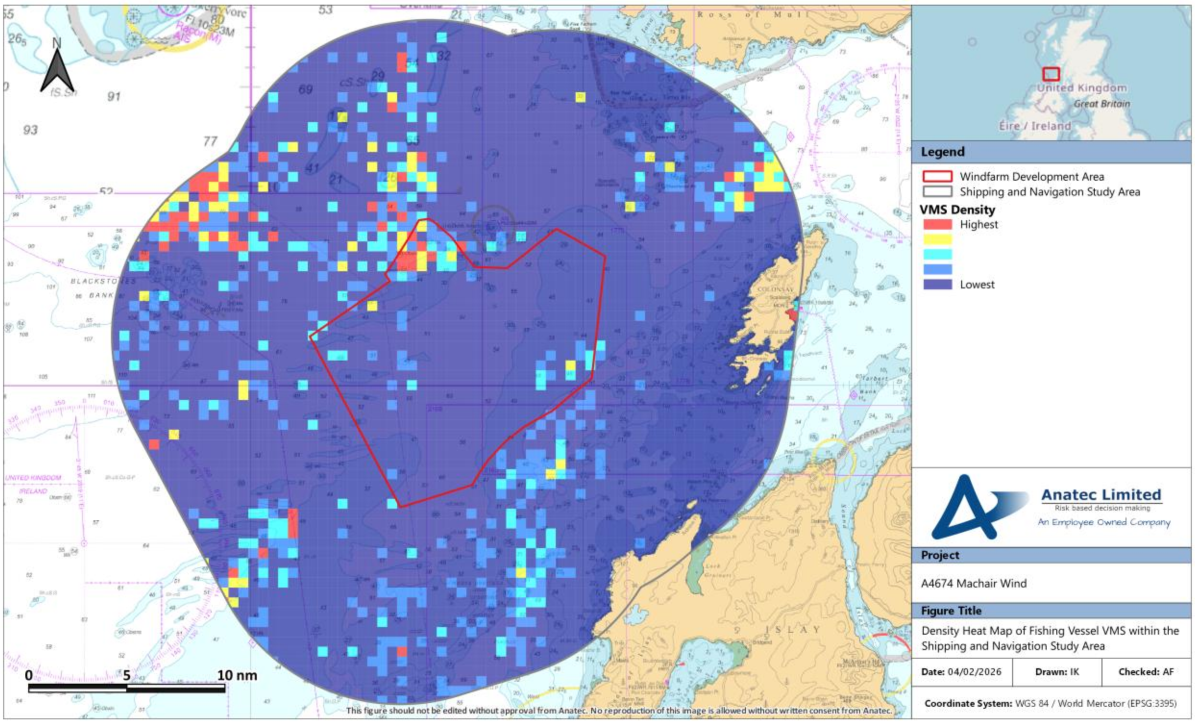

Figure 10.11 Density Heat Map of Fishing Vessel VMS within the Shipping and Navigation Study Area

154. Similarly to the vessel traffic data presented in **Section 10.2.3.1**, VMS fishing data noted activity in the north and west of the WDA, as well as to the southeast. Overall, the data also correlated well with the long-term fishing vessel AIS-only data shown in **Appendix E**.

10.2.4 Tankers

155. The tankers recorded within the shipping and navigation study area during the survey periods are presented in **Figure 10.12**.

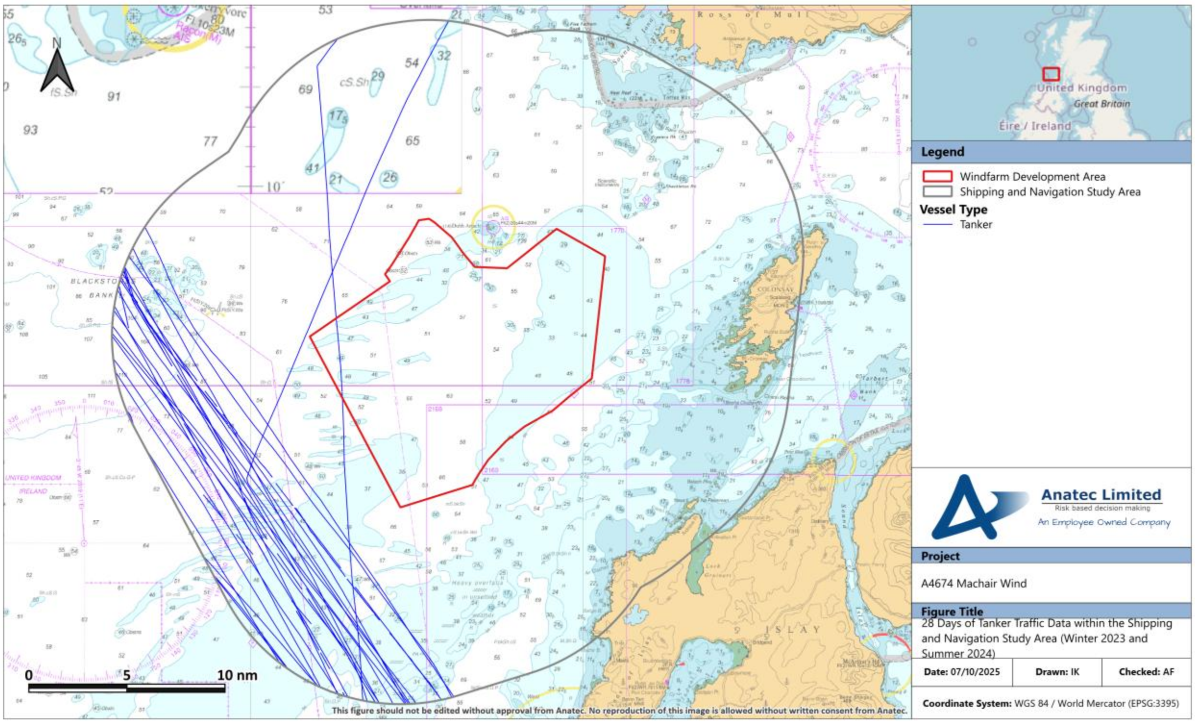

Figure 10.12 28 Days of Tanker Traffic Data within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

156. During the winter survey period, an average of one tanker per day was recorded within the shipping and navigation study area, with one tanker transit in total intersecting the WDA. During the summer survey period, an average of one tanker per day was also recorded within the shipping and navigation study area, with no tankers recorded intersecting the WDA.

157. All tanker tracks other than two were recorded on northwest-southeast transit to the west of the WDA. These primarily involved routeing between ports on the western UK coast such as Eastham, and Scandinavian ports such as Gothenburg.

10.2.5 Recreational Vessels

10.2.5.1 AIS Vessel Traffic

158. The recreational vessels recorded within the shipping and navigation study area during the survey periods are presented in **Figure 10.13**.

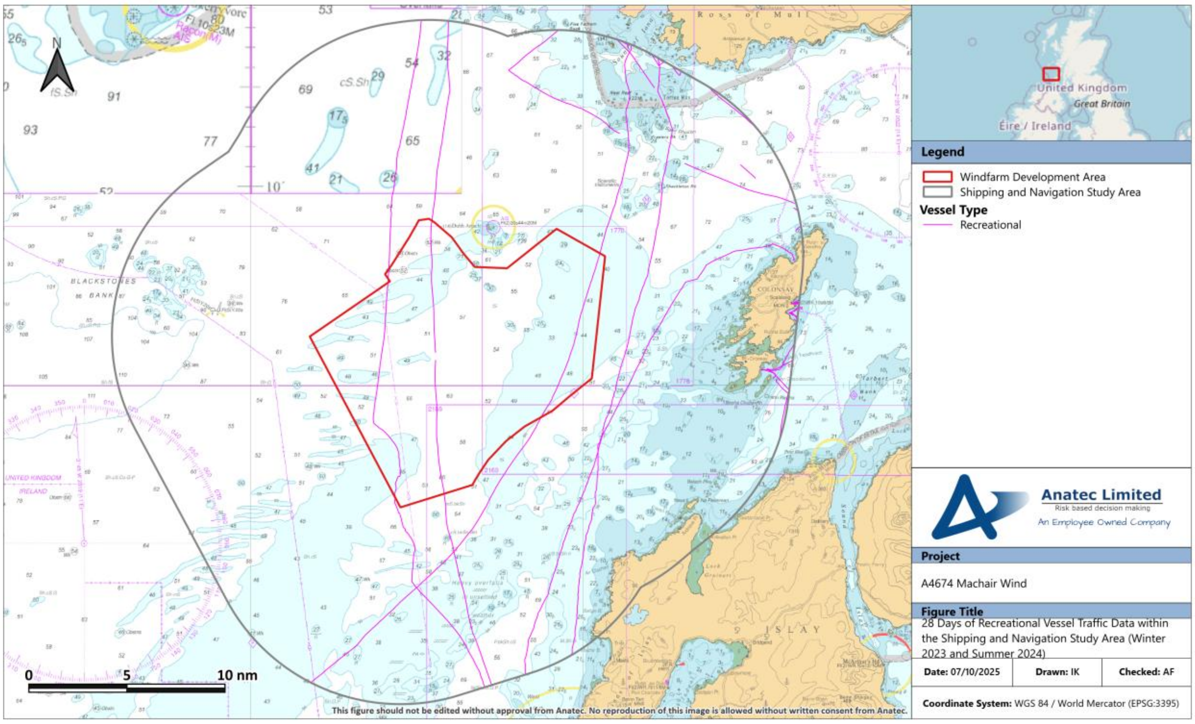

Figure 10.13 28 Days of Recreational Vessel Traffic Data within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

159. During the winter survey period, an average of one recreational vessel per week was recorded within the shipping and navigation study area, with no recreational vessels recorded intersecting the WDA. During the summer survey period, an average of one recreational vessel per day was recorded within the shipping and navigation study area, with an average of one fishing vessel every five days intersecting the WDA.

160. The majority of recreational vessels were noted inshore of Colonsay, with a limited number of transits on north-south passage through the WDA. This aligns with the Scottish Marine Recreation and Tourism Survey 2015 (Scottish Government, 2015). The survey noted that, other than a select band of sailing vessel activity through the east of the WDA on north-south passage, and a low density of power boats also through the east of the WDA, responses from participants indicated that recreational activities within the WDA were minimal.

10.2.5.2 RYA Coastal Atlas

161. In addition to the vessel traffic survey data, the RYA Coastal Atlas of Recreational Boating (RYA, 2019 (b)) has been reviewed for the region. The RYA Coastal Atlas may be used to "help identify and protect areas of importance to recreational boaters, to advise on new developmental proposals and in discussions over navigational safety". The RYA Coastal Atlas includes a heat map indicating the density of recreational activity around the UK coast, as well as features relevant to recreational boating (such as general boating areas, clubs, training centres, and marinas).

162. The RYA Coastal Atlas heat map is presented relative to the Project in **Figure 10.14**. Following this, the features relevant to recreational boating areas are presented in **Figure 10.15**.

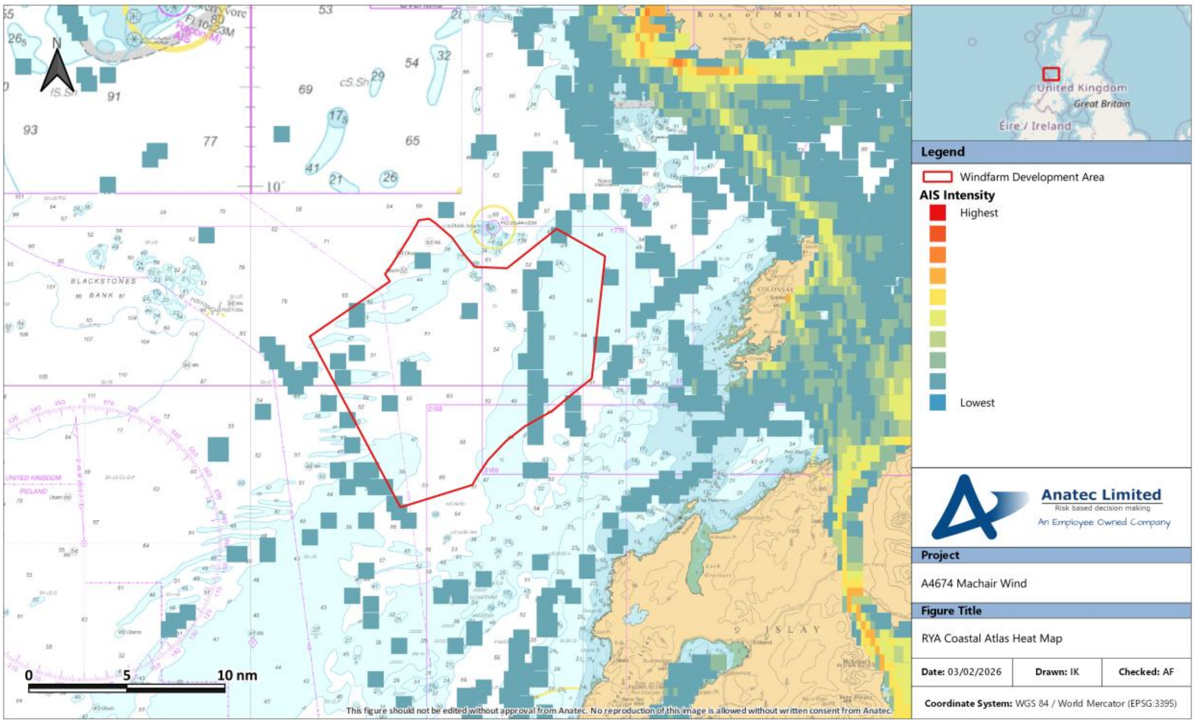

Figure 10.14 RYA Coastal Atlas Heat Map

163. Density of recreational activity was noted as being low within and in proximity to the WDA, with density increasing in close proximity to the coast. In particular, recreational vessel transits were frequently noted circumventing Mull, as well as transiting through the Sound of Islay.

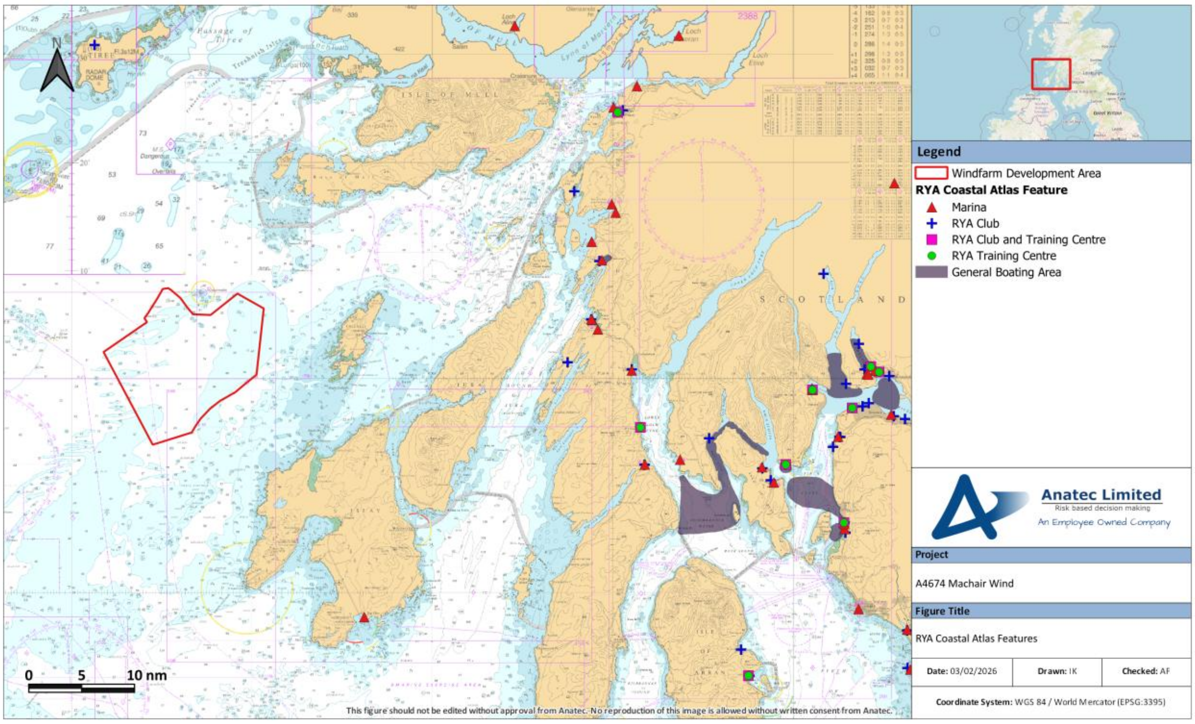

Figure 10.15 RYA Coastal Atlas Features

164. There are no RYA facilities in direct proximity to the WDA. The majority of those in the area are along the western coast of the mainland, with the closest being an RYA club approximately 23 nm to the north on Tiree, and a marina approximately 24 nm to the south on Islay.

10.3 Vessel Size

10.3.1 Vessel Length

165. Vessel length information was available for approximately 95% of vessels recorded throughout the winter and summer survey periods.

166. The vessel tracks recorded within the shipping and navigation study area during the survey periods are colour-coded by vessel length and presented in **Figure 10.16**. Following this, the distribution of these length classes is presented in **Figure 10.17**.

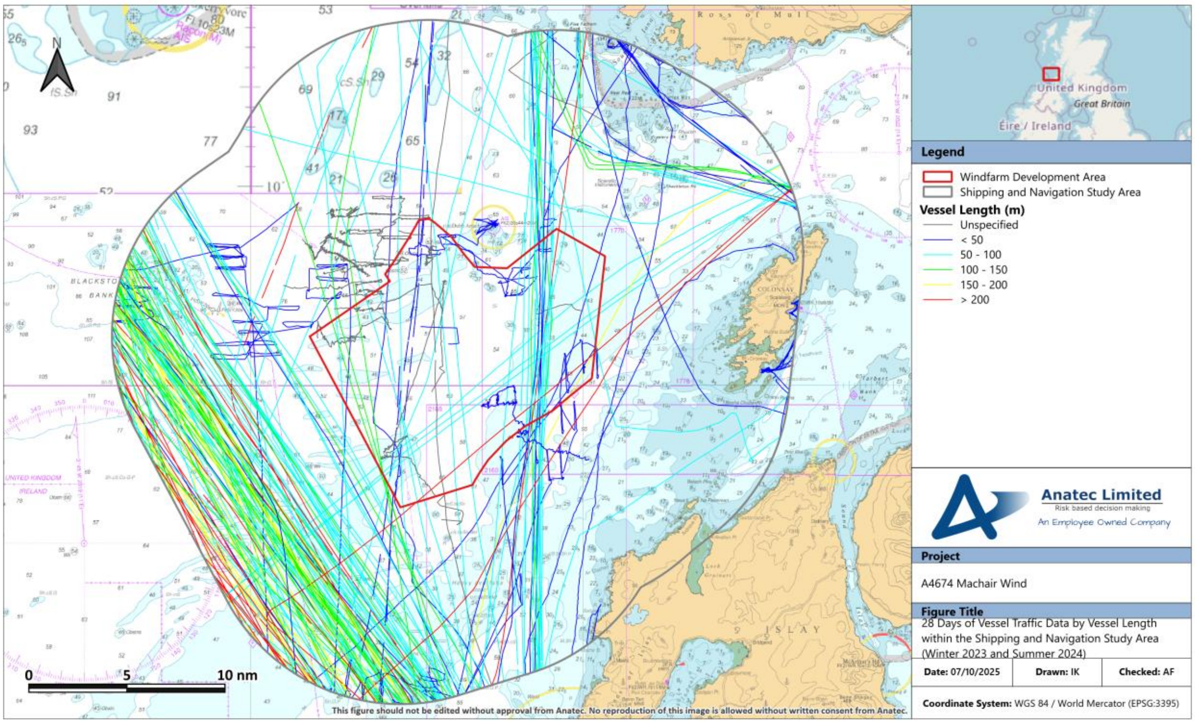

Figure 10.16 28 Days of Vessel Traffic Data by Vessel Length within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

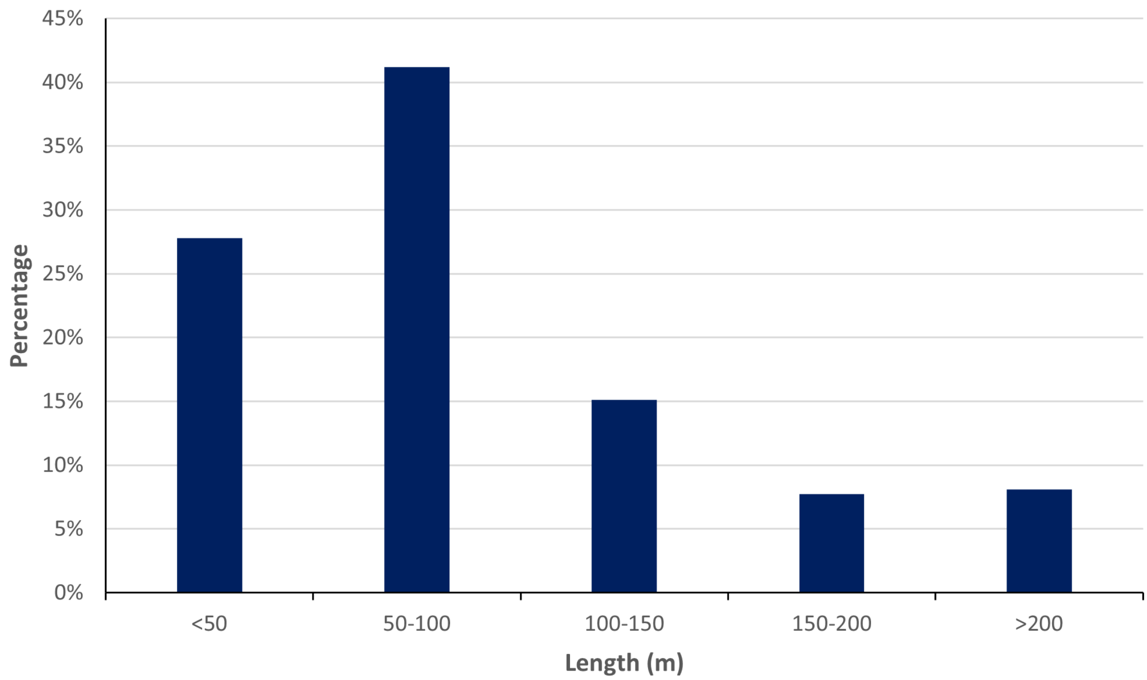

Figure 10.17 Vessel Length Distribution within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

167. The average length of vessels within the shipping and navigation study area was 95 m. Over the survey periods, vessel length ranged from 7 m for a fishing vessel to 330 m for a cruise liner.

10.3.2 Vessel Draught

168. Vessel draught information was available for approximately 81% of vessels recorded throughout the winter and summer survey periods.

169. The vessel tracks recorded within the shipping and navigation study area during the survey periods are colour-coded by vessel draught and presented in **Figure 10.18**. Following this, the distribution of these length classes is presented in **Figure 10.19**.

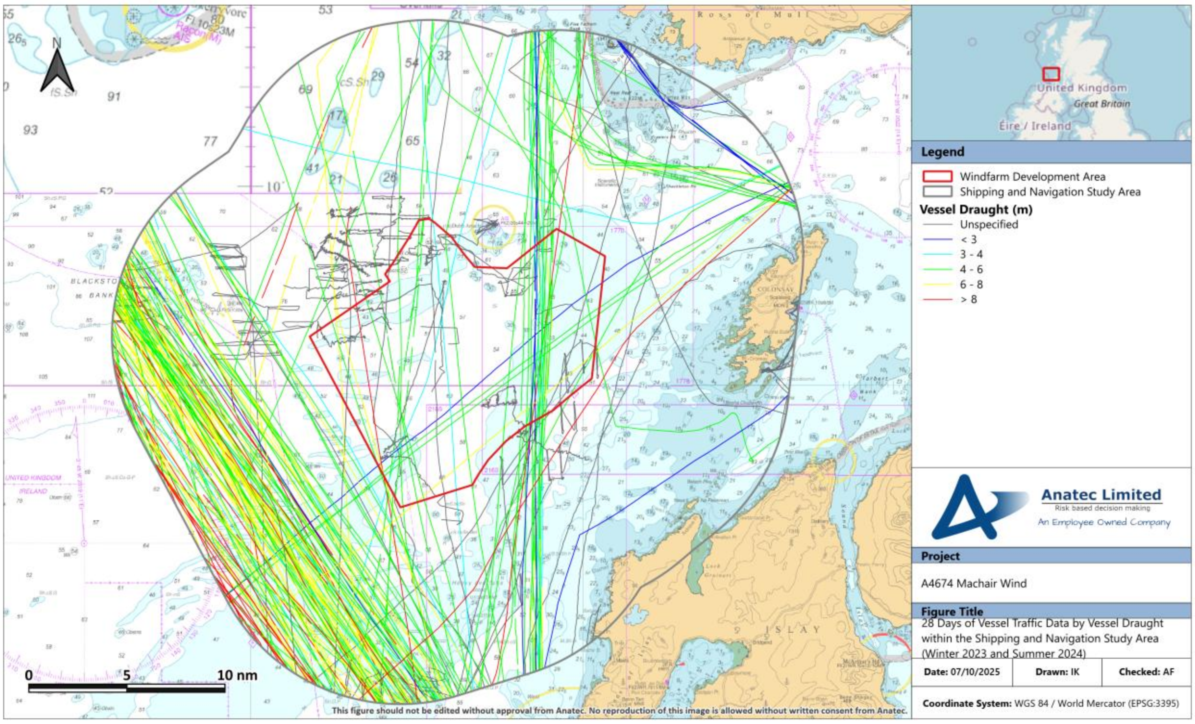

Figure 10.18 28 Days of Vessel Traffic Data by Vessel Draught within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

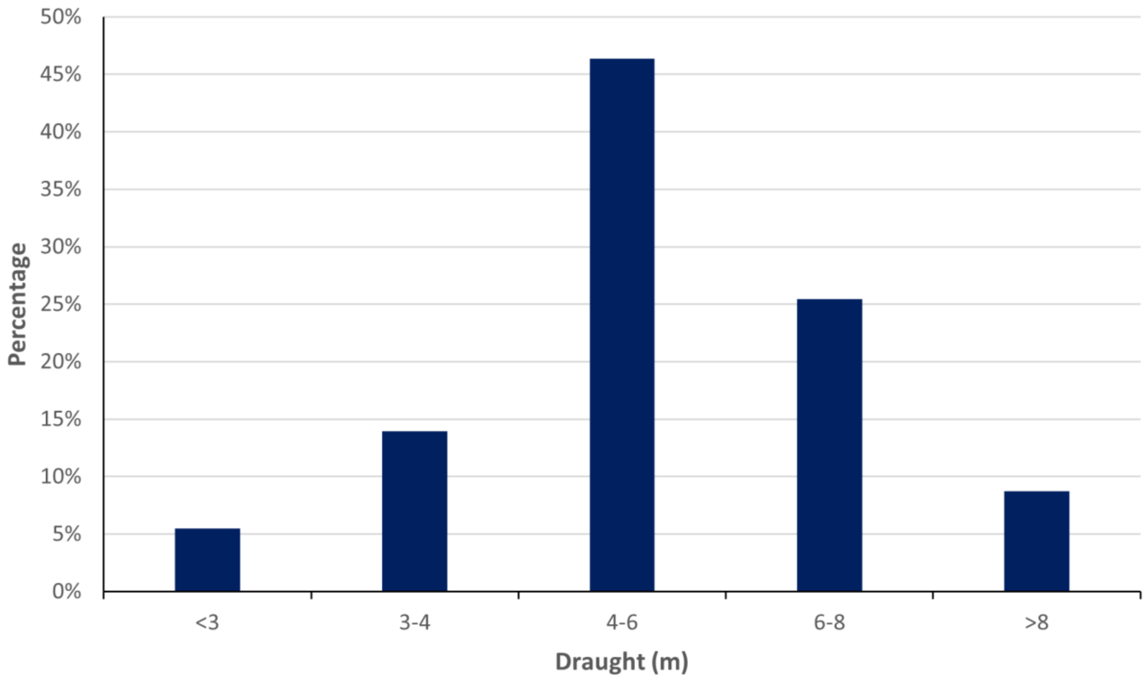

Figure 10.19 Vessel Draught Distribution within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

170. The average draught of vessels within the shipping and navigation study area was 5.5 m. Over the survey periods, vessel draught ranged from 1.5 m for a coastal tour vessel to 18.1 m for a bulk carrier.

171. The vessels of draught 12 m and above are colour-coded by vessel draught and presented in **Figure 10.20**.

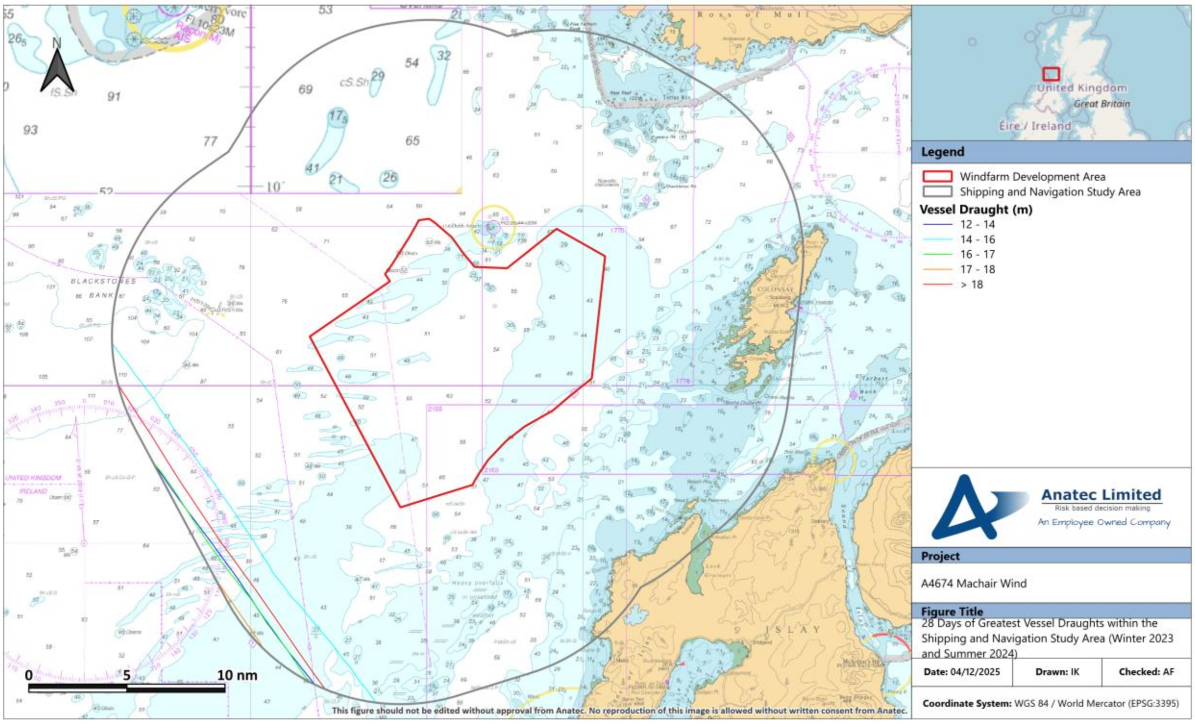

Figure 10.20 28 Days of Greatest Vessel Draughts within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

172. A total of five vessel transits from vessels of 12 m draught and above within the shipping and navigation study area during the vessel traffic surveys were recorded. All of these vessel transits were offshore of the WDA, at the southwestern periphery of the shipping and navigation study area.

10.4 Anchored Vessels

173. Vessels broadcast navigation status, including whether at anchor, via AIS. This data was reviewed for any vessels broadcasting their navigation status as ‘At Anchor’ and none were identified.

174. As an additional step, Anatec’s Speed Analysis model was used to identify any vessels that did not transmit their navigation status as ‘At Anchor’ but were travelling at a speed of less than 1 kt for at least 30 minutes. The output was then reviewed, and one potential case was identified where vessel behaviour indicated possible anchoring activity, inshore of Colonsay. These tracks are presented in **Figure 10.21**. It should be considered when viewing this figure that this vessel did not broadcast a status of ‘At Anchor’ via their AIS.

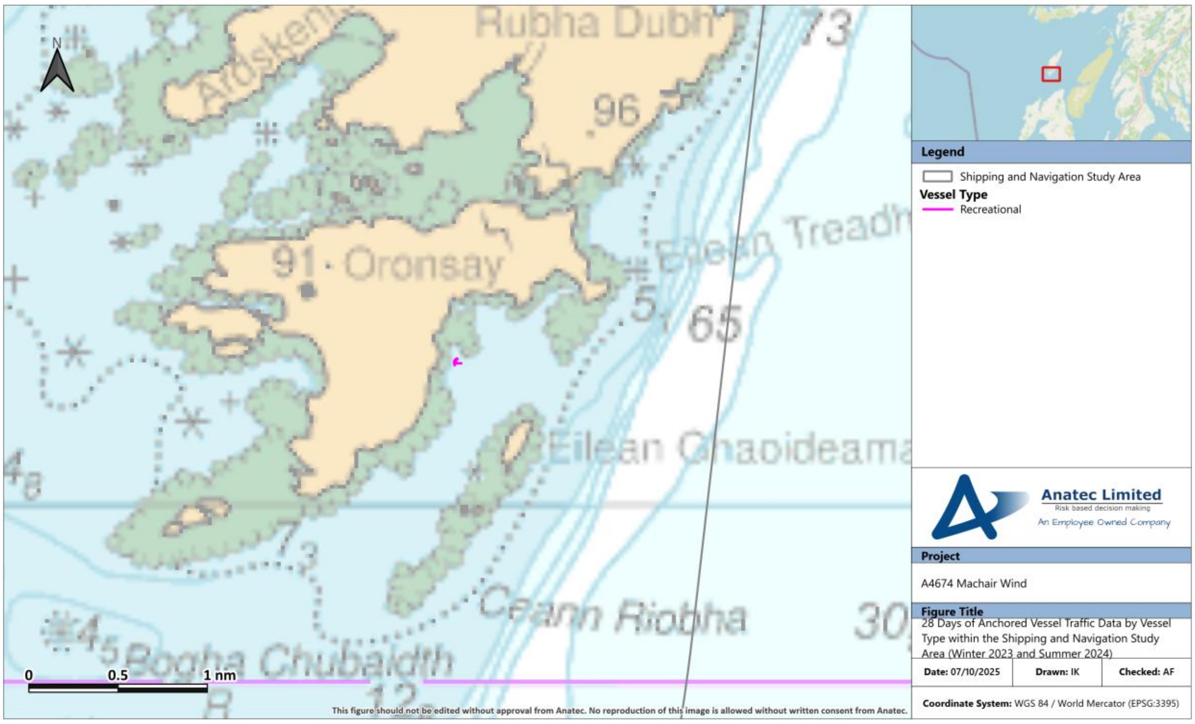

Figure 10.21 28 Days of Anchored Vessel Traffic Data by Vessel Type within the Shipping and Navigation Study Area (Winter 2023 and Summer 2024)

11 Base Case Vessel Routeing

11.1 Definition of a Main Commercial Route

175. Main commercial routes have been identified using the principles set out in MGN 654 (MCA, 2021). Vessel traffic data is assessed and vessels transiting at similar headings and locations are identified as a main route. To help identify main routes, vessel traffic data is also 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 mean position of the potential shipping route as shown in **Figure 11.1**.

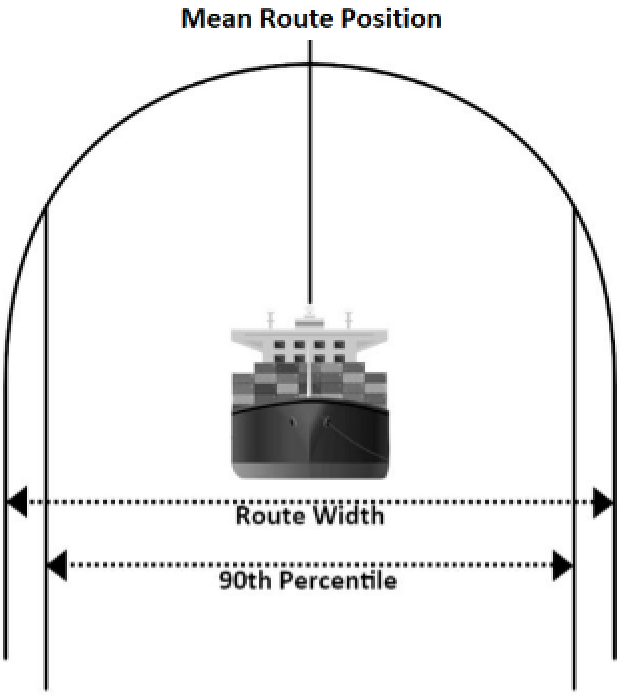

Figure 11.1 Illustration of a Main Route Calculation

11.2 Pre-windfarm Main Commercial Routes

176. A total of 12 main commercial routes within the shipping and navigation study area were identified from the vessel traffic survey data, in combination with Anatec's ShipRoutes database. These main commercial routes and corresponding 90^{th} percentiles within the shipping and navigation study area are shown relative to the WDA in **Figure 11.2**. Following this, a description of each route is provided in **Table 11.1**, including the average number of vessels per day, start and end locations, main vessel types and details of commercial ferry routeing (where applicable). It is noted that the start and end locations are based on the most common destinations transmitted via AIS by vessels on these routes. Although Routes 2 and 5 are within the shipping and navigation study area, as these are to/from Port Ellen on the east

of Colonsay, their presence within the area is minimal and they do not interact with the WDA.

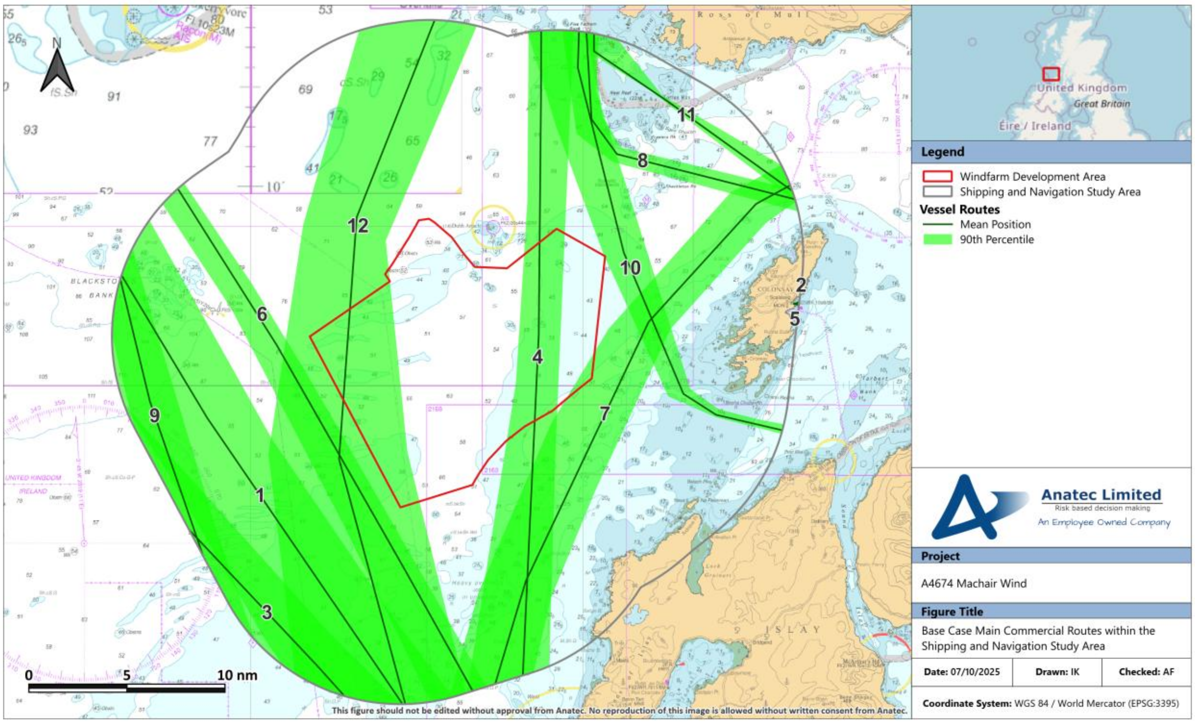

Figure 11.2 Base Case Main Commercial Routes within the Shipping and Navigation Study Area

Table 11.1 Description of Main Commercial Routes within the Shipping and Navigation Study Area

Route Number	Average Vessels per Day	Average Vessels per Week	Description
1	3-4	24	Belfast – Russia/Scandinavia. Composed primarily of cargo vessels (70%) and tankers (23%).
2	1	6	Oban – Colonsay. Composed primarily of passenger vessels (88%).
3	1	5-6	Belfast – Icelandic ports. Composed primarily of cargo vessels (50%), tankers (32%), and passenger vessels (14%).
4	0-1	4	Irish ports – Norwegian ports. Composed primarily of cargo vessels (82%). Includes regularly scheduled DFDS Seaways vessels routeing between Skogn, Belfast, and Greenock.
5	0-1	3-4	Colonsay – Port Askaig. Composed of cargo vessels (39%), passenger vessels (39%), and tankers (22%).
6	0-1	3	Belfast – Swedish ports. Composed primarily of cargo vessels (89%).
7	0-1	1-2	Oban – Liverpool (UK). Composed primarily of cargo vessels (70%) and passenger vessels (24%).

Route Number	Average Vessels per Day	Average Vessels per Week	Description
8	0-1	1-2	Mallaig (UK) – Firth of Clyde (UK). Composed primarily of cargo vessels (95%).
9	0-1	1-2	Derry (UK) – Norwegian ports. Composed primarily of cargo vessels (77%) and passenger vessels (19%).
10	0-1	1	Campbeltown (UK) – Northwest Scottish ports. Composed primarily of cargo vessels (81%) and passenger vessels (11%).
11	0-1	1	Colonsay – West Scottish ports. Composed primarily of cargo vessels (55%) and fish farm vessels (26%).
12	0-1	1	North Channel – Norwegian ports. Composed primarily of cargo vessels (76%) and passenger vessels (20%).

12 Adverse Weather Vessel Traffic Movements

177. Some vessels and vessel operators may transit alternative routes during periods of adverse weather. Consideration has been given to the implications of the presence of, or activities associated with, the Project during adverse weather. For example, if a commercial vessel is unable to make passage, or a small craft is unable to access safe havens.

178. Adverse weather includes wind, wave and tidal conditions as well as reduced visibility due to fog. Adverse weather can hinder a vessel's standard route, its speed of navigation and/or its 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 on the actual stability parameters, hull geometry, vessel type, vessel size and speed.

179. Adverse weather was raised as a point that would require consideration during consultation (see **Section 4**), with Admiralty charts in the area noting that there are 'Heavy overfalls in unsettled weather' approximately 5 nm south of the WDA. The location of these relative to the WDA is presented in **Figure 12.1**.

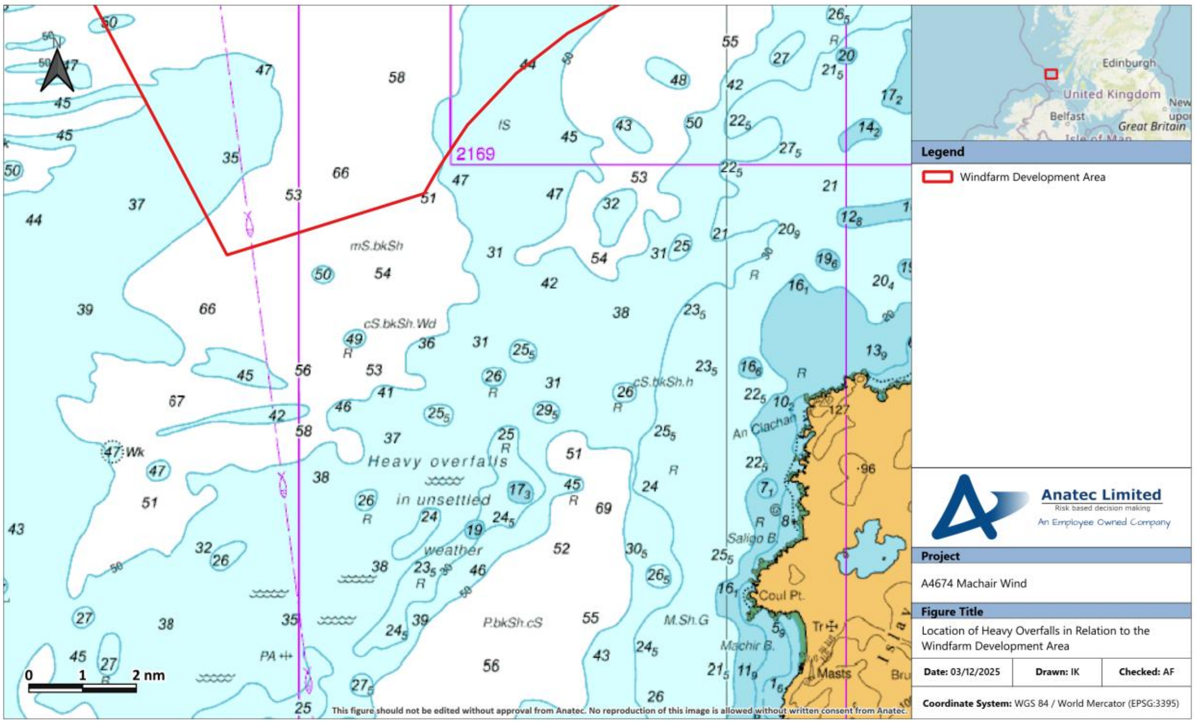

Figure 12.1 Location of Heavy Overfalls in Relation to the Windfarm Development Area

12.1 Consultation

180. During consultation (see **Section 4**), DFDS Seaways indicated that the presence of structures related to the Project may limit inshore routeing east of the WDA in certain weather conditions, and that larger deviations to the west may therefore be required. Due to this, the searoom between the WDA and Colonsay has been increased (see **Section 6.1**), with DFDS, MCA, NLB, and CoS all indicating contentment with the site updates made (see **Section 4**).

181. Therefore, based on review of the input received, it is likely that no commercial vessels would choose to make transit through the WDA during adverse weather conditions and will instead likely choose to pass either inshore or offshore of the WDA. As above, key stakeholders are content with the WDA refinement in terms of inshore searoom, and there is considered sufficient space to accommodate offshore transit. This has been assessed further in **Section 18**.

12.2 Identification of Periods of Adverse Weather

182. Historical weather information provided by the Met Office (Met Office, 2015) has been used to identify periods of adverse weather during from 2024-2025 (the year covered by the long-term vessel traffic data) when routes in proximity to the WDA could be considered most likely to be altered or cancelled. The key weather events identified are detailed in **Table 12.1**.

Table 12.1 Key Weather Events Relevant to the Project (2024-2025)

Weather event	Date(s)	Details
Storm Kathleen	06 to 07 April 2024	Strong winds gusting widely at over 50 kt around coastlines in the west and north UK, with ferry services disrupted.
Storm Ashley	20 to 21 October 2024	Wet and windy weather to the UK, with strongest winds across northwestern areas.
Storm Éowyn	24 January 2025	The UK's most powerful windstorm for over a decade. Northern Ireland and Scotland's Central Belt experienced the brunt of this storm with winds gusting over 80 kt in places.

183. The vessel traffic data within the shipping and navigation study area during storms Kathleen, Ashley, and Éowyn has been colour-coded by vessel type and presented in **Figure 12.2**, **Figure 12.3**, and **Figure 12.4** respectively.

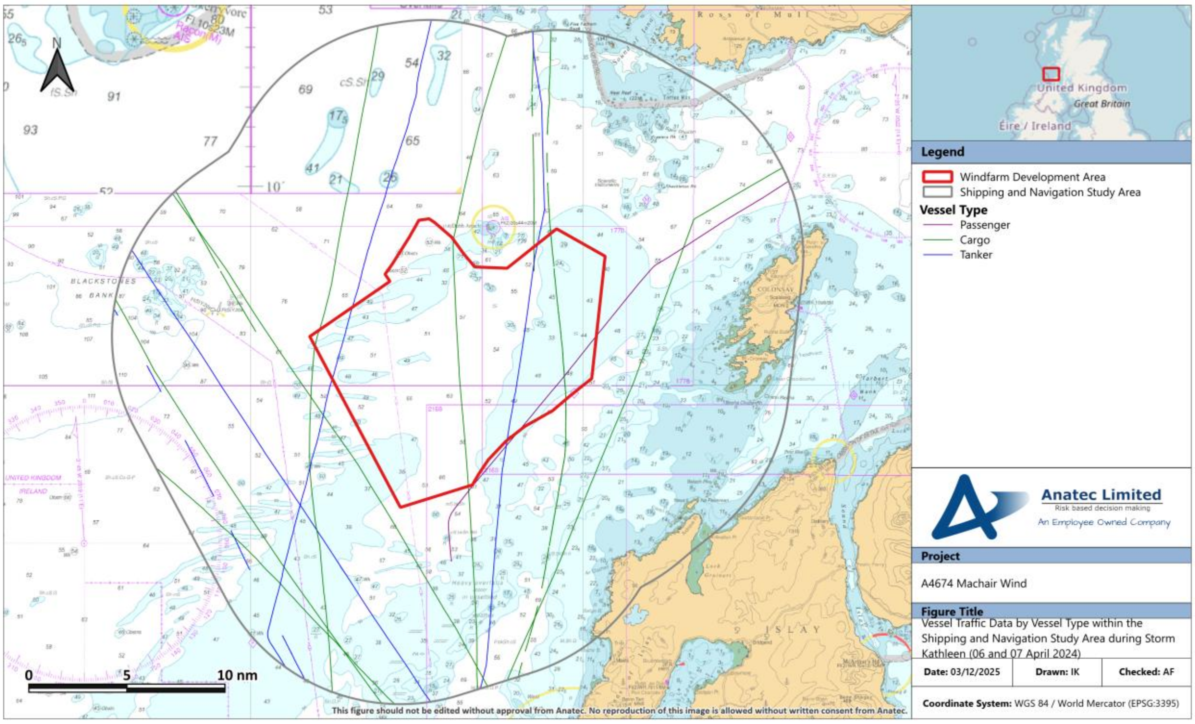

Figure 12.2 Vessel Traffic Data by Vessel Type within the Shipping and Navigation Study Area during Storm Kathleen (06 and 07 April 2024)

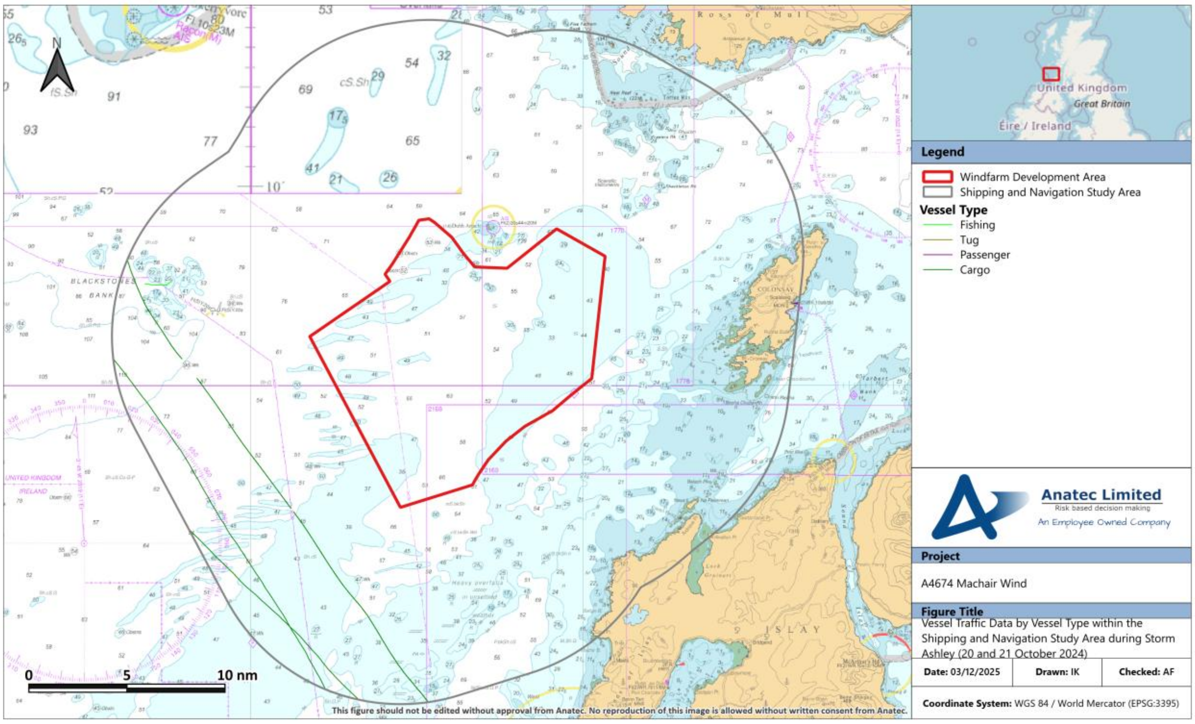

Figure 12.3 Vessel Traffic Data by Vessel Type within the Shipping and Navigation Study Area during Storm Ashley (20 and 21 October 2024)

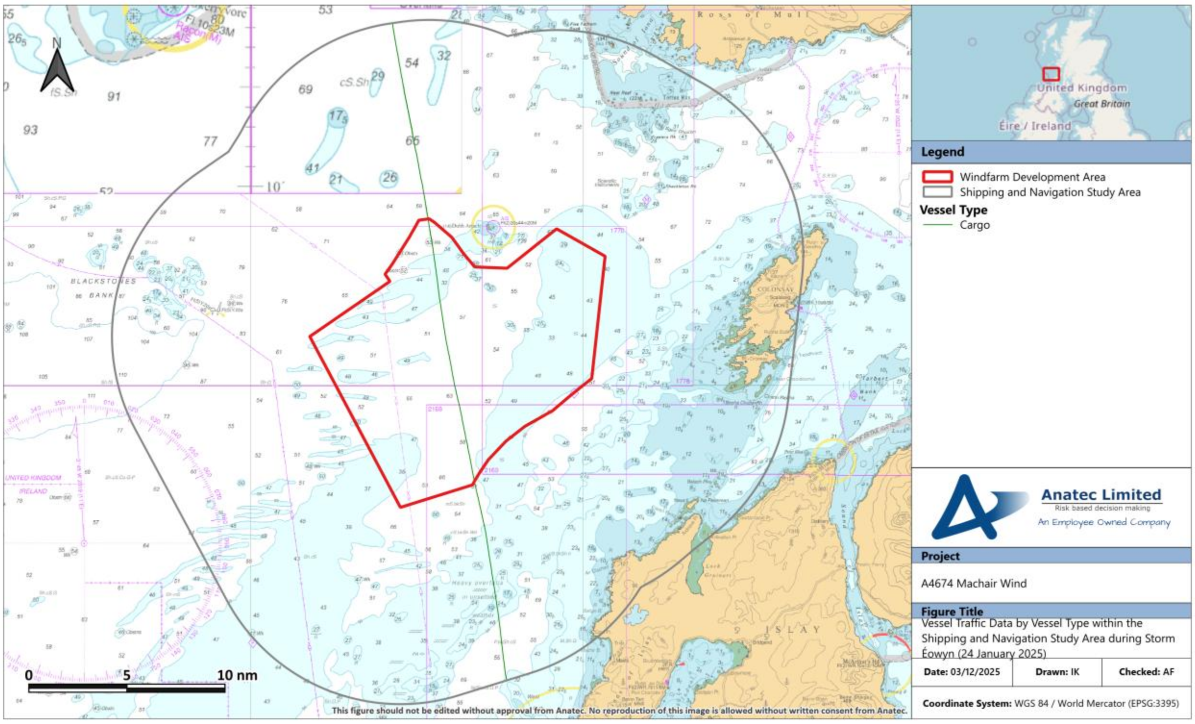

Figure 12.4 Vessel Traffic Data by Vessel Type within the Shipping and Navigation Study Area during Storm Éowyn (24 January 2025)

12.3 Commercial Routeing Changes

184. 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 12.1**. Overall, vessel numbers decreased notably within the shipping and navigation study area during all three periods of adverse weather. No substantial alternative routeing was observed.

185. However, as noted in **Section 10.2.1**, there were fewer instances of cargo vessel transits through both the shipping and navigation study area and the WDA in the summer vessel traffic survey period compared to the winter vessel traffic survey period. This may be due to a preference for vessel Masters to route further inshore in periods of inclement weather. The presence of the WDA Infrastructure may lead to vessels that would otherwise choose to pass inshore choosing to pass offshore of the WDA in certain unfavourable conditions (this aligns with DFDS input from consultation as per **Section 4**). However, the frequency at which this would be expected to occur has been lowered via the site refinements made that have increased searoom inshore.

186. Of the dates outlined as being of adverse weather, CalMac ferries ran only on the 21 October 2024, although these vessels transit from the eastern side of Colonsay so will not be affected by the Project under current routeing patterns.

12.4 Small Craft Use of Safe Havens

187. Both the long-term vessel traffic data and the 28-day vessel traffic survey data have been used to identify potential small craft use of safe havens related to adverse weather conditions in proximity to the Project, with the periods outlined in **Table 12.1** and fishing vessels and recreational vessels studied most closely.

188. A single fishing vessel transit was recorded via AIS during the adverse weather periods, with this again being on 21 October 2024. No recreational vessel tracks were noted. This may be expected for the season however, with an average of less than one recreational vessel and one fishing vessel per day recorded within the shipping and navigation study area from October to December.

189. From the vessel traffic data, an instance of a small craft anchoring within sheltered waters on the eastern coast of Colonsay was noted (see **Section 10.4**). This may indicate that this area could be used in the event of adverse weather. As the WDA is located on the opposite side of Colonsay, the Project will not impact upon the ability of small craft to shelter here.

190. The final layout will not be determined until post-consent, but small craft will be able to safely navigate within the WDA in the majority of conditions should they choose to do so based on minimum WTG spacing (944 m), and the application of MGN 654 (MCA, 2021) layout requirements. As per SOLAS Chapter V (IMO, 1974), all vessels at sea are required to passage plan and part of the passage planning process requires them to consider forecast weather conditions. It is anticipated that vessels would then take account of these forecasts prior to embarking on a passage inshore or offshore of the WDA.

191. Taking into account there will be MCA approval on the final layout and the requirements of SOLAS Chapter V, there are not considered to be any significant effect on access to safe havens due to the presence of activities associated with the Project.

13 Navigation, Communication, and Position-fixing Equipment

192. 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.

13.1 Very High Frequency Communications (Including Digital Selective Calling)

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

194. 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.

195. 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).

196. 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).

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

198. 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.

13.2 Very High Frequency Direction Finding

199. 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 50 m). This is deemed to be a relatively small-scale impact due to the

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

200. 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 1 nm, the homer system operated as expected with no apparent degradation.

201. 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.

13.3 AIS

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

203. 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.

13.4 Navigational Telex System

204. 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.

205. 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.

206. 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.

207. 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.

13.5 Global Positioning System

208. 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”.

209. 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).

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

13.6 Electromagnetic Interference

211. 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.

212. 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 EMF are minimised to ensure continued safe navigation.

213. 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.

13.6.1 Subsea Cables

214. The IACs for the Project will be 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).

215. The offshore export cables will be DC. With regard to this, the Moray Offshore Renewables Environmental Statement (Moray Offshore Renewables, 2012) notes that for both buried and protected DC cables the magnetic field would decrease exponentially with vertical distance from the seabed and with horizontal distance

from the cables (within a few metres), irrespective of whether cables are buried or protected. It states that “in all cases, where cables are buried to 1m depth, the predicted magnetic field is expected to be below the earth’s magnetic field (assumed to be 50 microtesla (µT)). Where DC cables cannot be buried and are instead protected, the magnetic field is expected to be below the earth’s magnetic field within 5m from the seabed”.

216. Considering that the minimum water depth within the WDA is 21 m (with the vast majority of the site being above 30 m), it is not expected that a vessel will be located close enough to an offshore export cable to be affected, given this far exceeds the 5 m value referenced above – especially considering the proposed cable burial/protection measures (see **Section 6.3**).

217. In addition, only vessels which use magnetic compasses as their sole means of navigation would be impacted. Given the distance from the shore, it is considered very unlikely that such vessels would be present within the WDA. In the unlikely scenario that such a vessel is present, as above any impact would be expected to be minimal, and only applicable for the brief period where the vessel is directly over the cable.

218. It is unknown at this stage whether the OSP link cables will be AC or DC, but as cable burial and protection methods are equivalent for these to offshore export cables, the above assessment will be applicable for either case.

13.6.2 Wind Turbine Generators

219. 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.

13.6.3 Experience at Operational Windfarms

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

13.7 Marine Radar

221. This section summarises the results of trials and studies undertaken in relation to Radar effects from offshore windfarms 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.

13.7.1 Trials

222. 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.

223. 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).

224. Side lobe patterns are produced by small amounts of energy from the transmitted pulses that are radiated outside of the narrow main beam. The effects of side lobes are most noticeable within targets at short range (below 1.5 nm) 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 13.1**.

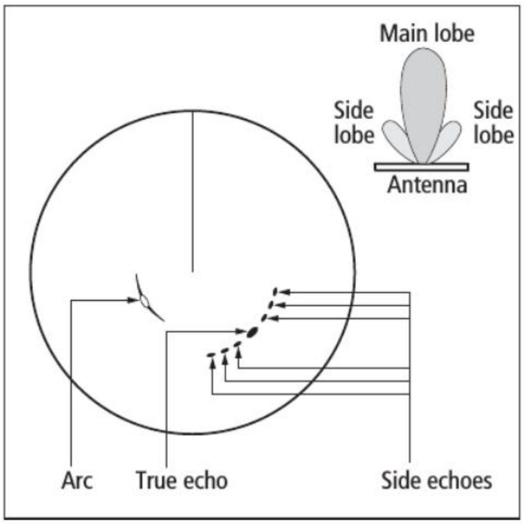

Figure 13.1 Illustration of Side Lobes on Radar Screen

225. 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 13.2**.

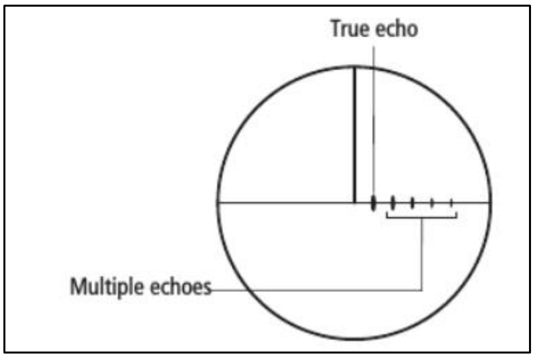

Figure 13.2 Illustration of Multiple Reflected Echoes on Radar Screen

226. Based on the results of the North Hoyle trials, the MCA produced a Shipping Route Template designed to give guidance to mariners on the distances which should be established between shipping routes and offshore windfarms. However, as experience of effects associated with use of marine Radar in proximity to offshore windfarms 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).

227. A second set of trials conducted at Kentish Flats Offshore Windfarm 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.

228. Theoretical modelling of the effects of the development of the proposed Atlantic Array Offshore Windfarm, 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 trials[3]. 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

[3] It is acknowledged that other theoretical analysis has been undertaken.

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 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.

229. In summary, experience in UK waters has shown that mariners have become increasingly aware of any Radar effects as more offshore windfarms 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".

230. 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 13.1** are based on MGN 654 (MCA, 2021), MGN 371 (MCA, 2008), MGN 543 (MCA, 2016) and MGN 372 (MCA, 2022).

Table 13.1 Distances at which Impacts on Marine Radar Occur

Distance at Which Effect Occurs (nm)	Identified Effects
0.5	▪ Intolerable impacts can be experienced. ▪ X-Band Radar interference is intolerable under 0.25 nm. ▪ Vessels may generate multiple echoes on shore-based Radars under 0.45 nm.

Distance at Which Effect Occurs (nm)	Identified Effects
1.5	▪ Under MGN 654, impacts on Radar are considered to be tolerable with mitigation between 0.5 and 3.5 nm. ▪ S-band Radar interference starts at 1.5 nm. ▪ Echoes develop at approximately 1.5 nm, 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.

231. As noted in **Table 13.1**, the onset range from the WTGs of false returns is approximately 1.5 nm, with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of 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 Vessel Traffic Service (VTS) or AIS (MCA, 2016).

13.7.2 Experience from Operational Developments

232. The evidence from mariners operating in proximity to existing offshore windfarms is that they quickly learn to adapt to any effects. **Figure 13.3** presents the example of the Galloper and Greater Gabbard Offshore Windfarm, which are located in proximity to IMO routeing measures. Despite this proximity to heavily trafficked Traffic Separation Scheme (TSS) lanes, there have been no reported incidents or issues raised by mariners who operate within the vicinity. The interference buffers presented in **Figure 13.3** are as per **Table 13.1**.

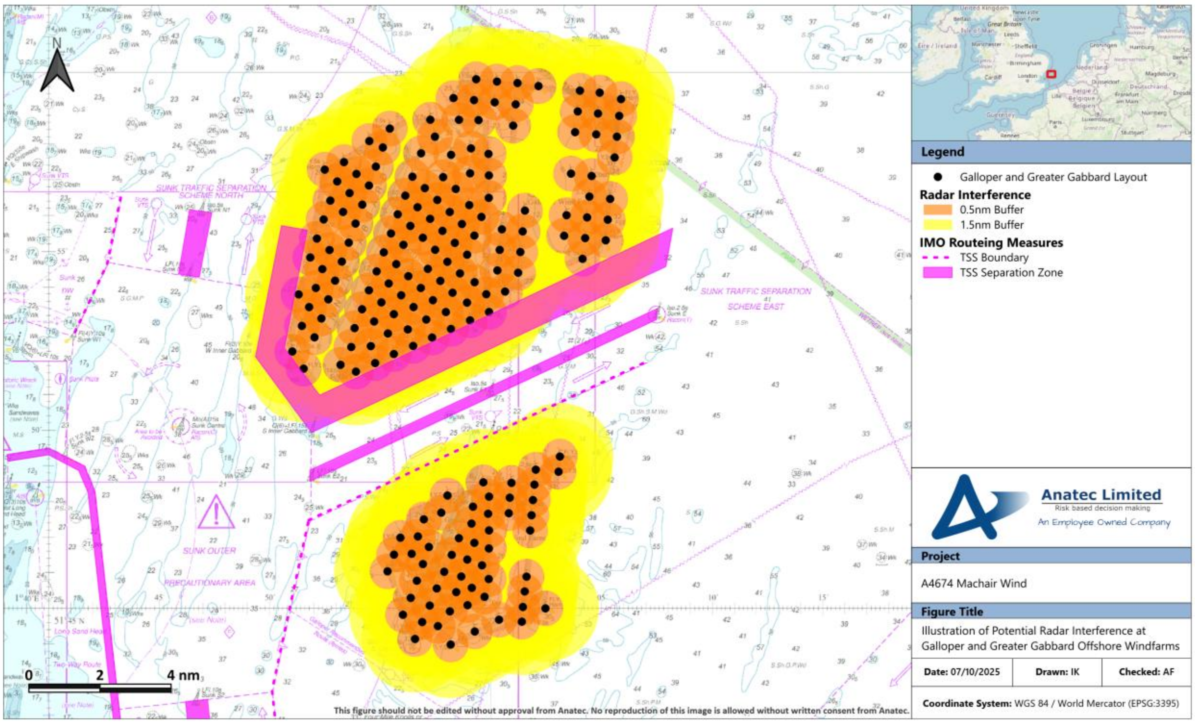

Figure 13.3 Illustration of Potential Radar Interference at Greater Gabbard and Galloper Offshore Windfarms

233. As indicated by **Figure 13.3**, 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.

234. AIS information can also be used to verify the targets of larger vessels (generally vessels over 15 m LOA – the minimum threshold for fishing vessel AIS carriage requirements). Approximately 12% of the vessel traffic recorded within the Project's shipping and navigation study area was under 15 m LOA in both 14-day survey periods, although throughout the vessel traffic surveys approximately 95% of vessel tracks were recorded on AIS, indicating a low level of AIS take-up among vessels for which AIS carriage is not mandatory.

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

13.7.3 Increased Radar Returns

236. 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.

237. 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 WDA will not create any effects in addition to those already identified from existing operational windfarms (interfering side lobes, multiple and reflected echoes).

238. 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.

13.7.4 Fixed Radar Antenna Use in Proximity to an Operational Windfarm

239. 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.

13.7.5 Application to the Project

240. Upon development of the Project, some commercial vessels may pass within 1.5 nm of structures within the WDA 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.

241. Vessels passing within the WDA 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.

242. **Figure 13.4** presents an illustration of potential Radar interference due to the Project. The Radar effects have been applied to the indicative layout introduced in **Section 6.2.1** to maximise the extent of potential Radar interference, with the estimated future case routes (presented in **Section 14.5**) also provided for context.

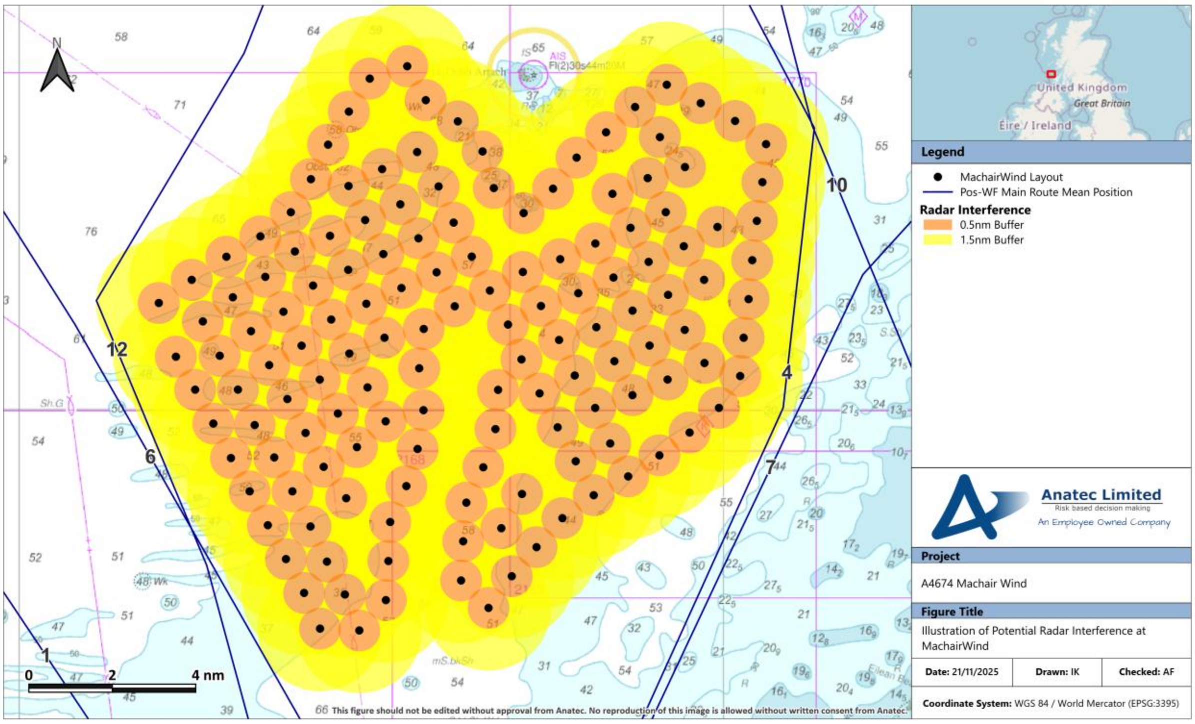

Figure 13.4 Illustration of Potential Radar Interference at MachairWind

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

244. 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.

13.8 Sound Navigation Ranging System

245. No evidence has been found to date with regard to Sound Navigation Ranging (SONAR) systems to suggest that existing offshore windfarms 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.

13.9 Noise

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

13.10 Existing Aids to Navigation

247. There are existing aids to navigation within the shipping and navigation study area, primarily including the Dubh Artach lighthouse approximately 2 nm from the WDA.

248. As noted in **Section 7.1**, the aid to navigation on the Lighthouse is at a height of 44 m, flashes a white light twice every 30s, and has a range of 20 nm. This exceeds the range of the expected lights on the WTGs, meaning vessels approaching from the north (i.e., vessels whose view of the lighthouse would not be inhibited) will observe the lighthouse aid to navigation first. As vessels approach and the Significant Peripheral Structure (SPS) lights become visible, the flashing characteristic and colour of the SPS is distinct from the Lighthouse, meaning vessels will be able to distinguish between the two.

249. Vessels approaching from other directions may experience some temporary visual obscuring of the Dubh Artach lighthouse, however the size of the towers and minimum spacing mean this will only be for short periods of time. Further, they will be able to utilise the SPS on the southern, eastern, and western peripheries of the WDA as a guide. For smaller craft which may opt to transit through the WDA, the distance of 2 nm between the WDA and the lighthouse is expected to be sufficient to discern the aids to navigation.

250. Consultation has been undertaken with NLB on impacts on the lighthouse, and they have confirmed they are content at this stage, and that it is appropriate to revisit the outcomes of this once the final layout has been defined.

13.11 Summary of Potential Effects on Use

251. 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 13.2** 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 18**.

Table 13.2 Summary of Risks to Navigation, Communication, and Position-fixing Equipment

Topic	Frequency	Consequence	Significance of Risk
VHF	Negligible	Minor	Broadly Acceptable
VHF DF	Extremely Unlikely	Minor	Broadly Acceptable
AIS	Negligible	Minor	Broadly Acceptable
NAVTEX	Negligible	Minor	Broadly Acceptable
GPS	Negligible	Minor	Broadly Acceptable

Topic	Frequency	Consequence	Significance of Risk
EMF	Extremely Unlikely	Negligible	Broadly Acceptable
Marine Radar	Remote	Minor	Broadly Acceptable
SONAR	Negligible	Minor	Broadly Acceptable
Noise	Negligible	Minor	Broadly Acceptable

14 Future Case Vessel Traffic

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

253. The following subsections provide a high-level future case scenario which has been used to inform the risk assessment.

14.1 Increases in Commercial Vessel Activity

254. There is uncertainty associated with long-term predictions of vessel traffic growth including the potential for any other new developments in UK or transboundary ports and the long-term effects of Brexit.

255. Therefore, two independent scenarios of potential growth in commercial vessel movements of 10% and 20% have been estimated throughout the lifetime of the Project.

14.2 Increases in Commercial Fishing Vessel and Recreational Vessel Activity

256. There is similar uncertainty associated with long-term predictions for commercial fishing vessel and recreational vessel transits given the limited reliable information on future trends upon which any firm assumption could be made. There are no known major developments which would increase commercial fishing or recreational vessel activity in the region.

257. As noted by RYA Scotland during consultation (see **Section 4**), post-windfarm recreational vessels in the area will likely transit further inshore of the WDA. In addition, it is noted that recreational users in the area will likely be experienced, and so more willing or able to transit the area with the WDA infrastructure in place.

258. As noted by SWFPA during consultation (see **Section 4**), transits of fishing vessels within the vicinity of the WDA will be dependent on finalised site parameters, as well as the discretion of each vessel Master.

259. Therefore, a conservative potential growth in commercial fishing vessel and recreational vessel movements of 10% and 20% has been estimated throughout the lifetime of the Project.

14.3 Increases in Traffic Associated with Offshore Windfarms

260. During the construction phase up to 5,700 round trips to port would be made by vessels involved in the installation of the Project (see **Section 6.4.1**). During the O&M

phase, up to 600 annual round trips to port would be made by vessels involved with the Project (see **Section 6.4.2**).

261. With no other offshore wind developments screened into the cumulative risk assessment (see **Section 15.1**), there are not anticipated to be any additional traffic associated with offshore windfarms past the traffic noted for the Project.

14.4 Methodology

262. 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 1 nm from offshore installations and existing offshore windfarm 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, aids to navigation, and known routeing preferences.

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

264. 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 1 nm of established offshore windfarms (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 1 nm off established developments. Evidence also demonstrates that commercial vessels do not transit through arrays.

265. 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 1 nm off developments. Evidence collected during numerous assessments at an industry level confirms that it is a safe and reasonable distance for vessels to pass; however, it is likely that a large number of vessels would instead choose to pass at a greater distance depending upon their own passage plan and the current conditions.

14.5 Post-windfarm Routeing

266. Each of the main routes identified (see **Section 11.2**) has been assessed for the potential to deviate considering the methodology set out in **Section 14.4**. A total of three of the 12 main routes identified are expected to deviate on this basis. The post-

windfarm routeing is shown in **Figure 14.1**. Following this, a summary of the deviation magnitudes is provided in **Table 14.1**.

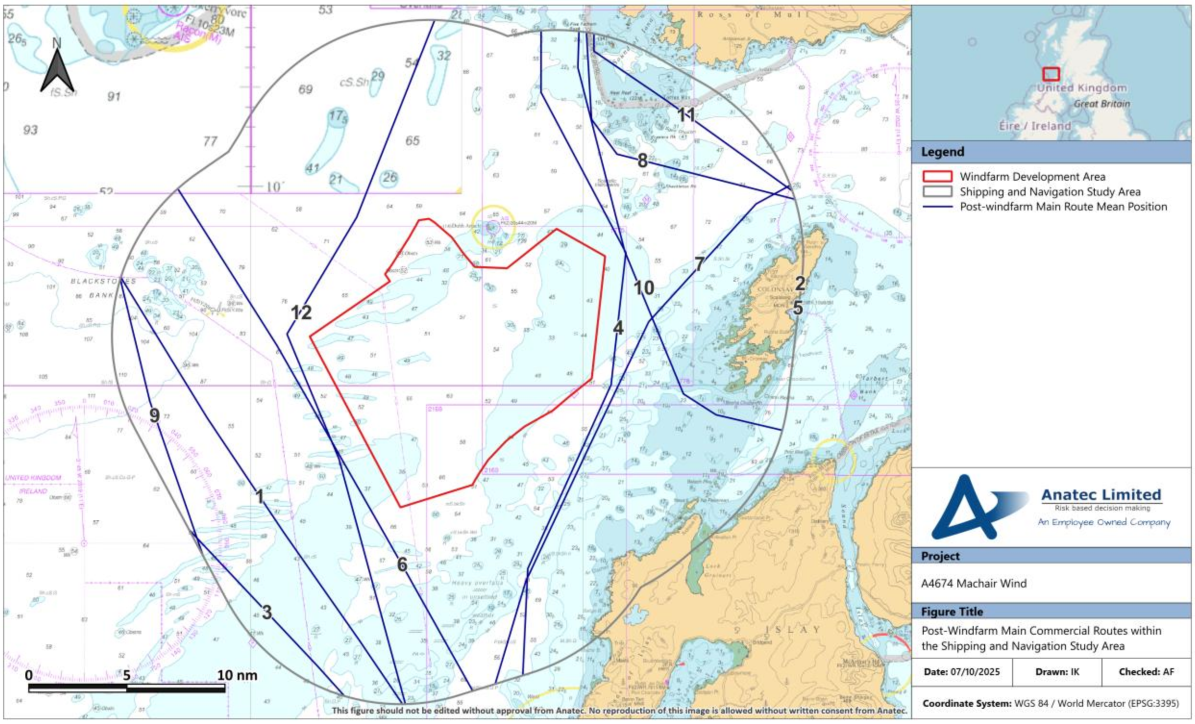

Figure 14.1 Post-Windfarm Main Commercial Routes within the Shipping and Navigation Study Area

Table 14.1 Post-Windfarm Main Commercial Route Deviation Summary

Route	Distance (nm)		Change In Total Route Length	
	Pre Wind Farm	Post Wind Farm	Distance (nm)	%
4	591.53	593.53	2.00	0.34
10	141.62	141.63	0.01	<0.01
12	583.71	585.18	1.47	0.25

267. The deviations of the three routes highlighted in **Table 14.1** are summarised as follows:

- Route 4: four vessels per week. Intersects WDA, with vessels anticipated to pass to the east post-windfarm. Estimated journey distance increase of 2.00 nm.
- Route 10: one vessel per week. Does not intersect WDA, vessels anticipated to pass very slightly to the east post-windfarm. Estimated journey distance increase of 0.01 nm.

- Route 12: one vessel per week. Intersects WDA, vessels anticipated to pass to the west post-windfarm. Estimated journey distance increase of 1.47 nm.

14.6 Inshore Area

268. Prior to the site refinement, the area to the east of the EIA Scoping WDA Boundary between the Project and the island of Colonsay (hereafter referred to as the ‘inshore area’), was raised in consultation (see **Section 4**) as a potential concern due to the available room for vessels to deviate, noting that this is relevant both for normal conditions, as well as in adverse weather. As per **Section 6.1**, the eastern boundary has since been reduced in the WDA to increase searoom. This section provides further vessel traffic assessment for vessels which may use the inshore in a future case.

269. An overview of the inshore area is presented in **Figure 14.2**. The following key points are also referenced within the figure:

- The nearest 10 m contour is located 4.2 nm from the WDA (labelled “A” in **Figure 14.2**);
- The nearest 20 m contour is located 2.7 nm from the WDA, noting this is a small area of water < 20 m in depth, with a minimum depth of 18.3 m CD (labelled “B” in **Figure 14.2**, and referenced in consultation in **Section 4**);
- The 20 m contour around Colonsay is 3.4 nm to the east at its closest with the areas including depths close to 10 m below CD (labelled “C” in **Figure 14.2**).

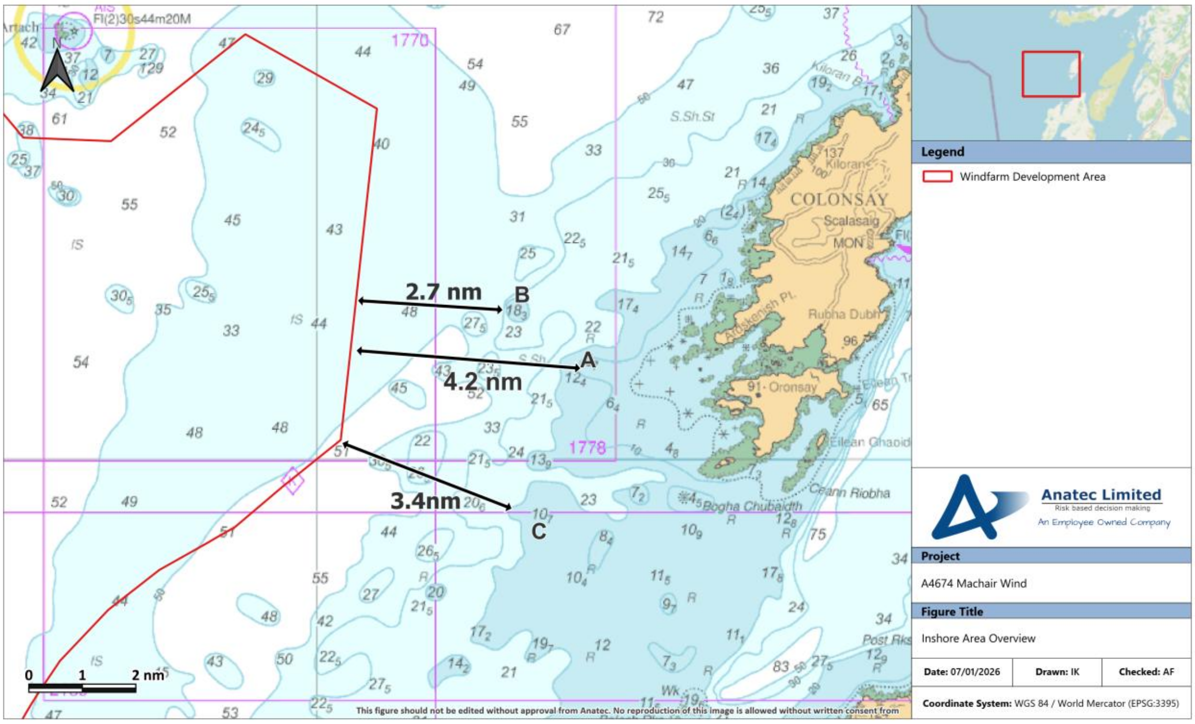

Figure 14.2 Inshore Area Overview

14.6.1 Vessel Traffic Assessment

270. The long-term vessel traffic (see **Appendix E**) has been used as a data source given it provides long term indication of vessel routeing, types and sizes. Vessel transits within this dataset which would potentially opt to transit inshore of the WDA (as opposed to transiting offshore) were identified (hereafter referred to in this section as the "potential users") and isolated for further assessment. The vessel tracks of potential users are colour-coded by vessel type and presented in **Figure 14.3**.

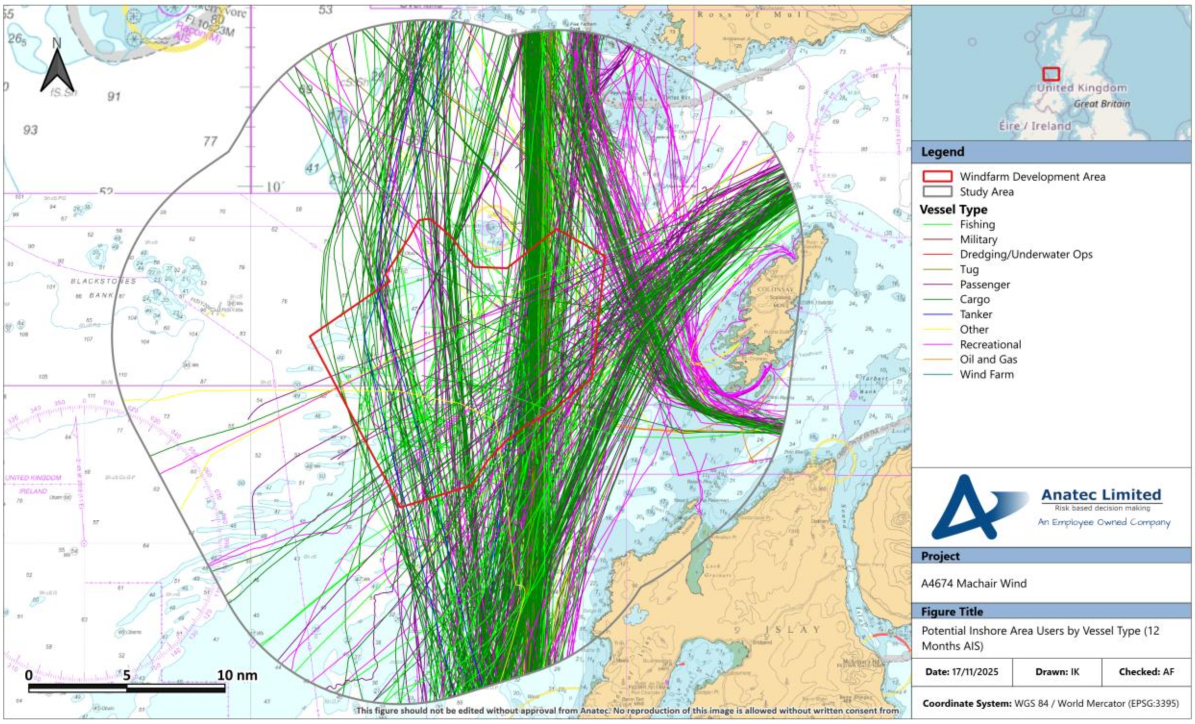

Figure 14.3 Potential Inshore Area Users by Vessel Type (12 Months AIS)

271. On average, two to three potential users per day were recorded within the shipping and navigation study area during the 12-month study period. These were primarily composed of cargo vessels (55%), with fishing vessels (13%), recreational vessels (13%), and passenger vessels (10%) also commonly noted. Overall, approximately 74% of potential users were commercial vessels (i.e., cargo vessels, passenger vessels, or tankers).

272. Noting that the majority of potential users were commercial vessels, and that these tend to be larger than recreational vessels or fishing vessels (both in terms of draught and length), the commercial vessels recorded have also been isolated. The length and draught values of all vessels, and of commercial vessel only, are presented in **Table 14.2**.

Table 14.2 Potential User Length and Draught Values

	All Vessels	Commercial Vessels Only
Length		
Average	76 m	100 m
90th Percentile	131 m	162 m
Maximum	250 m	250 m
Draught		
Average	4.9 m	5.1 m
90th Percentile	6.5 m	6.5 m
Maximum	13.8 m	13.8 m

273. Overall, approximately 99% of all vessel transits (and 98% of commercial vessel transits) were from vessels under 9 m draught. The overall draught breakdown is shown in **Figure 14.4**.

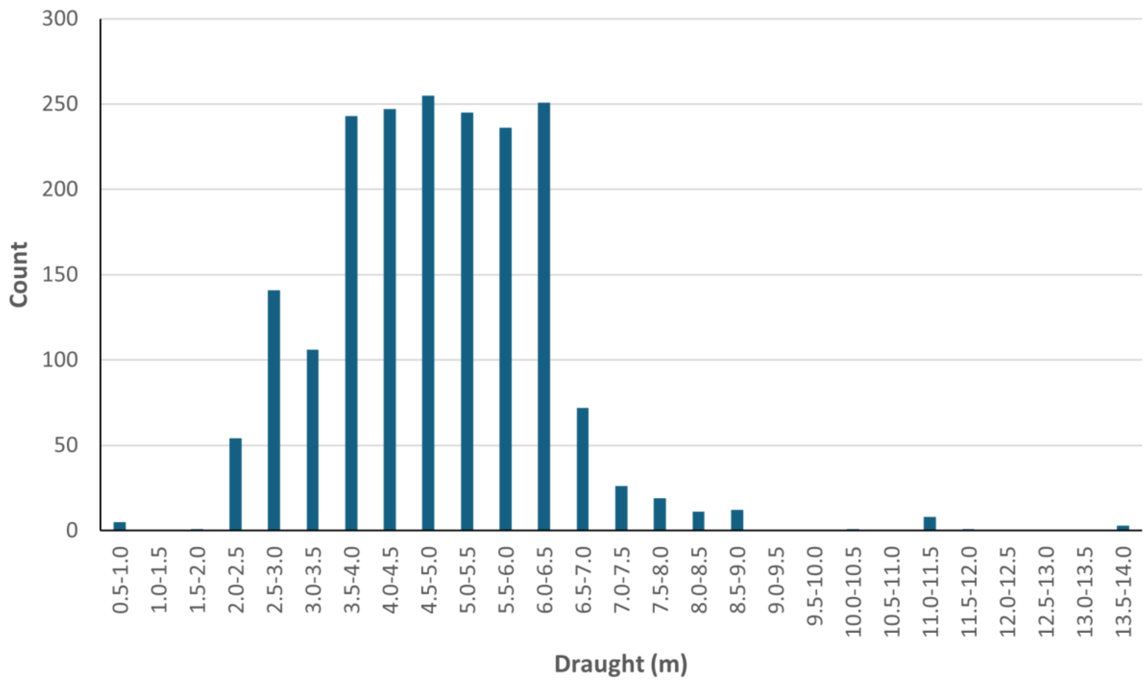

Figure 14.4 Inshore Area Potential Users – Vessel Draughts

274. It is considered likely on this basis that the vast majority of vessels will have a minimum of 3.4 nm of searoom i.e., distance "C" in **Figure 14.2**. The vessels with the very largest draughts may be required to account for the presence of the small area where water depths are circa (c). 18 m water depth above CD east of the WDA,

however available width would still be 2.7 nm. Transits from vessels of this size are expected to be very infrequent based on the vessel traffic data.

14.6.2 Yeoman Vessels

275. During the vessel traffic analysis and relevant consultation throughout this assessment, the importance of Yeoman vessel transits in relation to Glensanda was identified. Vessels operated by Yeoman have been routeing to/from the Port of Glensanda for over 30 years, primarily involved in the export of aggregate materials. Initial discussions with the Port of Glensanda (pre-site refinement) noted that the port were content with the available searoom in the inshore area, and that the majority of Yeoman transits to and from Glensanda occurred through the Sound of Mull (omitting the inshore area).

276. However, due to the importance of Yeoman vessel routeing in the area and noting that two of these vessels were the largest recorded that would likely use the inshore area, all Yeoman vessels recorded within the shipping and navigation study area during the study period were assessed further. These are presented in **Figure 14.5**, with the tracks recorded from the largest draught values (13.8 m) highlighted in red.

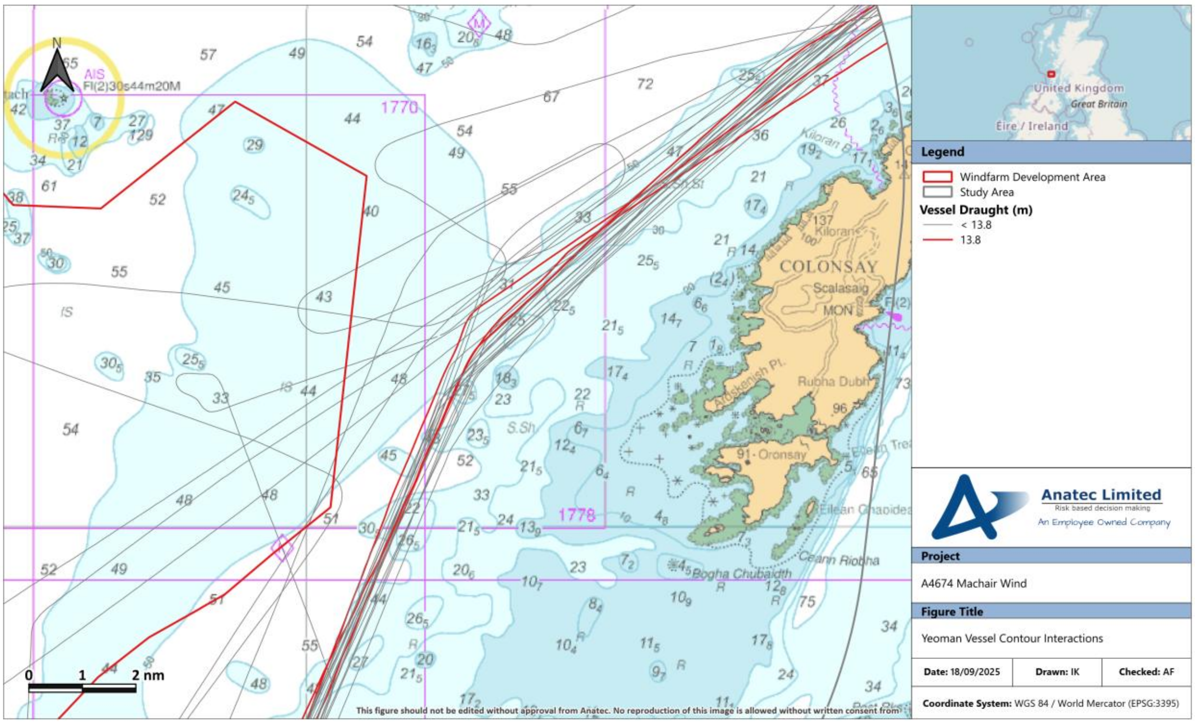

Figure 14.5 Yeoman Vessel Contour Interactions

277. Of the three transits from vessels with 13.8 m draught, two of these passed approximately 0.5 nm from the 18.3 m water depth marker (point "B" in **Figure 14.2)**, with the other passing approximately 0.85 nm from it. These distances would allow for Yeoman vessels to continue passing the 18.3 m water depths at similar distances while still maintaining distances in excess of 1 nm from the WDA.

14.6.3 Consultation Summary

278. Post site-refinement, consultation from the MCA, NLB, CoS, DFDS, and Port of Glensanda indicated contentment with future case vessel transits in the searoom to the east of the WDA (see **Section 4**).

14.6.4 Summary

279. The following key points are noted:

- Average vessel numbers in the inshore area are likely to be relatively low based on the vessel traffic data;
- The vast majority (99%) of potential users are less than 9 m in draught, and as such will have in excess of 3.4 nm of searoom based on available water depths;
- A small minority of larger deeper draughted vessels may be required to account for a spatially small area of water depths c. 18 m above CD, however these vessels will still have a minimum of 2.7 nm of searoom; and
- The MCA, NLB, CoS, DFDS, and the Port of Glensanda have all indicated they are broadly content with the WDA.

15 Cumulative and Transboundary Overview

280. 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.

281. The WDA alone cumulative scenario is considered first in **Section 15.1**. Following this, high level consideration has been provided for a scenario in which the offshore ECC is included in **Section 15.2**.

15.1 Overview of Cumulative Developments for WDA Alone

282. In addition to the Project, there are a number of other offshore developments in the area which may cumulatively impact upon Shipping and Navigation. Based on the criteria in **Section 3.3**, a total of four other developments have been identified for further cumulative assessment within the NRA for the WDA alone. These are the Dubh Artach lighthouse, Òran na Mara and Dunlossit tidal arrays, the Malin Sea OWF, and the Western Link 2 and LirIC subsea cables. These four cumulative developments are within 50 nm of the WDA (the 'cumulative Study Area') and are presented alongside the WDA and post-windfarm main commercial routes (see **Section 14.5**) in **Figure 15.1**.

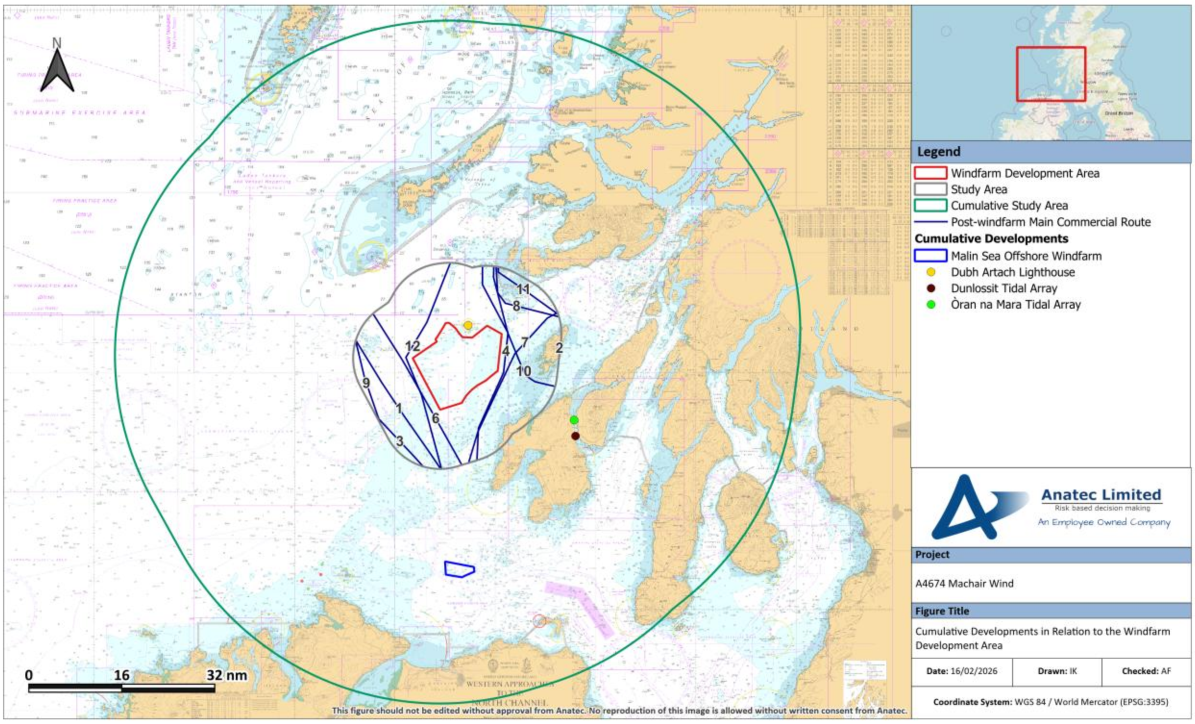

Figure 15.1 Cumulative Developments in Relation to the Windfarm Development Area

283. The Malin Sea OWF is located 26 nm south of the WDA, with the Òran na Mara and Dunlossit tidal array developments located within the Sound of Islay, approximately 15 nm and 17 nm to the southwest of the WDA respectively.

15.1.1 Offshore Windfarms

284. The Malin Sea OWF is a relatively small offshore wind farm development, with a capacity of up to 100 megawatts (MW), and an array area covering approximately 32 square kilometres (km^2) (Malin Sea Offshore Wind, 2026).

285. This development is located adjacent to the TSS in the North Channel, approximately 12 nm to the west, as shown in **Figure 15.2**.

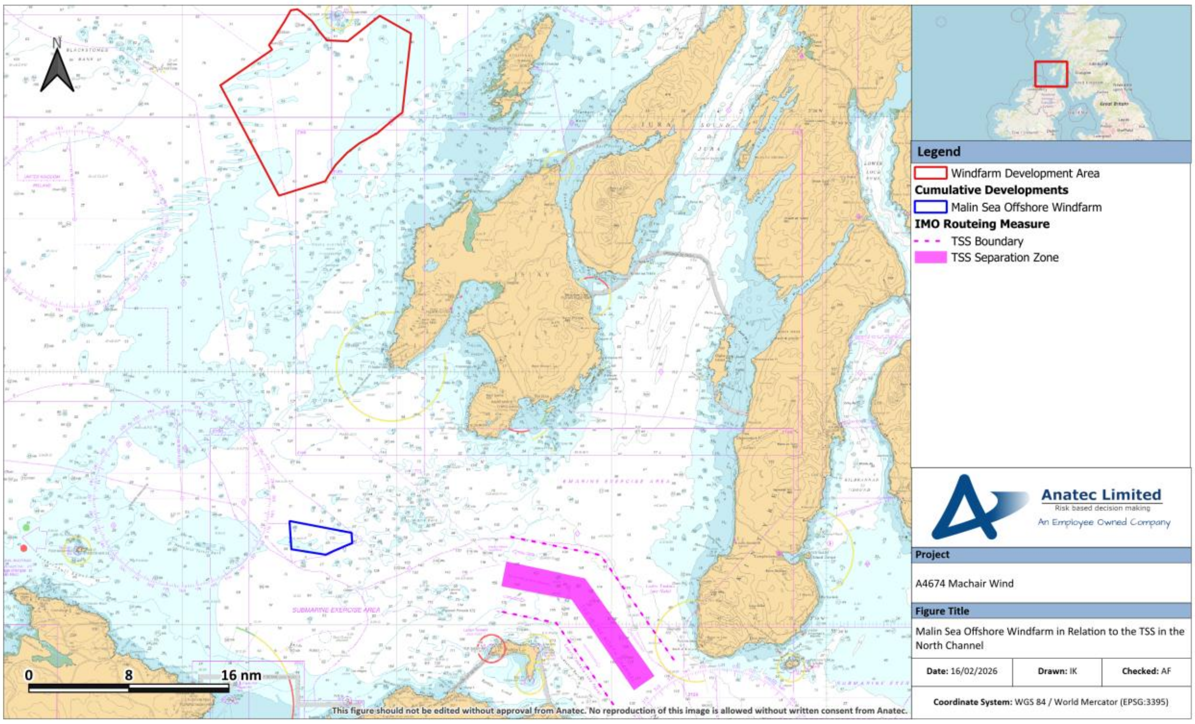

Figure 15.2 Malin Sea Offshore Windfarm in Relation to the TSS in the North Channel

286. The main commercial routes transiting south through the Study Area down the west coast of Scotland will therefore likely pass to the east of the Malin Sea OWF when routeing to the TSS. Likewise, those transiting north up the west coast of Scotland will likely turn north before reaching the Malin Sea OWF, passing west of Islay. There is therefore expected to be very limited interaction between post-windfarm routeing vessels and the Malin Sea OWF, noting the size of the Malin Sea array area is such that any deviations that do occur are likely to low in magnitude. Further, there is a large amount of sea room available between the developments (26 nm) to accommodate any deviated vessels.

287. There may be an overall cumulative increase in project vessel presence within the cumulative Study Area, with this dependent on the ports used for either

development. As such there is a potential for increased encounters and collision risk with third party traffic. However, along with the Applicant, the developer of the Malin Sea OWF is expected to establish appropriate vessel management systems including through marine coordination and as such any encounters will be managed, including by COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974), in addition to development-specific NSP and VMP.

288. Due to the distance between the Project and the Malin Sea OWF, it is unlikely that vessels will experience increased allision risk beyond the localised risk when passing either of the windfarms. In addition, during consultation (see **Section 4**), when queried on cumulative concerns with the Malin Sea OWF, stakeholders agreed that the distance was such that overall concerns were limited based on proximity.

289. Therefore, the Malin Sea OWF development is screened out of the cumulative risk assessment in **Section 19**.

15.1.2 Tidal Arrays

290. Other than general location in the centre of the Sound of Islay, there is limited information available on the Òran na Mara development. The Scoping Report from Òran na Mara states that "Nova will work to the principle that clearance will be at least the minimum required to avoid any navigational issues, taking into consideration local traffic and bathymetry" (Nova Innovation, 2023). This aligns with the requirements of MGN 654, which requires that any subsea tidal development will need to demonstrate that the clearance proposed is safe for navigation. The same applies to the Dunlossit tidal array. On this basis it is considered that vessels will continue to be able to use the Sound of Islay for transit should these developments progress, and as such there is unlikely to be any cumulative displacement.

291. As with the Malin Sea OWF, the developers of the tidal arrays are expected to establish appropriate project vessel management systems to ensure any potential encounters are managed, including COLREGs (IMO, 1972/77), SOLAS (IMO, 1974), and development-specific NSPs and VMPs.

292. It is therefore considered that the Project is unlikely to have any significant cumulative impacts alongside the Òran na Mara and Dunlossit tidal developments, and so both have been screened out of the cumulative risk assessment in **Section 19**.

15.1.3 Lighthouses

293. As raised by MD-LOT and NLB during consultation (see **Section 4**), the Dubh Artach lighthouse is scheduled to undergo refurbishment works (to be completed by 2031), during the first three years planned for construction of the Project.

294. The Dubh Artach lighthouse is presented in relation to the WDA and post-windfarm main commercial routes in **Figure 15.3**. As shown, a 2nm buffer has been retained

between the Dubh Artach lighthouse and the WDA in line with NLB requirements raised during consultation (see **Section 4**).

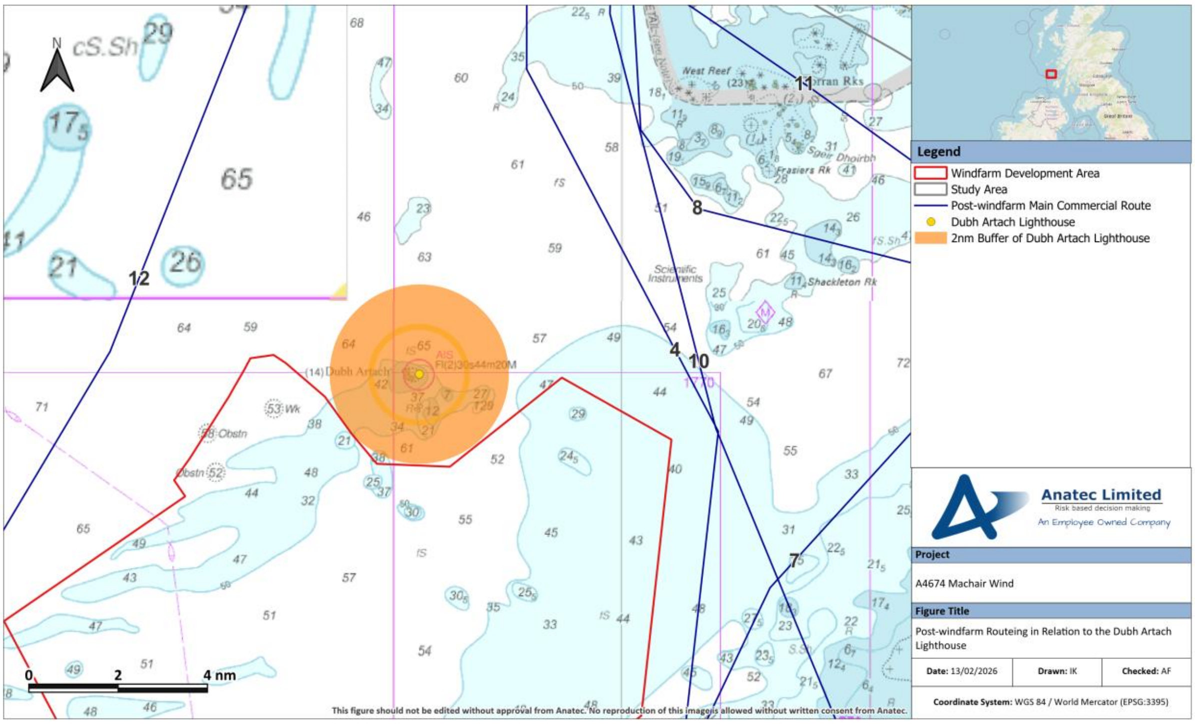

Figure 15.3 Post-windfarm Routeing in Relation to the Dubh Artach Lighthouse

295. With the refurbishment works and project construction occurring at the same time, there may be an increase in the number of vessels in vicinity to the WDA. This may then result in potential cumulative impacts to navigational safety in the area.

296. The Dubh Artach refurbishment works have therefore been screened into the cumulative assessment in **Section 19**.

15.2 Offshore ECC

297. Two subsea cable developments in the vicinity are planned to cross the Offshore ECC. These are the LirIC and Western Link 2 HVDC interconnector projects. Both developments cross the Offshore ECC near to landfall, as presented in **Figure 15.4**. LirIC is planned to connect Hunterston on the west coast of Scotland to Kilroot on the east coast of Northern Ireland. Western Link 2 will connect Ayshire in Scotland to Wales, with stages of the transmission cable from Kilmarnock to Girvan, and from Girvan to Pentir.

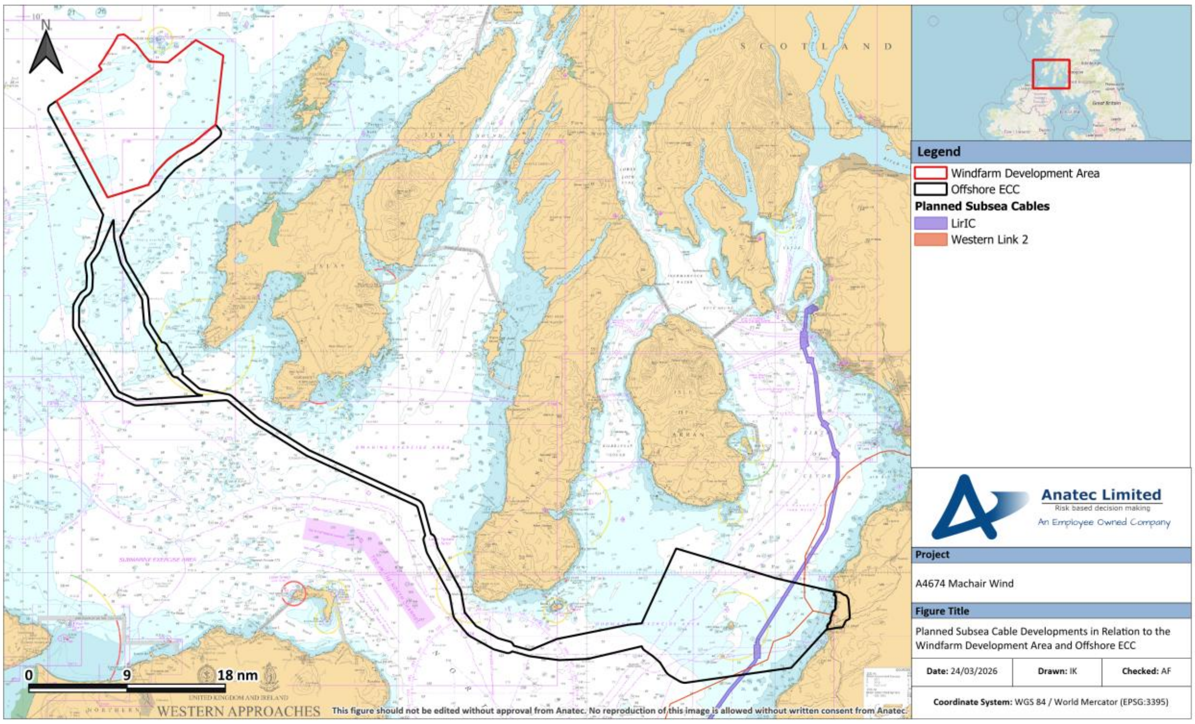

Figure 15.4 Planned Subsea Cable Developments relative to the Windfarm Development Area and Offshore ECC

298. Given the distance from the WDA, there is unlikely to be any cumulative impact from these two cables in a WDA alone scenario. However, there may be cumulative impact with the Offshore ECC.

299. Due to a likely overall cumulative increase in project vessels during construction and maintenance for the subsea cables, there is a potential for displacement leading to increased encounters and collision risk, both with project vessels and other third-party traffic. However, this would be limited to the small spatial area around each vessel, and only applicable during temporary operations involving surface activity. In addition, the relevant developers are expected to also establish appropriate vessel management systems to ensure any potential encounters are managed, and COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974) will be required to be complied with for all associated vessels. Similarly, any impacts from the subsea developments on both access to ports in the area (primarily Girvan) and emergency response access will be limited to the immediate area around each working vessel, with this being temporary in nature, and restricted to construction and periods of maintenance only.

300. The offshore export cables, along with the two subsea cable developments, could result in a reduction in underkeel clearance (particularly at cable crossings) as well as the potential for anchor interaction. However, the spatial extent of these impacts is small, with a vessel required to be in proximity of one of the cables for this to occur. MCA requirements are that cable protection does not reduce water depths by more than 5% (unless it can be demonstrated that any identified risks to any vessel type

are satisfactorily mitigated) and lesser reductions may still be unacceptable in critical areas of navigation e.g., port approaches. This will mitigate any cumulative underkeel risks including at cable crossings where these requirements still apply.

301. All subsea cable developments are also required to ensure the cables are suitably protected against anchors and fishing gear through cable burial or external protection.

302. It is therefore considered that the Project is unlikely to have any significant cumulative impacts alongside the LirIC and Western Link 2 subsea cable developments; and as such, both developments are screened out of the cumulative risk assessment in **Section 19.**

15.3 Summary

303. Based on analysis within this section of the NRA and taking all available information on each development into account, it is considered that there will be a cumulative impact on Shipping and Navigation from the Project and the Dubh Artach lighthouse refurbishment works only. Therefore, this development has been screened into the cumulative risk assessment in **Section 19**, with the others discussed screened out.

16 Collision and Allision Risk Modelling

16.1 Overview

304. To inform the risk assessment (**Section 18**), a quantitative assessment of some of the major hazards associated with the Project has been undertaken. The following subsections outline the inputs and methodology used for the collision and allision risk modelling.

16.1.1 Scenarios Under Consideration

305. For each element of the quantitative assessment, both a pre- and post-windfarm scenario with base and future case traffic levels have been considered. As a result, six distinct cases have been modelled:

- Pre-windfarm with base case traffic levels;
- Pre-windfarm future case with a 10% increase on base case traffic levels;
- Pre-windfarm future case with a 20% increase on base case traffic levels;
- Post-windfarm with base case traffic levels;
- Post-windfarm future case with a 10% increase on base case traffic levels; and
- Post-windfarm future case with a 20% increase on base case traffic levels.

16.1.2 Hazards Under consideration

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

- Increased vessel to vessel collision risk;
- Powered vessel to structure allision risk (post-windfarm only);
- Drifting vessel to structure allision risk (post-windfarm only); and
- Fishing vessel to structure allision risk (post-windfarm only).

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

16.2 Pre-windfarm Modelling

16.2.1 Vessel-to-vessel Encounters

308. An assessment of current vessel to vessel encounters has been undertaken by replaying at high speed the vessel traffic data collected as part of the long-term vessel traffic data (see **Appendix E**). The model defines an encounter as two vessels passing within 1 nm of each other within the same minute. This helps to illustrate where existing shipping congestion is highest and therefore where offshore developments, such as an offshore windfarm, could potentially increase congestion and therefore also increase the risk of encounters and collisions. No account of

whether encounters are head on or stern to head are given; only close proximity is identified for.

309. **Figure 16.1** presents a heat map based upon the geographical distribution of vessel encounter tracks within a density grid. Following this, **Figure 16.2** illustrates the daily number of encounters recorded within the shipping and navigation study area and WDA throughout the survey periods.

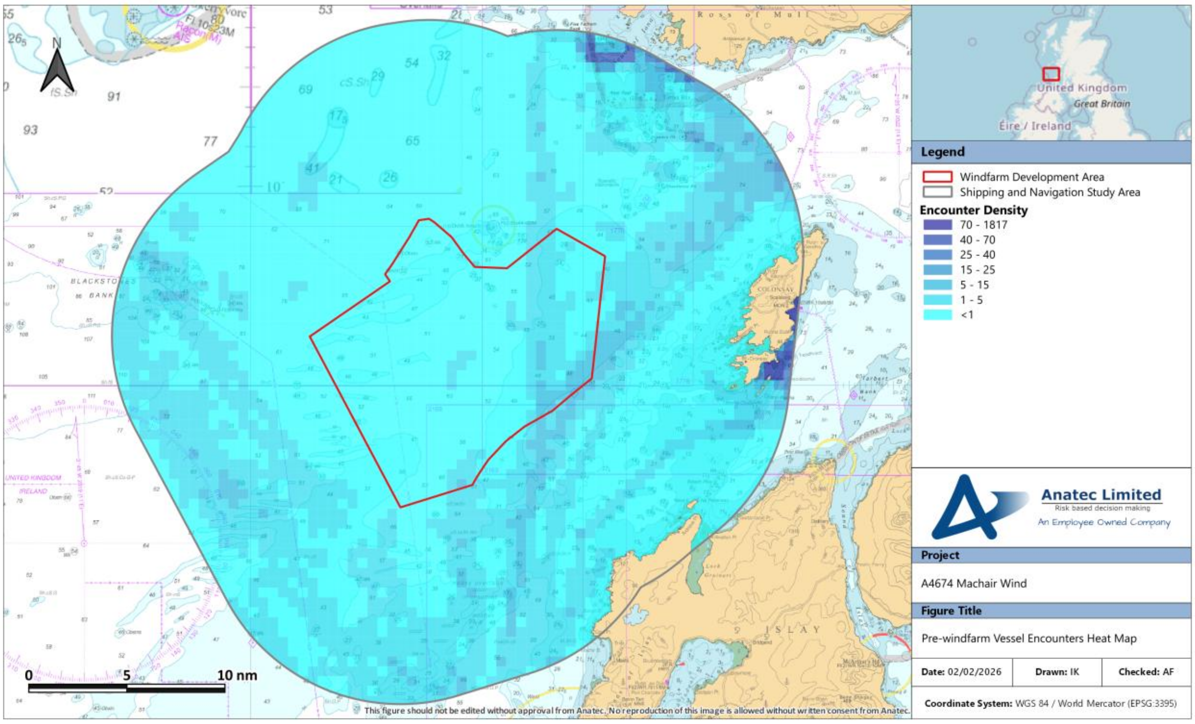

Figure 16.1 Pre-windfarm Vessel Encounters Heat Map

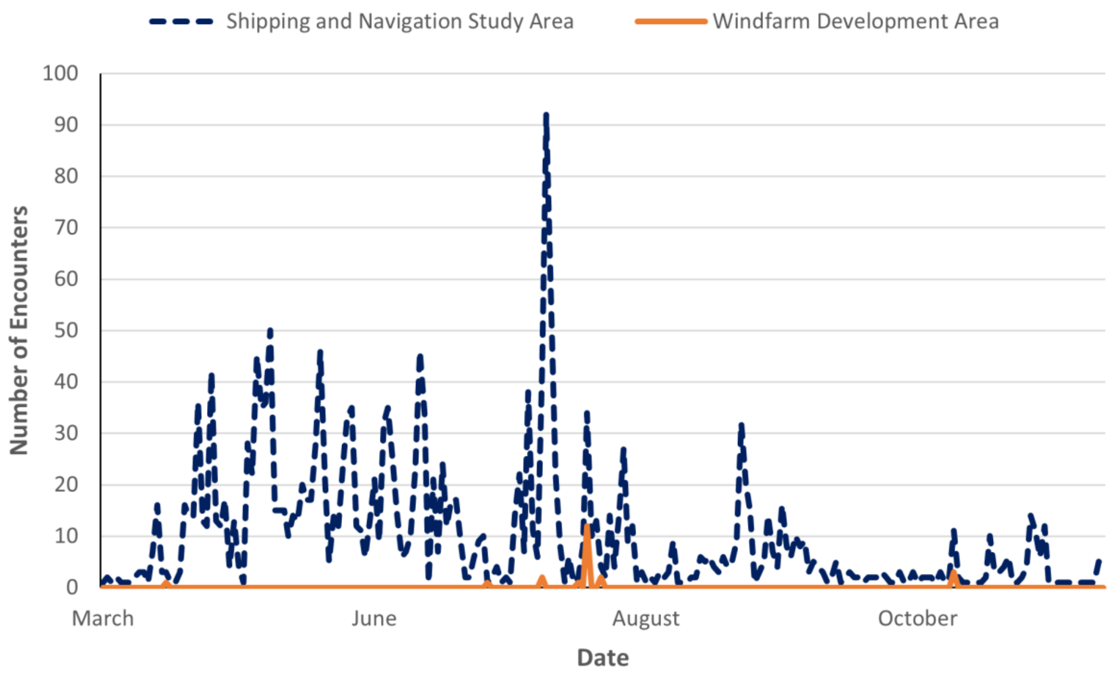

Figure 16.2 Vessel Encounters per Day

310. There was on average six encounters per day within the shipping and navigation study area throughout the long-term data period. The greatest number of encounters recorded in one day was 92, on 13 July 2024. As described within **Appendix E**, in which 13 July 2024 was the busiest day recorded, this is likely due to the Clipper Round the World Yacht Race, of which a leg terminated in Oban between 12 and 16 July 2024. The vessel encounters primarily involved recreational vessels sheltering to the east of Colonsay.

311. Geographically, the largest encounter density values were in proximity to areas of recreational activity on the east of Colonsay and are therefore unlikely to be impacted by the Project.

312. In contrast, an average of one encounter every two weeks was recorded within the WDA throughout the long-term data period. The greatest number of encounters recorded in one day was 12, on 22 July 2024. This coincided with vessels involved in the Clipper race departing from Oban.

313. The most frequent vessel types involved in encounters within the shipping and navigation study area were recreational vessels (31%).

16.2.2 Vessel-to-vessel Collision Risk

314. Using the pre-windfarm vessel routeing as input (see **Section 11.2**), Anatec's COLLRISK model has been run to estimate the existing vessel-to-vessel collision risk

in proximity to the WDA. The route positions and widths are based on the vessel traffic data sources considered (see **Section 4.3**).

315. 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 16.3**.

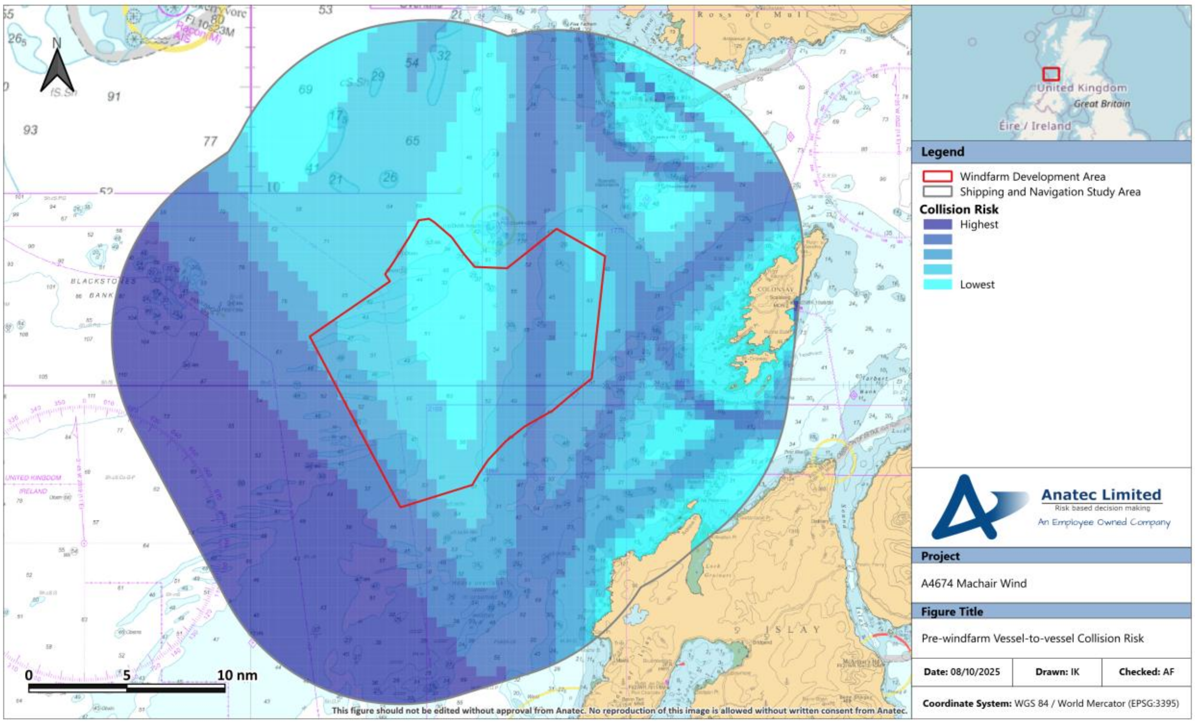

Figure 16.3 Pre-windfarm Vessel-to-vessel Collision Risk

316. The annual collision frequency pre windfarm was estimated to be 4.47×10^{-4}, corresponding to a return period of approximately one in 2,240 years. The highest risk areas generally correspond to the busiest main routes identified in **Section 11.2**.

317. 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 9**.

16.3 Post-windfarm Modelling

16.3.1 Simulated Automatic Identification System

318. Anatec's AIS Simulator software was used to gain an insight into the potential re-routed commercial traffic following the installation of the WDA infrastructure. The AIS Simulator uses the mean positions of the main commercial routes identified within the shipping and navigation study area and the anticipated shift post-windfarm, together with the standard deviations and average number of vessels on each main commercial route to simulate tracks.

319. A figure of 28 days of simulated AIS (matching the total duration of the two 14-day vessel traffic surveys) within the shipping and navigation study area, based on the deviated main commercial routes, is presented in **Figure 16.4**.

320. It is noted that the simulated AIS represents an MDS based on commercial routes passing at a minimum mean distance of 1 nm from the WDA.

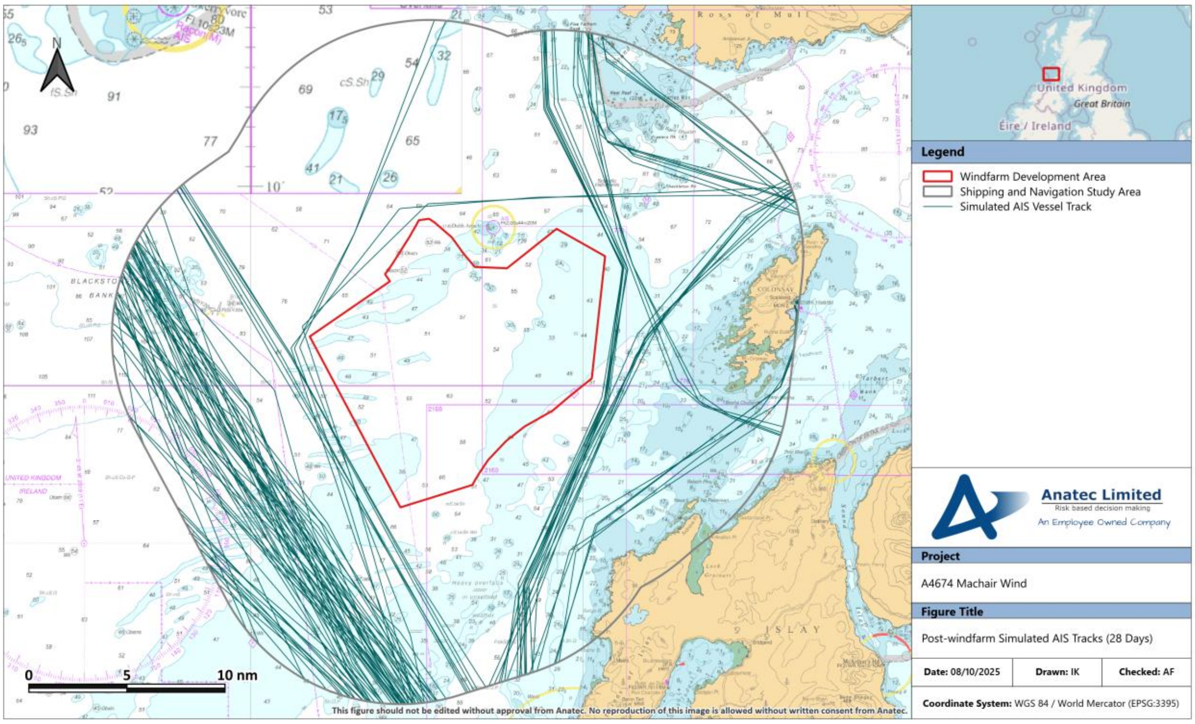

Figure 16.4 Post-windfarm Simulated AIS Tracks (28 Days)

16.3.2 Vessel-to-vessel Collision Risk

321. Using the post-windfarm routeing as input (see **Section 14.5**), Anatec's COLLRISK model has been run to estimate the anticipated vessel to vessel collision risk in proximity to the WDA.

322. 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 16.5**.

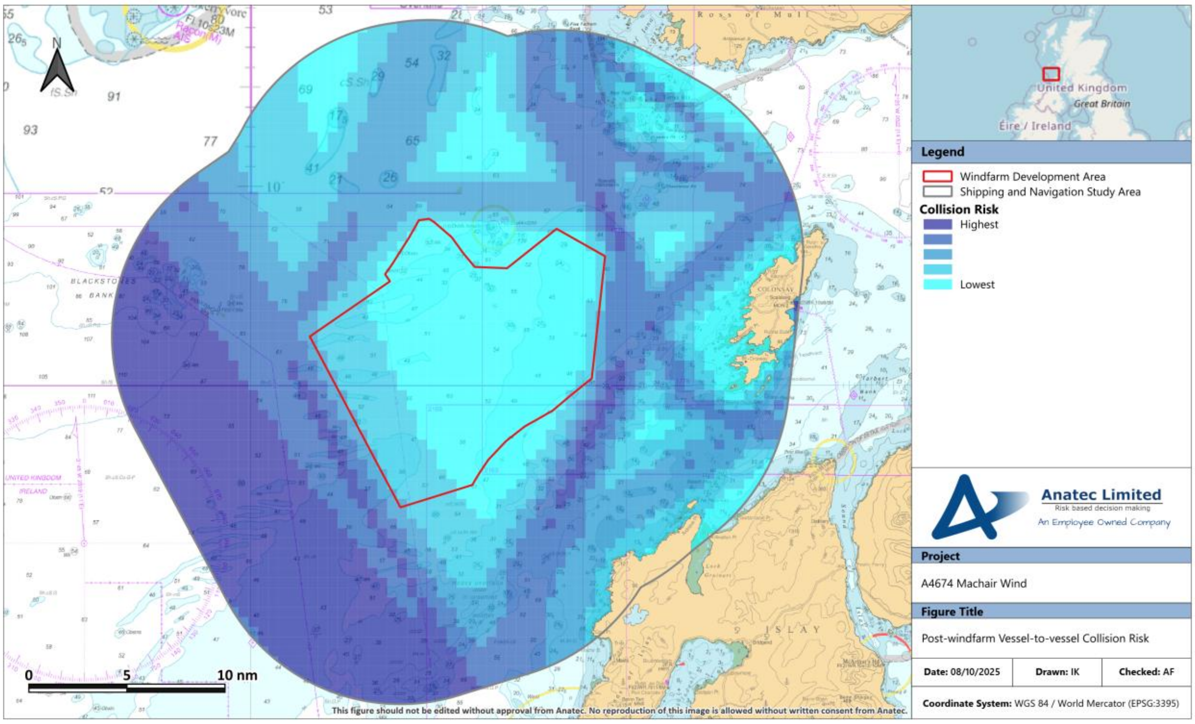

Figure 16.5 Post-windfarm Vessel-to-vessel Collision Risk

323. The annual collision frequency post windfarm was estimated to be 5.72×10^{-4}, corresponding to a return period of approximately one in 1,748 years. This represents a 28% increase in collision frequency compared to the pre-windfarm base case result.

16.3.3 Powered Vessel-to-structure Allision Risk

324. Based upon the vessel routeing identified in the shipping and navigation study area, the anticipated re-routeing as a result of the presence of the Project, and assumptions that relevant embedded mitigation measures are in place (see **Section 17**), the frequency of an errant vessel under power deviating from its route to the extent that it came into proximity with a windfarm structure associated with the Project is considered to be low.

325. From consultation with the shipping industry, it is also assumed that commercial vessels would be highly unlikely to navigate between the WDA infrastructure due to the restricted sea room and will instead be directed by the aids to navigation located in the region and those present at the Project (noting this is observed at other UK offshore windfarms). During the construction and decommissioning phases this will primarily consist of the buoyed construction area whilst during the O&M phase this will primarily consist of the lighting and marking of the WDA infrastructure.

326. Using the post-windfarm routeing as input, together with the worst-case indicative layout and local MetOcean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with the WDA infrastructure within whilst

under power. To maintain an MDS, the model did not consider one structure shielding another.

327. A plot of the annual powered allision frequency per structure for the base case is presented in **Figure 16.6**, with the chart background removed to increase the visibility of those structures with lower allision frequencies.

328. Assuming base case vessel traffic levels, the annual powered allision frequency was estimated to be 2.36×10^{-4}, corresponding to a return period of approximately one in 4,231 years.

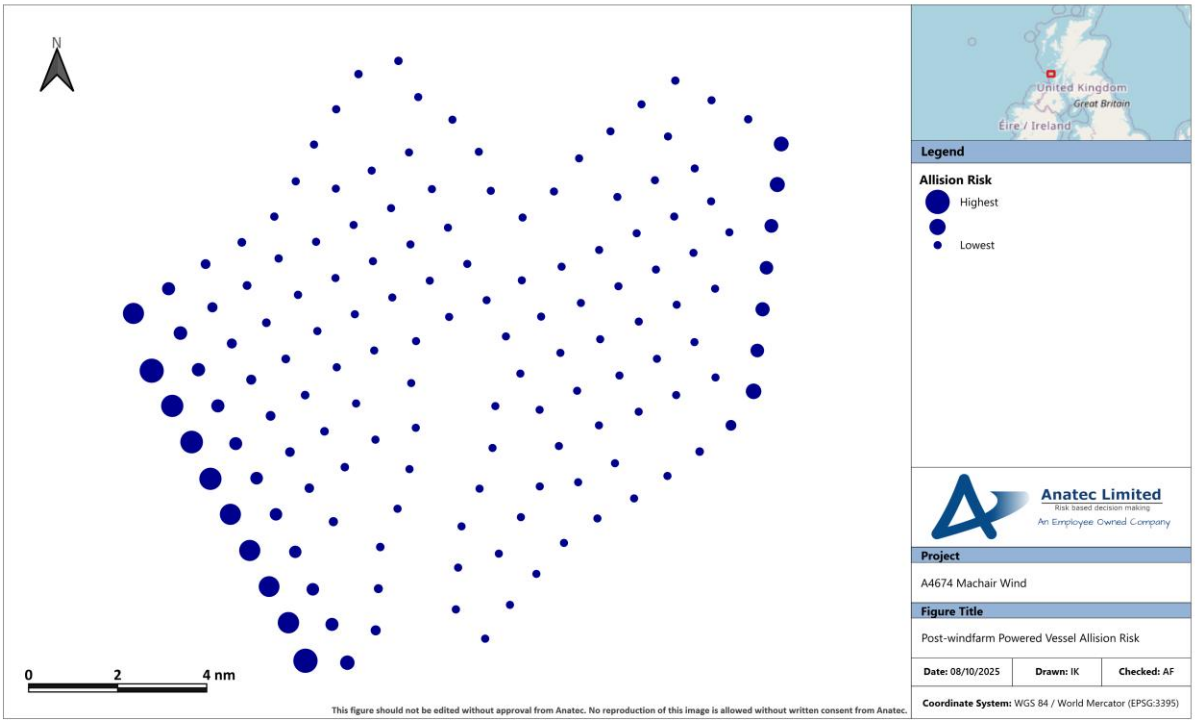

Figure 16.6 Post-windfarm Powered Vessel Allision Risk

329. The greatest powered vessel-to-structure allision risk was associated with the westernmost and easternmost WTGs where high volumes of traffic from multiple main commercial routes pass. The greatest individual allision risk was associated with the WTG on the southwestern periphery of the WDA (approximately 2.18×10^{-5} or one in 45,799 years).

16.3.4 Drifting Vessel-to-structure Allision Risk

330. Using the post-windfarm routeing as input, together with the worst-case indicative layout and local MetOcean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one the WDA infrastructure within the WDA. The model is based on the premise that propulsion on a vessel must fail before drifting will occur. The model takes account of the type and size of the vessel, the

number of engines and the average time required to repair but does not consider navigational errors caused by human actions.

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

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

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

333. After modelling the three drifting scenarios, it was established that the wind-dominated scenario produced the worst-case results. A plot of the annual drifting allision frequency per structure for the base case is presented in **Figure 16.7**, with the chart background removed to increase the visibility of those structures with a low allision frequency.

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

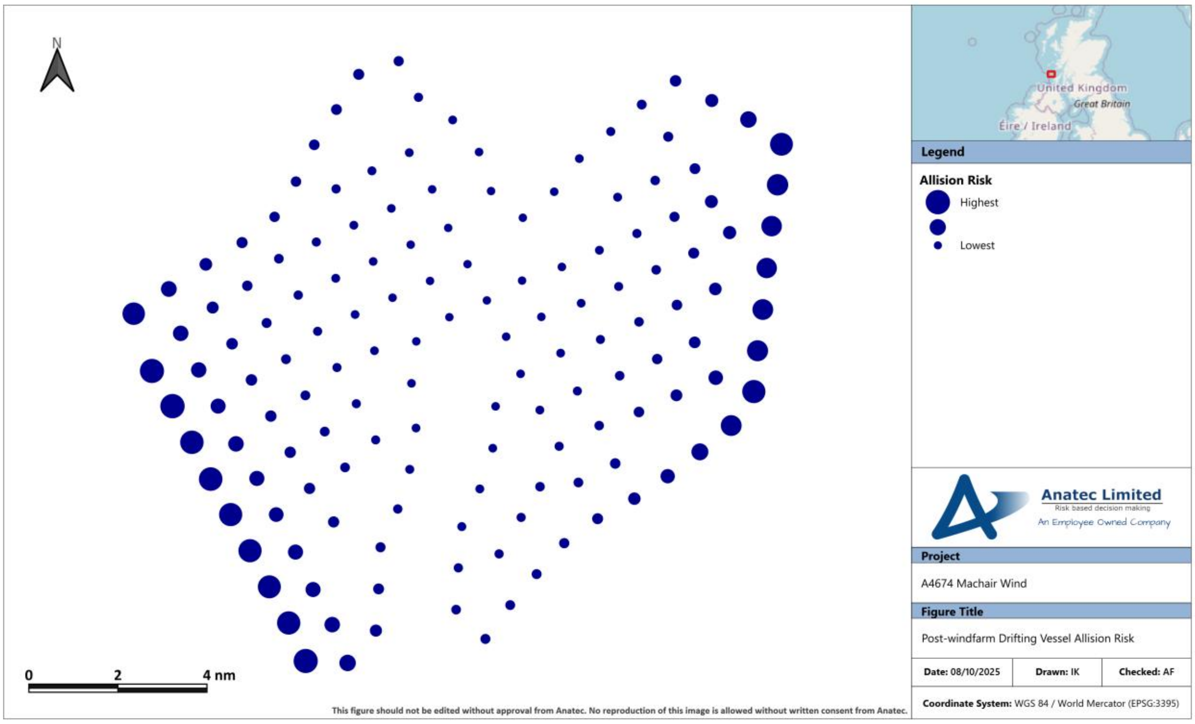

Figure 16.7 Post-windfarm Drifting Vessel Allision Risk

335. Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 6.38×10^{-5}, corresponding to a return period of approximately one in 15,680 years.

336. The greatest drifting vessel to structure allision risk was associated with structures at the western and eastern extents of the WDA. The greatest individual allision risk was associated with a WTG on the western periphery (approximately 3.05×10^{-6} or one in 327,972 years).

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

16.3.5 Fishing Vessel-to-structure Allision Risk

338. Using the vessel traffic survey data as input (both AIS and Radar), Anatec's COLLRISK model was run to estimate the likelihood of a fishing vessel alliding with the WDA infrastructure within the WDA.

339. A fishing vessel allision is classified separately from other allisions since fishing vessels may be located internally within the WDA (unlike the transiting commercial traffic characterised by the main commercial routes). Anatec's model uses vessel numbers, sizes (length and beam), layout, and structure dimensions. The likelihood of a major allision incident has been calibrated against historical maritime incident

data and historical AIS vessel traffic data within operational offshore windfarm arrays.

340. The model assumes no change in baseline fishing activity i.e., no account is made of vessels passing over or in close proximity to structure locations choosing to increase passing distance post-windfarm. This is a highly conservative assumption.

341. A plot of the annual fishing vessel allision frequency per structure for the base case is presented in **Figure 16.8**.

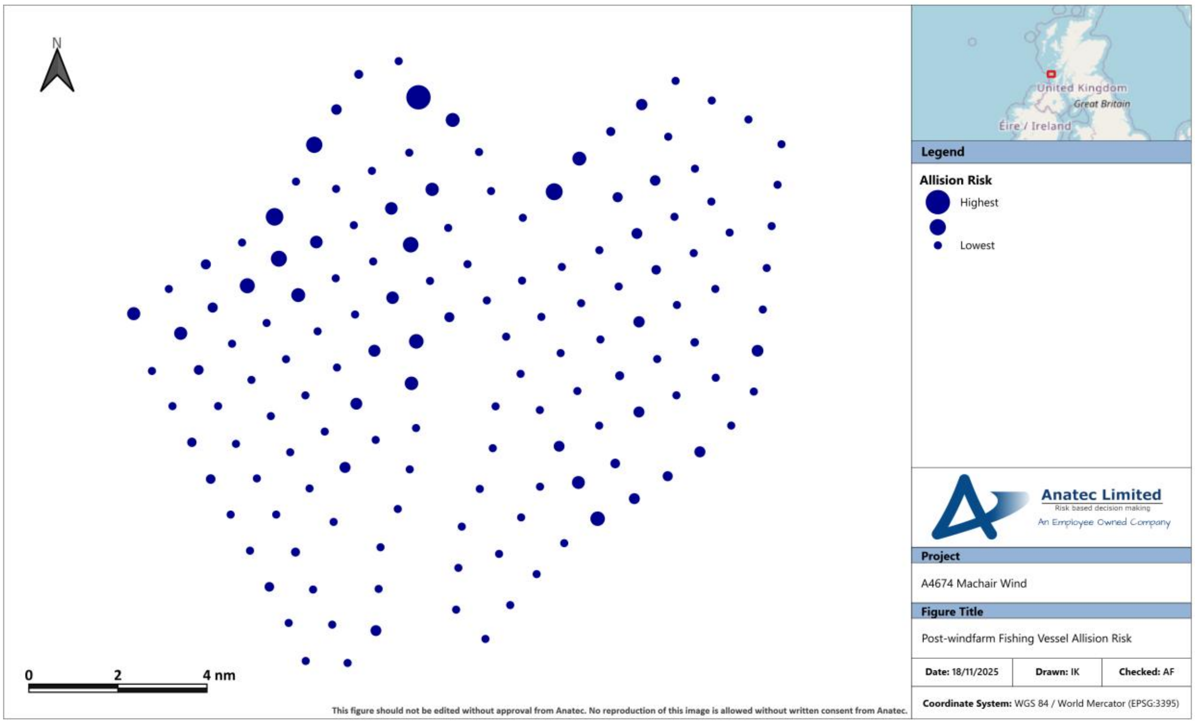

Figure 16.8 Post-windfarm Fishing Vessel Allision Risk

342. Assuming base case traffic levels, the annual fishing vessel to structure allision frequency was estimated to be 7.50×10^{-2}, corresponding to a return period of approximately one in 13 years.

343. The fishing vessel-to-structure allision risk varied throughout, reflecting the distribution of fishing vessels recorded in the vicinity. The greatest individual allision risk was associated with a WTG in the northwestern section of the WDA (approximately 1.33×10^{-2} or one in 75 years).

344. The model is calibrated against known allision incidents within UK offshore windfarms (see **Section 9.6**). Most likely consequences will be a low impact / minor contact with no significant damage, no injuries to persons, and no pollution (in line with incident statistics to date as per **Section 9.6.1**).

16.4 Risk Results Summary

345. The previous subsections modelled two scenarios, namely the pre- and post-windfarm scenarios with base case traffic levels. To incorporate the potential for future traffic growth, pre- and post-windfarm scenarios have also been modelled for future case traffic levels (both 10% and 20% increases). **Table 16.1** summarises the results of all six scenarios for the WDA.

346. Overall, the base case collision and allision frequency due to the presence of the Project was estimated to increase by approximately 7.54×10^{-2} (equating to an additional collision or allision every 13 years).

Table 16.1 Summary of Annual Collision and Allision Risk Results

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Windfarm	Post Windfarm	Change
Vessel to vessel collision	Base case	4.47×10^{-4} (1 in 2,240 years)	5.72×10^{-4} (1 in 1,748 years)	1.25×10^{-4} (1 in 7,969 years)
	Future case (10%)	5.37×10^{-4} (1 in 1,861 years)	6.89×10^{-4} (1 in 1,451 years)	1.52×10^{-4} (1 in 6,591 years)
	Future case (20%)	6.38×10^{-4} (1 in 1,568 years)	8.18×10^{-4} (1 in 1,223 years)	1.80×10^{-4} (1 in 5,554 years)
Powered vessel to structure allision	Base case	-	2.36×10^{-4} (1 in 4,231 years)	2.36×10^{-4} (1 in 4,231 years)
	Future case (10%)	-	2.58×10^{-4} (1 in 3,870 years)	2.58×10^{-4} (1 in 3,870 years)
	Future case (20%)	-	2.82×10^{-4} (1 in 3,550 years)	2.82×10^{-4} (1 in 3,550 years)
Drifting vessel to structure allision	Base case	-	6.38×10^{-5} (1 in 15,680 years)	6.38×10^{-5} (1 in 15,680 years)
	Future case (10%)	-	6.96×10^{-5} (1 in 14,362 years)	6.96×10^{-5} (1 in 14,362 years)
	Future case (20%)	-	7.55×10^{-5} (1 in 13,236 years)	7.55×10^{-5} (1 in 13,236 years)
Fishing vessel to structure allision	Base case	-	7.50×10^{-2} (1 in 13 years)	7.50×10^{-2} (1 in 13 years)
	Future case (10%)	-	8.25×10^{-2} (1 in 12 years)	8.25×10^{-2} (1 in 12 years)
	Future case (20%)	-	9.00×10^{-2} (1 in 11 years)	9.00×10^{-2} (1 in 11 years)
Total	**Base case**	**4.47×10^{-4} (1 in 2,240 years)**	**7.59×10^{-2} (1 in 13 years)**	**7.54×10^{-2} (1 in 13 years)**
	Future case (10%)	**5.37×10^{-4} (1 in 1,861 years)**	**8.35×10^{-2} (1 in 12 years)**	**8.30×10^{-2} (1 in 12 years)**

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Windfarm	Post Windfarm	Change
	Future case (20%)	6.38×10^{-4} (1 in 1,568 years)	9.12×10^{-2} (1 in 11 years)	9.06×10^{-2} (1 in 11 years)

17 Mitigation Measures

347. As part of the design process for the Project, a number of embedded mitigation measures have been adopted to reduce the risk of hazards identified, including those relevant to shipping and navigation.

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

349. The embedded mitigation measures within the design relevant to shipping and navigation are outlined in **Table 17.1**.

Table 17.1 Embedded Mitigation Measures Relevant to Shipping and Navigation

Embedded Mitigation Measure	Description
Application for safety zones.	An application will be made for safety zones post-consent including up to 500 m around ongoing activities during construction, major maintenance and decommissioning and up to 50 m for installed structures pre-commissioning.
Buoyed construction/ decommissioning area.	The construction/decommissioning area will be marked by buoyage as required by NLB. The buoyage will be in accordance with an LMP (which will include details in the management of aids to navigation), which will be created post-consent. An outline LMP has been provided in **Appendix 12 Outline Lighting and Marking Plan**.
Implementation and monitoring of cable protection.	Cables will typically be buried at a target burial depth to be determined by a CBRA. Where cable burial is not possible, cable protection will be applied. This will be agreed through the Cable Plan.
Marking of all offshore infrastructure on Admiralty charts.	All infrastructure associated with the Project (including subsea cables) will be shown on appropriately scaled UKHO Admiralty charts.
Compliance with MGN 654 and its annexes.	The Project will be compliant with MGN 654 and its annexes including in relation to layout design, reductions of no more than 5% in under keel clearance, creation of an ERCoP, and the SAR Checklist. Includes MGN 654 SAR Annex 5 (MCA, 2024).
Guard vessels as required under risk assessment.	A guard vessel(s) will be deployed where deemed appropriate by risk assessment.
Appropriate lighting and marking.	Marking and lighting of the site in agreement with NLB and in line with IALA O139 (IALA, 2021) and G1162 (IALA, 2022). This will be agreed through the LMP which will include details in the management of aids to navigation. This LMP will address concerns on the potential impact to existing aids to navigation.

Embedded Mitigation Measure	Description
Marine coordination.	Marine coordination and communication will be implemented to manage Project vessel movements. This will be included through the Navigational Safety Plan (NSP) and the VMP.
Suitable blade tip clearance.	There will be a minimum blade tip clearance of at least 29 m above MHWS.
Pollution contingency.	A Marine Pollution Contingency Plan (MPCP) will be developed outlining procedures to protect personnel working and to safeguard the marine environment in the event of a pollution event.
Project vessel compliance with international marine regulations	All project vessels entering the WDA will be subject to a Marine and Vessel Assurance process, which verifies compliance with international marine regulations as adopted by the Flag State (including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974), as well as industry guidance and best practice).
Appropriate promulgation of information.	Local Notifications to Mariners and Kingfisher Bulletins will be updated, and a weekly Notice of Operations shall be issued, and reissued at weekly intervals during construction and at least five days prior to planned maintenance works.
Development of and adherence to, a DSLP.	The DSLP will confirm the final array layout to ensure it is suitable for both surface navigation and SAR purposes.

17.1 Marine Aids to Navigation

350. Throughout all phases, aids to navigation will be provided in accordance with NLB and MCA requirements, with consideration being given to IALA Guidance G1162 (IALA, 2022), IALA Recommendation O-139 (IALA, 2021), and MGN 654 (MCA, 2021). As noted within IALA G1162, any proposed deviation from IALA guidance shall be approved by the NLB and MCA if applicable as part of the post consent LMP process.

17.1.1 Marking of Individual WDA Structures

351. As per IALA Guideline G1162, each surface structure within the WDA will be painted yellow from the level of HAT to at least 15 m 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.

352. 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 3 m above sea level and at a distance of at least 150 m from the WTG.

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

17.1.2 Marking of WDA as a Whole

353. The marking of the WDA as a whole will be agreed with NLB once the final 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 NLB, it will be ensured that:

- All corner structures will be marked as an SPS and where necessary, to satisfy the spacing requirements between SPSs, additional periphery structures may also be marked as SPSs;
- Structures designated as an SPS will exhibit a flashing yellow five second (flash yellow every five seconds) light of at least 5 nm nominal range and omnidirectional fog signals as appropriate and where prescribed by NLB, and will be sounded at least when the visibility is 2 nm or less;
- Further periphery structures may be marked as Intermediate Peripheral Structures (IPS) including a flashing yellow light with a distinctly different flash character from those displayed on the SPSs and at least 2 nm nominal range;
- All lights will be visible to shipping through 360˚ and if more than one lantern is required on a structure to meet the all-round visibility requirement, then all the lanterns on that structure will be synchronised;
- All lights will be exhibited at the same height at least 6 m above HAT and below the arc of the lowest WTG blades;
- Remote monitoring sensors using Supervisory Control and Data Acquisition (SCADA) will be included as part of the lighting and marking scope to ensure a high level of availability for all aids to navigation;
- Aviation lighting will be as per Civil Aviation Authority (CAA) requirements and will likely be synchronised Morse “W” at the request of NLB;
- Aviation and SAR lighting will be compatible with Night Vision Imaging System (NVIS) infrared wavelength in line with MCA guidance; and
- All lighting will be considered cumulatively with existing aids to navigation to avoid the potential for light confusion to passing traffic.

17.2 Design Specifications Noted in Marine Guidance Note 654

354. 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) and will be described in full within the ERCoP.

18 Risk Assessment

355. This section provides a qualitative and quantitative risk assessment (using FSA) for the hazards identified due to the development of the Project, based on baseline data, expert opinion, outputs of the Hazard Workshops, stakeholder concerns and lessons learnt from existing offshore developments. The hazards assessed are as follows:

- Vessel displacement and increased third-party vessel to vessel collision risk;
- Increased third-party vessel to project vessel collision risk;
- Reduced access to local ports and harbours;
- Reduction of emergency response capability;
- Vessel-to-structure allision risk (powered, drifting and internal navigation);
- Reduction of under keel clearance; and
- Anchor interaction with subsea cables.

356. For each hazard, embedded mitigation measures which have been identified as relevant to reducing risk are listed, with full descriptions provided in **Section 17**. 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 3.1**.

357. The risk control log (see **Section 20**) summarises the risk assessment and a concluding risk statement is provided (see **Section 22.5**).

18.1 Impact 1: Vessel Displacement and Increased Third-party Vessel to Vessel Collision Risk

18.1.1 Construction

358. Construction activities associated with the Project may displace existing vessel routes or activity in normal or adverse conditions, which may increase the risk of a collision between third-party vessels.

359. These related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

18.1.1.1 Vessel Displacement in Normal Conditions

18.1.1.1.1 Vessel Displacement

360. Vessel traffic data collected during the winter 2023 and summer 2024 surveys has been used to establish the vessel traffic baseline, alongside 12 months of AIS collected via terrestrial receivers between March 2024 and February 2025 (alongside a supplementary seasonal vessel traffic survey). These vessel traffic datasets have been validated by Anatec's ShipRoutes database and analysed to identify the volume of traffic passing within or in proximity to WDA. Additionally, main routes were recognised from these datasets using the principles set out in MGN 654 (MCA, 2021) (see **Section 10**).

361. Although there will be no restrictions on entry into the buoyed construction area, other than through active safety zones, based on experience at previously under construction offshore windfarms and consultation it is anticipated that the significant majority of commercial vessels will choose not to navigate within the buoyed construction area; therefore, some main route deviations are likely to be required. This aligns with outputs of the consultation process (see **Section 4**), with general consensus being that most commercial vessels would choose to pass either inshore or offshore of the WDA.

362. The full methodology for classifying main route deviations is provided in **Section 14.4**, noting it is in line with MGN 654 (MCA, 2021). A deviation will be required for three of the 12 main routes identified within the shipping and navigation Study Area, with details provided in **Table 14.1**. Combined, a total of six vessels per week are estimated to require route deviations due to the WDA, summarised as follows:

- Route 4: four vessels per week, anticipated to deviate inshore of the WDA;
- Route 10: one vessel per week, anticipated to deviate inshore of the WDA; and
- Route 12: one vessel per week, anticipated to deviate offshore of the WDA.

363. The deviations are in general relatively low magnitude, with all three increasing the total route length by less than 0.4%. Route 4 is anticipated to increase distance by the largest, both in absolute and relative terms, with a 2.0 nm increase (equating to a 0.34% increase in total route length).

364. For vessels choosing to pass inshore, reductions on the eastern boundary of the WDA have increased the available searoom for potential users between the WDA and the nearby islands of Colonsay and Islay. Key stakeholders including the MCA, NLB, CoS, DFDS and the Port of Glensanda have confirmed they are content with the reductions made and subsequent searoom when the expected number of vessels and their relative sizes are accounted for i.e., that vessels displaced inshore of the WDA will have sufficient searoom. Further details are provided in **Section 6.1**. The locations of construction buoys near the inshore area will be agreed with NLB as part of the LMP process to ensure that the available searoom remains suitable during the construction phase.

365. For the limited number of displaced vessels choosing to pass offshore, there is searoom to the west to accommodate such deviations, noting that other than the two buoys located approximately 5 nm from the WDA (see **Section 7**), as well as a small section at depth 17.5 m below CD approximately 8 nm to the west, there are no other navigational restrictions in the vicinity. No concerns with the available searoom to the west were raised during consultation, including during the Hazard Workshops.

366. It is noted that no lifeline ferry routes will be impacted by the buoyed construction area. The closest such routeing involves ferry routeing to/from Scalascaig on the

eastern coast of Colonsay, approximately 9.8 nm to the east. Based on consultation outputs (see **Section 4**), only one to two Calmac Ferries per year transit through the shipping and navigation Study Area in proximity to the WDA (with the vessel traffic surveys indicating that the majority of those recorded head to/from the east of Colonsay and are as such unlikely to be impacted by the Project); however these vessels would route inshore of the buoyed construction area.

367. Based on experience at previously-constructed offshore windfarms, it is anticipated that fishing vessels and recreational vessels may also choose not to routinely navigate internally within the buoyed construction area, noting there would be no restriction on transit other than through active safety zones (and that, as per consultation from SWFPA in **Section 4**, this depends both on the WTG characteristics and vessel Master discretion). Safety zones will be applied for and are proposed to entail an area of up to 500 m around structures during construction where activity is ongoing, and up to 50 m around installed structures pre-commissioning. However, fishing vessels and recreational vessels may be more likely to transit through the WDA than commercial vessels, in particular in any areas of the WDA where active construction is not ongoing, or structures are not yet present.

368. For any smaller vessels that do choose to deviate, there is considered to be sufficient searoom outside of the WDA for transits from such vessels to be accommodated, for similar reasoning to that outlined for commercial vessels above.

369. The main consequences of vessel displacement will be increased journey times and distances for affected third-party vessels, under the assumption that the buoyed construction area will be deployed around the maximum extent of the WDA. Any notable safety impacts are considered unlikely given the available searoom. Vessels are expected to comply with international and flag state regulations (including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974)) and will be able to passage plan in advance given the promulgation of information relating to the WDA and relevant nautical charts.

370. Relevant embedded mitigation measures include charting of infrastructure, compliance with MGN 654, promulgation of information, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), and guard vessels. These will ensure an increased awareness from third-party vessels and will also assist in passage planning to limit the extent of deviations.

18.1.1.1.2 Collision Risk

371. From historical incident data, no collision incidents between third-party vessels have occurred directly as a result of a UK offshore windfarm.

372. In poor visibility, third-party vessels may experience limitations regarding visual identification of other third-party vessels, when passing on the periphery of, or inside of, the buoyed construction area if any structures have been installed, with the impact increasing as more structures are installed. This limitation may increase the

potential for an encounter. However, this would be mitigated by the application of the COLREGs (including reduced speeds) in adverse weather conditions. Moreover, the minimum spacing between structures (944 m) will be sufficient to ensure any visual hindrance is very short-term in nature.

373. Based on the pre-windfarm modelling, the baseline collision risk levels within the shipping and navigation Study Area are low, with an estimated vessel to vessel collision risk of one every 2,240 years. This rises to an estimate of a return period of one every 1,568 years for a future case growth of 20% in vessel traffic, due to the volume of traffic in the area relative to available sea space.

374. Post-windfarm, the collision frequency was estimated at one in 1,748 years, representing an additional collision incident every 7,969 years. This rises to an estimated return period of one every 1,223 years for a future case growth of 20% in vessel traffic. This remains a low level of collision risk, which is also reflected when considering future case traffic levels. Reductions made to the WDA throughout the EIA process have facilitated a lower collision risk relative to the boundary at Scoping, with key stakeholders content with navigational safety in the inshore area (see **Section 4**).

375. Due to the likelihood for deviation of routes east of the buoyed construction area (dependent on weather conditions), it is possible that commercial vessels will be displaced closer to inshore areas in which fishing vessels are noted to be actively fishing (see Section **Section 4** and **Section 10**). This may then lead to an increase in encounters between commercial vessels and fishing vessels. However, there will be a low number of commercial vessels expected to be inshore (see **Section 14.6.1**) and with the application of the COLREGs in relation to the exhibiting of appropriate lights and shapes for fishing vessels engaged in fishing, the risk is considered manageable. This aligns with local fisher feedback from the local Hazard Workshop (see Section **Section 4**), there were no concerns expressed regarding collision risk in the sea area between the WDA and Colonsay.

376. Historical collision incident data studied (see **Section 9**) noted a total of one collision within the shipping and navigation Study Area between 2015 and 2024 in the RNLI dataset (a fishing vessel outside the WDA); and one collision between 2005 and 2024 in the MAIB dataset (a recreational vessel inside the WDA). No further details on these collisions are available, including the second vessel involved for each case.

377. 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.

378. Based on historic incident data, should an encounter develop into a collision incident, it is most likely to involve minor contact resulting in minor damage to the vessels with no harm to people and no substantial reputational risks. As a worst-case with

very low frequency of occurrence one of the vessels could receive substantial damage or founder with Potential Loss of Life (PLL) and pollution. Foundering may be more likely where one of the vessels is a small craft (e.g. fishing vessel or recreational vessel) due to the size and stability of the vessel.

379. Relevant embedded mitigation measures include charting of infrastructure, compliance with MGN 654, promulgation of information, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), guard vessels, and vessel marine regulations (i.e., the presence of Project vessels which may be able to assist in the event of an incident). These will ensure an increased awareness from third-party vessels and will also assist in passage planning to limit the extent of deviations.

18.1.1.1.3 Frequency of Occurrence

380. The frequency of occurrence in relation to displacement of vessel traffic resulting in increased third-party collision risk during the construction phase is considered Extremely Unlikely.

18.1.1.1.4 Severity of Consequence

381. The severity of consequence in relation to displacement of vessel traffic resulting in increased third-party collision risk during the construction phase is considered Moderate.

18.1.1.1.5 Significance of Effect

382. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of vessel displacement and increased third-party vessel to vessel collision risk during construction of the Project is considered to be broadly acceptable.

383. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.1.1.2 Vessel Displacement in Adverse Weather

18.1.1.2.1 Qualification of Risk

384. Adverse weather includes wind, wave, and tidal conditions as well as reduced visibility due to fog. Adverse weather can hinder a vessel’s standard route, its speed of navigation and/or its 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 on the actual stability parameters, hull geometry, vessel

type, vessel size and speed. Various stakeholders have noted that the local area to the WDA is known for unfavourable transit conditions.

385. Based on review of the input received, it is unlikely that commercial vessels would choose to make transit through the buoyed construction area during adverse weather conditions. Larger deviations may be required than during more favourable conditions (e.g., vessels may choose to increase passing distance from the buoyed construction area, or vessels that would typically choose to pass inshore may choose to pass offshore). However, with consultation feedback from the MCA noting that the inshore area is of suitable width to allow for safe navigation (see **Section 4**), and due to the distance of the WDA from navigational features to the west (see **Section 7**), there is considered to be sufficient searoom to safely accommodate either transit option.

386. The Applicant engaged with DFDS and the Port of Glensanda throughout the NRA process, with feedback for a site reduction in the eastern portion of the WDA requested by DFDS to provide additional room for vessels transiting inshore in adverse weather. As noted in **Section 6.1**, this was actioned, and as per **Section 4**, DFDS and the Port of Glensanda were content with the site updates made.

387. As noted during consultation (see **Section 4**), the majority of CalMac ferries operate to the east of Colonsay, with these vessels heading to/from destinations further to the east. Due to the location of the WDA west of Colonsay, the Project will not impact upon routeing of these vessels. It was also noted that, if Project vessels chose to shelter east of Colonsay, this may impact CalMac routeing. An outline VMP and NSP are provided in **Appendix 13 Vessel Management Plan and Navigational Safety Plan**, noting that the final version of this document will address anchoring locations. Various factors will go into the decision of anchoring locations if shelter is sought, including baseline routeing in the area including that of CalMac.

388. From a navigational safety perspective, the likely consequences are an increase in delays, deviations or as an unlikely worst-case a cancellation of sailing. However, due to the distance between the WDA and ports in the vicinity, there will likely be sufficient time to plan passage accordingly to allow for minimisation of required deviations. Key stakeholders including DFDS have confirmed they are content with the WDA.

389. Full details of the assessment and consultation undertaken in relation to adverse weather are provided in **Section 12** and **Section 4**, respectively.

390. Relevant embedded mitigation measures include charting of infrastructure, compliance with MGN 654, promulgation of information, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), and guard vessels. These will ensure an increased awareness from third-party vessels and will also assist in passage planning to limit the extent of deviations.

391. It was raised during consultation that consideration would need to be given to the often-challenging conditions in the area regarding loss of buoys and general navigation (see **Section 4**). The LMP will include specific management procedures pertinent to each aid to navigation, to ensure that risks to mariners from the loss of an aid to navigation (either due to confusion on position or an aid to navigation becoming an allision hazard) are minimised. Indicative procedures have been provided in **Appendix 12 Outline Lighting and Marking Plan**, noting that details of this will be agreed in the final LMP once layout positions have been defined. For this hazard, this would pertain to loss of station of a cardinal mark or special mark, loss of key navigational light on a structure which is marked with temporary lighting during construction, and any aid to navigation failing to meet IALA standards.

18.1.1.2.2 Frequency of Occurrence

392. The frequency of occurrence in relation to displacement of vessel traffic in adverse weather during the construction phase is considered Extremely Unlikely.

18.1.1.2.3 Severity of Consequence

393. The severity of consequence in relation to displacement of vessel traffic in adverse weather during the construction phase is considered Serious.

18.1.1.2.4 Significance of Effect

394. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of vessel displacement in adverse weather during construction of the Project is considered to be tolerable.

395. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable with Mitigation** and **not significant** in EIA terms.

18.1.2 Operation and Maintenance

396. The presence of surface-piercing WDA infrastructure, as well as maintenance activities associated with the Project, may displace existing vessel routes or activity which may increase the risk of a collision between third-party vessels.

397. These two related elements are each considered in the subsequent assessment in terms of frequency of occurrence and severity of consequence.

18.1.2.1 Vessel Displacement in Normal Conditions

18.1.2.1.1 Vessel Displacement

398. Based on experience at existing operational offshore windfarms and input during consultation, it is anticipated that the significant majority of commercial vessels will choose not to navigate within the WDA and therefore some main route deviations are likely to be required as per the respective construction phase hazard.

399. The nature of the deviations is expected to be similar to that discussed for the equivalent construction phase hazard, with the deviations in general relatively low magnitude and effective passage planning likely reducing the extent. Further, it is likely that deviations will be well established by the time that construction has been completed and O&M has commenced, with vessels becoming familiar with the Project.

400. The minimum spacing of 944 m between windfarm structures is considered sufficient to accommodate transits of smaller vessels, noting there will be no restrictions on entry into the WDA with the exception of any active 500 m major maintenance safety zones. Based on experience at existing operational offshore windfarms, fishing vessels and recreational vessels may be more likely to navigate through the WDA than commercial vessels (noting that as per consultation from SWFPA in **Section 4**, this depends on the WTG characteristics and vessel Master discretion). It was noted during the local Hazard Workshop that the structure separation distance would likely allow for transit and active fishing operations again at individual Master discretion (see **Section 4**). Given the completion of construction activities and lower frequency of any major maintenance, the level of displacement for these vessels is likely to be reduced during the O&M phase compared to construction.

401. It is noted that displacement of active commercial fishing is assessed separately in **Chapter 12 Commercial Fisheries**.

402. RYA Scotland noted that the WDA is on the direct route from Ireland to the west of Mull, through the Passage of Tiree to the north or to the Western Isles, and that a large deviation would be required to avoid the WDA. These vessels would be free to utilise the WDA for transit should they choose to, noting that the layout will be approved by the Scottish Ministers following consultation with the MCA and NLB to ensure safe surface navigation for vessels choosing to navigate internally.

403. Regarding displacement as a result of project vessel activity in the vicinity, given that any maintenance activities associated with the Project will be less frequent than during the construction phase and localised, the likelihood of vessel displacement due to these activities is considered to be low. Additionally, such activities will likely be limited to within the WDA and therefore not impact upon commercial vessel routeing.

404. The main consequences of vessel displacement will be increased journey times and distances for affected third-party vessels, under the assumption that the WTGs will be built to the full extent of the WDA. Any notable safety impacts are considered unlikely given the available searoom. Vessels are expected to comply with international and flag state regulations (including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974)) and will be able to passage plan in advance given the promulgation of information relating to the Project and relevant nautical charts.

405. Relevant embedded mitigation measures include charting of infrastructure, compliance with MGN 654, promulgation of information, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), guard vessels, and vessel marine regulations.

18.1.2.1.2 Collision Risk

406. As noted for the equivalent construction phase hazard, three of the 12 main routes will likely deviate as a result of the presence of the Project. Post windfarm collision frequency was estimated at one every 1,748 years.

407. Any displacement of commercial vessels due to maintenance activities is not anticipated to affect available searoom to such an extent that the risk of a collision between third-party vessels is materially increased. This is due to the lesser frequency of maintenance activities compared to during construction, spatially limited extent of the maintenance operation at any given time and the likelihood that maintenance activities are located internally with the WDA.

408. An additional factor is the potential for structures to obscure vessels from one another, thus hindering ability to comply with COLREGs (IMO, 1972/77), noting that during O&M all structures will be present. The minimum spacing of 944 m between windfarm structures will likely provide sufficient searoom for visual observations, with full obstruction likely only to occur when vessels are at opposite ends of a row. Collision risk is likely to be low in such cases due to the distance between vessels.

409. In the event of an encounter between third-party vessels arising from displacement during O&M, it is likely to be localised and short in duration, with collision avoidance action implemented by the vessels involved, as per compliance with COLREGs (IMO, 1972/77), to ensure that a collision incident does not develop.

410. As per the respective construction phase hazard, historical collision incident data indicates that the most likely consequences will be low should a collision occur, with minor contact between the vessels resulting in minor damage and no injuries to persons, with the vessels involved able to resume their respective passages and undertake a full inspection at the next port.

411. As with the equivalent construction phase hazard, the displacement of commercial vessels inshore of the WDA may result in closer proximity to fishing vessels actively fishing. This may then lead to an increase in encounters between commercial vessels and fishing vessels but there is sufficient searoom to allow both activities to safely occur with application of the COLREGs.

412. As an unlikely worst-case scenario, a high impact collision event could occur. This may result in vessel foundering and subsequent PLL, as well as pollution. Foundering may be more likely where one of the vessels is a small craft (e.g. fishing vessel or recreational vessel) due to the size and stability of the vessel. In such a circumstance, vessels associated with the Project may attend the incident under SOLAS obligations

and in liaison with the MCA and the procedures within the ERCoP and MPCP would be implemented.

413. Relevant embedded mitigation measures include charting of infrastructure, compliance with MGN 654, promulgation of information, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), guard vessels, and vessel marine regulations (i.e., the presence of Project vessels which may be able to assist in the event of an incident).

18.1.2.1.3 Frequency of Occurrence

414. The frequency of occurrence in relation to displacement of vessel traffic resulting in increased third-party collision risk during the O&M phase is considered Extremely Unlikely.

18.1.2.1.4 Severity of Consequence

415. The severity of consequence in relation to displacement of vessel traffic resulting in increased third-party collision risk during the O&M phase is considered Moderate.

18.1.2.1.5 Significance of Effect

416. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of vessel displacement and increased third-party vessel to vessel collision risk during O&M of the Project is considered to be broadly acceptable.

417. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.1.2.2 Vessel Displacement in Adverse Weather

18.1.2.2.1 Qualification of Risk

418. Based on review of the input received, it is likely that no commercial vessels would choose to make transit through the WDA during adverse weather conditions. Larger deviations may be required than during more favourable conditions (e.g., vessels may choose to increase passing distance from the WDA or transit inshore); however, there is considered to be sufficient searoom to safely accommodate the chosen transits.

419. The Applicant engaged with DFDS and the Port of Glensanda throughout the NRA process, with feedback requesting a site reduction in the eastern portion of the WDA to provide additional room for vessels transiting inshore including in adverse weather. As noted in **Section 6.1**, this was actioned. Stakeholders have since confirmed they are content with the WDA.

420. As noted during consultation (see **Section 4**), the majority of CalMac ferries operate to the east of Colonsay, with these vessels heading to/from destinations further to the east. Due to the location of the WDA west of Colonsay, the Project will therefore

not impact upon routeing of these vessels. It was also noted that, if Project vessels chose to shelter east of Colonsay, this may impact CalMac routeing. An outline VMP and NSP are provided in **Appendix 13 Vessel Management Plan and Navigational Safety Plan**, noting that the final version of this document will address anchoring locations. Various factors will go into the decision of anchoring locations if shelter is sought, including baseline routeing in the area including that of CalMac. Such activity is less likely in O&M when compared to construction.

421. From a navigational safety perspective, worst-case consequences are an increase in delays, deviations or cancellation. However, due to the distance between the WDA and ports in the vicinity, there will likely be sufficient time to plan passage accordingly to allow for minimisation of required deviations. Key stakeholders including DFDS have confirmed they are content with the WDA.

422. Full details of the assessment and consultation undertaken in relation to adverse weather are provided in **Section 12** and **Section 4**, respectively.

423. Relevant embedded mitigation measures include charting of infrastructure, compliance with MGN 654, promulgation of information, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), and guard vessels.

424. It was raised during consultation that consideration would need to be given to the often-challenging conditions in the area regarding loss of buoys and general navigation (see **Section 4**). The LMP will include specific management procedures pertinent to each aid to navigation, to ensure that risks to mariners from the loss of an aid to navigation (either due to a structure being obscured or confusion on position) are minimised. Indicative procedures have been provided in **Appendix 12 Outline Lighting and Marking Plan**, noting that details of this will be agreed in the final LMP once layout positions have been defined. For this hazard, this would pertain to loss of key navigational light on a structure, failure of a sound signal for greater than 120 hours, any aid to navigation failing to meet IALA standards, and throughout significant maintenance works where an increase in navigational risk is posed (such as removal/replacement of a key aid to navigation).

18.1.2.2.2 Frequency of Occurrence

425. The frequency of occurrence in relation to displacement of vessel traffic in adverse weather during the O&M phase is considered Extremely Unlikely.

18.1.2.2.3 Severity of Consequence

426. The severity of consequence in relation to displacement of vessel traffic in adverse weather during the O&M phase is considered Serious.

18.1.2.2.4 Significance of Effect

427. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of vessel displacement in adverse weather during O&M of the Project is considered to be tolerable.

428. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable with Mitigation** and **not significant** in EIA terms.

18.1.3 Decommissioning

18.1.3.1 Vessel Displacement in Normal Conditions

18.1.3.1.1 Qualification of Risk

429. Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, this hazard is expected to be similar in nature to the equivalent construction stage hazard. It is noted that in the case of subsea cables, sections may be left in situ to avoid unnecessarily disturbing the seabed, resulting in fewer areas in which project removal operations would occur, and so less disruption to third-party vessel transits. This would be confirmed through consultation and assessment to ensure the most suitable approach was taken. But for the purposes of this assessment, as a worst-case, it has been assumed that all subsea cables will be removed during decommissioning with only cable protection left in situ. Post-decommissioning, as there will be no requirement for Project vessels to participate in works involving the subsea cables, there will be no impact from the Project on vessel displacement and subsequent increased risk of third-party collisions.

430. The use of a buoyed decommissioning area analogous to the buoyed construction area and decommissioning safety zone analogous to its construction phase equivalent are assumed and will result in similar main route deviations to those established for the equivalent construction stage hazard. By the time of decommissioning, deviations will be well established, with vessels likely to continue on their typical routeing around the buoyed decommissioning area. Assuming removal of the surface-piercing infrastructure, there will be no further need for vessels to deviate post-decommissioning.

431. Relevant embedded mitigation measures would be as per the respective construction phase.

18.1.3.1.2 Frequency of Occurrence

432. The frequency of occurrence in relation to displacement of vessel traffic resulting in increased third-party collision risk during the decommissioning phase is considered Extremely Unlikely.

18.1.3.1.3 Severity of Consequence

433. The severity of consequence in relation to displacement of vessel traffic resulting in increased third-party collision risk during the decommissioning phase is considered Moderate.

18.1.3.1.4 Significance of Effect

434. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of vessel displacement and increased third-party vessel to vessel collision risk during decommissioning of the Project is considered to be broadly acceptable.

435. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.1.3.2 Vessel Displacement in Adverse Weather

18.1.3.2.1 Qualification of Risk

436. Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, this hazard is expected to be similar in nature to the equivalent construction stage hazard. It is noted that in the case of subsea cables, sections may be left in situ to avoid unnecessarily disturbing the seabed, resulting in fewer areas in which project removal operations would occur, and so less disruption to third-party vessel transits. This would be confirmed through consultation and assessment to ensure the most suitable approach was taken. But for the purposes of this assessment (as a worst-case) it has been assumed that all subsea cables will be removed during decommissioning with only cable protection left in situ. The Project will not impact upon vessel displacement in adverse weather once decommissioning has completed assuming all surface piercing infrastructure is removed.

437. Relevant embedded mitigation measures would be as per the respective construction phase.

18.1.3.2.2 Frequency of Occurrence

438. The frequency of occurrence in relation to displacement of vessel traffic in adverse weather during the decommissioning phase is considered Extremely Unlikely.

18.1.3.2.3 Severity of Consequence

439. The severity of consequence in relation to displacement of vessel traffic in adverse weather during the decommissioning phase is considered Serious.

18.1.3.2.4 Significance of Effect

440. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of vessel displacement in adverse weather during decommissioning of the Project is considered to be tolerable.

441. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable with Mitigation** and **not significant** in EIA terms.

18.2 Impact 2: Increased Third-party Vessel to Project Vessel Collision Risk

18.2.1 Construction

18.2.1.1 Qualification of Risk

442. The presence of vessels associated with construction activities of the Project may increase encounters and thus collision risk for vessels already operating in the area.

443. During the construction phase of the Project there may be up to 1,140 vessel movements per year made by up to 117 project vessels on-site simultaneously. This will include large vessels including those which are RAM. It is assumed that construction vessels will be on-site throughout the entire duration of the construction phase.

444. Encounters and collision risk involving project vessels will be managed through the implementation of marine coordination with full details of this to be provided in the NSP and VMP. Project vessels will also be expected to carry AIS and comply with flag state regulations including the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974). COLREGs will remain the navigational priority for project vessels at all times.

445. Applications for safety zones of 500 m around structures with on-going construction activities will be sought during the construction phase and will protect deployed project vessels. Minimum advisory passing distances and guard vessels, as defined by risk assessment, may also be implemented where safety zones do not apply, for example around cable installation vessels. Details of safety zones, minimum safe passing distances and guard vessels will be promulgated including via Notifications to Mariners and Kingfisher Bulletins.

446. Appropriate marine lighting and marking during construction including the buoyed construction area will be set out in the LMP for approval by the Scottish Ministers following consultation with the NLB. These navigational aids will increase mariner awareness when in proximity to ongoing construction works and sensitive operations in the WDA.

447. Third-party vessels may experience decreased capability to visually identify project vessels entering and exiting the WDA during reduced visibility; however, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and the mandatory carriage of AIS by project vessels regardless of size.

448. Based on historical incident data, there has been one instance of a third-party vessel colliding with a project vessel in the UK (see **Section 9** for further details). In this case, moderate vessel damage was reported with no harm to persons. It is noted that the incident occurred in 2011 and awareness of offshore wind developments and application of the measures outlined above has improved and been refined considerably in the interim, with no further collision incidents reported since.

449. If an encounter between a project vessel and third-party vessel occurs, it is likely to be localised and short in duration. Assuming the implementation of collision avoidance action as required by the COLREGs, the most likely outcome will be any vessels involved being able to resume their respective passages or activities with no long-term consequences.

450. In the event of a collision, the likely consequences will be minor contact between the vessels resulting in minor damage and no injuries to persons. As an unlikely worst-case scenario, foundering could occur resulting in PLL and pollution. Foundering may be more likely where one of the vessels is a small craft (e.g., fishing vessel, recreational vessel, or Crew Transfer Vessel (CTV)) due to the size and stability of the vessel. Other project vessels may be able to assist in the event of a collision under SOLAS obligation and the adherence to the ERCoP, noting this would be done in liaison with the MCA. If pollution were to occur in proximity to the WDA or involving a project vessel, the MPCP will be implemented to reduce the risks.

451. As noted during consultation (see **Section 4**), there is the potential for a construction buoy to drift off-station. An outline LMP has been included within **Appendix 12 Outline Lighting and Marking Plan** to provide monitoring and management plans to facilitate IALA availability requirements to be met and include details of the process to be followed in the event that a buoy does lose station. Full details will be expanded in the finalised post-consent version of this document.

452. Relevant embedded mitigation measures include advisory passing distances, application for safety zones, buoyed construction / decommissioning area, charting of infrastructure, guard vessels, marine coordination for Project vessels, pollution planning, Project vessel compliance with international marine regulations (i.e., COLREGs), and promulgation of information.

18.2.1.2 Frequency of Occurrence

453. The frequency of occurrence in relation to encounters and collision risk between project vessels and third-party vessels during the construction phase is considered to be Extremely Unlikely.

18.2.1.3 Severity of Consequence

454. The severity of consequence in relation to encounters and collision risk between project vessels and third-party vessels during the construction phase is considered to be Moderate.

18.2.1.4 Significance of Effect

455. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of encounters and collision risk between project vessels and third-party vessels during construction of the Project is considered to be broadly acceptable.

456. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.2.2 Operation and Maintenance

18.2.2.1 Qualification of Risk

457. The presence of vessels associated with maintenance activities of the Project may increase encounters and thus collision risk for vessels already operating in the area. During the O&M phase of the Project there may be up to 423 vessel movements annually (during major maintenance; i.e. likely fewer during normal operations). This will include vessels which are RAM.

458. As for the construction phase, encounter and collision risk involving project vessels will be managed through the implementation of marine coordination as will be set out in the NSP and VMP. Project vessels will also be expected to carry AIS and comply with flag state regulations including the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974). COLREGs will remain the navigational priority for project vessels at all times.

459. Applications for safety zones of 500 m around structures with major maintenance activities during O&M will be sought and will protect deployed project vessels. Minimum advisory passing distances and guard vessels, as defined by risk assessment, may also be implemented where safety zones do not apply. Details of safety zones, minimum safe passing distances and guard vessels will be promulgated including via Notifications to Mariners and Kingfisher Bulletins.

460. Appropriate operational marine lighting and marking will be set out in an LMP for approval by the Scottish Ministers, following consultation with the NLB. These navigational aids will increase mariner awareness when in proximity to the WDA. In the event of the loss of an aid to navigation, procedures detailed within the LMP will be followed to minimise disruption to navigation (as discussed with key stakeholders including the MCA). This LMP will be finalised post-consent.

461. Third-party vessels may experience decreased capability to visually identify project vessels during reduced visibility, especially if visual observations are obscured by WTGs. However, this hazard will be mitigated by the application of the COLREGs (reduced speeds) in adverse weather conditions and the mandatory carriage of AIS by project vessels regardless of size.

462. As discussed in the equivalent construction phase hazard, there has been one instance of a third-party vessel colliding with a project vessel in the UK (moderate vessel damage reported with no harm to persons). This incident occurred in 2011, and awareness of offshore wind developments and application of the measures outlined above has improved and been refined considerably in the interim, with no further collision incidents reported since. If an encounter between a project vessel and third-party vessel occurs, it is likely to be localised and short in duration.

Assuming the implementation of collision avoidance action as required by the COLREGs, the most likely outcome will be any vessels involved being able to resume their respective passages or activities with no long-term consequences.

463. In the event of a collision, the likely consequences will be minor contact between the vessels resulting in minor damage and no injuries to persons. As an unlikely worst-case scenario, foundering could occur resulting in PLL and pollution. Foundering may be more likely where one of the vessels is a small craft (e.g., fishing vessel, recreational vessel, or CTV) due to size and stability. Other project vessels may be able to assist in the event of a collision under SOLAS obligation and the adherence to the ERCoP, noting this would be done in liaison with the MCA. If pollution were to occur in proximity to the Project or involving a project vessel, the MPCP will be implemented to reduce the risks.

464. Relevant embedded mitigation measures include advisory passing distances, application for safety zones, charting of infrastructure, guard vessels, marine coordination for Project vessels, pollution planning, Project vessel compliance with international marine regulations (i.e., COLREGs), and promulgation of information.

18.2.2.2 Frequency of Occurrence

465. The frequency of occurrence in relation to encounters and collision risk between project vessels and third-party vessels during the O&M phase is considered to be Extremely Unlikely.

18.2.2.3 Severity of Consequence

466. The severity of consequence in relation to encounters and collision risk between project vessels and third-party vessels during the O&M phase is considered to be Moderate.

18.2.2.4 Significance of Effect

467. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of encounters and collision risk between project vessels and third-party vessels during O&M of the Project is considered to be broadly acceptable.

468. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.2.3 Decommissioning

18.2.3.1 Qualification of Risk

469. The presence of vessels associated with decommissioning activities of the Project may increase encounters and thus collision risk for vessels already operating in the area.

470. Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them, including the vessels involved, this hazard is expected to be similar in nature to the equivalent construction phase, including the number of vessel movements by decommissioning vessels. It is noted that in the case of subsea cables it is expected that they will be left in situ (resulting in fewer areas in which project removal operations would occur, and so less disruption to third-party vessel transits) but for the purposes of this assessment (as a worst-case) it has been assumed that all cables will be removed during decommissioning, with only cable protection left in situ. As Project vessels will not be on-site post-decommissioning, there will be no impact upon third-party to Project vessel collision risk, assuming that all surface-piercing infrastructure is removed.

471. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

18.2.3.2 Frequency of Occurrence

472. The frequency of occurrence in relation to encounters and collision risk between project vessels and third-party vessels during the decommissioning phase is considered to be Extremely Unlikely.

18.2.3.3 Severity of Consequence

473. The severity of consequence in relation to encounters and collision risk between project vessels and third-party vessels during the decommissioning phase is considered to be Moderate.

18.2.3.4 Significance of Effect

474. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of encounters and collision risk between project vessels and third-party vessels during decommissioning of the Project is considered to be broadly acceptable.

475. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.3 Impact 3: Reduced Access to Local Ports and Harbours

18.3.1 Construction

18.3.1.1 Qualification of Risk

476. Activities associated with the construction of structures and cables may displace existing routes/activity restricting access to ports/harbours.

477. Up to 1,140 vessel movements per year by construction vessels may be made throughout the construction phase and will include vessels which are RAM. The Project has concluded a preliminary study of which ports may be suitable sufficient for construction and Hunterston, Kishorn and Stornoway seem to be potentially suitable at this stage. However, the Project will decide on which ports to use post-consent. Project vessels will be managed by marine coordination, including the use of traffic management procedures such as the designation of entry and exit points to and from the buoyed construction area and indicative routes to and from construction ports. Project vessels will also carry AIS and be compliant with flag state regulations including the COLREGs (IMO 1972/77); there is therefore not anticipated to be an impact on port access from project vessels.

478. In terms of the WDA itself, the closest port or harbour is Port Ellen, located approximately 24 nm to the southeast. Given the relative distance to ports in the vicinity and the anticipated deviations for the main commercial routes, it is not anticipated that there will be any substantial effect on vessel approaches to and from these beyond the deviations already outlined for impacts on vessel displacement arising from the buoyed construction area.

479. As identified during the EIA process, regular vessel transits to/from the Port of Glensanda occurred throughout the study period, and thus future transits of a similar nature may be affected. The Port of Glensdanda were therefore consulted with, as per **Section 4**. As noted by the Port of Glensanda, the majority of vessels transit through the Sound of Mull as opposed to the area in which the WDA lies, and as such would be unaffected by the Project. In addition, the port noted that the searoom between Colonsay and the eastern boundary of the WDA is suitable for transits should they occur.

480. Due to the distance to nearby ports and harbours in the area, as well as the acknowledgement of the Port of Glensanda that regular commercial vessels to/from Glensanda will be unaffected, the WDA infrastructure and buoyed construction area are considered not likely to result in a reduction in port access past the deviations highlighted in **Section 18.1**.

481. The most likely consequences are increased journey times and distances, as per the vessel displacement hazard. As there are no pilot boarding stations in the vicinity of the Project, no effect is anticipated on port related services such as pilotage.

482. Relevant embedded mitigation measures include compliance with MGN 654, charting of infrastructure, and promulgation of information.

18.3.1.2 Frequency of Occurrence

483. The frequency of occurrence in relation to reduced access to local ports and harbours during the construction phase is considered to be Remote.

18.3.1.3 Severity of Consequence

484. The severity of consequence in relation to reduced access to local ports and harbours during the construction phase is considered to be Minor.

18.3.1.4 Significance of Effect

485. Taking the frequency of occurrence as remote and the severity of consequence as minor, the overall effect of reduced access to local ports and harbours during construction of the Project is considered to be broadly acceptable.

486. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.3.2 Operation and Maintenance

18.3.2.1 Qualification of Risk

487. Activities associated with the maintenance of structures and cables may displace existing routes/activity restricting access to ports/harbours.

488. Up to 423 vessel movements annually by O&M vessels may be made throughout the O&M phase, which will include vessels which are RAM. The Project has concluded a preliminary study of which ports may be suitable sufficient for O&M and Campbeltown, Hunterston, or the King George V dock of Glasgow are potentially suitable. This will be decided post-consent, however. Project vessels will be managed by marine coordination, including the use of traffic management procedures such as the designation of entry and exit points to and from the WDA and indicative routes to and from the base port. Project vessels will also carry AIS and be compliant with flag state regulations including the COLREGs (IMO 1972/77); there is therefore not anticipated to be an impact on ports access from project vessels.

489. As discussed in the baseline description and equivalent construction phase hazard, the closest port or harbour is Port Ellen, located approximately 24 nm to the southeast. In addition to the distances to nearby ports and subsequent limited impacts that will likely occur on these ports, it is expected that vessel patterns in the area will be well established by the O&M phase (including transits to Glensanda). It is therefore not anticipated that there will be any substantial effect on vessel

approaches to and from here beyond the deviations already outlined for impacts on vessel displacement.

490. The most likely consequences are increased journey times and distances, as per the vessel displacement hazard. As there are no pilot boarding stations in the vicinity of the Project, no effect is anticipated on port-related services such as pilotage.

491. Relevant embedded mitigation measures include advisory passing distances, compliance with MGN 654, charting of infrastructure, and promulgation of information.

18.3.2.2 Frequency of Occurrence

492. The frequency of occurrence in relation to reduced access to local ports and harbours during the O&M phase is considered to be Extremely Unlikely.

18.3.2.3 Severity of Consequence

493. The severity of consequence in relation to reduced access to local ports and harbours during the O&M phase is considered to be Minor.

18.3.2.4 Significance of Effect

494. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as minor, the overall effect of reduced access to local ports and harbours during O&M of the Project is considered to be broadly acceptable.

495. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.3.3 Decommissioning

18.3.3.1 Qualification of Risk

496. Decommissioning activities associated with the removal of structures and cables may displace existing routes/activity restricting access to ports/harbours.

497. Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them (and as, although it is expected that subsea cables will be left in situ, for the purposes of this assessment it has been assumed that all cables will be removed during decommissioning as worst-case with only cable protection left in situ), this hazard is expected to be similar in nature to the equivalent construction phase. This includes the number of vessel movements by decommissioning vessels. Once decommissioning vessels have ceased operations, there is not expected to be an impact upon access to local ports and harbours due to the Project.

498. As with the construction stage, it is not yet known from which port(s) decommissioning activity will be based for the Project; at an indicative level however, these will likely be located at either Hunterston, Kishorn, or Stornoway.

499. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

18.3.3.2 Frequency of Occurrence

500. The frequency of the risk of reduced access to local ports and harbours during the decommissioning phase is considered to be Remote.

18.3.3.3 Severity of Consequence

501. The severity of consequence of the risk of reduced access to local ports and harbours during the decommissioning phase is considered to be Minor.

18.3.3.4 Significance of Effect

502. Taking the frequency of occurrence as remote and the severity of consequence as minor, the overall effect of reduced port access during decommissioning of the Project is considered to be broadly acceptable.

503. Hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.4 Impact 4: Reduction of Emergency Response Capability

18.4.1 Construction

18.4.1.1 Qualification of Risk

504. The presence of structures (including partially completed structures) as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the construction phase of the Project by increasing the number of incidents, increasing consequences, or reducing access for the responders.

505. The spatial extent of this hazard is large given the area covered by the WDA (131 nautical miles squared (nm^2)) within the buoyed construction area, as well as the distance covered by air-based SAR support (the nearest SAR helicopter base is located at Prestwick, 71 nm southeast of the WDA). However, it is unlikely that a SAR operation will require the entirety of the buoyed construction area to be searched, and it is probable that a search will be restricted to a smaller area in which a casualty is known to be located (accounting for assumptions on any potential drift of the casualty).

506. During the construction phase of the Project there may be up to 1,140 vessel movements per year made by up to 117 project vessels on-site simultaneously. The presence of these vessels increases the likelihood of an incident and subsequently increases the likelihood of multiple incidents occurring simultaneously, diminishing emergency response capability. However, in the event of an incident involving a project vessel occurring in proximity to the WDA, it may be possible for Project personnel to coordinate a response independently, in liaison with the MCA.

507. Similarly, project vessels may also be able to provide additional response resource in the event of an incident involving third-party vessels, dependent on the Project vessels available, the casualty vessel(s), and the nature of the incident. Again, this would be undertaken in liaison with the MCA.

508. Of the potential impacts on reduction of emergency response capability, the most likely would be a delay to any emergency response request. As an unlikely worst-case, this could lead to a failure of emergency response to an incident resulting in PLL and pollution. However, project vessels will be managed via marine coordination, and the presence of project vessels themselves may mitigate this risk as they may assist at incidents involving other project vessels under the obligation of SOLAS (IMO, 1974) and adherence to an ERCoP, noting this would be undertaken with liaison with the MCA. The MPCP will also be implemented should pollution occur.

509. From recent SAR data, there was an average of two to three SAR taskings per year recorded throughout the ten-year period within the shipping and navigation Study Area, although none were recorded within the WDA itself. The frequency of incidents in proximity to the WDA is not anticipated to increase significantly from the current level given the measures noted above which will be in place.

510. The layout will be approved by the Scottish Ministers following consultation with the MCA and in line with MGN 654 requirements to ensure any SAR operations that do occur within the WDA are facilitated. This will ensure both the final layout and any interim scenarios during construction facilitate SAR access. A SAR checklist will also be completed and agreed with the MCA as required under MGN 654.

511. Relevant embedded mitigation measures include compliance with MGN 654, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), marine coordination for Project vessels, pollution planning, and Project vessel compliance with international marine regulations (i.e., SOLAS).

18.4.1.2 Frequency of Occurrence

512. The frequency of occurrence relating to the risk of reduced emergency response capabilities during the construction phase is considered to be Extremely Unlikely.

18.4.1.3 Severity of Consequence

513. The severity of consequence relating to the risk of reduced emergency response capabilities during the construction phase is considered to be Serious.

18.4.1.4 Significance of Effect

514. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during construction of the Project is considered to be tolerable.

515. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable with Mitigation** and **not significant** in EIA terms.

18.4.2 Operation and Maintenance

18.4.2.1 Qualification of Risk

516. The presence of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the O&M phase of the Project by increasing the number of incidents, increasing consequences or reducing access for the responders.

517. Up to 423 vessel movements may be made annually by project vessels during the O&M phase of the Project. It is assumed that maintenance vessels will be on-site throughout the majority of the O&M phase, although severe weather may lead to vessels being withdrawn. The presence of these vessels will increase the likelihood of an incident occurring, diminishing emergency response capability. As noted in the equivalent construction impact, it may be possible both for the Project to respond appropriately to a project vessel incident occurring in proximity to the WDA, reducing potential impacts on SAR resources; as well as to assist with SAR operations for third-party incidents. In addition, it is unlikely that a SAR operation will require the entirety of the WDA to be searched, with any necessary searches restricted to a smaller area in which a casualty is known to be located (accounting for assumptions on any potential drift of the casualty).

518. Of the potential impacts on reduction of emergency response capability, the most likely would be a delay to any emergency response request. As an unlikely worst-case, this could lead to a failure of emergency response to an incident resulting in PLL and pollution. However, project vessels will be managed via marine coordination, and the presence of project vessels themselves may mitigate this risk as they may assist at incidents involving other project vessels under the obligation of SOLAS (IMO, 1974) and adherence to an ERCoP, noting this would be undertaken with liaison with the MCA and updated for O&M prior to completion of construction. The MPCP will also be implemented should pollution occur.

519. From recent SAR data, there was an average of two to three SAR taskings per year recorded throughout the ten-year period within the shipping and navigation Study Area, although none were recorded within the WDA itself. The frequency of incidents in proximity to the WDA is not anticipated to increase significantly from the current level given the measures noted above which will be in place.

520. The layout will be approved by the Scottish Ministers following consultation with the MCA and in line with MGN 654 requirements to ensure any SAR operations that do occur within the WDA are facilitated. A SAR checklist will also be completed and agreed with the MCA as required under MGN 654.

521. Relevant embedded mitigation measures include compliance with MGN 654, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), marine coordination for Project vessels, pollution planning, and Project vessel compliance with international marine regulations (i.e., SOLAS). In addition, the ERCoP will be updated from its construction version to account for the O&M phase.

18.4.2.2 Frequency of Occurrence

522. The frequency of occurrence relating to the risk of reduced emergency response capabilities during the O&M phase is considered to be Extremely Unlikely.

18.4.2.3 Severity of Consequence

523. The severity of consequence relating to the risk of reduced emergency response capabilities during the O&M phase is considered to be Serious.

18.4.2.4 Significance of Effect

524. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during O&M of the Project is considered to be tolerable with mitigation.

525. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable with Mitigation** and **not significant** in EIA terms.

18.4.3 Decommissioning

18.4.3.1 Qualification of Risk

526. The presence of structures as well as increased vessel activity and personnel numbers may reduce emergency response capabilities during the decommissioning phase of the Project by increasing the number of incidents, increasing consequences, or reducing access for the responders.

527. Since the methods used to remove structures and subsea cables are expected to be similar to those used to install them (and as, although it is expected that subsea

cables will be left in situ, for the purposes of this assessment it has been assumed that all cables will be removed during decommissioning as worst-case with only cable protection left in situ), this hazard is expected to be similar in nature to the equivalent construction phase. This includes the number of vessel movements by decommissioning vessels.

528. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

18.4.3.2 Frequency of Occurrence

529. The frequency of occurrence relating to the risk of reduced emergency response capabilities during the decommissioning phase is considered to be Extremely Unlikely.

18.4.3.3 Severity of Consequence

530. The severity of consequence relating to the risk of reduced emergency response capabilities during the decommissioning phase is considered to be Serious.

18.4.3.4 Significance of Effect

531. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as serious, the overall effect of reduced emergency response capability during decommissioning of the Project is considered to be tolerable with mitigation.

532. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable with Mitigation** and **not significant** in EIA terms.

18.5 Impact 5: Vessel-to-structure Allision Risk

533. Presence of surface-piercing structures will lead to creation of allision risk for vessels. The spatial extent of the hazard is small given that a vessel must be in close proximity to a structure for an allision incident to occur. Each allision element is considered in turn in terms of frequency of occurrence and severity of consequence, with the resulting significance of the residual risk across the various elements summarised at the end of the assessment. The forms of allision considered include:

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

18.5.1 Construction

18.5.1.1 Powered Allision Risk

18.5.1.1.1 Qualification of Risk

534. Presence of surface-piercing structures, including those that are partially constructed, within the buoyed construction area of the WDA will lead to the creation of allision risk for vessels during the construction phase.

535. Marine lighting and marking for the construction phase will be implemented as defined within the LMP approved by the Scottish Ministers following consultation with the NLB. This will include use of a buoyed construction area to alert mariners to the ongoing works and potential for partially completed structures. Individual structures will also be marked with temporary lighting throughout the construction phase. In the event of the loss of an aid to navigation, procedures detailed within the LMP will be followed to minimise disruption to navigation (as discussed with key stakeholders including the MCA). This LMP will be finalised post-consent.

536. Promulgation of information and marking on charts of the buoyed construction area will ensure vessels can passage plan in advance to minimise risk.

537. Should an allision occur, the consequences will depend on multiple factors. Fishing vessels and recreational vessels are considered most vulnerable to the hazard and in such cases, the most likely consequences will be minor damage with the vessel able to resume passage and undertake a full inspection at the next port. As an unlikely worst-case, the vessel could founder resulting in PLL and pollution. Project vessels may assist in the event of an allision under SOLAS obligations and the adherence to the ERCoP, in liaison with the MCA. If pollution were to occur, then the MPCP will be implemented to reduce the environmental risk.

538. Relevant embedded mitigation measures include safety zones, advisory passing distances, charting of infrastructure, compliance with MGN 654, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), marine coordination for Project vessels, pollution planning, Project vessel compliance with international marine regulations (i.e., SOLAS), and promulgation of information.

18.5.1.1.2 Frequency of Occurrence

539. The frequency of occurrence in relation to powered vessel to structure allision risk during the construction phase is considered to be Extremely Unlikely.

18.5.1.1.3 Severity of Consequence

540. The severity of consequence in relation to powered vessel to structure allision risk during the construction phase is considered to be Moderate.

18.5.1.1.4 Significance of Effect

541. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during construction of the Project is considered to be broadly acceptable.

542. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.5.1.2 Drifting Allision Risk

18.5.1.2.1 Qualification of Risk

543. Based on historical incident data, there have been no instances of a third-party vessel alliding with an offshore windfarm structure whilst not under command. However, there is considered to be potential for a vessel to be adrift; this is reflected in the RNLI incident data reviewed in proximity to the WDA which indicates that machinery failure is the most common incident type. During construction, third-party vessels may choose to avoid the WDA. However, it should also be considered that vessels may be less familiar with the Project than they will be by the O&M phase.

544. In circumstances where a vessel drifts towards a structure during the construction phase, powered vessels may be able to regain power prior to reaching the WDA (by rectifying any fault). Failing this, the vessel's emergency response procedures would be implemented which may include an emergency anchoring event or the use of thrusters (depending on availability and power supply).

545. Where the deployment of the anchor is not possible (e.g. for small craft), any project vessels on-site associated with construction 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 His Majesty's Coastguard (HMCG) and marine coordination and depends on the type and capability of vessels on-site, as well as the size of the casualty vessel in question. 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.

546. Should an allision occur, the consequences will include the unlikely worst-case of foundering, PLL and pollution. In the highly unlikely scenario of a drifting allision incident resulting in pollution, the implementation of the MPCP will reduce the environmental risk. Project vessels may assist in the event of an allision under SOLAS (IMO, 19742) obligation and the adherence to the ERCoP, in line with the MCA. Additionally, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel, thus reducing the energy of the impact, including in the case of a recreational vessel under sail.

547. Relevant embedded mitigation measures include pollution planning, implementation of an ERCoP, and Project vessel compliance with international marine regulations (i.e., SOLAS).

18.5.1.2.2 Frequency of Occurrence

548. The frequency of occurrence in relation to drifting vessel to structure allision risk during the construction phase is considered to be Extremely Unlikely.

18.5.1.2.3 Severity of Consequence

549. The severity of consequence in relation to drifting vessel to structure allision risk during the construction phase is considered to be Moderate.

18.5.1.2.4 Significance of Effect

550. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during construction of the Project is considered to be broadly acceptable.

551. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.5.1.3 Internal Allision Risk

18.5.1.3.1 Qualification of Risk

552. Based on experience at offshore windfarms under construction, it is anticipated that commercial vessels will be unlikely to choose to navigate internally within the WDA, and will begin to avoid the area following deployment of the buoyed construction area. However, fishing and recreational vessels may be more likely to transit through. As noted during the local Hazard Workshop (see **Section 4**), fishers commented that the minimum spacing of 944 m would be sufficient both for transit and active fishing to occur, and as such they may also choose to utilise the WDA when partially completed structures are present.

553. The worst-case consequences reported for vessels involved in an allision incident involving a UK offshore windfarm has been flooding, with no life-threatening injuries to persons reported. If an allision incident were to occur, project vessels may assist under obligation of SOLAS (IMO, 1974) and adherence to the ERCoP in liaison with the MCA. Additionally, if pollution occurs as a result of an allision incident, the MPCP would be implemented where appropriate.

554. If a vessel chooses to transit within the WDA, the minimum spacing of 944 m between structures including partially completed structures is considered sufficient for safe internal navigation, with fishers noting during the Hazard Workshop the space would be suitable both for transiting and active fishing (dependent on conditions). In addition, as noted by RYA Scotland during consultation, those operating recreational craft in the area will likely be experienced sailors (see **Section 4**). Furthermore, the temporary lighting and marking and display on nautical

charts will provide mitigation against internal allision risk. Failure of aids to navigation were raised as a concern by RYA Scotland during the mainland Hazard Workshop (see **Section 4**) - in the case of loss of an aid to navigation through any means, the LMP will outline specific management procedures to alleviate any navigational safety concerns. Any vessel planning to transit through the WDA is expected to passage plan in advance in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information will ensure that vessels have good awareness of the Project.

555. Relevant embedded mitigation measures include the buoyed construction area, advisory passing distances, charting of infrastructure, compliance with MGN 654, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), marine coordination for Project vessels, pollution planning, Project vessel compliance with international marine regulations (i.e., SOLAS), promulgation of information, and minimum blade tip clearance of 28.4 m above HAT.

556. It was raised during consultation that consideration would need to be given to the often-challenging conditions in the area regarding loss of buoys and general navigation (see **Section 4**). The LMP will include specific management procedures pertinent to each aid to navigation, to ensure that risks to mariners from the loss of an aid to navigation (either due to a structure being obscured or confusion on position) are minimised. For this hazard, this would pertain to loss of key navigational light on a structure, failure of a sound signal for greater than 120 hours, any aid to navigation failing to meet IALA standards, and throughout significant maintenance works where an increase in navigational risk is posed (such as removal/replacement of a key aid to navigation).

18.5.1.3.2 Frequency of Occurrence

557. The frequency of occurrence of internal vessel to structure allision risk during the construction phase is considered to be Remote.

18.5.1.3.3 Severity of Consequence

558. The severity of consequence of internal vessel to structure allision risk during the construction phase is considered to be Moderate.

18.5.1.3.4 Significance of Effect

559. Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during construction of the Project is considered to be tolerable.

560. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable with Mitigation** and **not significant** in EIA terms.

18.5.2 Operation and Maintenance

18.5.2.1 Powered Allision Risk

18.5.2.1.1 Qualification of Risk

561. The base case annual powered vessel to structure allision frequency was estimated to be 2.36×10^{-4}, corresponding to a return period of one every 4,231 years. This rises to an estimate of 2.82×10^{-4} for a future case growth of 20% in vessel traffic, corresponding to a return period of one every 3,550 years. This relatively low allision risk is reflective of the volume of traffic passing at the minimum mean distance of 1 nm from the WDA.

562. Based on historical incident data, there have been four reported instances of a third-party vessel alliding with an operational offshore windfarm structure in the UK (in the Irish Sea and Southern North Sea). All four of these incidents involved a fishing vessel. These allisions resulted in minor to moderate damage to the vessels with minor injury to crew members.

563. Marine lighting and marking will be implemented in agreement with the NLB and defined within the LMP. Promulgation of information and marking on charts will ensure vessels can passage plan in advance to minimise risk. In the event of the loss of an aid to navigation, procedures detailed within the LMP will be followed to minimise disruption to navigation (as agreed upon with key stakeholders including the MCA). This LMP will be finalised post-consent.

564. Should an allision occur, the consequences will depend on multiple factors. Fishing vessels and recreational vessels are considered most vulnerable to the hazard and in such cases, the most likely consequences will be minor damage with the vessel able to resume passage and undertake a full inspection at the next port. As an unlikely worst-case, the vessel could founder resulting in PLL and pollution. Project vessels may assist in the event of an allision under SOLAS obligations and the adherence to the ERCoP, in liaison with the MCA. If pollution were to occur, then the MPCP will be implemented to reduce the environmental risk.

565. Relevant embedded mitigation measures include advisory passing distances, charting of infrastructure, compliance with MGN 654, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), marine coordination for Project vessels, pollution planning, Project vessel compliance with international marine regulations (i.e., SOLAS), and promulgation of information.

18.5.2.1.2 Frequency of Occurrence

566. The frequency of occurrence in relation to powered vessel to structure allision risk during the O&M phase is considered to be Extremely Unlikely.

18.5.2.1.3 Severity of Consequence

567. The severity of consequence in relation to powered vessel to structure allision risk during the O&M phase is considered to be Moderate.

18.5.2.1.4 Significance of Effect

568. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of powered vessel to structure allision risk during O&M of the Project is considered to be broadly acceptable.

569. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.5.2.2 Drifting Allision Risk

18.5.2.2.1 Qualification of Risk

570. The base case annual drifting vessel to structure allision frequency was estimated to be 6.38×10^{-5}, corresponding to a return period of one every 15,680 years. This rises to an estimate of $7.55\text{x}10^{-5}$ for a future case growth of 20% in vessel traffic, corresponding to a return period of one every 13,236 years. This relatively low allision risk is reflective of the volume of traffic passing at the minimum mean distance of 1 nm from the WDA and the need for a vessel to become adrift prior to a drifting allision event occurring.

571. Based on historical incident data, there have been no instances of a third-party vessel alliding with an operational offshore windfarm structure whilst not under command. However, there is considered to be potential for a vessel to be adrift; this is reflected in the RNLI incident data reviewed in proximity to the WDA which indicates that machinery failure is the most common incident type.

572. In circumstances where a vessel drifts towards a structure, powered vessels may be able to regain power prior to reaching the WDA (by rectifying any fault). Failing this, the vessel’s emergency response procedures would be implemented which may include an emergency anchoring event or the use of thrusters (depending on availability and power supply).

573. 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 HMCG and marine coordination and depends on the type and capability of vessels on-site, as well as the size of the casualty vessel in question. 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.

574. Should an allision occur, the consequences will include the unlikely worst-case of foundering, PLL and pollution. In the highly unlikely scenario of a drifting allision incident resulting in pollution, the implementation of the MPCP will reduce the environmental risk. Project vessels may assist in the event of an allision under SOLAS (IMO, 19742) obligation and the adherence to the ERCoP, in line with the MCA.

Additionally, a drifting vessel is likely to transit at a reduced speed compared to a powered vessel, thus reducing the energy of the impact, including in the case of a recreational vessel under sail.

575. Relevant embedded mitigation measures include pollution planning, implementation of an ERCoP, and Project vessel compliance with international marine regulations (i.e., SOLAS).

18.5.2.2.2 Frequency of Occurrence

576. The frequency of occurrence in relation to drifting vessel to structure allision risk during the O&M phase is considered to be Extremely Unlikely.

18.5.2.2.3 Severity of Consequence

577. The severity of consequence in relation to drifting vessel to structure allision risk during the O&M phase is considered to be Moderate.

18.5.2.2.4 Significance of Effect

578. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of drifting vessel to structure allision risk during O&M of the Project is considered to be broadly acceptable.

579. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.5.2.3 Internal Allision Risk

18.5.2.3.1 Qualification of Risk

580. Based on experience at existing operational offshore windfarms, it is anticipated that commercial vessels will be unlikely to choose to navigate internally within the WDA. However, fishing and recreational vessels may be more likely to transit through noting they may choose not to depending on various conditions. As noted during the local Hazard Workshop (see **Section 4**), fishers commented that the minimum spacing of 944 m would be sufficient both for transit and active fishing to occur.

581. The base case fishing vessel to structure allision frequency is estimated to be 7.5×10^{-2}, corresponding to a return period of approximately one in 13 years. This rises to an estimate of 9.0×10^{-2} for a future case growth of 20% in vessel traffic, corresponding to a return period of one every 11 years. This return period is reflective of the volume of fishing vessel traffic in the shipping and navigation Study Area, both in transit and engaged in active fishing. Conservative modelling has been undertaken with the assumption that fishing levels in proximity to the WTGs will not change. In reality, fishing vessels will account for the presence of the WTGs and may choose to transit or fish elsewhere.

582. The worst-case consequences reported for vessels involved in an allision incident involving a UK offshore windfarm has been flooding, with no life-threatening injuries

to persons reported. If an allision incident were to occur, project vessels may assist under obligation of SOLAS (IMO, 1974) and adherence to the ERCoP in liaison with the MCA. Additionally, if pollution occurs as a result of an allision incident, the MPCP would be implemented where appropriate.

583. If a vessel chooses to transit within the WDA, the minimum spacing of 944 m between structures is considered sufficient for safe internal navigation, with fishers noting during the Hazard Workshop the space would be suitable both for transiting and active fishing (dependent on conditions). In addition, as noted by RYA Scotland during consultation, those operating recreational craft in the area will likely be experienced sailors (see **Section 4**). Furthermore, operational lighting and marking and marking on nautical charts will provide mitigation against internal allision risk. Failure of aids to navigation were raised as a concern by RYA Scotland during the mainland Hazard Workshop (see **Section 4**) - in the case of loss of an aid to navigation through any means, the LMP will outline specific management procedures to alleviate any navigational safety concerns. Any vessel planning to transit through the WDA is expected to passage plan in advance in accordance with SOLAS Chapter V (IMO, 1974) and promulgation of information will ensure that vessels have good awareness of the Project.

584. As raised by SWFPA during the mainland Hazard Workshop (see **Section 4**), should a recreational vessel under sail enter the proximity of a WTG, there are 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, 2022) but that no negative effects on recreational craft have been reported on the basis of the limited spatial extent of the effect and its similarity to that experienced when passing a large vessel or close to other large structures 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.

585. Relevant embedded mitigation measures include advisory passing distances, charting of infrastructure, compliance with MGN 654, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), marine coordination for Project vessels, pollution planning, Project vessel compliance with international marine regulations (i.e., SOLAS), promulgation of information, and minimum blade tip clearance of 28.4 m above HAT.

586. It was raised during consultation that consideration would need to be given to the often-challenging conditions in the area regarding loss of buoys and general navigation (see **Section 4**). The LMP will include specific management procedures pertinent to each aid to navigation, to ensure that risks to mariners from the loss of an aid to navigation (either due to a structure being obscured or confusion on position) are minimised. For this hazard, this would pertain to loss of key navigational light on a structure, failure of a sound signal for greater than 120 hours, any aid to

navigation failing to meet IALA standards, and throughout significant maintenance works where an increase in navigational risk is posed (such as removal/replacement of a key aid to navigation).

18.5.2.3.2 Frequency of Occurrence

587. The frequency of occurrence of internal vessel to structure allision risk during the O&M phase is considered to be Remote.

18.5.2.3.3 Severity of Consequence

588. The severity of consequence of internal vessel to structure allision risk during the O&M phase is considered to be Moderate.

18.5.2.3.4 Significance of Effect

589. Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of internal vessel to structure allision risk during O&M of the Project is considered to be tolerable.

590. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable with Mitigation** and **not significant** in EIA terms.

18.5.3 Decommissioning

18.5.3.1 Qualification of Risk

591. It is likely that allision risk during decommissioning will be similar to that observed for the construction phase, noting similar scenarios on-site, including partially removed structures within a buoyed decommissioning area. On this basis the same assumptions made for the equivalent construction phase hazard in terms of frequency and consequence apply.

592. There will be no allision risk post decommissioning if all surface piercing structures are removed.

18.5.3.2 Frequency of Occurrence

593. The frequency of occurrence of vessel to structure allision risk during the decommissioning phase is considered to be Extremely Unlikely for powered and drifting allision risk, and Remote for internal allision risk.

18.5.3.3 Severity of Consequence

594. The severity of consequence of vessel to structure allision risk during the decommissioning phase is considered to be Moderate for all three types.

18.5.3.4 Significance of Effect

595. Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of vessel to structure powered and drifting allision risk during decommissioning of the Project is considered to be broadly acceptable.

596. For powered and drifting allision risk, the hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms for powered and drifting allision risk.

597. Taking the frequency of occurrence as remote and the severity of consequence as moderate, the overall effect of vessel to structure internal allision risk during decommissioning of the Project is considered to be tolerable.

598. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Tolerable with Mitigation** and **not significant** in EIA terms.

18.6 Impact 6: Reduction of Under Keel Clearance

18.6.1 Operation and Maintenance

18.6.1.1 Qualification of Risk

599. The presence of subsea cables and associated protection may reduce under keel clearance during the O&M phase of the Project.

600. The minimum target burial depth for the cables is 0.3 m in the case of the IACs, and 1m for the OSP link cables and export cable(s). Final required burial depths will be determined via the CBRA process which will be undertaken post consent.

601. Where burial is not reasonably practicable, cable protection may be used instead, which again will be determined by the CBRA. In line with MGN 654, any reduction in water depth which exceeds 5% will be discussed with the MCA to determine if additional mitigation is necessary. 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).

602. As depths within the WDA range between 24 m to 79 m below LAT and maximum cable protection height may be up to 3.0m, there may be reductions in water depth of more than the 5% threshold allowable under MGN 654 (MCA, 2021). Although maximum draught recorded within the vessel traffic surveys was 18.1 m (see **Section 10.3**), it is not anticipated that the larger commercial vessels with greater draughts will transit through the WDA; only small craft are expected to navigate internally. Therefore, even if the 5% threshold is triggered, it is considered unlikely that an underkeel incident would occur. In addition, no specific concerns from

stakeholders were raised during consultation. Regardless, in the event that water depths are proposed to be reduced by more than 5%, consultation with the MCA and NLB would be undertaken as required under MGN 654 (noting it is also typical to include a marine licence condition requiring approval through MD-LOT where depths are proposed to be decreased by more than 5%).

603. Concerns were raised during consultation that the Project could have an impact on the Dubh Artach lighthouse as an aid to navigation, noting that part of its purpose is to mitigate grounding risk (i.e., under keel). The NLB confirmed that they were content that any impacts on the ability of the lighthouse to be used as an aid to navigation can be mitigated through the post-consent LMP process (see **Section 4**).

604. In the event of an underwater allision the most likely consequence is minor damage. The unlikely worst-case consequence may be vessel foundering resulting in PLL and pollution, although this is considered highly improbable.

605. Relevant embedded mitigation measures include charting of infrastructure, promulgation of information, implementation of a Cable Plan, pollution planning, and compliance with MGN 654 and its annexes.

18.6.1.2 Frequency of Occurrence

606. The frequency of occurrence of the risk of reduced under keel clearance due to the presence of subsea cables during O&M is considered Extremely Unlikely.

18.6.1.3 Severity of Consequence

607. The severity of consequence of the risk of reduced under keel clearance due to the presence of subsea cables during O&M is considered to be Minor.

18.6.1.4 Significance of Effect

608. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as minor, the overall effect of reduced under keel clearance due to subsea cables during O&M of the Project is considered to be broadly acceptable.

609. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

18.7 Impact 7: Anchor Interaction with Subsea Cables

18.7.1 Operation and Maintenance

18.7.1.1 Qualification of Risk

610. The presence of subsea cables within the WDA may increase the risk of anchor interaction.

611. The spatial extent of the hazard is small given that a vessel must be in close proximity to an IAC for an interaction to occur.

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

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

613. Although the second of these scenarios may involve limited decision-making time if drifting towards a hazard (as discussed by the SWFPA in **Section 4**), in all three scenarios it is anticipated that the charting of infrastructure including the subsea cables will inform the decision to anchor, as per Regulation 34 of SOLAS (IMO, 1974).

614. Only one vessel was observed to likely be at anchor within the shipping and navigation Study Area during the survey periods, with this being to the east of Colonsay. Although one anchoring vessel every one to two days was recorded within the shipping and navigation Study Area during the long-term dataset, all instances other than four were to the east of Colonsay (with three in Kilaran Bay in the northwest of Colonsay, and the other east of Nave Island). Risk of interaction with an inter-array, offshore export, or OSP link cable on a planned anchoring or dragged anchoring basis is therefore anticipated to be extremely low. In terms of emergency anchoring, any areas of high traffic volume are likely to represent the areas of highest risk, particularly where there are hazards nearby (for example, structures, rocks, shallows).

615. The likelihood of anchor interaction with a subsea cable is further reduced by the burial of the cables and use of external cable protection where required, which will be informed by the CBRA process, noting this will account for traffic volumes and vessel sizes. Moreover, with all subsea cables located within the WDA, there is a limited pathway through which commercial vessels may be subject to this hazard.

616. Should an anchor interaction occur, the most likely consequence is no damage to the cable or anchor, based on previous anchor interaction incidents. As an unlikely worst-case consequence, a snagging incident could occur and the vessel's anchor as well as the cable could be damaged, resulting in a loss of stability noting this would only occur for a smaller vessel which would be less likely to penetrate deeper into the seabed than a larger vessel.

617. Relevant embedded mitigation measures include charting of infrastructure, compliance with MGN 654, implementation and monitoring of cable protection, implementation of a Cable Plan, and promulgation of information.

18.7.1.2 Frequency of Occurrence

618. The frequency of occurrence relating to the risk of anchor interaction with subsea cables during the O&M phase is considered to be Extremely Unlikely.

18.7.1.3 Severity of Consequence

619. The severity of consequence relating to the risk of anchor interaction with subsea cables during the O&M phase is considered to be Moderate.

18.7.1.4 Significance of Effect

620. Taking the frequency of occurrence as extremely unlikely and the severity of consequence as moderate, the overall effect of anchor interaction with subsea cables during O&M of the Project is considered to be broadly acceptable.

621. The hazard is considered ALARP with embedded mitigation in place and therefore no additional mitigation is required. The hazard is therefore **Broadly Acceptable** and **not significant** in EIA terms.

19 Cumulative Risk Assessment

622. All planned developments (see **Section 15**) with the potential to have a cumulative environmental impact with the Project have been considered. Following a screening process, the Dubh Artach lighthouse refurbishment works have been identified as requiring further assessment with regard to shipping and navigation. Due to the refurbishment works planned to be inclusive of the construction phase of the Project, only this phase has been considered within the cumulative risk assessment.

19.1 Cumulative Impact 1: Vessel Displacement and Increased Third-party Vessel to Vessel Collision Risk

623. Construction activities and the presence of WDA infrastructure in combination with Dubh Artach refurbishment works 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.

624. Due to the nature of the works, it is likely that any cumulative displacement associated with Dubh Artach will be temporary – i.e., limited to periods when vessels are actively working on the lighthouse, and spatially limited to the area around the operations. Due to the proximity of the lighthouse to the Project it is unlikely that a commercial vessel would opt to transit near to Dubh Artach at this time (as they are expected to avoid the buoyed construction area). For any smaller craft (such as fishing and recreational vessels) not wishing to transit in proximity to the lighthouse during this time, there will be no restrictions on transiting through the buoyed construction area of the Project assuming active safety zones are avoided.

625. Increased vessel encounters arising from displacement due to the simultaneous construction of Dubh Artach and the Project are therefore expected to be minimal. In the event of an encounter occurring however, involved vessels are expected to comply with international and flag state regulations including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974).

626. The frequency of occurrence of cumulative vessel displacement and increased third-party vessel to vessel collision risk is considered to be Extremely Unlikely, with the severity of consequence considered to be Serious. The resulting significance of effect is therefore considered **Tolerable with Mitigation** and **not significant** in EIA terms, and so ALARP.

19.2 Cumulative Impact 2: Increased Third-party Vessel to Project Vessel Collision Risk

627. Cumulative increases in vessel activity associated with the Project in combination with the Dubh Artach lighthouse works could lead to increased cumulative collision rates in the area with third-party vessels.

628. Larger vessels would be expected to avoid the buoyed construction area and therefore by extension the refurbishment works. For smaller vessels, although the addition of vessels associated with both developments may lead to a minor increase in the potential for vessel encounters, the risk will be managed by project-specific management procedures detailed in **Section 18.2**. In the event of an encounter between a third-party vessel and vessel for either under-construction development, vessels are expected to comply with international and flag state regulations including COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974).

629. The frequency of occurrence of cumulative increased third-party vessel to project vessel collision risk is considered to be Extremely Unlikely, with the severity of consequence considered to be Moderate. The resulting significance of effect is therefore considered **Broadly Acceptable** and **not significant** in EIA terms, and so ALARP.

19.3 Cumulative Impact 3: Reduced Access to Local Ports and Harbours

630. Construction activities and the presence of WDA infrastructure in combination with Dubh Artach refurbishment works may result in the displacement of vessels from pre-existing routes, restricting access to ports/harbours.

631. Due to the location of the Dubh Artach lighthouse, it will likely be within the overarching extent of the buoyed construction area for the Project. The assessment considered for vessel routeing post-construction of the Project (see **Section 18.1**) is therefore applicable in this case – there is not expected to be an additional displacement effect noted when considering Dubh Artach alongside the Project.

632. In addition, with the closest port or harbour to the WDA being Port Ellen approximately 24 nm to the southeast, and from consultation with the Port of Glensanda noting that vessel transits will not be impacted by the Project (see **Section 13.3**), it is not expected that that there will be an impact on port access cumulatively due to Dubh Artach and the Project.

633. The frequency of occurrence of cumulative reduced access to local ports and harbours is considered to be Remote, with the severity of consequence considered to be Minor. The resulting significance of effect is therefore considered **Broadly Acceptable** and **not significant** in EIA terms, and so ALARP.

19.4 Cumulative Impact 4: Reduction of Emergency Response Capability

634. The presence of WDA infrastructure 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.

635. Due to the relatively few incidents in the area, and presence of the lighthouse itself being a mitigating factor against potential groundings in the vicinity, it is considered unlikely that there will be a notable increase in incidents on a cumulative basis.

636. Regardless, the relatively small area encompassing the lighthouse refurbishment works at any one time will not likely impact on emergency response vessels to undertake operations in the area. The Project will also have ERCoP procedures in place to further minimise impacts on emergency response capability, with this document to consider the presence of the lighthouse and related works.

637. The frequency of occurrence of cumulative reduction of emergency response capability is considered to be Extremely Unlikely, with the severity of consequence considered to be Serious. The resulting significance of effect is therefore considered **Tolerable with Mitigation** and **not significant** in EIA terms, and so ALARP.

19.5 Cumulative Impact 5: Vessel-to-structure Allision Risk

638. The WDA infrastructure will create cumulative allision risk to third-party passing vessels in combination with the Dubh Artach refurbishment works.

639. Although the potential for allision risk within the WDA will be localised to the structures related to the Project, there may be a minor increase in allision risk cumulatively with the WDA infrastructure and Dubh Artach works due to displacement of vessels closer to the WDA. As discussed in **Section 17**, marine lighting and marking of the WDA will be implemented including during construction in agreement with NLB post-consent to manage this risk.

640. The frequency of occurrence of cumulative increased vessel to structure allision risk is considered to be Remote, with the severity of consequence considered to be

Moderate. The resulting significance of effect is therefore considered **Tolerable with Mitigation** and **not significant** in EIA terms, and so ALARP.

20 Risk Control Log

641. **Table 20.1** presents a summary of the risk assessment of shipping and navigation hazards associated with the Project. This includes (per hazard) the proposed embedded mitigation measures, frequency of occurrence, severity of consequence and resulting significance of risk.

642. Any additional mitigation measures proposed are then listed per hazard alongside the residual risk.

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Table 20.1 Risk Control Log

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel displacement and increased third-party vessel-to-vessel collision risk	Construction	Charting of infrastructure, compliance with MGN 654, promulgation of information, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), guard vessels, and vessel marine regulations.	Extremely Unlikely	Serious	Tolerable with Mitigation, not significant	N/A	Tolerable with Mitigation, not significant
	O&M		Extremely Unlikely	Serious	Tolerable with Mitigation, not significant		Tolerable with Mitigation, not significant
	Decommissioning		Extremely Unlikely	Serious	Tolerable with Mitigation, not significant		Tolerable with Mitigation, not significant
	Cumulative		Extremely Unlikely	Serious	Tolerable with Mitigation, not significant		Tolerable with Mitigation, not significant
Increased third-party vessel to	Construction	Advisory passing distances, application for safety zones, buoyed construction / decommissioning area, charting of	Extremely Unlikely	Moderate	Broadly Acceptable, not significant	N/A	Broadly Acceptable, not significant

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
project vessel collision risk	O&M	infrastructure, guard vessels, marine coordination for Project vessels, pollution planning, Project vessel compliance with international marine regulations (i.e., COLREGs), and promulgation of information	Extremely Unlikely	Moderate	Broadly Acceptable, not significant		Broadly Acceptable, not significant
	Decommissioning		Extremely Unlikely	Moderate	Broadly Acceptable, not significant		Broadly Acceptable, not significant
	Cumulative		Extremely Unlikely	Moderate	Broadly Acceptable, not significant		Broadly Acceptable, not significant
Reduced access to local ports and harbours	Construction	Advisory passing distances, compliance with MGN 654, charting of infrastructure, and promulgation of information.	Remote	Minor	Broadly Acceptable, not significant	N/A	Broadly Acceptable, not significant
	O&M		Extremely Unlikely	Minor	Broadly Acceptable, not significant		Broadly Acceptable, not significant
	Decommissioning		Remote	Minor	Broadly Acceptable, not significant		Broadly Acceptable, not significant

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
	Cumulative		Remote	Minor	Broadly Acceptable, not significant		Broadly Acceptable, not significant
Reduction of emergency response capability	Construction	Compliance with MGN 654, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), marine coordination for Project vessels, pollution planning, and Project vessel compliance with international marine regulations.	Extremely Unlikely	Serious	Tolerable with Mitigation, not significant	N/A	Tolerable with Mitigation and ALARP
	O&M		Extremely Unlikely	Serious	Tolerable with Mitigation, not significant		Tolerable with Mitigation and ALARP
	Decommissioning		Extremely Unlikely	Serious	Tolerable with Mitigation, not significant		Tolerable with Mitigation and ALARP
	Cumulative		Extremely Unlikely	Serious	Tolerable with Mitigation, not significant		Tolerable with Mitigation and ALARP

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel to structure allision risk	Construction	Applications for safety zones, buoyed construction / decommissioning area, advisory passing distances, charting of infrastructure, compliance with MGN 654, lighting and marking in agreement with NLB (in line with IALA Recommendation G1162), marine coordination for Project vessels, pollution planning, implementation of an ERCoP, Project vessel compliance with international marine regulations, minimum blade tip clearance, and promulgation of information.	Remote	Moderate	Tolerable with Mitigation, not significant	N/A	Tolerable with Mitigation, not significant
	O&M		Remote	Moderate	Tolerable with Mitigation, not significant		Tolerable with Mitigation, not significant
	Decommissioning		Remote	Moderate	Tolerable with Mitigation, not significant		Tolerable with Mitigation, not significant
	Cumulative		Remote	Moderate	Tolerable with Mitigation, not significant		Tolerable with Mitigation, not significant
Reduction of under keel clearance	O&M	Charting of infrastructure, promulgation of information, implementation of a Cable Plan, pollution planning, and compliance with MGN 654 and its annexes.	Extremely Unlikely	Minor	Broadly Acceptable, not significant	N/A	Broadly Acceptable, not significant

Hazard	Phase	Embedded Mitigation Measures	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Anchor interaction with subsea cables	O&M	Charting of infrastructure, compliance with MGN 654, implementation and monitoring of cable protection, implementation of a Cable Plan, and promulgation of information.	Extremely Unlikely	Moderate	Broadly Acceptable, not significant	N/A	Broadly Acceptable, not significant

21 Through Life Safety Management

643. Health, Safety, Environment, and Quality (HSEQ) processes and documentation will be in place for the Project and will be continually updated throughout the development process. The following subsections provide an overview of this documentation and how it will be maintained and reviewed with reference, where required, to specific marine documentation.

644. Monitoring, reviewing and auditing will be carried out by the Applicant on all procedures and activities and feedback actively sought. Any designated person (identified in HSEQ 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.

21.1 Incident Reporting

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

646. The Applicant will maintain records of investigation and analyse incidents to:

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

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

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

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

21.2 Review of Documentation

650. The Applicant will be responsible for reviewing and updating all documentation including the risk assessments, ERCoP, MGN 654 Annex 5 SAR checklist, and, if required, will convene a review panel of stakeholders to quantify risk.

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

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

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

21.3 Inspection of Resources

653. All vessels, facilities and equipment necessary for marine operations are to be subject to appropriate inspection and testing to determine fitness for purpose and availability in relation to their performance standards. This will include monitoring and inspection of all aids to navigation to determine compliance with the performance standards specified by NLB. In addition, the Applicant will carry out inspections of all project vessels to ensure compliance with relevant legislation and regulatory standards, including industry-best practices throughout all phases of the project. Furthermore, all project vessels will adhere to operational standards set out in Applicant Documentation, including the Marine Operations Management Manual and Masters Handbook (as set out in **Appendix 13 Vessel Management and Navigational Safety Plan**).

21.4 Audit Performance

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

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

21.5 Safety Management System

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

21.6 Cable Monitoring

657. The subsea cables will be subject to periodic inspection post-construction to monitor the cable protection, including burial depths. Maintenance of the protection will be undertaken as necessary.

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

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

21.7 Hydrographic surveys

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

21.8 Decommissioning plan

661. A Decommissioning Plan will be developed post-consent. With regards to hazards to shipping and navigation, this will also include consideration of the scenario where upon decommissioning and completion of removal operations, an obstruction is left on-site (attributable to the Project) which is considered to be a danger to navigation and which it has not proved possible to remove. Such an obstruction may require marking 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 Applicant. The Decommissioning Plan will be based on good decommissioning offshore windfarm practices at the time of decommissioning.

22 Summary

22.1 Consultation

662. 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, and two Hazard Workshops. Key stakeholders consulted include:

- CalMac Ferries;
- Clyde Fishermen's Association;
- DFDS Seaways;
- Local fishers;
- MCA;
- NLB;
- Port of Glensanda;
- Royal Highland Yacht Club;
- RYA Scotland;
- Scottish Fishermen's Federation (SFF);
- Southwest Coast Regional Inshore Fisheries Group (SWCRIFG);
- Scottish White Fish Producers Association (SWFPA); and
- UK Chamber of Shipping.

22.2 Existing Environment

22.2.1 Navigational Features

663. Key navigational features in the area include the Dubh Artach lighthouse approximately 2 nm to the north of the WDA, with one charted wreck and two charted obstructions noted within the WDA. A single preferred anchorage location is located near the WDA, 8.5 nm to the southeast. Although there are no ports or harbours in immediate proximity to the Project, Port Ellen is located approximately 24 nm to the southeast of the WDA on Islay, with the Port of Glensanda approximately 40 nm to the northeast.

22.2.2 Maritime Incidents

664. From DfT SAR helicopter taskings data there were a total of 25 SAR helicopter taskings recorded between April 2015 and March 2025 within the shipping and navigation study area. The were primarily on Colonsay, with none recorded within the WDA and several recorded offshore of the WDA.

665. There were a total of 20 recorded RNLI responses to five unique incidents within the shipping and navigation study area from 2015 to 2024, corresponding to an average of two incidents per year. The most frequent incident type was machinery failure

(65%), with the majority of incidents involving fishing vessels (44%). The Islay RNLI station was used for 74% of the callouts. Two incidents were recorded within the WDA overall.

666. There were a total of 11 unique incidents recorded by the MAIB within the shipping and navigation study area from 2015 to 2024, corresponding to an average of one incident per year. The most frequent incident type was machinery failure (45%), with the majority of incidents involving fishing vessels (64%). One incident was recorded within the WDA overall. This was a decrease from the previous 10 years of MAIB data (2005 to 2014), in which a total of 15 unique incidents were recorded.

22.2.3 Vessel Traffic Movements

667. From the 28 days of vessel traffic survey data recorded in winter 2023 and summer 2024 within the shipping and navigation study area, there was an average of ten to eleven unique vessels per day recorded during the winter survey period, with an average of two to three unique vessels per day recorded within the WDA. During the summer survey period, an average of 11 unique vessels were recorded per day with an average of two unique vessels per day recorded within the WDA. Approximately 23% and 17% of vessel traffic intersected the WDA during the winter and summer periods, respectively.

668. The main vessel types within the shipping and navigation study area during the winter survey period were cargo vessels (62%) and fishing vessels (12%). The main vessel types within the shipping and navigation study area during the summer survey period were cargo vessels (36%) and passenger vessels (20%).

669. A total of 12 main commercial routes were identified from the vessel traffic data. The highest use main commercial route was between Belfast and Russia/Scandinavia, with an average of three to four unique vessels per day.

22.3 Future Case Vessel Traffic

670. Of the 12 main routes identified within the shipping and navigation study area, it is anticipated that three will deviate as a result of the Project. The largest percentage increase in terms of overall change in route length was to Route 4, with a 0.34% increase. The largest change on an absolute basis was also to Route 4, with a 2.00 nm increase.

22.4 Collision and Allision Risk Modelling

671. The NRA process included quantitative modelling of the change in allision and collision frequency as a result of the Project, with consideration given to future cases in terms of potential future traffic increases.

672. It was estimated that the return period of a vessel being involved in a collision post windfarm was one in 1,748 years assuming base case traffic levels. This represents a

28% increase in collision frequency compared to the pre-windfarm base case result, although the value itself remains very low.

673. The powered allision return period post windfarm was estimated at one in 4,231 years assuming base case traffic levels. The corresponding drifting allision return period post windfarm was estimated at one in 15,680 years. The fishing vessel allision return period was estimated at one in 13 years. As per **Section 16.3.5**, a conservative approach has been taken to fishing allision modelling, and consequences are likely to be minor to moderate should one occur based on incident statistics.

22.5 Risk Statement

674. Using the baseline data, quantitative modelling, expert opinion, outputs of the Hazard Workshop, and lessons learnt from existing offshore developments, shipping and navigation hazards have been identified and assessed in line with the FSA methodology for all of the relevant scenarios. The full risk control log including details of hazards, mitigation measures, and significant of risk is presented in **Section 20**.

675. The significance of risk has been determined as either Broadly Acceptable or Tolerable with Mitigation for all shipping and navigation hazards assessed, assuming the mitigation identified is in place. Therefore, all risks highlighted have been assessed as ALARP.

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Appendix A MGN 654 Checklist

676. 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.

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

Table A.1 MGN 654 Checklist

Issue	Compliance	Reference and Notes
Site and Installation Co-ordinates. 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.		
Traffic Survey. Includes:		
All vessel types.	✓	**Section 10: Vessel Traffic Movements** All vessel types are considered with specific breakdowns by vessel type given within the shipping and navigation study area.
At least 28 days duration, within either 12 or 24 months prior to submission of the ES.	✓	**Section 4.3: Data Sources** The NRA is primarily based on 28 days of vessel traffic survey data collected during winter 2023 and summer 2024. Vessel traffic datasets used were agreed with the MCA.
Multiple data sources.	✓	**Section 4.3: 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.
Seasonal variations.	✓	**Section 4.3: Data Sources** The NRA is based primarily on 28 days of vessel traffic survey data collected during winter 2023 and summer 2024. **Appendix E: Long-Term Vessel Traffic Movements** To assist with the assessment of seasonal variation a long-term AIS dataset covering 12 months in March 2024 - April 2025 has also been assessed.
MCA consultation.	✓	**Section 4: Consultation** The MCA has been consulted as part of the NRA process including through the Hazard Workshops.

Issue	Compliance	Reference and Notes
General Lighthouse Authorities (GLA) consultation.	✓	**Section 4: Consultation** NLB has been consulted as part of the NRA process including through the Hazard Workshops.
UK CoS.	✓	**Section 4: Consultation** The UK CoS has been consulted as part of the NRA process including through the Hazard Workshops.
Recreational and fishing vessel organisations consultation.	✓	**Section 4: Consultation** RYA Scotland, SFF, SWFPA, and local fishers were all invited to input into the NRA process including through the Hazard Workshops.
Port and navigation authorities consultation, as appropriate.	✓	**Section 4: Consultation** The Port of Glensanda have been consulted as part of the NRA process. Other local port and harbour authorities were invited to participate in the hazard workshops.
Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the WDA has been analysed. **Section 18: Risk Assessment** The hazards due to the Project have been assessed.
ii. Numbers, types and sizes of vessels presently using such areas.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the WDA 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 anchoring. **Section 10: Vessel Traffic Movements** Non-transit users were identified in the vessel traffic survey data and included fishing vessels engaged in fishing activities, maintenance dredgers engaged in dredging activities, and anchoring activities.
iv. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✓	**Section 11: Base Case Vessel Routeing** Main commercial routes have been identified using the principles set out in MGN 654 in proximity to the WDA, 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.	✓	There are no IMO routeing measures in proximity to the Project.
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	✓	There are no IMO routeing measures in proximity to the Project.

Issue	Compliance	Reference and Notes
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 7.5** identifies port approaches in proximity to the Project and **Section 7.3** 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 7.5** 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 10: Vessel Traffic Movements** Fishing vessel movements are considered within the shipping and navigation study area. Detailed analysis of dedicated fishing vessel activities is undertaken in **Chapter 12 Commercial Fisheries**.
x. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	**Section 7: Navigational Features** **Section 7.6** identifies the military practice areas in proximity to the Project.
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 7.2** identifies the charted wrecks and obstructions in proximity to the Project. **Section 15: 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.	✓	There are no other baseline offshore windfarm developments in proximity to the Project. **Section 15: 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.	✓	There are no spoil and dumping grounds in proximity to the Project.
xiv. Proximity of the site to aids to navigation and/or VTS in or adjacent to the area and any impact thereon.	✓	**Section 7: Navigational Features** **Section 7.1** identifies key aids to navigation in proximity to the Project.
xv. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of ‘choke points’ in areas of high traffic density and nearby or	✓	**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 WDA.

Issue	Compliance	Reference and Notes
consented OREI sites not yet constructed.		
xvi. With reference To xv. above, the number and type of incidents to vessels which have taken place in or near to the proposed site of the OREI to assess the likelihood of such events in the future and the potential impact of such a situation.	✓	**Section 9: Emergency Response and Incident Overview** Historical vessel incident data published by DfT (**Section 9.1**), RNLI (**Section 9.2**), and MAIB (**Section 9.5**) in proximity to the Project has been considered alongside historical offshore windfarm incident data throughout the UK (**Section 9.6**).
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area.	✓	**Section 10: Vessel Traffic Movements** Non-transit users were identified in the vessel traffic survey data and included recreational activities.
Predicted effect of OREI on traffic and interactive boundaries. Where appropriate, the following should be determined:		
a. The safe distance between a shipping route and OREI boundaries.	✓	**Section 14: Future Case Vessel Traffic** A methodology for post-windfarm routeing is outlined and includes a minimum distance of 1 nm from offshore installations and existing offshore windfarm boundaries.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	There are no corridors between the Project and other sites.
OREI Structures. The following should be determined:		
a. Whether any feature of the OREI, including auxiliary platforms outside the main generator site, mooring and anchoring systems, inter-device and export cabling could pose any type of difficulty or danger to vessels underway, performing normal operations, including fishing, anchoring and emergency response.	✓	**Section 18: Risk Assessment** 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 22 m (above MHWS for fixed). Floating WTG allow for degrees of motion.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** **Section 6.5** 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 6.5** outlines the shipping and navigation MDS for subsea cables including the cable burial specifications.

Issue	Compliance	Reference and Notes
d. Whether structures block or hinder the view of other vessels or other navigational features.	✓	**Section 18: Risk Assessment** 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 NRA and includes the range of existing water depths. **Section 10: 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 and allision risk.
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, and allision modelling which includes account of tidal conditions.
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓	
d. The set is across the major axis of the layout at any time, and, if so, at what rate.	✓	
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, and allision risk which will includes 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 and allision risk modelling which includes 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 18 : Risk Assessment** 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	✓	**Section 10: Vessel Traffic Movements**

Issue	Compliance	Reference and Notes
conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.		Vessel traffic data in proximity to the Project has been analysed including recreational vessels. **Section 12: Adverse Weather Routeing** **Section 183** identifies alternative vessel routeing in proximity to the Project in adverse weather. **Section 18: Risk Assessment** 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 18: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of internal allision risk for vessels under sail.
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.	✓	**Section 15: Collision and Allision Risk Modelling** Provides quantification of collision risk and allision risk modelling which includes account of tidal conditions. **Section 18: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of drifting allision risk.
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.	✓	**Section 4: Consultation** **Section 4.1** outlines Regular Operator consultation undertaken following the vessel traffic surveys. **Section 12: Adverse Weather Routeing** **Section 12.3** discusses alternative vessel routeing in proximity to the Project in adverse weather. **Section 15: Collision and Allision Risk Modelling** Provides quantification of collision risk and allision risk modelling which includes account of tidal conditions. **Section 18: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of internal allision risk.
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:		

Issue	Compliance	Reference and Notes
i. For specified vessel types, operations and/or sizes.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** Assesses potential hazards on navigation of the different communications and position fixing devices used in and around offshore windfarms. **Section 14: Future Case Vessel Traffic** A methodology for post windfarm routeing is outlined and includes a minimum distance of 1 nm from offshore installations and existing offshore windfarm boundaries, i.e., it is assumed that commercial vessels will avoid the WDA. **Section 18: Risk Assessment** The hazards due to the Project have been assessed for each phase and include consideration of vessel displacement.
ii. In respect of specific activities.	✓	
iii. In all areas or directions.	✓	
iv. In specified areas or directions.	✓	
v. In specified tidal or weather conditions.	✓	
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 18: Risk Assessment** 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 14: 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 17: 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 *Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for and Emergency Response* (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 17: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including compliance with MGN 654 and its annexes.
c. A SAR checklist will be completed to record	✓	**Section 17: Embedded Mitigation Measures**

Issue	Compliance	Reference and Notes
discussions regarding the requirements, recommendations and considerations outlined in Annex 5 (to be agreed with MCA).		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.
Hydrography. 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 21: 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 13: Navigation, Communication and Position Fixing Equipment** Potential hazards on navigation of the different communications and position fixing devices used in and around offshore windfarms are assessed.
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 13: Navigation, Communication and Position Fixing Equipment**
ii. Vessel to shore.	✓	
iii. VTS Radar to vessel.	✓	

Issue	Compliance	Reference and Notes
iv. Radar Beacon (Racon) to/from vessel.	✓	Potential hazards on navigation of the different communications and position fixing devices used in and around offshore windfarms are assessed.
c. The structures and generators might produce SONAR interference affecting fishing, industrial or military systems used in the area.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** **Section 13.8** assesses the potential risk of SONAR interference due to the Project.
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** **Section 13.9** assesses the potential risk of noise due to the Project.
e. Generators and the seabed cabling within the site and onshore might produce EMFs affecting compasses and other navigation systems.	✓	**Section 13: Navigation, Communication and Position Fixing Equipment** **Section 13.6** assesses the potential risk of electromagnetic interference due to the Project.
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 17: 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 17: 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[4].	✓	**Section 17: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards including the application for Safety Zones.
iv. Designation of the site as an Area to be Avoided (ATBA).	✓	There are no plans to designate the Project as an ATBA.
v. Provision of aids to navigation as determined by the GLA.	✓	**Section 17: 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 NLB and MCA requirements.

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

Issue	Compliance	Reference and Notes
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 17: 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 21: 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 17: 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 17: 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 17: 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 subsea) within the WDA.
xiii. Design of OREI structures to minimise risk to contacting vessels or craft.	✓	There is no additional risk posed to craft compared to previous offshore windfarms and so no additional measures are identified.
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	**Section 17: Embedded Mitigation Measures** Outlines the embedded mitigation measures to be implemented to reduce the significance of risk of shipping and navigation hazards. **Section 21: Through Life Safety Management** Outlines how HSEQ documentation will be maintained and reviewed.

Table A.2 MGN 654 Annex 1 Checklist

Item	Compliance	Comments
A risk claim is included that is supported by a reasoned argument and evidence.	✓	**Section 18: Risk Assessment** The risk assessment provides a risk claim for a range of hazards based on a number of inputs including (but not limited to) baseline data, expert opinion, outputs of the Hazard Workshops, stakeholder concerns and lessons learnt from existing offshore developments.
Description of the marine environment.	✓	**Section 7: Navigational Features** Relevant navigational features in proximity to the Project have been described including (but not limited to) other offshore windfarm developments, ports, harbours and related facilities, charted anchorage areas, aids to navigation, subsea cables, and charted wrecks. **Section 15: Cumulative and Transboundary Overview** Potential future developments have been screened into the cumulative risk assessment where a cumulative or in combination activity has been identified based upon the location and distance from the Project.
SAR overview and assessment.	✓	**Section 9: Emergency Response and Incident Overview** Existing SAR resources in proximity to the Project are summarised including the UK SAR operations contract, RNLI stations and assets, and HMCG stations. **Section 18: Risk Assessment** The risk assessment includes an assessment of how activities associated with the Project may restrict emergency response capability of existing resources.
Description of the OREI development and how it changes the marine environment.	✓	**Section 6: Project Description Relevant to Shipping and Navigation** The maximum extent of the Project for which any shipping and navigation hazards are assessed is provided including a description of the boundary, WDA infrastructure, construction phase programme and indicative vessel and helicopter numbers during the construction and O&M phases. **Section 14: Future Case Vessel Traffic** Worst-case alternative routeing for commercial traffic has been considered.
Analysis of the marine traffic, including base case and future traffic densities and types.	✓	**Section 10: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed and includes vessel density and breakdowns of vessel type. **Section 14: Future Case Vessel Traffic** Worst-case alternative routeing for commercial traffic has been considered, and potential future case increases of 10 and 20% have been modelled.

Item	Compliance	Comments
Status of the hazard log: ▪ Hazard identification; ▪ Risk assessment; ▪ Influences on level of risk; ▪ Tolerability of risk; and ▪ Risk matrix.	✓	**Section 3: Navigational Risk Assessment Methodology** A tolerability matrix has been defined to determine the tolerability (significance) of risks. **Appendix 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.
NRA: ▪ Appropriate risk assessment; ▪ MCA acceptance for assessment techniques and tools; ▪ Demonstration of results; and ▪ Limitations.	✓	**Section 2: Guidance and Legislation** MGN 654 and the IMO's FSA guidelines are the primary guidance documents used for the assessment. **Section 15: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk with the results outlined numerically and graphically, where appropriate.
Risk control log	✓	**Section 20: 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.

Appendix B Hazard Log

678. The complete hazard log, created following the Hazard Workshops, is presented in **Table B.1**. Definitions of the rankings used in the Hazard Log are detailed in **Section 3**.

Table B.1 Hazard Log

User	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							Additional Comments and Further Mitigation Required
					Frequency	Consequences					Risk		Frequency	Consequences					Risk	
						People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
Vessel Displacement for Third-Party Vessels																				
Commercial vessels	C/D	• Charting of infrastructure • Compliance with MGN 654 • Promulgation of information	• Presence of buoyed construction/ decommissioning area • Construction/ decommissioning vessels which are RAM • Safety zones	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	5	1	1	1	2	1.3	Tolerable with Mitigation	Increased journey time/distance which impacts on schedules or compliance with COLREGs	2	1	2	1	2	1.5	Broadly Acceptable	Noted that commercial vessels deviating inshore of the WDA may encounter static fishing gear.
	O	• Charting of infrastructure • Compliance with MGN 654 • Lighting and marking in agreement with NLB (and in line with IALA Recommendation G1162) • Promulgation of information	• Presence of surface structures • Maintenance vessels which are RAM • Major maintenance safety zones		5	1	1	1	2	1.3	Tolerable with Mitigation		2	1	2	1	2	1.5	Broadly Acceptable	
Commercial fishing vessels in transit	C/D	• Charting of infrastructure • Compliance with MGN 654 • Promulgation of information	• Presence of buoyed construction/ decommissioning area • Construction/ decommissioning vessels which are RAM • Safety zones	Increased journey time/distance but does not impact on transits or compliance with COLREGs	4	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance which impacts on transits or compliance with COLREGs	2	1	2	1	3	1.8	Broadly Acceptable	
	O	• Charting of infrastructure • Compliance with MGN 654 • Lighting and marking in agreement with NLB (and in line with IALA Recommendation G1162) • Promulgation of information	• Presence of surface structures • Maintenance vessels which are RAM • Major maintenance safety zones		4	1	1	1	2	1.3	Broadly Acceptable		2	1	2	1	3	1.8	Broadly Acceptable	
Recreational vessels (2.5 to 24 m length)	C/D	• Charting of infrastructure • Compliance with MGN 654 • Promulgation of information	• Presence of buoyed construction/ decommissioning area • Construction/ decommissioning vessels which are RAM • Safety zones	Increased journey time/distance but does not impact on transits or compliance with COLREGs	3	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance which impacts on transits or compliance with COLREGs	1	1	1	1	2	1.3	Broadly Acceptable	Noted that inclusion of content about Machair in the Clyde Cruising Club Sailing Directions would be useful.
	O	• Charting of infrastructure • Compliance with MGN 654 • Lighting and marking in agreement with NLB (and in line with IALA Recommendation G1162) • Promulgation of information	• Presence of surface structures • Maintenance vessels which are RAM • Major maintenance safety zones		3	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	2	1.3	Broadly Acceptable	

User	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							Additional Comments and Further Mitigation Required
					Frequency	Consequences					Risk		Frequency	Consequences					Risk	
						People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
Displacement of Commercial Vessels in Adverse Weather																				
Commercial vessels	C/D	• Charting of infrastructure • Compliance with MGN 654 • Promulgation of information	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased journey time/distance but does not impact on schedules or compliance with COLREGs	5	1	1	1	3	1.5	Tolerable with Mitigation	Large deviation or cancellation of sailing	3	2	2	2	4	2.5	Broadly Acceptable	
	O	• Charting of infrastructure • Compliance with MGN 654 • Lighting and marking in agreement with NLB (and in line with IALA Recommendation G1162) • Promulgation of information	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		5	1	1	1	3	1.5	Tolerable with Mitigation		3	2	2	2	4	2.5	Broadly Acceptable	
Increased Vessel to Vessel Collision Risk between Third-Party Vessels																				
Commercial vessels	C/D	• Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased encounters resulting in a low impact collision event	3	2	2	3	2	2.3	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, Potential Loss of Life (PLL), and/or pollution	2	4	3	4	4	3.8	Broadly Acceptable	
	O	• Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Lighting and marking in agreement with NLB (and in line with IALA Recommendation G1162) • Pollution planning • Promulgation of information	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		3	2	2	3	2	2.3	Broadly Acceptable		2	4	3	4	4	3.8	Broadly Acceptable	
Commercial fishing vessels in transit	C/D	• Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased encounters resulting in a low impact collision event	3	3	1	3	2	2.3	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	2	5	3	4	3	3.8	Broadly Acceptable	Noted that commercial vessels deviating inshore of the WDA may increase collision risk to inshore vessels including fishing vessels.

User	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							Additional Comments and Further Mitigation Required
					Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	
	O	• Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Lighting and marking in agreement with NLB (and in line with IALA Recommendation G1162) • Pollution planning • Promulgation of information	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		3	3	1	3	2	2.3	Broadly Acceptable		2	5	3	4	3	3.8	Broadly Acceptable	
Recreational vessels (2.5 to 24 m length)	C/D	• Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Pollution planning • Promulgation of information	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters resulting in a high impact collision event with vessel damage, PLL, and/or pollution	1	5	2	4	2	3.3	Broadly Acceptable	
	O	• Charting of infrastructure • Compliance with MGN 654 • Guard vessels • Lighting and marking in agreement with NLB (and in line with IALA Recommendation G1162) • Pollution planning • Promulgation of information	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		2	3	1	3	1	2.0	Broadly Acceptable		1	5	2	4	2	3.3	Broadly Acceptable	
Increased Vessel to Vessel Collision Risk Between a Third-Party Vessel and a Project Vessel																				
Commercial vessels	C/D	• Advisory passing distances • Application for safety zones • Buoyed construction/ decommissioning area • Charting of infrastructure • Guard vessels • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (COLREGs) • Promulgation of information	• Project vessels in transit • Lack of third-party awareness	Increased encounters resulting in a low impact collision event	3	2	2	3	2	2.3	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	2	4	3	4	4	3.8	Broadly Acceptable	
	O				3	2	2	3	2	2.3	Broadly Acceptable		2	4	3	4	4	3.8	Broadly Acceptable	
Commercial fishing vessels in transit	C/D	• Advisory passing distances • Application for safety zones • Buoyed construction/ decommissioning area • Charting of infrastructure	• Project vessels in transit • Lack of third-party awareness	Increased encounters resulting in a low impact collision event	3	3	1	3	2	2.3	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with	2	5	3	4	3	3.8	Broadly Acceptable	As jacket foundations may be used which would have to be either towed to site or taken on a barge, the potential

User	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							Additional Comments and Further Mitigation Required
					Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	
	O	• Guard vessels • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (COLREGs) • Promulgation of information			3	3	1	3	2	2.3	Broadly Acceptable	vessel damage, PLL, and/or pollution	2	5	3	4	3	3.8	Broadly Acceptable	for collisions between these and vessels actively fishing in proximity was raised at the Hazard Workshop. It will be important to ensure project vessels are aware of the VMP. Weekly Notice of Operations are useful.
Recreational vessels (2.5 to 24 m length)	C/D	• Advisory passing distances • Application for safety zones • Buoyed construction/ decommissioning area • Charting of infrastructure • Guard vessels • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (COLREGs) • Promulgation of information	• Project vessels in transit • Lack of third-party awareness	Increased encounters resulting in a low impact collision event	2	3	1	3	1	2.0	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs, resulting in a collision event with vessel damage, PLL, and/or pollution	1	5	2	4	2	3.3	Broadly Acceptable	
	O				2	3	1	3	1	2.0	Broadly Acceptable		1	5	2	4	2	3.3	Broadly Acceptable	
Reduced Access to Local Ports																				
Commercial vessels	C/D	• Advisory passing distances • Compliance with MGN 654 • Charting of infrastructure • Promulgation of information • Cable Burial Risk Assessment	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased journey time/distance but does not impact on schedules, berth times, or compliance with COLREGs	3	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance impacting on schedules, berth times, and/or compliance with COLREGs	2	1	3	1	3	2.0	Broadly Acceptable	Noted that Calmac Ferries may be affected depending in what ports were used by the project.
	O	• Advisory passing distances • Compliance with MGN 654 • Charting of infrastructure • Promulgation of information • Cable Burial Risk Assessment	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		2	1	1	1	2	1.3	Broadly Acceptable		1	1	3	1	3	2.0	Broadly Acceptable	
Commercial fishing vessels in transit	C/D	• Advisory passing distances • Compliance with MGN 654 • Charting of infrastructure • Promulgation of information • Cable Burial Risk Assessment	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased journey time/distance but does not impact on transits, berth times, or	3	1	1	1	2	1.3	Broadly Acceptable	Increased journey time/distance impacting on transits, berth times, and/or compliance with COLREGs	2	1	2	1	3	1.8	Broadly Acceptable	

User	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							Additional Comments and Further Mitigation Required
						Consequences								Consequences						
					Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk	
	O	• Advisory passing distances • Compliance with MGN 654 • Charting of infrastructure • Promulgation of information • Cable Burial Risk Assessment	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM	compliance with COLREGs	2	1	1	1	2	1.3	Broadly Acceptable		1	1	2	1	3	1.8	Broadly Acceptable	
Recreational vessels (2.5 to 24 m length)	C/D	• Advisory passing distances • Compliance with MGN 654 • Charting of infrastructure • Promulgation of information • Cable Burial Risk Assessment	• Presence of buoyed construction/ decommissioning area • Adverse weather • Construction/ decommissioning vessels which are RAM	Increased journey time/distance but does not impact on transits, berth times, or compliance with COLREGs	2	1	1	1	1	1.0	Broadly Acceptable	Increased journey time/distance impacting on transits, berth times, and/or compliance with COLREGs	1	2	1	1	2	1.5	Broadly Acceptable	
	O	• Advisory passing distances • Compliance with MGN 654 • Charting of infrastructure • Promulgation of information • Cable Burial Risk Assessment	• Presence of surface structures • Adverse weather • Maintenance vessels which are RAM		1	1	1	1	1	1.0	Broadly Acceptable		1	2	1	1	2	1.5	Broadly Acceptable	
Creation of Vessel to Structure Allision Risk (Including Powered, Drifting and Internal)																				
Commercial vessels	O	• Advisory passing distances • Charting of infrastructure • Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (SOLAS) • Promulgation of information	• Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure	Vessel passes in close proximity resulting in a need to make a late adjustment to course/speed, or drifts towards a structure but is able to regain power prior to an allision event.	3	1	1	1	2	1.3	Broadly Acceptable	Allision event occurs with a structure involving vessel damage, PLL, and/or pollution	2	3	3	4	5	3.8	Broadly Acceptable	
Commercial fishing vessels in transit	O	• Advisory passing distances • Charting of infrastructure • Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (SOLAS) • Promulgation of information	• Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure	Vessel passes in close proximity resulting in a need to make a late adjustment to course/speed, or drifts towards a structure but is able to regain power prior to an allision event.	4	1	1	1	2	1.3	Broadly Acceptable	Allision event occurs with a structure involving vessel damage, PLL, and/or pollution	3	4	3	4	4	3.8	Tolerable with Mitigation	During the Hazard Workshop it was noted that fishing vessel allisions with wind turbines have occurred and should therefore be accounted for in the frequency ranking, and that there could be multiple fatalities. See workshop minutes for full discussion record.

User	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							Additional Comments and Further Mitigation Required
					Frequency	Consequences					Risk		Frequency	Consequences					Risk	
						People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence		
Recreational vessels (2.5 to 24 m length)	O	• Advisory passing distances • Charting of infrastructure • Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels • Minimum blade tip clearance • Pollution planning • Project vessel compliance with international marine regulations (SOLAS) • Promulgation of information	• Presence of surface structures • Human/navigation error • Mechanical/technical failure • Adverse weather • Aid to navigation failure	Vessel passes in close proximity resulting in a need to make a late adjustment to course/speed, or drifts towards a structure but is able to regain power prior to an allision event.	3	1	1	1	1	1.0	Broadly Acceptable	Allision event occurs with a structure involving vessel damage, PLL, and/or pollution	2	4	2	4	2	3.0	Broadly Acceptable	As raised at the Hazard Workshop, the likelihood of a recreational vessel entering the WDA (and increasing allision risk) depends on the number of commercial vessels routeing to the east.
Vessel Anchor Interaction with Subsea Cables																				
All vessels	O	• Charting of infrastructure • Compliance with MGN 654 • Implementation and monitoring of cable protection • Promulgation of information	• Presence of subsea cables • Human/navigation error • Mechanical/technical failure • Adverse weather	Commercial vessel drops or drag anchor in vicinity of an installed cable, but no interaction occurs	2	1	1	1	2	1.3	Broadly Acceptable	Vessel anchors on or drags anchor over a cable/protection resulting in damage to the cable/protection and/or anchor	1	3	2	3	2	2.5	Broadly Acceptable	During the Hazard Workshop it was noted that, in the event of a potential drifting allision, a fishing vessel Master would likely prioritise preventing a drift towards a WTG over risk of cable/anchor interaction.
Interference with Marine Navigation, Communication and Position Fixing Equipment																				
All vessels	O	• Implementation and monitoring of cable protection	• Human error relating to adjustment of Radar controls • Presence of surface structures • EMF from cables	Structures have no material 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 (Including SAR Access)																				
Emergency responders	O	• Compliance with MGN 654 • Lighting and marking • Marine coordination for Project vessels • Pollution planning • Project vessel compliance with international marine regulations (SOLAS)	• Array does not facilitate responder access • Limited resource capability • Adverse weather	Delay to response request	3	1	1	1	2	1.3	Broadly Acceptable	Delay to response request resulting from incident within the WDA leading to vessel damage, injury to person, PLL, and/or pollution	2	5	3	5	4	4.3	Tolerable with Mitigation	

Appendix C Consequence Assessment

C.1 Introduction

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

680. The significance of the risk due to the presence of the Project is also assessed based on risk evaluation criteria and comparison with historical incident data in UK waters[5].

C.2 Risk Evaluation Criteria

C.2.1 Risk to People

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

- Individual risk; and
- Societal risk.

C.2.2 Individual Risk

682. Individual risk considers whether the risk from an incident to a particular individual changes significantly due to the presence of the Project. Individual risk considers not only the frequency of the incident and the consequences (e.g., likelihood of death), but also the individual's fractional exposure to that risk, i.e. the probability of the individual being in the given location at the time of the incident.

683. The purpose of estimating the individual risk is to ensure that individuals who may be affected by the presence of the Project are not exposed to excessive risks. This is achieved by considering the significance of the change in individual risk resulting from the presence of the Project relative to the UK background individual risk levels.

684. Annual risk levels to crew (the annual risk to an average crew member) for different vessel types are presented in **Figure C.1**, which also includes the upper and lower bounds for risk acceptance criteria as suggested in IMO MSC 72 / 16 (IMO, 2001). The annual individual risk level to crew falls within the ALARP region for each of the vessel types presented.

[5] For the purposes of this assessment, UK waters are defined as the UK EEZ and UK territorial waters refers to the 12 nm limit from the British Isles, excluding the Republic of Ireland.

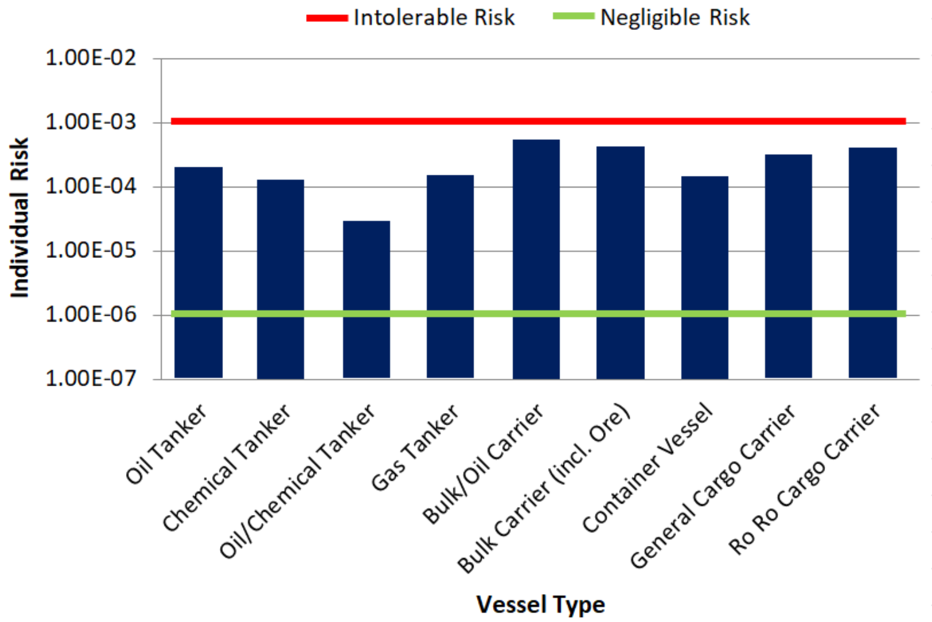

Figure C.1 Individual Risk Levels and Acceptance Criteria per Vessel Type

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

Table C.1 Individual Risk ALARP Criteria

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

686. On a UK basis, the MCA have presented individual risks for various UK industries based on HSE data from 1987–1991. The risks for different industries are presented in **Figure C.2**.

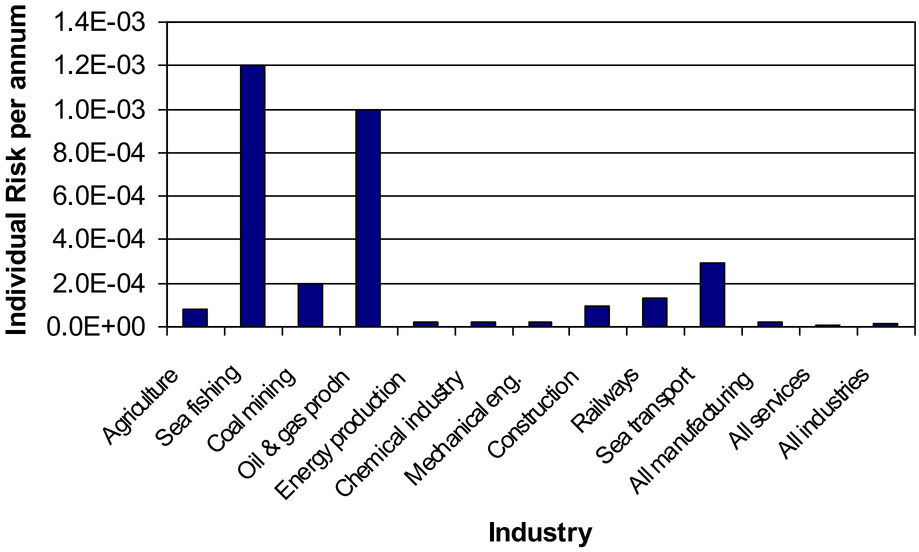

Figure C.2 Individual Risk per Year for Various UK Industries

687. The individual risk for sea transport of 2.9×10^{-4} per year is consistent with the worldwide data presented in **Figure C.2**, whilst the individual risk for sea fishing of 1.2×10^{-3} per year is the highest across all of the industries included.

C.2.3 Societal Risk

688. Societal risk is used to estimate risks of incidents affecting many persons (catastrophes) and acknowledging risk adverse or neutral attitudes. Societal risk includes the risk to every person, even if a person is only exposed to risk on one brief occasion. For assessing the risk to a large number of affected people, societal risk is desirable because individual risk is insufficient in evaluating risks imposed on large numbers of people.

689. Within this assessment, societal (navigation based) risk can be assessed for the Project, giving account to the change in risk associated with each incident scenario cause by the introduction of the windfarm structures. Societal risk may be expressed as:

- Annual fatality rate where frequency and fatality are combined into a convenient one-dimensional measure of societal risk (also known as PLL); and
- F-N diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

690. When assessing societal risk this study focuses on PLL, which accounts for the number of people likely to be involved in an incident (which is higher for certain vessel types) and assesses the significance of the change in risk compared to the UK background risk levels.

C.2.4 Risk to Environment

691. For risk to the environment the key criteria considered in terms of the risk due to the Project is the potential quantity of oil spilled from a vessel involved in an incident.

692. It is recognised that there will be other potential pollution, e.g., hazardous containerised cargoes; however, oil is considered the most likely pollutant, and the extent of predicted oil spills will provide an indication of the significance of pollution risk due to the Project compared to UK background pollution risk levels.

C.3 Marine Accident Investigation Branch Incidents

C.3.1 All Incidents in UK Waters

693. All UK flagged commercial vessels are required to report incidents to the MAIB. Non-UK flagged vessels do not have to report an incident to the MAIB unless located at a UK port or within 12 nm territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report incidents to the MAIB; however, a significant proportion of such incidents are reported to and investigated by the MAIB.

694. The MCA, harbour authorities and inland waterway authorities also have a duty to report incidents to the MAIB. Therefore, whilst there may be a degree of underreporting of incidents with minor consequences, those resulting in more serious consequences, such as fatalities, are likely to be reported.

695. Only incidents occurring in UK waters have been considered within this assessment for which the MAIB data is most comprehensive. It is also noted that incidents occurring in ports / harbours and rivers / canals have been excluded since the causes and consequences may differ considerably from an incident occurring offshore, which is the location of most relevance to the Project.

696. Accounting for these criteria, a total of 11,773 accidents, injuries and hazardous incidents were reported to the MAIB in the 20-year period between 2002 and 2021 involving 13,415 vessels (some incidents, such as collisions, involved more than one vessel).

697. The location of all incidents in proximity to the UK are presented in **Figure C.3**. The majority of incidents occur in coastal waters.

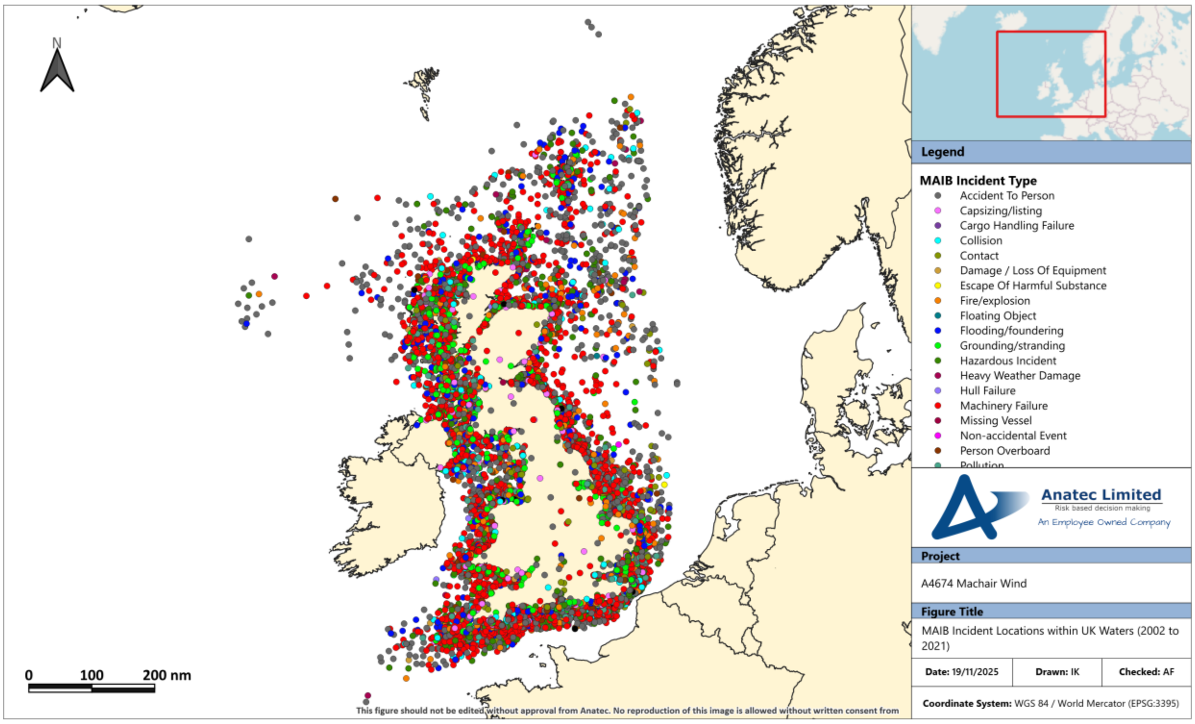

Figure C.3 MAIB Incident Locations within UK Waters (2002 to 2021)

698. The distribution of incidents by year in UK waters is presented in **Figure C.4**.

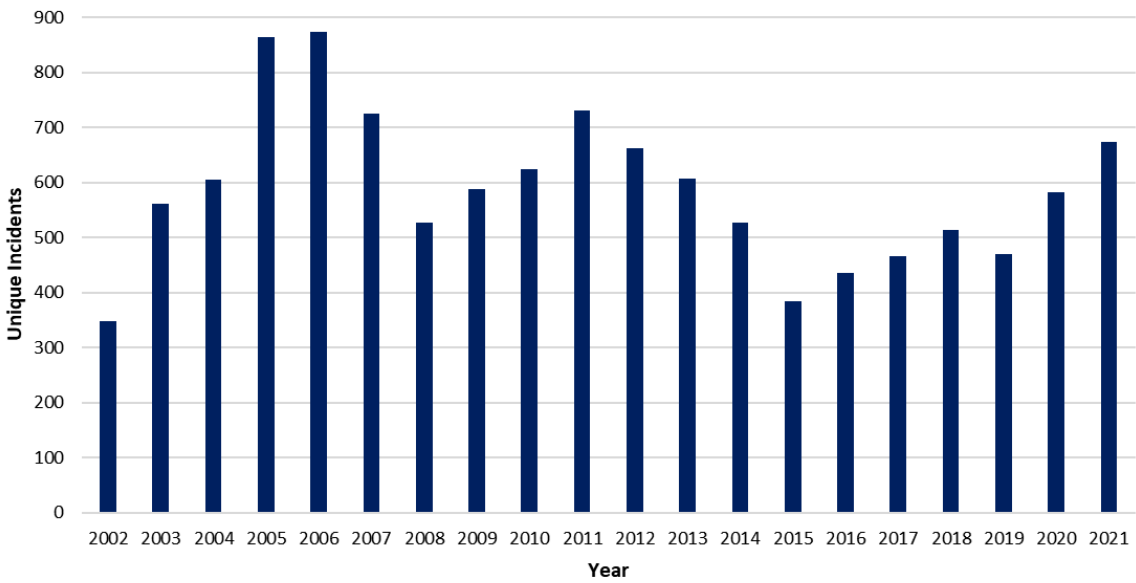

Figure C.4 MAIB Unique Incidents per Year within UK Waters (2002 to 2021)

699. The average number of unique incidents per year was 589. There has generally been a fluctuating trend in incidents over the 20-year period.

700. The distribution of incidents in UK waters by incident type is presented in **Figure C.5.**

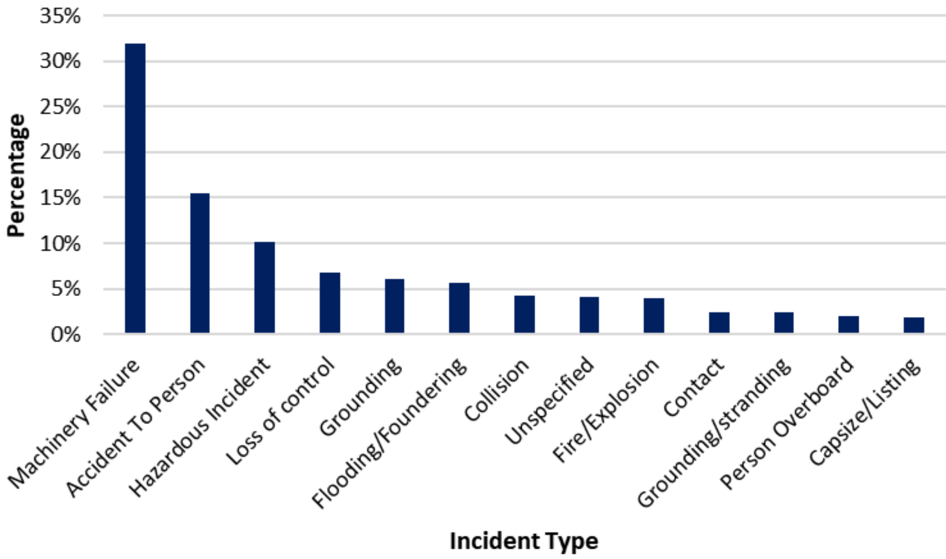

Figure C.5 MAIB Incident Types Breakdown within UK Waters (2002 to 2021)

701. The most frequent incident types were "machinery failure" (32%), "accident to person" (16%) and "hazardous incident" (10%). "Collision" and "contact" incidents represented 4% and 2% of total incidents, respectively.

702. The distribution of incidents in UK waters by vessel type is presented in **Figure C.6**.

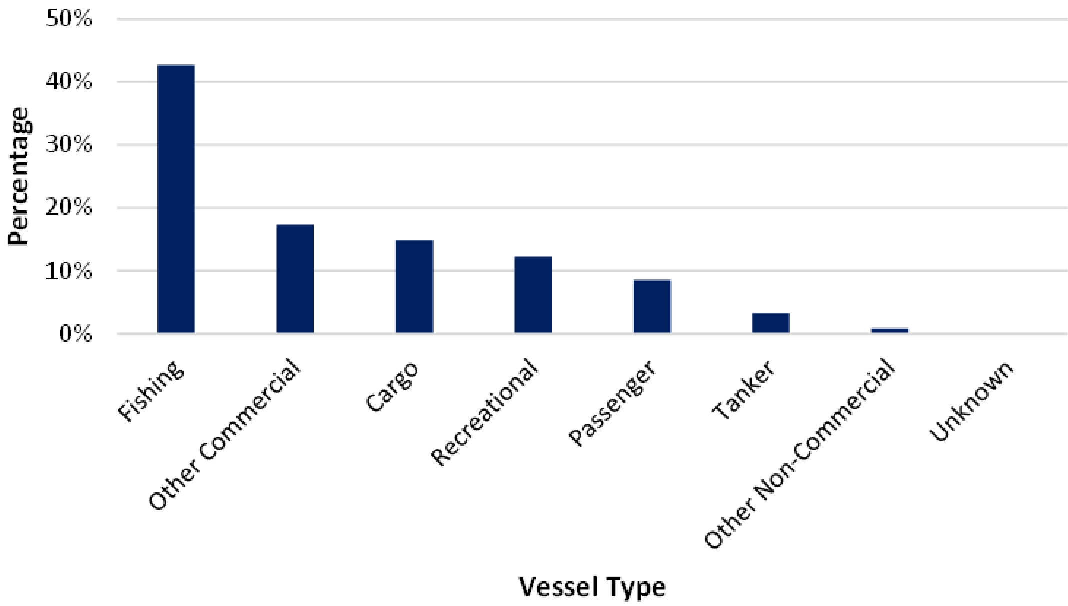

Figure C.6 MAIB Vessel Types Breakdown within UK Waters (2002 to 2021)

703. The most frequent vessel types involved in incidents were fishing vessels (43%), other commercial vessels (17%) (including offshore industry vessels, tugs, workboats and pilot vessels) and cargo vessels (15%).

704. A total of 414 fatalities were reported in the MAIB incidents within UK waters between 2002 and 2021, corresponding to an average of 21 fatalities per year.

705. The distribution of fatalities in UK waters by vessel type and person category (crew, passenger and other) is presented in **Figure C.7**.

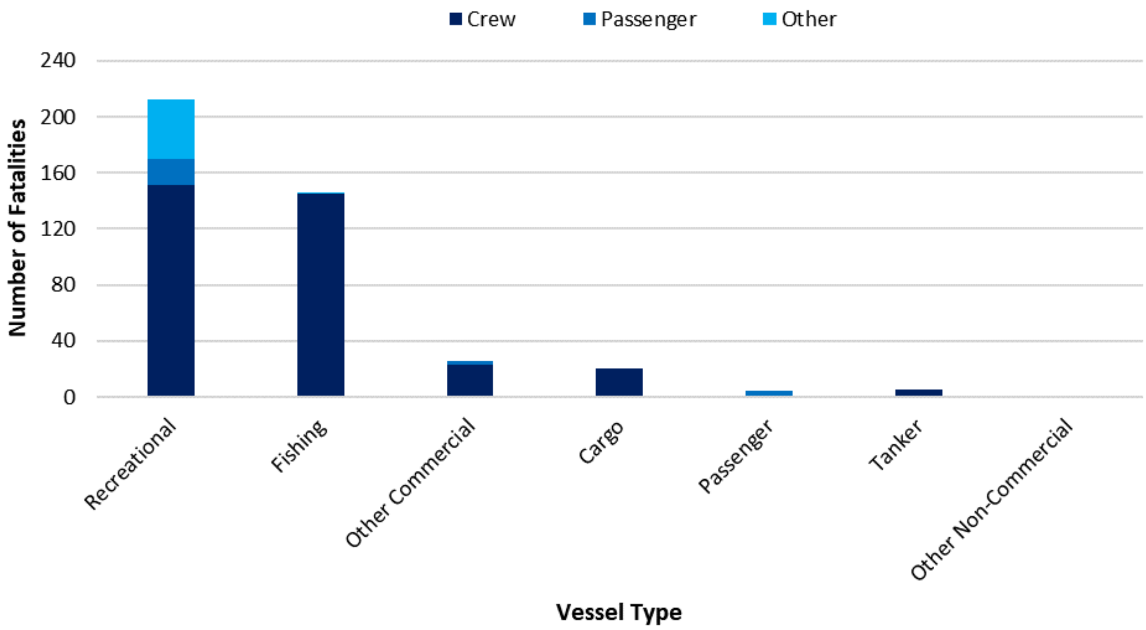

Figure C.7 MAIB Fatalities by Vessel Type within UK Waters (2002 to 2021)

706. The majority of fatalities occurred to recreational vessels (51%) and fishing vessels (35%), with crew members the main personnel involved.

C.3.2 Collision Incidents

707. The MAIB define a collision incident as “*ships striking or being struck by another ship, regardless of whether the ships are underway, anchored or moored*” (MAIB, 2013).

708. A total of 481 collision incidents were reported to the MAIB in UK waters between 2002 and 2021 involving 1,068 vessels (in a small number of cases the other vessel involved was not logged).

709. The locations of collision incidents reported in proximity to the UK are presented in **Figure C.8**.

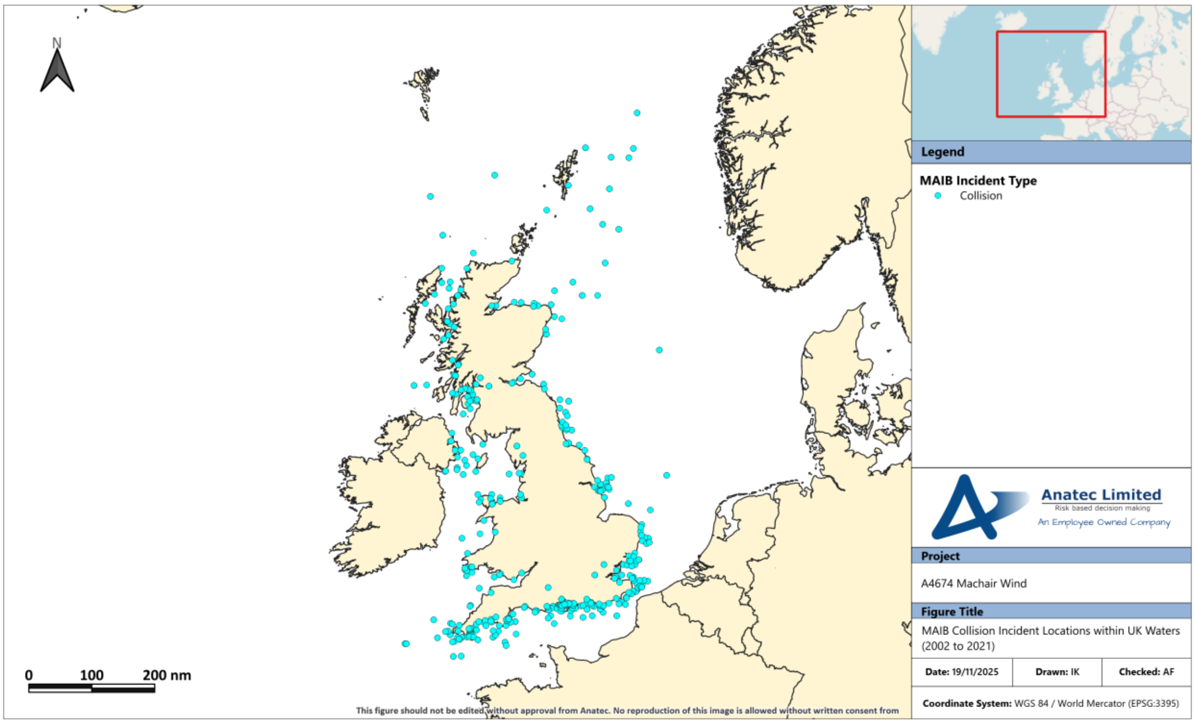

Figure C.8 MAIB Collision Incident Locations within UK Waters (2002 to 2021)

710. The distribution of collision incidents per year is presented in **Figure C.9**.

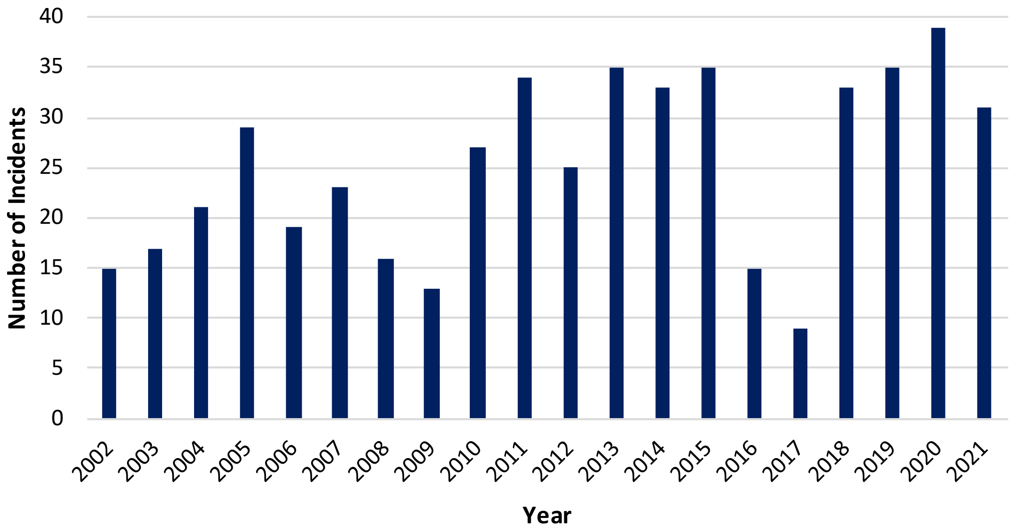

Figure C.9 MAIB Collision Incidents per Year within UK Waters (2002 to 2021)

711. The average number of collision incidents per year was 25. There has been an overall slight increasing trend in collision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

712. The most frequent vessel types involved in collision incidents were recreational vessels (29%), fishing vessels (26%), other commercial vessels (24%) and cargo vessels (13%).

713. A total of five fatalities were reported in MAIB collision incidents within UK waters between 2002 and 2021. Details of each of these fatal incidents reported by the MAIB are presented in **Table C.2**.

Table C.2 Description of Fatal MAIB Collision Incidents (2002 to 2021)

Date	Description	Fatalities
July 2005	Collision between two powerboats at night. Both vessels were unlit and both helmsmen had consumed alcohol. One of the helmsmen died.	1
October 2007	Collision between fishing vessel and coastal general cargo vessel following failure to keep an effective lookout. Fishing vessel sank with three of the four crew members abandoning ship into a life raft, but the fourth crew member was not recovered.	1
August 2010	Collision between passenger ferry and fishing vessel. Fishing vessel sank with one of the two crew members recovered from the sea, but the other member was not recovered despite an extensive search.	1
June 2015	Collision between RIB and yacht. Believed that around a dozen persons were onboard the motorboat with the majority taken ashore by lifeboat. One person seriously injured and airlifted to hospital before being pronounced dead later.	1
June 2018	Collision between power boats during a race. One of the vessels overturned with the pilot pronounced dead at the scene.	1

C.3.3 Allision Incidents

714. The MAIB define a contact incident as "*ships striking or being struck by an external object. The objects can be: floating object (cargo, ice, other or unknown); fixed object, but not the sea bottom; or flying object*" (MAIB, 2013). In line with the NRA as a whole, an allision is considered to involve a moving object and a stationary object at sea, with port infrastructure excluded from consideration; the MAIB contact incidents have been individually inspected and filtered in line with the NRA definition.

715. A total of 119 allision incidents were reported to the MAIB within UK waters between 2002 and 2021 involving 119 vessels.

716. The locations of allision incidents reported in proximity to the UK are presented in **Figure C.10**.

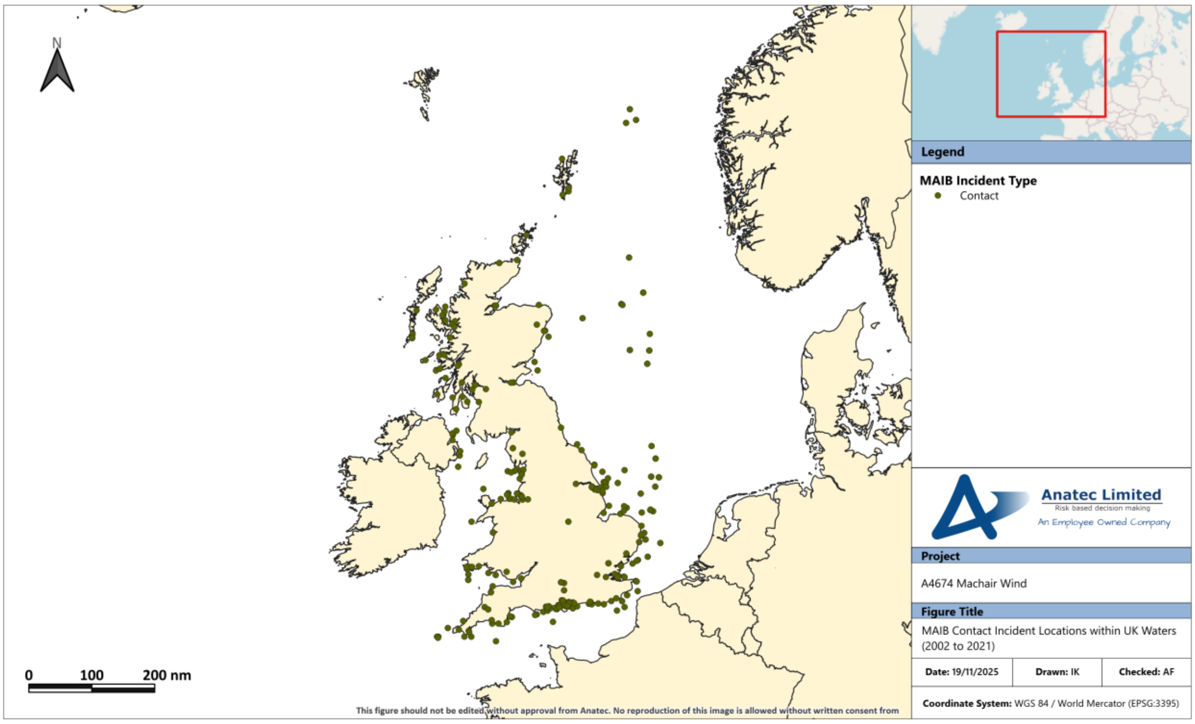

Figure C.10 MAIB Contact Incident Locations within UK Waters (2002 to 2021)

717. The distribution of allision incidents per year is presented in **Figure C.11**.

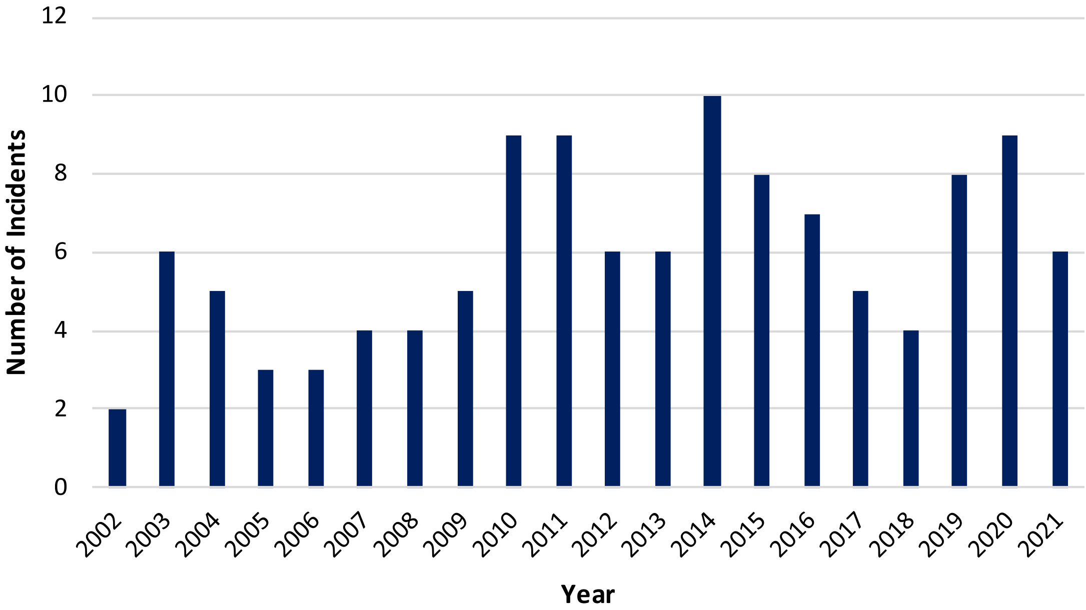

Figure C.11 MAIB Contact Incidents per Year within UK Waters (2002 to 2021)

718. The average number of allision incidents per year was six. As with collision incidents, there has been an overall slight increasing trend in allision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

719. The distribution of vessel types involved in allision incidents is presented in **Figure C.12**.

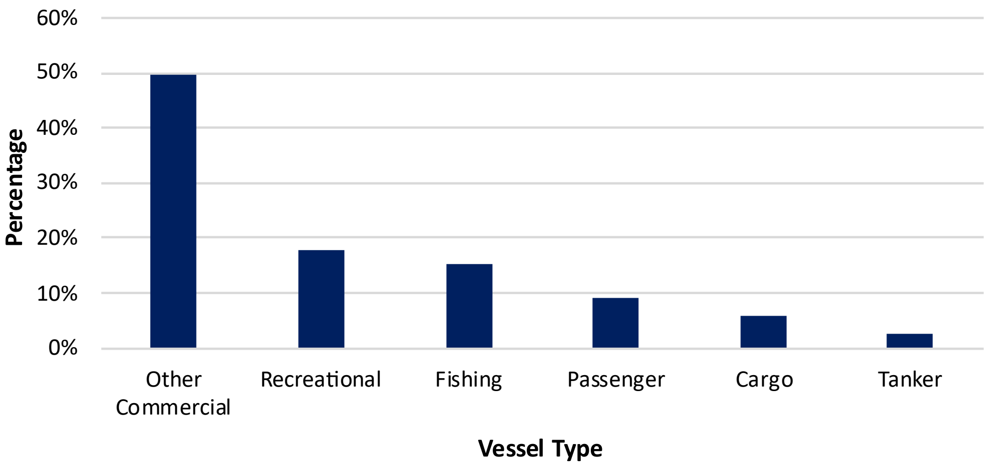

Figure C.12 MAIB Allision Incidents by Vessel Type within UK Waters (2002 to 2021)

720. The most frequent vessel types involved in allision incidents were other commercial vessels (50%), recreational vessels (18%) and fishing vessels (15%).

721. No fatalities were reported in MAIB allision incidents within offshore UK waters between 2002 and 2021.

C.4 Fatality Risk

C.4.1 Incident Data

722. This section uses the MAIB incident data along with information on average manning levels per vessel type to estimate the probability of a fatality in a maritime incident associated with the Project.

723. The Project is assessed to have the potential to affect the following incidents:

- Vessel to vessel collision;
- Powered vessel to structure allision;
- Drifting vessel to structure allision; and
- Fishing vessel to structure allision.

724. Of these incident types, only vessel to vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in **Section C.4.2** is considered directly applicable to these types of incidents.

725. The other scenarios of powered vessel to structure allision, drifting vessel to structure allision and fishing vessel to structure allision are technically contacts since they would involve a vessel striking an immobile object in the form of a WTG or OSP. Additionally, none of the allision incidents reported by the MAIB between 2002 and 2021 resulted in a fatality.

726. As the mechanics involved in a vessel contacting a WTG may differ in severity from hitting, for example, a buoy, quayside, or moored vessel, the MAIB collision fatality risk rate has also been conservatively applied for the allision incident types.

C.4.2 Fatality Probability

727. Five of the 504 collision incidents reported by the MAIB within UK waters between 2002 and 2021 resulted in fatalities. This gives a 0.99% probability that a collision incident will lead to a fatal accident.

728. To assess the fatality risk for personnel onboard a vessel (crew, passenger or other) the number of persons involved in the incidents needs to be estimated. **Table C.3** presents the average number of persons on board (POB) estimated for each category of vessel navigating in proximity to the Project. For passenger vessels this is based upon information available for the specific vessels recorded in the long-term data analysis. For other vessel categories, this is based upon information available from the MAIB incident data.

Table C.3 Estimated Average POB by Vessel Category

Vessel Category	Sub Categories	Source of Estimated Average POB	Estimated Average POB
Cargo / freight	Dry cargo, other commercial, service ship, etc.	MAIB incident data	15
Tanker	Tanker / combination carrier	MAIB incident data	23
Passenger	Ro-Ro passenger, cruise liner, etc.	Vessel traffic survey data / online information	1,057
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3

729. It is recognised that these average POB numbers can be substantially higher or lower on an individual vessel basis depending upon the size, subtype, etc. but applying reasonable averages is considered sufficient for this analysis.

730. Using the average POB, along with the vessel type information involved in collision incidents reported by the MAIB there was an estimated 49,143 POB the vessels involved in the collision incidents.

731. Based upon five fatalities during the period 2002–2021, the overall fatality probability in a collision for any individual onboard is approximately 1.02×10^{-4} per collision.

732. It is considered inappropriate to apply this rate uniformly as the statistics indicate that the fatality probability associated with smaller craft, such as fishing vessels and recreational vessels, is higher. Therefore, the fatality probability has been subdivided into three categories of vessel as presented in **Table C.4**.

733. In addition, due to zero fatalities resulting from commercial vessel collisions between 2002 and 2021, the time period used to assess the fatality probability for commercial vessels has been extended by five years to ensure a meaningful probability is captured.

Table C.4 Collision Incident Fatality Probability by Vessel Category

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability	Time Period
Commercial	Dry cargo, passenger, tanker, etc.	1	47,193	2.12×10^{-5}	1997–2021 (25 years)
Fishing	Trawler, potter, dredger, etc.	2	927	2.2×10^{-3}	2002 –2021 (20 years)
Recreational	Yacht, small commercial motor yacht, etc.	3	1,023	2.9×10^{-3}	2002 –2021 (20 years)

C.4.3 Fatality Risk due to the Project

734. The base case and future case annual collision frequency levels pre and post windfarm are summarised in **Table 16.1**, where change refers to the increase in collision and allision frequency due to the presence of the Project; estimated at overall 7.54×10^{-2}, equating to an additional collision or allision every 13 years for the base case.

735. From the detailed results of the collision and allision risk modelling, the distribution of the predicted change in annual collision and allision frequency by vessel type due to the Project for the base case and future cases are presented in **Figure C.13**.

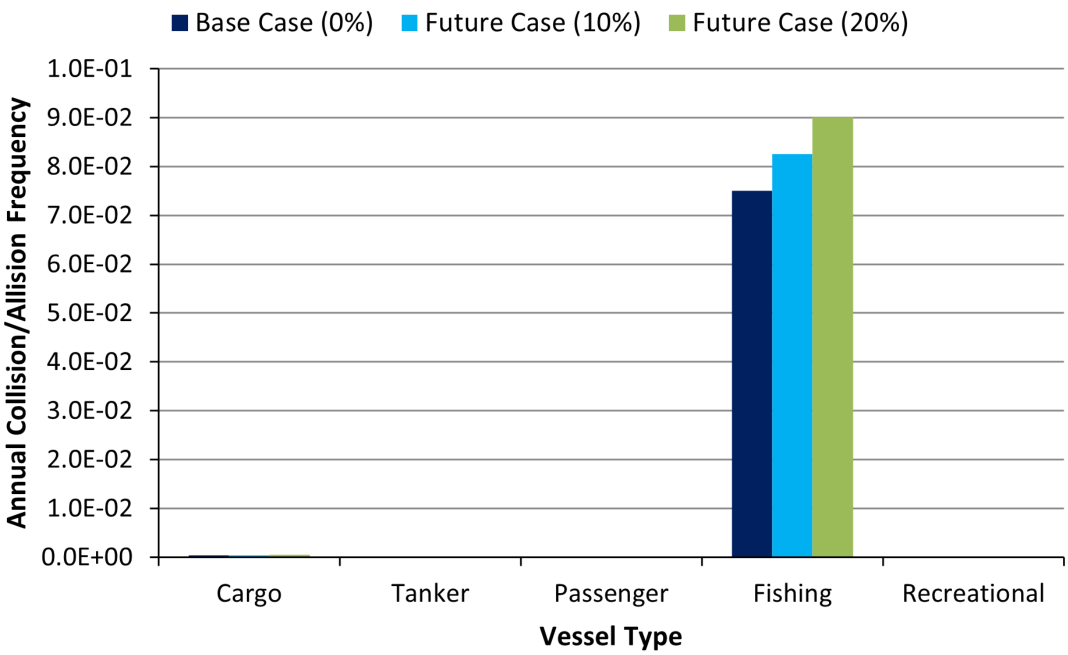

Figure C.13 Estimated Change in Annual Collision and Allision Frequency by Vessel Type

736. It can be seen that the majority of change in collision and allision frequency is associated with fishing vessels, due to the level of internal fishing activity and the conservative nature of Anatec's COLLRISK model for fishing vessel allisions.

737. Combining the annual collision and allision frequency, estimated number of POB for each vessel type, and estimated fatality probability for each vessel category, the total annual increase in PLL due to the presence of the Project for the base case is estimated to be 5.06×10^{-4}, equating to one additional fatality every 1,976 years.

738. The estimated incremental increases in PLL, distributed by vessel type for the base and future cases, are presented in **Figure C.14**.

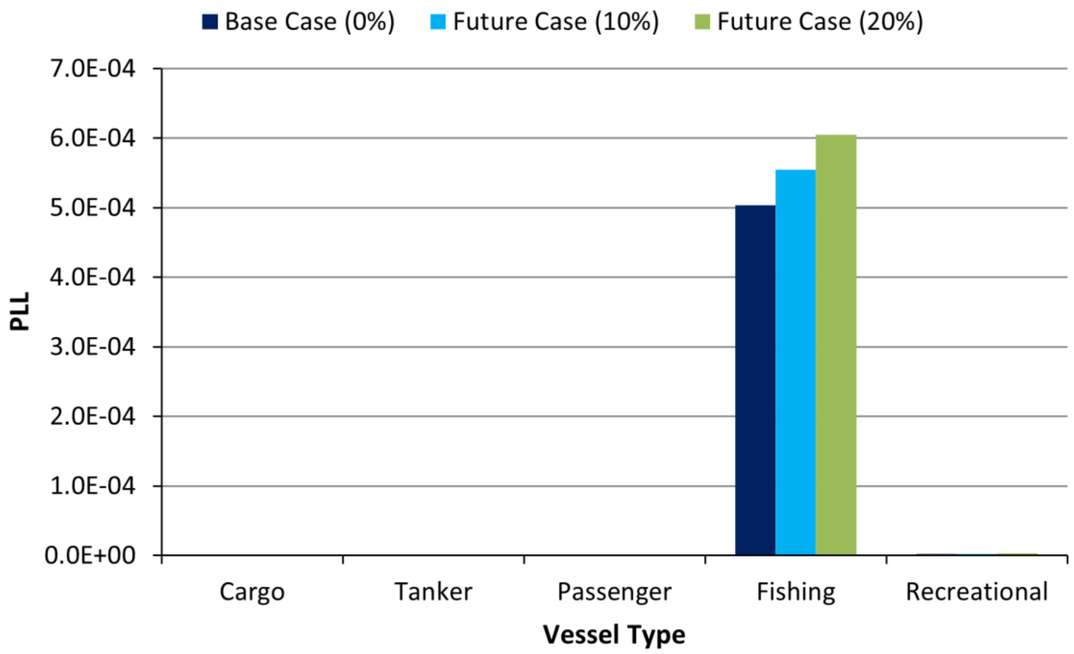

Figure C.14 Estimated Change in Annual PLL by Vessel Type

739. It can be seen that the majority of the change in annual PLL is associated with fishing vessels.

740. Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented in **Figure C.15**.

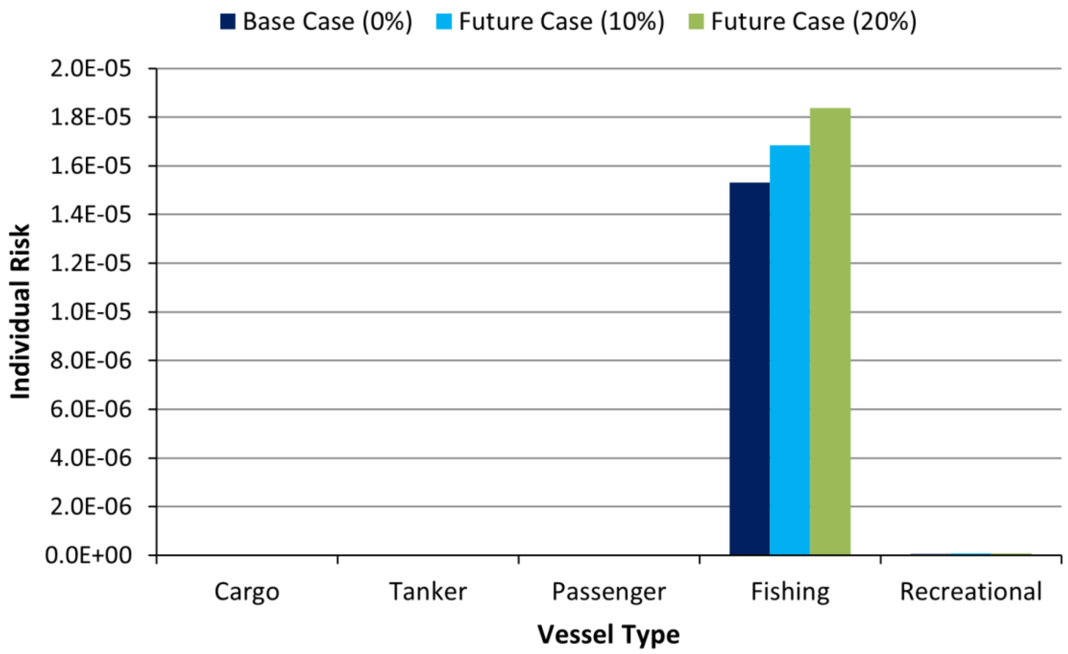

Figure C.15 Estimated Change in Individual Risk by Vessel Type

741. It can be seen that the individual risk is highest for people on fishing vessels, which reflects the higher probability of a fatality occurring in the event of an incident involving a fishing vessel.

C.4.4 Significance of Increase in Fatality Risk

742. In comparison to MAIB statistics, which indicate an average of 18–19 fatalities per year in UK territorial waters during the 20-year period between 2002 and 2021, the overall increase for the base case in PLL of one additional fatality per 1,976 years, represents a small change.

743. In terms of individual risk to people, the change for commercial vessels attributed to the Project (approximately 1.4×10^{-9} for the base case) is significantly lower compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

744. For fishing vessels, the change in individual risk attributed to the Project (approximately 1.5×10^{-5} for the base case) is lower compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year. It is also noted that in the event that an incident were to occur involving a fishing vessel, project vessels may be able to assist.

C.5 Pollution Risk

C.5.1 Historical Analysis

745. The pollution consequences of a collision in terms of oil spill depend upon the following criteria:

- Spill probability (i.e., the likelihood of outflow following an incident); and
- Spill size (quantity of oil).

746. Two types of oil spill are considered in this assessment:

- Fuel oil spills from bunkers (all vessel types);
- Cargo oil spills (laden tankers).

747. The research undertaken as part of the DfT's Marine Environmental High Risk Areas (MEHRAs) Project (DfT, 2001) has been used it was comprehensive and based upon worldwide marine oil spill data analysis. From this research, the overall probability of a spill per incident was calculated based upon historical incident data for each incident type as presented in **Figure C.16**.

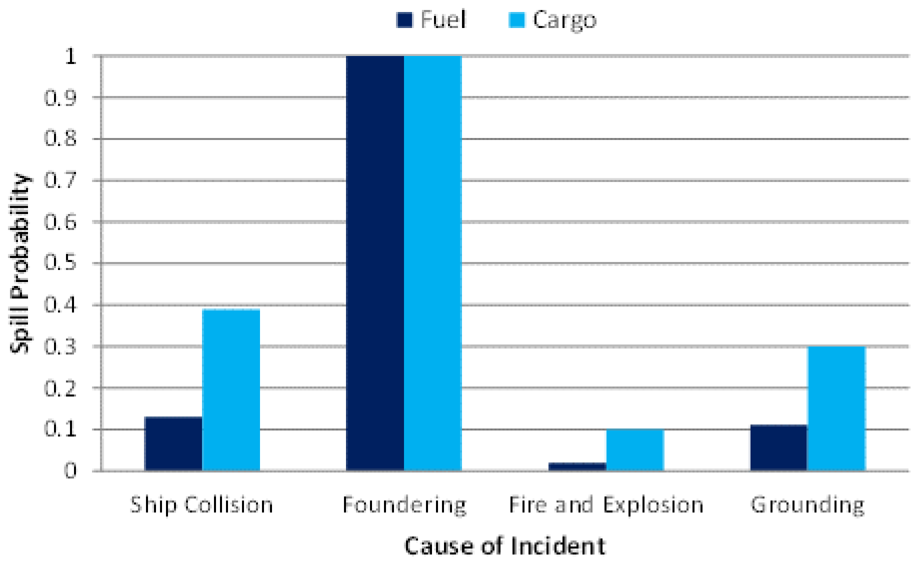

Figure C.16 Probability of an Oil Spill Resulting from an Accident

748. Therefore, it was estimated that 13% of vessel collisions result in a fuel oil spill and 39% of collisions involving a laden tanker result in a cargo oil spill.

749. In the event of a bunker spill, the potential outflow of oil depends upon the bunker capacity of the vessel. Historical bunker spills from vessels have generally been limited to a size below 50% of bunker capacity, and in most incidents much lower.

750. For the types and sizes of vessels exposed to the Project, an average spill size of 100 tonnes of fuel oil is considered a conservative assumption.

751. For cargo spills from laden tankers, the spill size can vary significantly. The ITOPF reported the following spill size distribution for tanker collisions between 1974 and 2004:

- 31% of spills below seven tonnes;
- 52% of spills between seven and 700 tonnes; and
- 17% of spills greater than 700 tonnes.

752. Based upon this data and the tankers transiting in proximity to the Project, an average spill size of 400 tonnes is considered a conservative assumption.

753. For fishing vessel collisions, comprehensive statistical data is not available. Consequently, it is conservatively assumed that 50% of all collisions involving fishing vessels will lead to oil spill with the quantity spilled being on average five tonnes. Similarly for recreational vessels, due to a lack of data 50% of collisions are conservatively assumed to lead to a spill with an average size of one tonne.

C.5.2 Pollution Risk due to the Project

754. Applying the above probabilities to the annual collision and allision frequency by vessel type and the average spill size per vessel, the amount of oil spilled per year due to the impact of the Project is estimated to be 0.21 tonnes for the base case. For the future case scenarios, this estimate increases to 0.23 tonnes and 0.25 tonnes for traffic increases of 10% and 20%, respectively.

755. The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base case and future case are presented in **Figure C.17**.

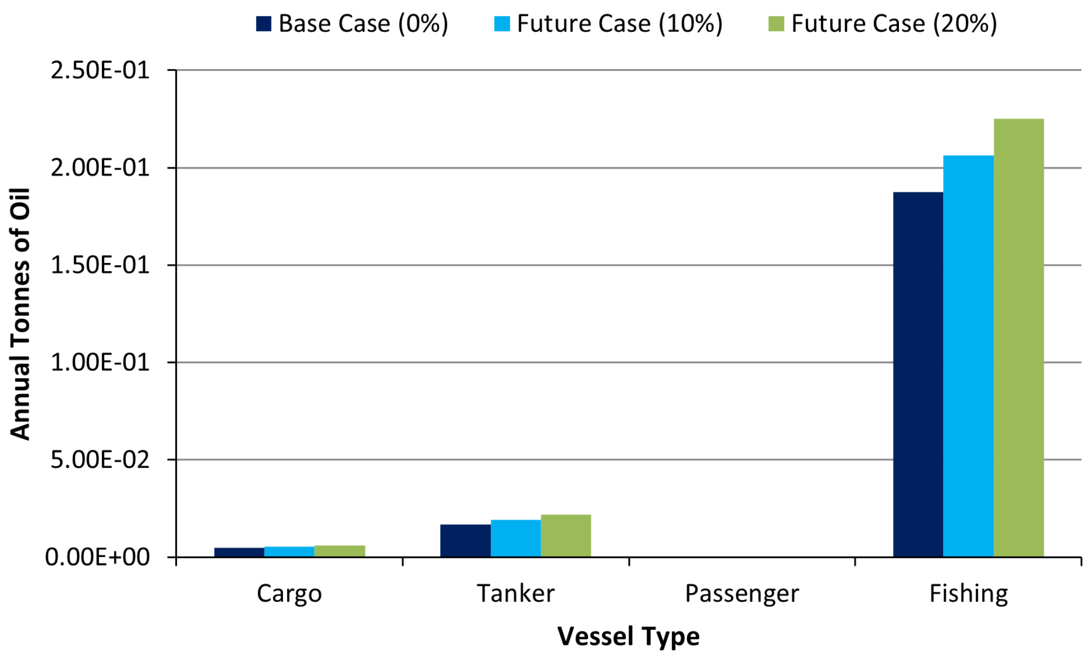

Figure C.17 Estimated Change in Pollution by Vessel Type

756. The annual oil spill results are primarily associated with fishing vessels due to the associated annual collision and allision frequency.

C.5.3 Significance of Increase in Pollution Risk

757. To assess the significance of the increased pollution risk from vessels caused by the Project, historical oil spill data for the UK has been used as a benchmark.

758. From the MEHRAs research, the annual average tonnes of oil spilled in UK waters due to maritime incidents in the 10-year period from 1989–1998 was 16,111. This is based upon a total of 146 reported oil pollution incidents of greater than one tonne (smaller spills are excluded as are incidents which occurred within port or harbour areas or resulting from operational errors or equipment failure). Commercial vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

759. The overall increase in pollution estimated due to the Project of 0.21 tonnes per year for the base case represents a 0.001% increase compared to the historical average pollution quantities from maritime incidents in UK waters.

C.6 Conclusion

760. This appendix has quantitively assessed the fatality and pollution risk associated with the Project in the event of a collision or allision incident occurring. The assessment indicates that the fatality and pollution risk associated with fishing vessels is greatest compared to other vessel types.

761. Overall, the impact of the Project on people and the environment is relatively low compared to the existing background risk levels in UK waters. However, this is the localised impact of a single offshore windfarm development and there will be additional maritime risks associated with other offshore windfarm developments, including across the UK as a whole.

762. Discussion of relevant mitigation measures and monitoring is provided in **Section 17**.

Appendix D Regular Operator Consultation

763. As part of the consultation process for the Project, Regular Operators identified (from the vessel traffic surveys) that would be required to deviate their routes due to the presence of the WDA were consulted via email. An example of the correspondence sent to the Regular Operators (which shows the extent of the WDA at that time) is presented below.

Address: Anatec Ltd.
10 Exchange Street
Aberdeen AB11 6PH
Tel: 01224 253700

Email: aberdeen@anatec.com
Website: www.anatec.com

Date: 16 05 2025
Ref: A4674-RHD-RO-1

Opportunity to Participate in Consultation Relating to Shipping and Navigation for the Proposed MachairWind Offshore Windfarm – Windfarm Development Area

Dear Stakeholder,

MachairWind Limited, wholly owned by ScottishPower Renewables (UK) Limited, is developing the MachairWind Offshore Windfarm ('the Project'), located northwest of Islay and west of Colonsay. With a generating capacity of around 2 Gigawatts, MachairWind could produce enough clean, green electricity to power the equivalent of up to 2 million homes across the UK. As outlined below, your company has been identified as a potential marine stakeholder for the Project. We therefore invite and welcome your feedback, including any impact it may have upon the navigation of vessels.

Windfarm Development Area

Following the submission of the MachairWind Offshore Windfarm Development Area (WDA) Scoping Report to the Scottish Ministers in September 2024 (see here), a Scoping Opinion was provided by the Marine Directorate in January 2025 (see here). As outlined in the MachairWind WDA Scoping Report, separate consents for three development areas will be sought: the WDA, the Offshore Transmission Development Area (OfTDA) and the Onshore Transmission Development Area (OnTDA). All works required outside of the WDA will be subject to separate consent applications in due course.

Navigational Risk Assessment Approach

MachairWind is proceeding to undertake the associated Navigational Risk Assessment (NRA) which will inform the shipping and navigation assessment undertaken for the WDA consent application. Recognising the interlinked nature of the three development areas, listed above, this NRA will consider an appraisal of the construction, O&M and decommissioning of the WDA activities, OfTDA activities, and OnTDA activities (commensurate with the level of detail that is available at the time of carrying out that appraisal). A separate NRA will be undertaken for the OfTDA consent application at a later date; this assessment will comprise of more refined information relating to the OfTDA activities and will take account of the interlinking WDA and OnTDA infrastructure and associated activities.

As part of the NRA process, MachairWind would like to ensure that comprehensive consultation is undertaken to identify any potential impacts that the WDA may have on shipping and navigation users. To analyse shipping movements within and in the vicinity of the WDA, vessel traffic survey data collected across three survey periods (December 2023, August 2024, and January 2025) has been analysed. Additionally, Automatic Identification System (AIS) data covering 12 months from March 2024 to February 2025 has been collected and assessed and will feed into the NRA. According to the assessment of the available datasets, your company's vessel(s) have been recorded navigating within and/or in the vicinity of the WDA.

An overview of the WDA is provided in **Figure 1** overleaf. This includes the area within which the wind turbine generators and offshore substation(s) will be located. **Figure 2** and **Table 1** overleaf present the key coordinates of the WDA.

Your Feedback

We would be grateful if you could provide us with any feedback that you may have, including any impact the WDA may have upon the navigation of your vessels, by Friday 6th June 2025. This will allow MachairWind to assess your feedback as part of the NRA, which is currently being undertaken. We would also be grateful if you could forward a copy of this information to any other vessel operators/owners you feel may be interested in commenting.

Whilst we welcome all feedback, we are particularly interested in any comments or feedback on the following:

1. Whether the proposal to construct the WDA is likely to impact the routeing of any specific vessels, including the nature of any change in regular passage;
2. Whether the presence of the WDA is likely to impact any adverse weather routes;
3. Whether any aspect of the WDA poses any safety concerns to your vessels, including any adverse weather routeing;
4. Whether you would choose to make passage internally through the WDA; and
5. Whether you wish to be retained on our list of marine stakeholders and consulted throughout the NRA process.

NRA Workshop

We would like to invite you to attend a hazard workshop. Due to the location of the WDA, we are currently in the process of organising two workshops:

1. One workshop will be held on Islay for local stakeholders and is anticipated to take up to 2.5 hours (6pm to 8.30pm). *This is anticipated to take place on the 11th June.*
2. One workshop will be held in Glasgow or Edinburgh and is anticipated to take up to 6 hours (10am to 4pm). *This is anticipated to take place in late June or early July.*

You are welcome to attend either workshop, however we are mindful of your time and geographical constraints therefore to make the best use of your time, we would ask that you kindly indicate:

- Whether you have a preferred mainland location between Glasgow or Edinburgh;
- Whether you would wish to attend the local workshop on Islay also/instead; or
- Whether you would prefer to dial into the workshop via Microsoft Teams.

As in person engagement generally allows for richer discussion and more organic conversation, it is our strong preference to hold this workshop face to face, however we will of course accommodate a hybrid set up, if this is required.

Please provide your feedback via email to [redacted] by Friday 6th June 2025, as well as an indication of whether you are interested in attending the hazard workshop and preferences, as noted above. If your preference is to attend an in-person workshop, please share your dietary requirements or preferences as lunch and refreshments will be provided.

Yours sincerely,

[redacted]
Anatec Ltd

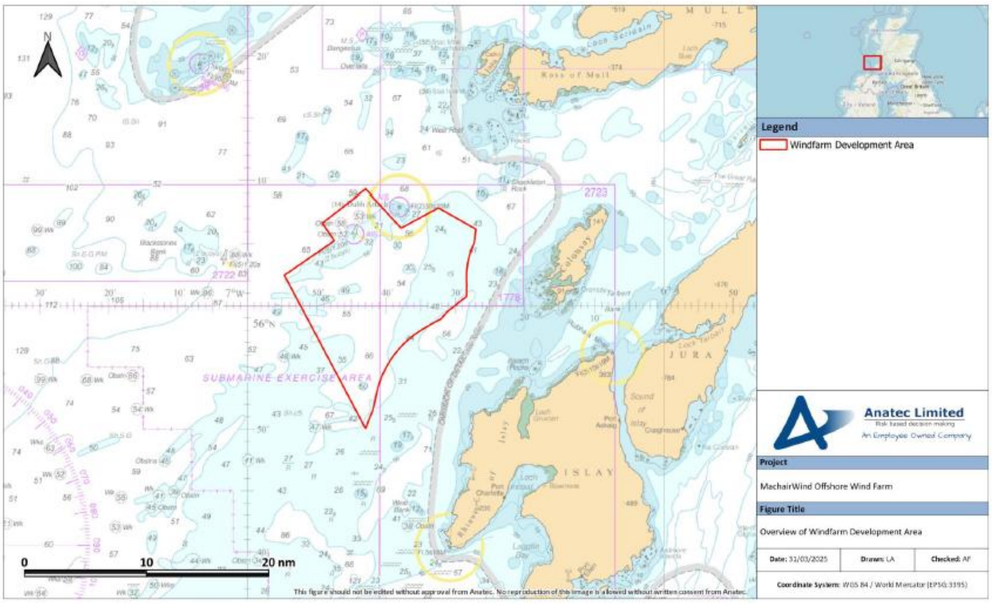

Figure 1 MachairWind Windfarm Development Area (WDA)

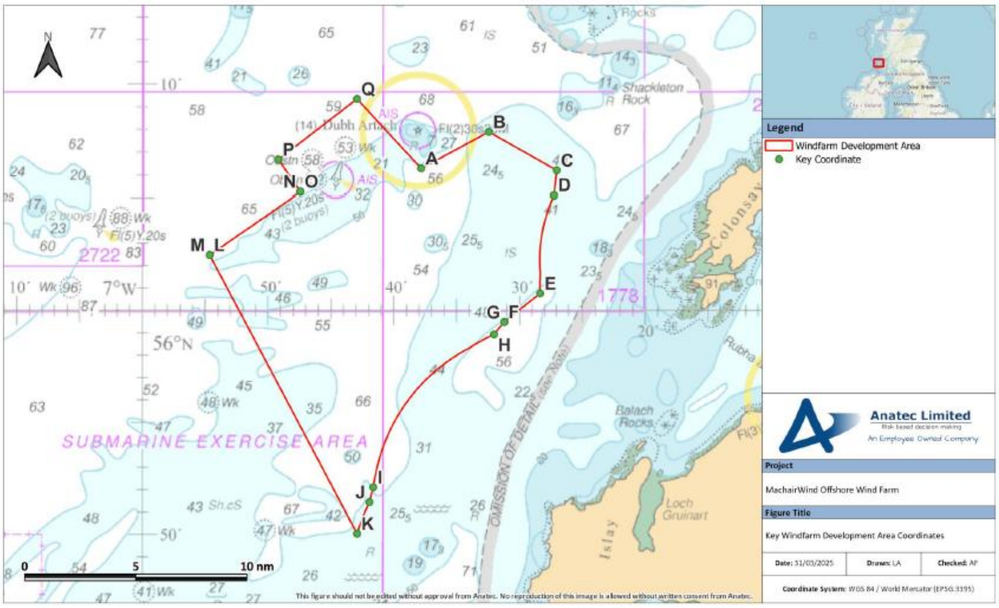

Figure 2 Key Windfarm Development Area (WDA) Coordinates

Table 1 Key Windfarm Development Area Coordinates

Key Coordinate	Latitude (World Geodetic System 1984 (WGS84))	Longitude (WGS84)
A	56°06'15.39"N	6°37'45.92"W
B	56°07'52.77"N	6°32'22.65"W
C	56°06'10.40"N	6°26'58.34"W
D	56°05'05.02"N	6°27'11.16"W
E	56°00'44.91"N	6°28'17.52"W
F	55°59'28.62"N	6°31'08.91"W
G	55°59'28.05"N	6°31'08.89"W
H	55°58'55.10"N	6°31'58.15"W
I	55°52'05.84"N	6°41'35.30"W
J	55°51'26.07"N	6°41'53.56"W
K	55°50'00.95"N	6°42'52.80"W
L	56°02'27.27"N	6°54'37.78"W
M	56°02'27.29"N	6°54'37.76"W
N	56°05'14.11"N	6°47'24.05"W
O	56°05'14.50"N	6°47'24.43"W
P	56°06'39.01"N	6°49'08.95"W
Q	56°09'20.51"N	6°42'52.94"W

Appendix E Long-term Vessel Traffic Movements

E.1 Introduction

764. This appendix assesses the additional long-term vessel traffic data for the Project. The NRA and **Chapter 13 Shipping and Navigation** consider 28-days of AIS, Radar and visual observation data as the primary vessel traffic data source. 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.

765. Therefore, in line with good practice assessment procedures, this NRA has also considered a longer-term dataset covering 12-months from 01 March 2024 to 28 February 2025 to ensure a comprehensive characterisation of vessel traffic movements can be established including the capture of any seasonal variation.

766. This approach (i.e., the use of both short- and long-term data) has been agreed with the MCA.

E.2 Methodology

E.2.1 Study Area

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

E.2.2 Data Period and Temporary Vessel Traffic

768. The long-term vessel traffic data was collected from coastal AIS receivers for the 12-months between 01 March 2024 and 28 February 2025. The percentage uptime for the AIS receivers that the AIS data has used within this report was analysed, with this occurring at less than 1% of the study period.

769. 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, and was comprised of vessels engaged in survey work, including surveys for the Project.

E.2.3 AIS Carriage

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

E.3 Long-Term Vessel Traffic Movements

771. 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 E.1**.

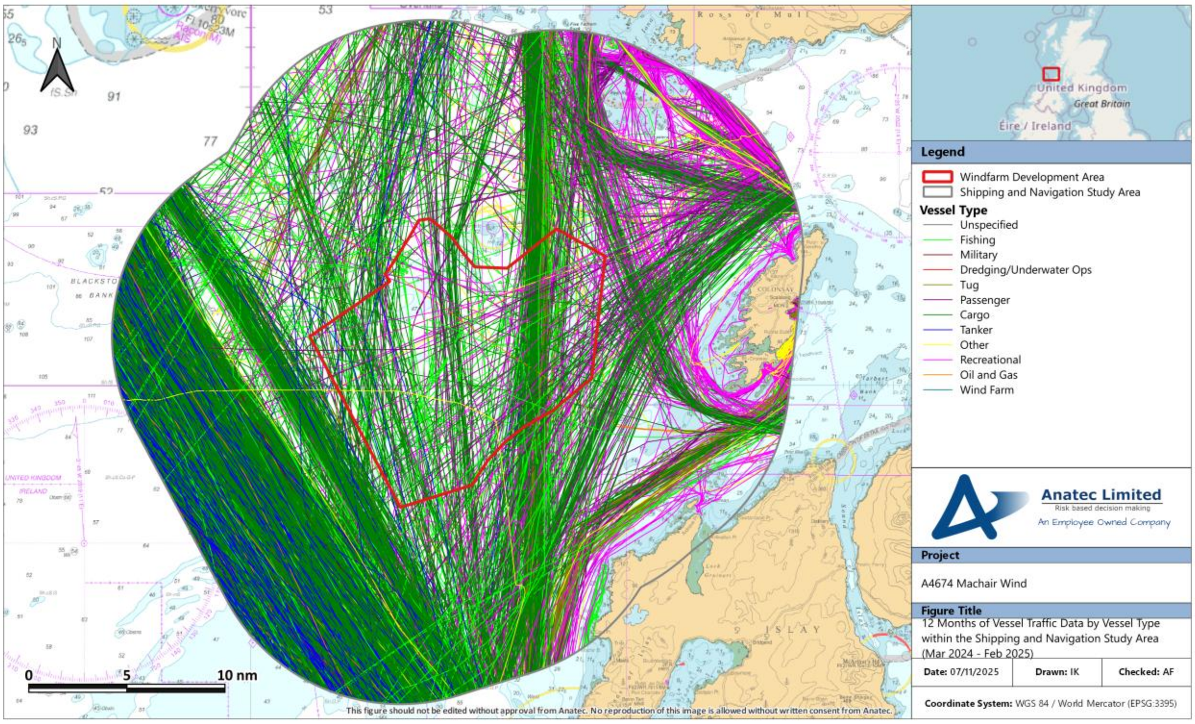

Figure E.1 12 Months of Vessel Traffic Data by Vessel Type within the Shipping and Navigation Study Area (Mar 2024 – Feb 2025)

E.3.2 Vessel Count

772. **Figure E.2** presents the average number of daily unique vessels recorded within the shipping and navigation study area per month of the study period.

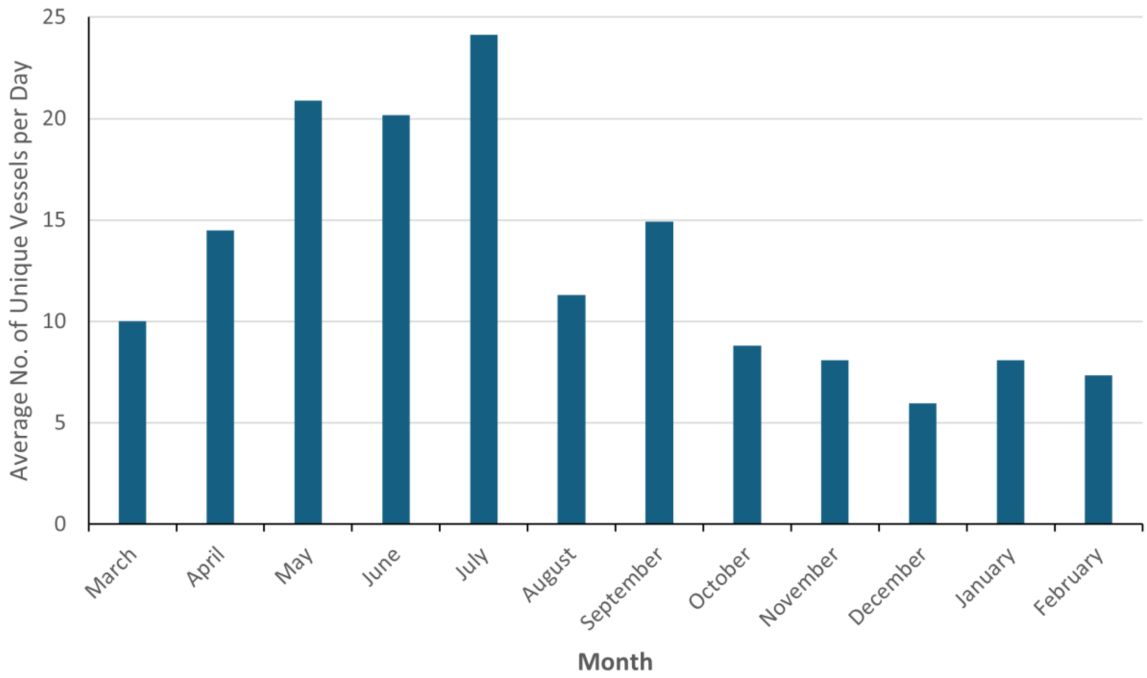

Figure E.2 Average Daily Unique Vessels per Month (12 Months AIS)

773. There was an overall average of 13 unique vessels per day recorded within the shipping and navigation study area across the 12-month period. The busiest month was July 2024, during which an average of 11 unique vessels per day were recorded within the shipping and navigation study area. This was primarily due to a peak in recreational and fishing vessel activity.

774. The busiest day overall was 13 July 2024 which recorded 41 unique vessels within the shipping and navigation study area, of which 26 were recreational vessels. The number of recreational vessels present is likely related to both the Clipper Round the World Yacht Race, in which recreational craft berthed in Oban (UK) between 12 and 16 July 2024 heading from the US through the WDA (Clipper Round the World, 2024); as well as the second leg of the Tobermory Race 2024 which saw recreational vessels transit around Mull at the northeastern extent of the shipping and navigation study area (Clyde Cruising Club, 2024). Further details are provided in **Section E.4.3**.

775. The quietest month was December 2024 which recorded an average of six unique vessels per day within the shipping and navigation study area. Vessels displayed general seasonal trends, with higher numbers recorded during summer months compared to those of autumn, winter, and spring.

E.3.3 Vessel Type

776. **Figure E.3** shows the distribution of vessel types recorded within the shipping and navigation study area during the study period.

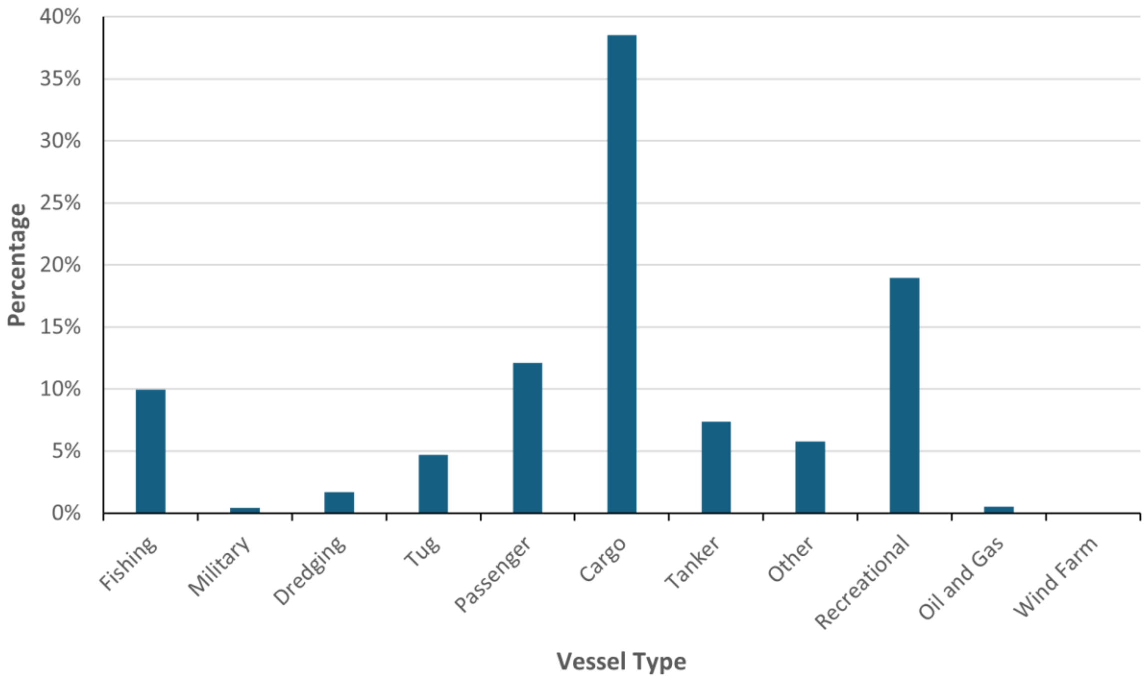

Figure E.3 Distribution of Vessel Types (12 Months AIS)

777. The most common vessel type recorded within the shipping and navigation study area during the study period were cargo vessels (39%), with other notable vessel types including recreational vessels (19%), passenger vessels (12%), and fishing vessels (10%). Vessels in the 'Other' category included a dive vessel, fishery patrol vessel, buoy-laying vessels, transiting survey vessels, and RNLI lifeboats.

E.4 Site-specific Analysis

E.4.1 Commercial Vessels

778. 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 E.4**.

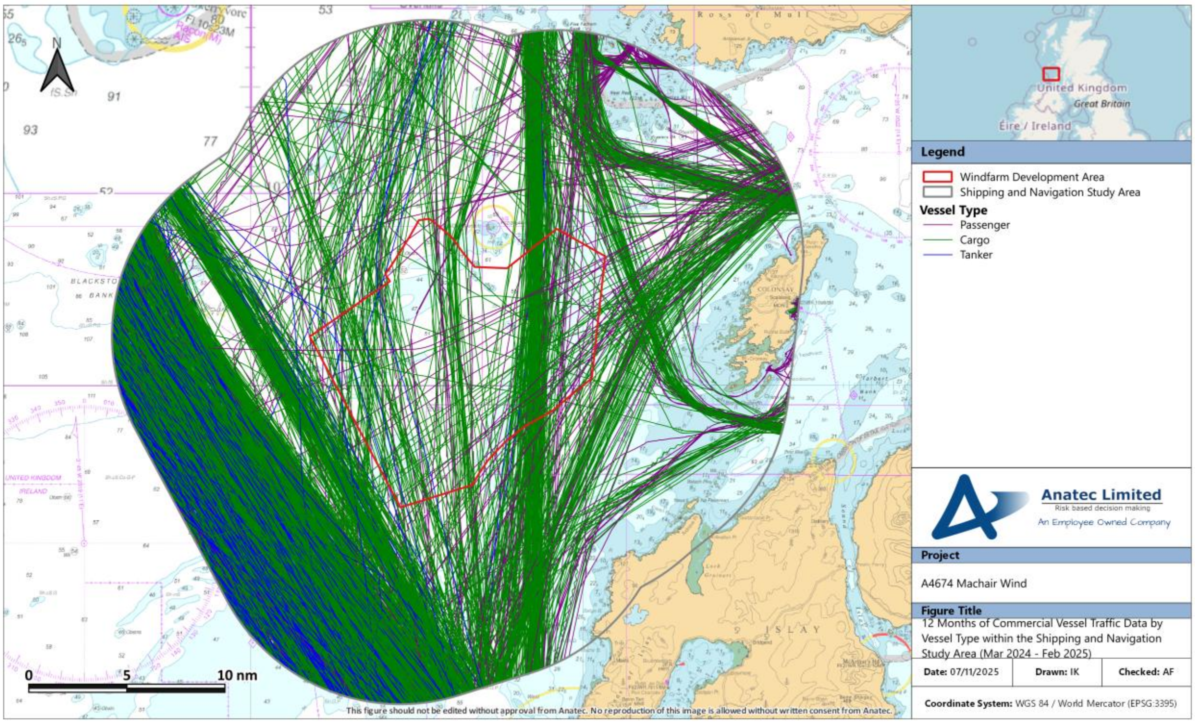

Figure E.4 12 Months of Commercial Vessel Traffic Data by Vessel Type within the Shipping and Navigation Study Area (Mar 2024 – Feb 2025)

779. Cargo vessels were recorded primarily routeing directly to the west of the WDA. These vessels routed largely between Belfast (UK) and Norwegian ports such as Verdal. A notable split in routeing traffic is observed here, due to a portion of vessels opting to transit to the east of two buoys.

780. A narrow cargo vessel route on a north/south bearing in the east of the WDA was also observed. This route included vessels owned by Godby Shipping and chartered by DFDS Seaways on a circular passage between Skogn (Norway), Belfast (UK), and Greenock (UK). These DFDS chartered vessels were recorded at an average of one vessel cycle every three to four weeks.

781. Other vessels routeing inshore included those transiting to/from Glensanda and southern ports such as Liverpool (UK) and Amsterdam (Netherlands), as well as vessels associated with fish farms on the west coast of Scotland.

782. Passenger vessels were observed throughout the shipping and navigation study area, with these offshore tracks primarily related to cruise line activity. Regularly scheduled CalMac RoPax vessels to/from Colonsay and Oban/Islay were also recorded, noting that due to the location of these tracks to the east of Colonsay, it is not expected that they will be impacted by the WDA.

783. The majority of tankers recorded within the shipping and navigation study area were on northwest-southeast passage to the west of the WDA, with several other tracks transiting north-south through the WDA. Tanker tracks predominantly involved

routeing between ports on the western UK coast (e.g., Liverpool and Milford Haven)/eastern Irish coast (Belfast and Dublin), and Scandinavian ports such as Mongstad and Gothenburg.

784. **Figure E.5** presents the average number of daily unique commercial vessels recorded within the shipping and navigation study area per month of the long-term study period.

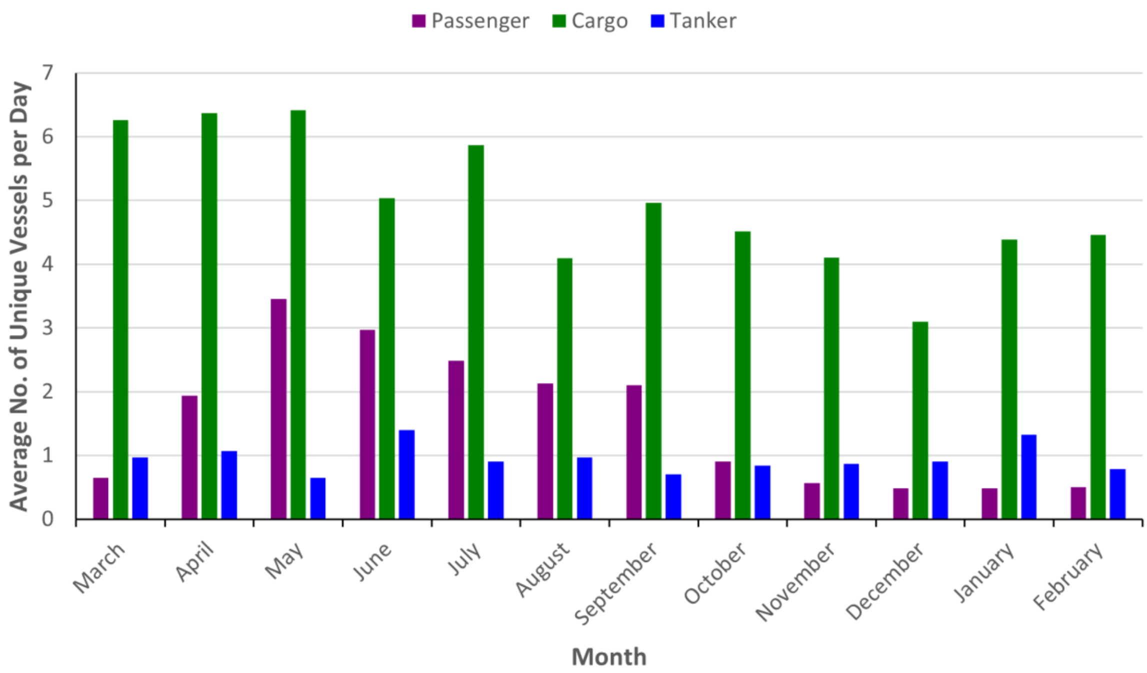

Figure E.5 Average Daily Unique Commercial Vessels per Month

785. Overall, there was an average of approximately five unique cargo vessels per day recorded within the shipping and navigation study area across the long-term study period. The busiest month for cargo vessels was May 2024, during which approximately six to seven cargo vessels per day were recorded within the shipping and navigation study area. Cargo vessels did not display high seasonality overall, though a general decrease in the latter part of 2024 and early 2025 was noted.

786. Overall, there was an average of one to two unique passenger vessels per day recorded within the shipping and navigation study area across the long-term study period. The busiest month was May 2024 when an average of three to four unique passenger vessels were recorded per day. Passenger vessels (inclusive of RoPax vessels) displayed high seasonality, which broadly aligns with cruise timetables as well as favourable sailing conditions.

787. There was an average of one tanker recorded per day across the shipping and navigation study area during the long-term study period. The busiest month for tankers was June 2024, during which one to two tankers per day were recorded

within the shipping and navigation study area. The quietest month was May 2024, during which one tanker every two days was recorded. Tankers did not display high seasonality overall, with vessel numbers per day relatively similar across the months assessed.

E.4.2 Fishing Vessels

788. As a general rule, fishing vessels operating at below 6 kt may be actively fishing. To highlight potential fishing vessel behaviour, **Figure E.6** presents the fishing vessel traffic recorded within the shipping and navigation study area during the study period colour-coded by average speed.

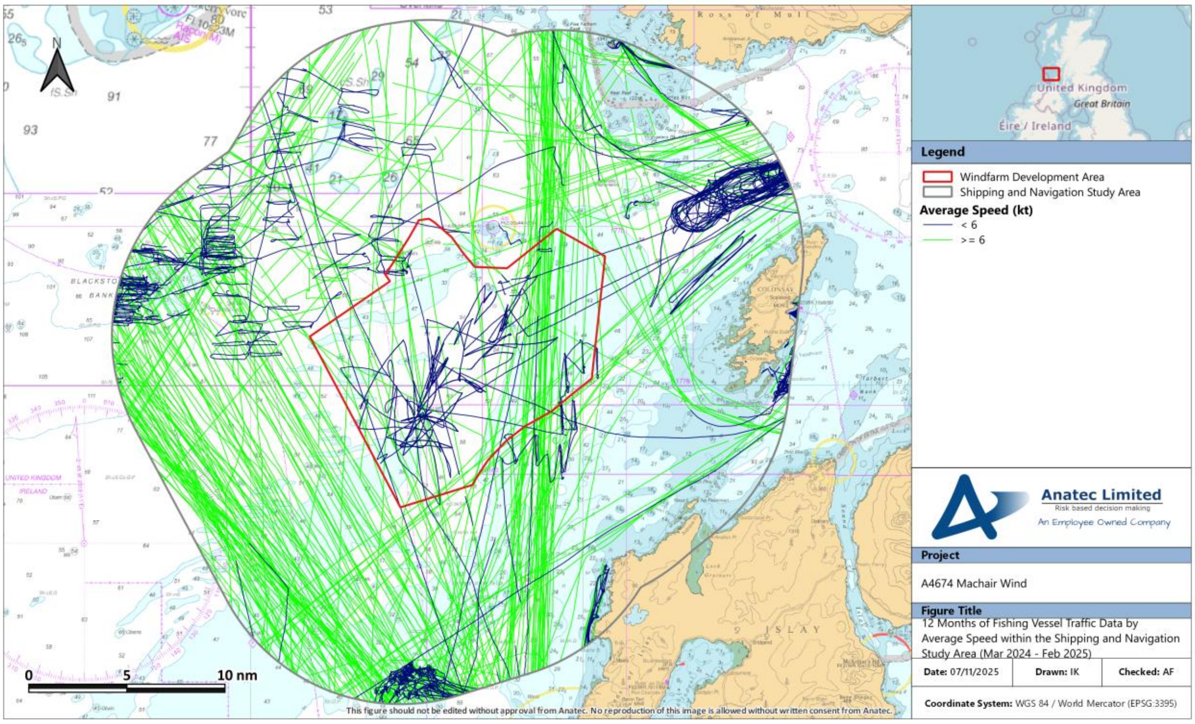

Figure E.6 12 Months of Fishing Vessel Traffic Data by Average Speed within the Shipping and Navigation Study Area (Mar 2024 – Feb 2025)

789. Fishing vessels operating below 6 kt were observed throughout the shipping and navigation study area, with particular prevalence within the WDA, as well as to the northwest, northeast, and to the south. Based on analysis of vessel track speed and behaviour, as well as information broadcast on AIS such as navigation status, it is considered that fishing vessels engaged in active fishing behaviour commonly operated below 6 kt.

790. **Figure E.7** presents the average number of daily unique fishing vessels recorded within the shipping and navigation study area per month of the long-term study period.

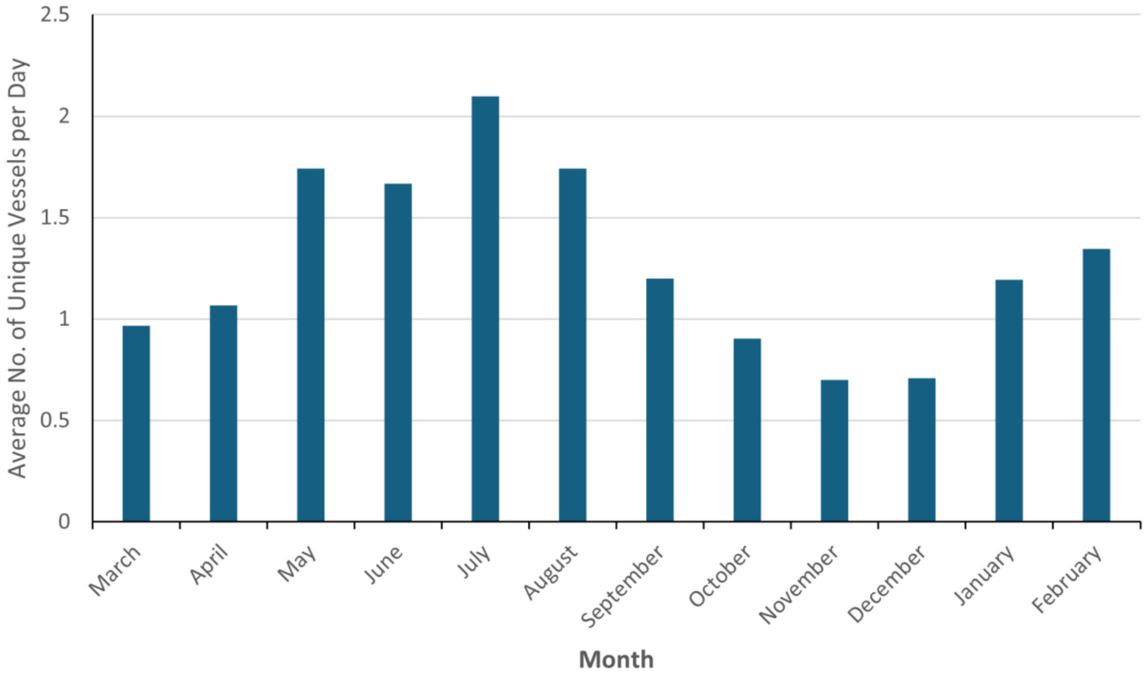

Figure E.7 Average Daily Unique Fishing Vessels per Month

791. Overall, there was an average of one unique fishing vessel per day recorded within the shipping and navigation study area across the long-term study period. The busiest month was July 2024, during which an average of two unique fishing vessels per day were recorded within the shipping and navigation study area.

E.4.3 Recreational Vessels

792. **Figure E.8** presents the tracks of recreational vessel traffic recorded within the shipping and navigation study area during the study period.

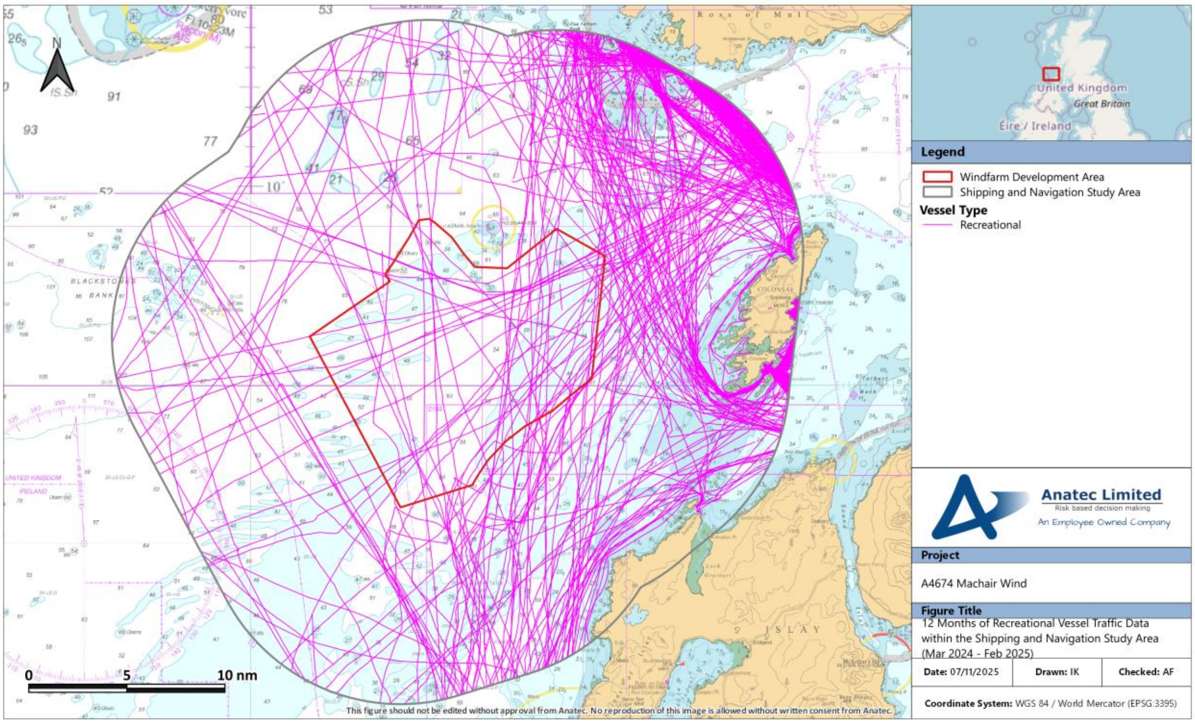

Figure E.8 12 Months of Recreational Vessel Traffic Data within the Shipping and Navigation Study Area (Mar 2024 – Feb 2025)

793. The majority of recreational vessels were observed inshore of the WDA and primarily associated with Colonsay. As referenced in **Section E.3.3**, a number of tracks were likely associated with two recreational races occurring around the coast. These included a leg of the Clipper Round the World Yacht Race with vessels transiting between the US and Oban, as well as the second leg of the Tobermory Race, in which vessels transited around Mull. It was not possible to determine for sure which vessels were participating in the Tobermory Race, however the race route would indicate they would have passed north of the Wind Development Area around Mull.

794. **Figure E.9** presents the average number of daily unique recreational vessels recorded within the shipping and navigation study area per month of the long-term study period.

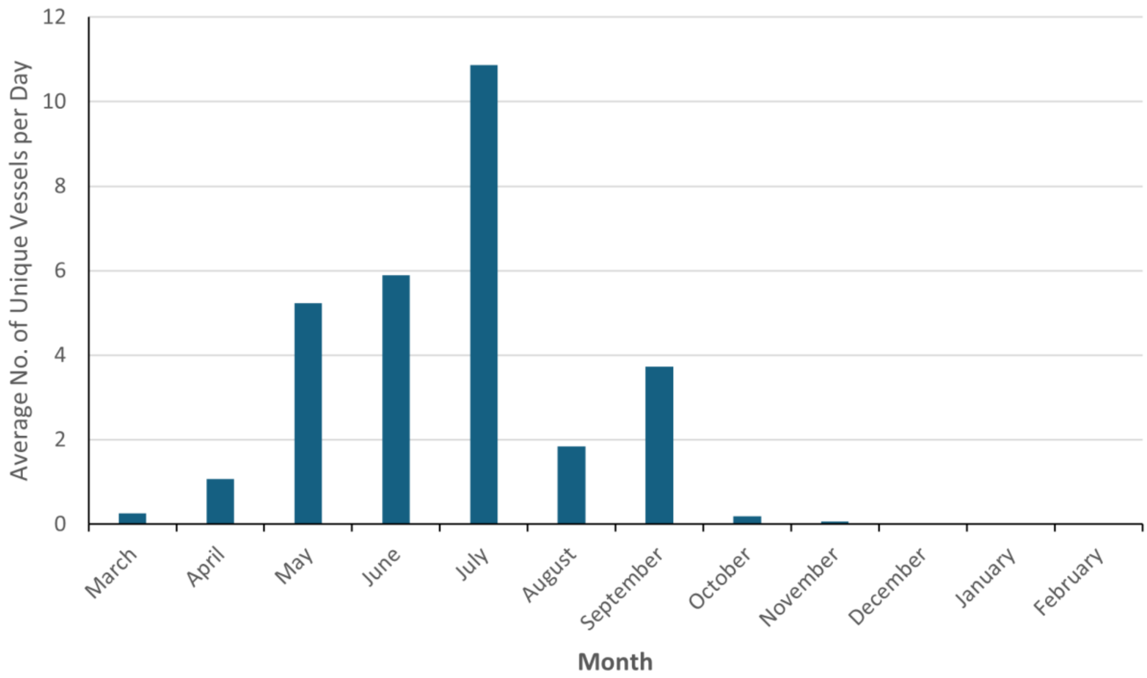

Figure E.9 Average Daily Unique Recreational Vessels per Month

795. There was an overall average of two to three unique recreational vessel recorded per day across the long-term study period. When only the summer season is considered (May to September), this increases to approximately five to six unique recreational vessels per day.

796. As shown, recreational vessels are highly seasonal, with summer months offering more favourable sailing conditions. The busiest month for recreational vessels was July 2024, during which approximately eleven unique recreational vessels were recorded per day. No recreational vessel transits were recorded between December 2024 and February 2025.

E.5 Survey Data Comparison

797. A comparison of the average number of each main vessel type analysed in the previous sections recorded throughout the study period against the average number of each vessel type recorded throughout the two vessel traffic surveys are presented in **Table E.1**.

Table E.1 Comparison of the Number of Each Main Vessel Type Detected During the Long-term and Vessel Traffic Survey Datasets

Vessel type	Long-term AIS data			Winter survey	Summer survey
	Busiest month	Quietest month	Average vessels per day		
Cargo vessels	May	December	5	6-7	3-4
Recreational vessels	July	Dec - Feb	2-3	<1	1-2
Passenger vessels	May	Dec – Jan	1-2	<1	2
Fishing vessels	July	November	1	1	1-2
Tankers	June	September	1	1	1

798. The only notable difference between the long-term AIS and the vessel traffic surveys was the number of recreational vessels, which were higher during the long-term AIS than either of the vessel traffic surveys – notably the summer survey. This is likely due to the summer vessel traffic survey occurring in August, which was the fourth busiest month recorded within the long-term AIS. An average of 11 unique vessels per day were recorded during July in the long-term AIS dataset, although as per **Section E.3.3**, this included vessels involved in two separate race events.