TotalEnergies E&P North Sea UK Ltd

Culzean - Floating Offshore Wind Turbine Pilot Project

Appendix I: Navigational Risk Assessment

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Aberdeen

The Capitol Building
431 Union Street . Aberdeen
AB11 6DA . UK

T +44 1224 219 955
E deborah.morgan@xodusgroup.com
www.xodusgroup.com

REVISIONS & APPROVALS

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Culzean Floating Offshore Wind Turbine Pilot Project Navigational Risk Assessment

Prepared by	Anatec Limited
Presented to	Xodus on behalf of TotalEnergies E&P North Sea UK Ltd
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	Aberdeen Office	Cambridge Office
Address	10 Exchange Street, Aberdeen, AB11 6PH, UK	Braemoor, No. 4 The Warren, Witchford Ely, Cambs, CB6 2HN, UK
Tel	01224 253700	01353 661200
Email	aberdeen@anatec.com	cambs@anatec.com

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Table of Contents

Table of Figures

Table of Tables

Glossary of Terms

Abbreviation	Definition
Allision	The act of striking or collision of a moving vessel against a stationary object.
Automatic Identification System (AIS)	A system by which vessels automatically broadcast their identity, key statistics including location, destination, length, speed and current status, e.g., under power. Most commercial vessels and European Union (EU) fishing vessels over 15 m length are required to carry AIS.
Collision	The act or process of colliding (crashing) between two moving objects.
Design Envelope	A description of the range of possible elements that make up the Project, incorporating the Wind Turbine Generator (WTG), floater, mooring and anchoring system, and export cable. This envelope is used to define the Project for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the 'Rochdale Envelope' approach.
Embedded mitigation measure	A commitment made by TEPNSUK to reduce and / or eliminate the potential for significant risks.
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into United Kingdom (UK) law by the EIA Regulations.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity.
Future Case	The assessment of risk based on the predicted growth in future shipping densities and traffic types as well as foreseeable changes in the marine environment.
Hazard	A potential threat to human life, health, property, or the environment.
International Maritime Organization (IMO) Routeing	Predetermined shipping routes established by the IMO.
Main Commercial Route	Defined transit route (mean position) of commercial vessels identified within the specified Study Area.
Marine Guidance Note (MGN)	A system of guidance notes issued by the Maritime and Coastguard Agency (MCA) which provide significant advice relating to the improvement of the safety of shipping at sea, and to prevent or minimise pollution from shipping.
Maximum Design Scenario (MDS)	The combination of realistic parameters for the Culzean Floating Offshore Wind Turbine Pilot Project anticipated to produce the worst-case consequences.
Navigational Risk Assessment (NRA)	A document which assesses the overall impact to shipping and navigation of a proposed Offshore Renewable Energy Installation (OREI) based upon Formal Risk Assessment (FSA).
Offshore Renewable Energy Installation (OREI)	As defined by MGN MGN 654 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response (MCA, 2021). For the purposes of this report and in keeping with the consistency of the EIA, OREI can mean offshore wind turbines and the associated electrical infrastructure such as offshore substations.
Radio Detection and	An object-detection system which uses radio waves to determine the range,

Abbreviation	Definition
Ranging (Radar)	altitude, direction or speed of objects.
Regular Operator	Commercial operator whose vessel(s) are observed to transit through a particular region on a regular basis.
Traffic Separation Scheme (TSS)	A traffic management route system ruled by the International Maritime Organization (IMO). The traffic lanes (or clearways) indicate the general direction of the vessels in that zone; vessels navigating within a TSS all sail in the same direction or they cross the lane at an angle as close to 90 degrees (°) as possible.
Significance of risk	The combination of frequency of occurrence and severity of consequence of a hazard.
User	The sufferer of a risk arising from a hazard.
Unique Vessel	An individual vessel identified on any particular calendar day, irrespective of how many tracks were recorded for that vessel on that day. This prevents vessels being over counted. Individual vessels are identified using their Maritime Mobile Service Identity (MMSI).
Vessel Traffic Service (VTS)	A service implemented by a Competent Authority designed to improve the safety and efficiency of vessel traffic and to protect the environment. The service should have the capability to interact with the traffic and to respond to traffic situations developing in the VTS area.

Abbreviations Table

Abbreviation	Definition
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ALB	All-Weather Lifeboat
AtoN	Aid to Navigation
BEIS	Department for Business, Energy and Industrial Strategy
CBA	Cost Benefit Analysis
CD	Chart Datum
CEA	Cumulative Effects Assessment
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
CTV	Crew Transfer Vessel
DF	Direction Finding
DfT	Department for Transport
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ERCoP	Emergency Co-operation Plan

Abbreviation	Definition
ERRV	Emergency Response and Rescue Vessel
ETAP	Eastern Trough Area Project
FPSO	Floating Production Storage and Offloading
FSA	Formal Safety Assessment
FSO	Floating Storage and Offloading
GLA	General Lighthouse Authority
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GT	Gross Tonnes
HM Government	His Majesty's Government
HMCG	His Majesty's Coastguard
HMSO	His Majesty's Stationary Office
HSE	Health and Safety Executive
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ILB	Inshore Lifeboat
IMO	International Maritime Organisation
INTOG	Innovation and Targeted Oil and Gas
ITOPF	International Tanker Owners Pollution Federation
JRCC	Joint Rescue Coordination Centre
kt	Knot
LOA	Length Overall
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MD-LOT	Marine Directorate Licensing Operations Team
MEHRA	Marine Environment High Risk Area
MF	Medium Frequency
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MRCC	Maritime Rescue Coordination Centres
MSL	Mean Sea Level
NAVTEX	Navigation Telex
NCP	National Contingency Plan
NLB	Northern Lighthouse Board

Abbreviation	Definition
NRA	Navigational Risk Assessment
OREI	Offshore Renewable Energy Installation
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PLL	Potential Loss of Life
POB	People on Board
QHSE	Quality, Health, Safety and Environment
RADAR	Radio Detection and Ranging
REZ	Renewable Energy Zone
RNLI	Royal National Lifeboat Institution
RYA	Royal Yachting Association
SFF	Scottish Fishermen's Federation
SMS	Safety Management System
SOLAS	Safety of Life at Sea
SONAR	Sound Navigation and Ranging
SOV	Service Operations Vessel
SWFPA	Scottish White Fish Producers Association
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
VHF	Very High Frequency
VMS	Vessel Monitoring System
WTG	Wind Turbine Generator

1 Introduction

1.1 Background

1. Anatec was commissioned by Xodus to undertake a Navigational Risk Assessment (NRA) on behalf of TotalEnergies (hereafter referred to as 'the Applicant') for the proposed Culzean Floating Offshore Wind Turbine Pilot Project hereby referred to as 'the Project'). The NRA presents information on the Project relative to the existing and estimated future navigational activity and forms the technical appendix to **Chapter 13: Shipping and Navigation**.

1.2 Navigational Risk Assessment

2. An Environmental Impact Assessment (EIA) is a process which identifies the environmental risks of a proposed development, both negative and positive. An important element / requirement of the EIA for offshore projects is the NRA. Following the relevant Maritime and Coastguard Agency (MCA) guidance, the NRA includes:

- Outline of methodology applied in the NRA;
- Summary of consultation undertaken with shipping and navigation stakeholders to date;
- Lessons learnt from previous offshore developments;
- Summary of the project description relevant to shipping and navigation;
- Baseline characterisation of the existing environment;
- Discussions of potential risks on navigation, communication and position fixing equipment;
- Future case vessel traffic characterisation;
- Collision and allision risk modelling;
- Risk assessment (applying the Formal Safety Assessment (FSA) process);
- Outline of embedded and additional mitigation measures; and
- Outline of through life safety management features.

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

- Construction;
- Operation and maintenance; and
- Decommissioning.

2 Guidance and Legislation

2.1 Legislation

4. As part of the EIA Directive (2011/92/EU, as amended by Directive 2014/52/EU), an Environmental Impact Assessment Report (EIAR) is required to be submitted to support the application through the Marine Works (Environmental Impact Assessment) Regulations 2007 (United Kingdom (UK) Government, 2007). The MCA require that, as part of the EIA, an NRA is undertaken to '*inform the shipping and navigation chapter of the EIAR*' (MCA, 2021).

2.2 Primary Guidance

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

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

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

7. The MCA require that their methodology (Annex 1 to MGN 654) is used as a template for preparing NRAs. It is centred on risk management and requires a submission that shows that sufficient controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with mitigation (see Section 3.2). Across **Chapter 13: Shipping and Navigation** and the NRA, both base and future case levels of risk have been identified, in addition to the measures required to ensure that both the future case remains broadly acceptable or tolerable with mitigation.

8. It is noted that the MCA methodology discusses proportionality of the assessment and indicates that the requirements of a submission may be dependent upon the scale of the development being assessed.

2.3 Other Guidance

9. Other guidance documents used during the assessment include:

- *MGN 372 Amendment 1 (Merchant and Fishing) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs* (MCA, 2022);

- *International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures* (IALA, 2021);
- *IALA Guideline G1162 The Marking of Offshore Man-Made Structures* (IALA, 2021);
- *The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy* (RYA, 2019);
- *Standard Marking Schedule for Offshore Installations* (DECC), 2011);
- *Regulatory Expectations on Moorings for Floating Wind and Marine Devices* (MCA and Health and Safety Executive (HSE), 2017); and
- UK Marine Policy Statement (His Majesty's (HM) Government, 2011).

3 Navigational Risk Assessment Methodology

3.1 Formal Safety Assessment Methodology

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

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

11. It is noted that, with regards to commercial fishing vessels, the methodology and assessment has been applied to hazards considering commercial fishing vessels in transit (i.e., where gear is not deployed). A separate methodology and assessment have been applied in **Chapter 12: Commercial Fisheries** to consider hazards which are directly related to commercial fishing activity (as opposed to commercial fishing vessels in transit) including hazards of a commercial nature.

3.2 Formal Safety Assessment Process

12. In line with the standard approach to marine risk assessment, the IMO FSA process (IMO, 2018) as approved by the IMO in 2018 under Maritime Safety Committee – Marine Environment Protection Committee (MECP).2/circ.12/Rev.2 has been applied to the risk assessment within this NRA and informs **Chapter 13: Shipping and Navigation**.

13. 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 by Figure 3.1 and summarised in the following list:

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

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

Figure 3-1 Flow Chart of the FSA Methodology

3.3 Hazard Workshop Methodology

14. A key tool used in the NRA process is the Hazard Workshop which ensures that all hazards are identified, and the corresponding risks qualified in discussion with relevant stakeholders. Table 3.1 and Table 3.2 define the severity of consequence and the frequency of occurrence rankings that have been used to assess risks within the hazard log, completed based on the outputs of the Hazard Workshop.

Table 3.1 Severity of Consequences Ranking Definitions

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

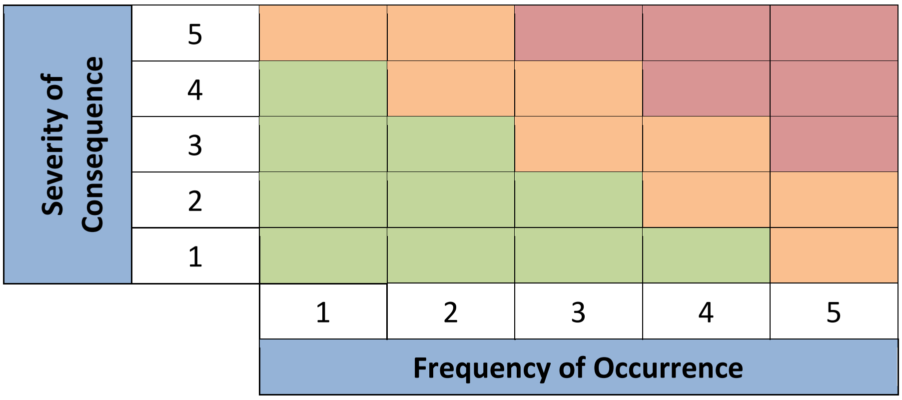
Table 3.2 Frequency of Occurrence Ranking Definitions

Rank	Description	Definition
1	Negligible	< 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

15. The severity of consequence and frequency of occurrence are then used to define the significance of risk via a tolerability matrix approach as shown in Table 3.3. The significance of risk is defined as **Broadly Acceptable** (low risk), **Tolerable with Mitigation** (intermediate risk), or **Unacceptable** (high risk).

[1] Pollution incident tiers are based on those established in the National Contingency Plan (NCP) (MCA, 2014)

Table 3.3 Tolerability Matrix and Risk Rankings



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

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

3.4 Cumulative Risk Assessment Methodology

17. All hazards identified and assessed within the FSA process should also be assessed for potential cumulative risks when accounting for other offshore developments.

18. The approach for screening in or out cumulative developments for shipping and navigation includes consideration of the following criteria:

- Project status (noting that operational developments are accounted for in the baseline assessment);
- Distance to the Project;
- Level of interaction with baseline traffic relevant to the Project;
- Level of stakeholder concern; and
- Data confidence.

19. As the Project is situated significantly offshore, only other Innovation and Targeted Oil & Gas (INTOG) developments are considered relevant to the cumulative effects assessment (CEA); these are presented in Figure 3-2.

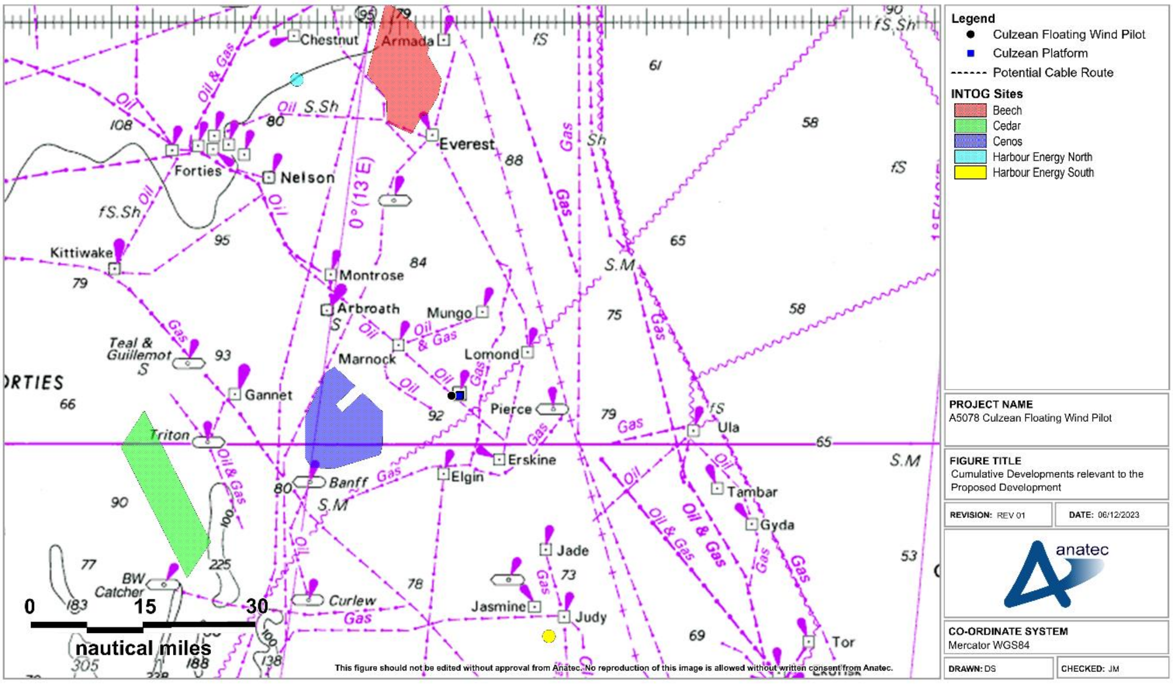


Figure 3-2 Cumulative Developments relevant to the Project

20. Due to the relative size of the Project, only cumulative issues within 10 nautical miles (nm) have been considered. The only development within 10 nm is the Cenos Floating Offshore Windfarm; this development has been scoped and is situated 9.3 nm to the west. Taking into account the baseline traffic, no substantial interaction between the Project and Cenos is anticipated, and therefore Cenos has been screened out of the CEA.

21. Existing oil and gas infrastructure is noted in the vicinity; however, this is considered part of the shipping and navigation baseline.

22. Since there are no cumulative developments screened into the CEA, no assessment of cumulative risk has been undertaken in this NRA. This approach was discussed with stakeholders at the Hazard Workshop, with general agreement that there were no cumulative issues relating to shipping and navigation that required further consideration.

4 Consultation

4.1 Scoping Opinion

23. The Scoping Report was submitted to Scottish Ministers (Via Marine Directorate – Licensing Operations Team(MD-LOT)), on 14th April 2023, who then circulated the report to relevant consultees. The Scoping Opinion was received on 20th July 2023. A summary of the key points raised is provided in Table 4.1, with full responses provided in **Chapter 13: Shipping and Navigation**. Responses confirming no issues raised at this stage were also received from the Northern Lighthouse Board (NLB), RYA Scotland, and Cruising Association.

Table 4.1 Scoping Opinion Summary

Consultee	Point Raised	Where Addressed in the NRA
MCA	An NRA will need to be submitted in accordance with MGN 654 (and MGN 372) and the MCA's methodology. The NRA should be accompanied by a detailed MGN 654 Checklist.	This document is an NRA and has been undertaken in line with MGN 654 and its annexes (see Section 2.2). The MGN 654 Checklist has been completed (see 0).
	The MCA suggest that the two 14-day surveys should be carried out from a vessel-based survey using Automatic Identification System (AIS), Radio Detection and Ranging (Radar) and visual observations, to capture all vessels navigating in the Study Area.	A dedicated meeting with the MCA was undertaken in July 2023 where it was agreed that use of a 12-month AIS dataset alongside other available data was sufficient in lieu of dedicated vessel traffic surveys (see Section 4.2).
	The final WTG position will require MCA approval prior to construction to minimise the risks to surface vessels.	The position of the WTG will be confirmed in consultation with the MCA post consent.
	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.	A cable burial risk assessment and compliance with MGN 654 (including the MCA's 5% reduction requirement) are included as an embedded mitigation measure (see Section 15).
	Regulatory mooring expectations should be identified as a potential mitigation.	Compliance with the MCA's floating foundation guidance is included as an embedded mitigation measure (see Section 15).
MD-LOT	The EIAR must include a full and detailed description of the chosen location within the Design Envelope.	A detailed description of the Project is provided in **Chapter 4: Project Description** and key elements for shipping and navigation are outlined in Section 6.
	It must be clear in the EIAR which anchor	Details pertaining to the mooring and

Consultee	Point Raised	Where Addressed in the NRA
	and mooring design options are being considered within the Design Envelope.	anchoring systems are provided in Section 6.
	The decommissioning programme should be submitted for approval no later than six months in advance of construction, and that the first drafts should be submitted about 18 months in advance.	A Decommissioning Programme is included an embedded mitigation (see Section 15).
	An Emergency Co-operation Plans (ERCoP), a Lighting and Marking Plan (LMP), a Design Specification and Layout Plan, a Construction Environmental Management Plan, and a Navigational Safety Plan should be submitted alongside the marine licence application and the EIAR.	Compliance with MGN 654, including creation of an ERCoP, is included as an embedded mitigation measure. Requirements for an LMP, Development Specification and Layout Plan (DSLP), a Construction Environmental Management Plan, and a Navigational Safety Plan will be agreed with MD-LOT as required post consent
Scottish Fishermen's Federation (SFF)	With the length of the moorings being approximately 600m, SFF would like to see safety measures taken to protect fishing vessels in the area.	A hazard relating to reduction in under keel clearance due to the presence of the mooring system has been assessed (see Section 14.6) noting that snagging risks for fishing gear are considered separately in **Chapter 12: Commercial Fisheries**.

4.2 Dedicated Meeting with Maritime and Coastguard Agency

24. A meeting was held with the MCA in July 2023 to provide an introduction to the Project and discuss the requirements for vessel traffic data collection.

25. The MCA confirmed that there were no concerns with using Automatic Identification System (AIS) data and the requirement for a dedicated vessel traffic survey could be waived for the Project[2]. The MCA also requested that Vessel Monitoring System (VMS) data be used to support the AIS data.

26. In the same meeting, the MCA also confirmed that a 10 nm buffer of the WTG location (see Section **Error! Reference source not found.**) serves as a suitable Study A rea for analysis of vessel traffic data.

4.3 Hazard Workshop

27. The Hazard Workshop was organised as a meeting of local and national marine stakeholders to identify and discuss potential shipping and navigation hazards. Using the information gathered from the Hazard Workshop, a hazard log (see 0) was produced for use as input into the risk assessment undertaken in Section 14.

[2] With the caveat that this decision is location and case specific and should not be taken as a precedent for future developments.

28. The Hazard Workshop was attended by:

- MCA;
- NLB;
- UK Chamber of Shipping;
- RYA Scotland; and
- Scottish White Fish Producers Association (SWFPA).

29. Other invited parties included the Cruising Association, SFF, Vroon, REM Offshore, and Remøy Shipping, noting that Vroon, REM Offshore, and Remøy Shipping were identified as Regular Operators based on an analysis of the vessel traffic data (see Section 5) in proximity to the WTG location.

30. A summary of the key points raised is provided in Table 4.2.

Table 4.2 Hazard Workshop Summary

Consultee	Point Raised	Where Addressed in the NRA
MCA	Routeing by commercial vessels (cargo vessels and tankers) clearly avoids the existing infrastructure at the Culzean Oil Field and therefore there are no concerns.	Acknowledged in the assessment of vessel displacement (see Section 14.1).
	Slight deviations associated with oil and gas routeing is not an issue.	Acknowledged in the assessment of vessel displacement (see Section 14.1).
NLB	NLB have the responsibility to retrieve wrecks in areas of navigation, noting that should the floater sink (whilst on-site or under tow) then it may present a navigational risk. Protocol for wreck response should be considered for the ERCoP.	The foundering of the WTG / floater is considered as a worst case consequence for a collision event during towage operations (see Section 14.3).
	No concerns with displacement of commercial routeing and such routeing is unlikely to change in the future.	Acknowledged in the assessment of vessel displacement (see Section 14.1).
	No construction buoyage is required given the short nature of the installation campaign, presence of the ERRV for the Culzean Oil Field, and coverage from the nearby platform.	Acknowledged as not required in the embedded mitigation measures (see Section 15).
	For lighting and marking purposes the WTG will be treated as an isolated structure following IALA guidelines.	Acknowledged in the assessment of allision risk (see Section 14.4).
RYA Scotland	Recently there have been delays in the United Kingdom Hydrographic Office (UKHO) Admiralty charts being updated but other forms of mitigation including notifications to mariners and Kingfisher should raise awareness.	Acknowledged in the assessment of vessel displacement (see Section 14.1).

Consultee	Point Raised	Where Addressed in the NRA
	No further data is required to characterise recreational vessel movements.	Acknowledged in the data limitations for AIS data (see Section 5.2.1).
	Recreational routeing between Peterhead and the Baltic may be expected but given the presence of existing infrastructure the additional presence of the WTG does not increase concerns. Any issue arising would likely be in adverse weather conditions.	Acknowledged in the characterisation of recreational vessel movements (see Section 9.2.5).
SWFPA	AIS does not capture all activity but will capture the majority at the distance offshore of the Project. The area is generally quiet for fishing vessels with movements predominantly transits close to existing infrastructure. There are no concerns.	Acknowledged in the data limitations for AIS data (see Section 5.2.1) and VMS data has also been used to characterise fishing vessel movements (see Section 9.2.4).
Vroon (post meeting response)	No concerns raised.	Acknowledged in the assessment of vessel displacement (see Section 14.1).

5 Data Sources

31. This section summarises the main data sources used to characterise the shipping and navigation baseline relative to the WTG.

5.1 Study Area

32. The Study Area within which the shipping and navigation baseline has primarily been characterised is a 10 nm buffer of the WTG, as shown in Figure 5-1.

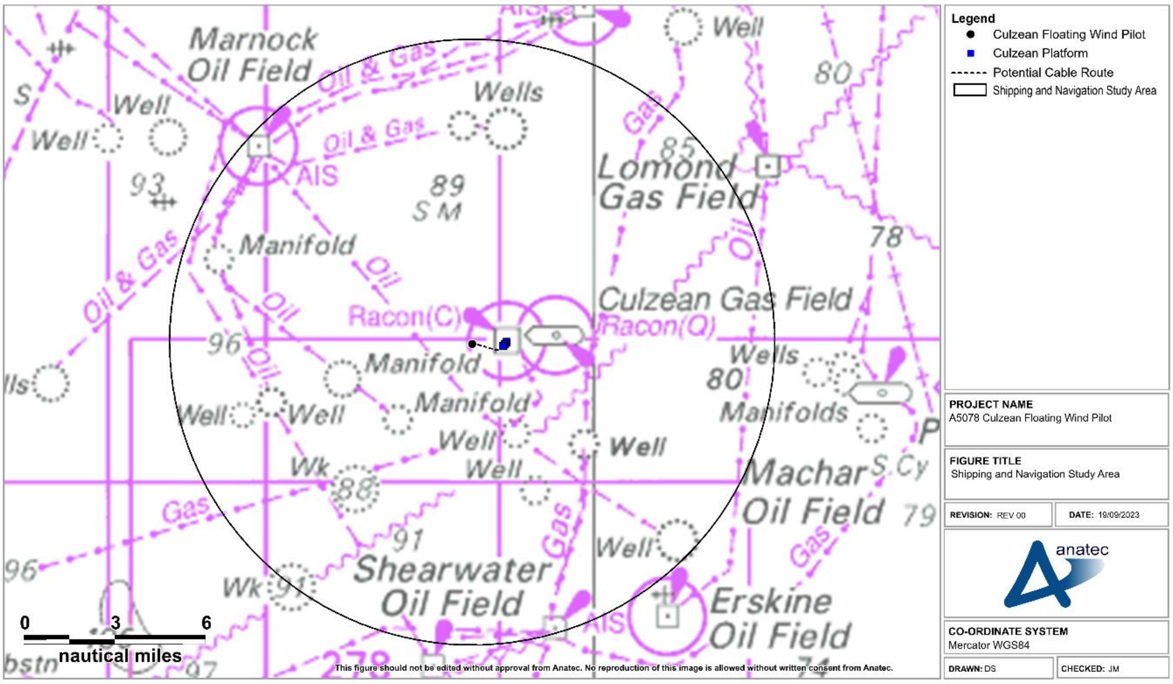


Figure 5-1 Shipping and Navigation Study Area

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

Table 5.1 Data Sources

Data	Source	Purpose
Vessel traffic	AIS data (12 months recorded between July 2022 and June 2023 via receivers located at the Culzean Gas Field)	Characterising vessel traffic movements in proximity to the Project.
	Anatec's ShipRoutes database (2023)	Validation of AIS data.
	VMS data (2022)	Validation of fishing vessel movements.
Maritime incidents	Royal National Lifeboat Institution (RNLI) incident data (2011 to 2020)	Characterising incident rates in proximity to the Project.
	MAIB marine accidents database (2002 to 2021)	

Data	Source	Purpose
	Department for Transport (DfT) UK civilian SAR helicopter taskings (April 2015 to March 2023)	
Other navigational features	Admiralty Charts 274-0, 278-0 and 2182B-0 (UKHO, 2023)	Characterising other navigational features in proximity to the Project.
Weather	Tidal data provided by Admiralty Charts 274 and 278 (United Kingdom Hydrographic Office (UKHO), 2023).	Characterising weather conditions in proximity to the Project for use as input to the collision and allision risk modelling.
	Visibility data provided in Admiralty Sailing Directions North Sea (West) Pilot NP54 (UKHO, 2021).	
	HSE data pertaining to wind direction and significant wave height	
	Site specific data provided by TEPNSUK	Validation of other weather data.

5.2 Data Limitations

5.2.1 Automatic Identification System Data

34. The carriage of AIS is required on board all vessels of greater than 300 Gross Tonnage (GT) engaged on international voyages, cargo vessels of more than 500 GT not engaged on international voyages, passenger vessels irrespective of size built on or after 1st July 2002, and fishing vessels over 15 metres (m) length overall (LOA). Therefore, some fishing vessels under 15 m and recreational craft may be underrepresented in the data, although SWFPA and RYA Scotland confirmed during the Hazard Workshop that there were no concerns with the extent of data collected, noting given the distance offshore that smaller fishing vessels are less likely to be present.

5.2.2 Vessel Monitoring System Data

35. The carriage of VMS is required on board all fishing vessels of greater than 12 m LOA. Additionally, the vessel's position is reported at a minimum of every two hours only. Therefore, some fishing vessels and especially those under 12 m LOA may be underrepresented in the data, although again SWFPA confirmed during the Hazard Workshop that there were no concerns with the extent of data collected and given the distance offshore smaller fishing vessels are less likely to be present.

5.2.3 Historical Incident Data

36. Although all UK commercial vessels are required to report accidents to the Marine Accident Investigation Branch (MAIB), non-UK vessels do not have to report unless they are in a UK port or within 12 nm territorial waters or carrying passengers to a UK port. There are also no requirements for non-commercial recreational craft to report accidents to the MAIB.

37. The RNLI incident data cannot be considered comprehensive of all incidents in the Study Area. Although hoaxes and false alarms are excluded, any incident to which a RNLI resource was not mobilised has not been accounted for in this dataset.

5.2.4 United Kingdom Hydrographic Office Admiralty Charts

38. 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. However, during consultation input has been sought from relevant stakeholders regarding the navigational features baseline.

6 Project Description Relevant to Shipping and Navigation

39. The NRA reflects the Design Envelope which is detailed in full in **Chapter 4: Project Description**. The following subsections outline the maximum extent for which any shipping and navigation hazards are assessed.

6.1 Wind Turbine Generator

40. A single WTG will be installed in the Culzean Gas Field, approximately 1 nm west of the Culzean ULQ Platform and approximately 120 nm off the UK east coast. The location of the WTG relative to the Culzean Gas Field is presented in Figure 6-1 and provided in Table 6.1.

41. The WTG will have a maximum rotor diameter of 112 m and a minimum upper blade tip height of 22 m above Mean Sea Level (MSL).

42. Charted water depths in proximity to the WTG are 89 m below Chart Datum (CD).

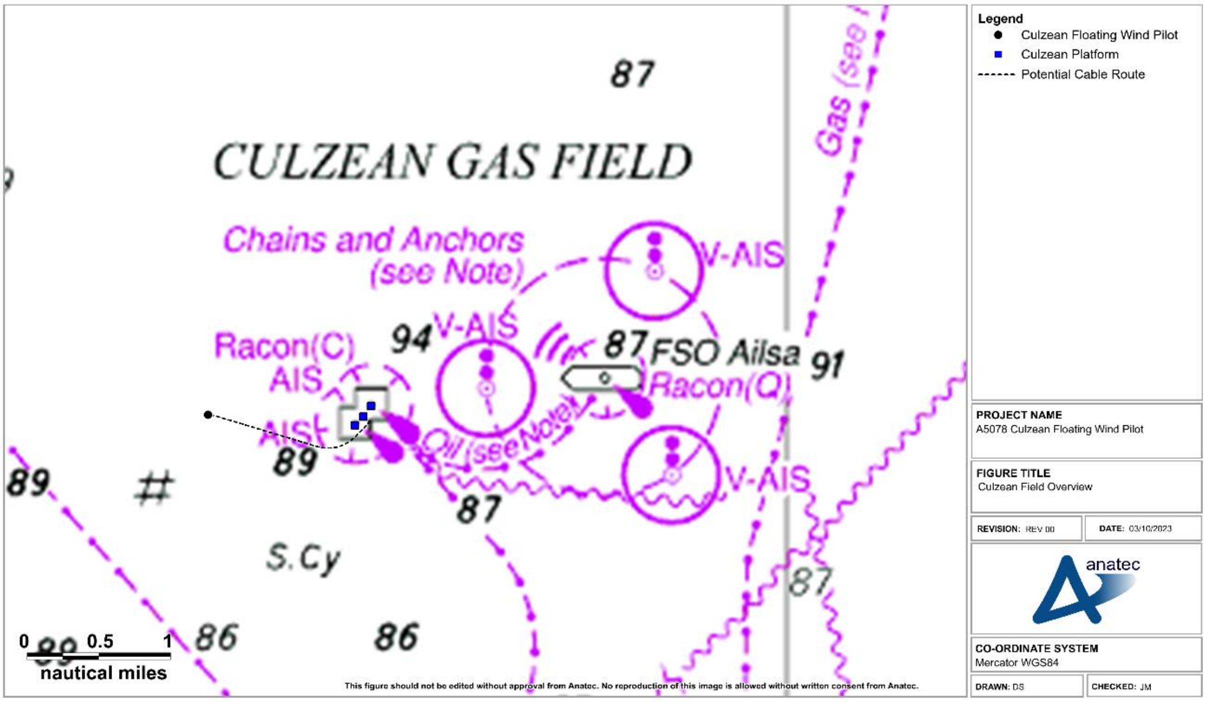


Figure 6-1 Culzean Field Overview

Table 6.1 WTG Coordinates (World Geodetic System 1984 (WGS84))

Latitude	Longitude
57° 11' 29" N	001° 52' 35" E

6.2 Floater

43. The WTG will be attached to a semi-submersible floating foundation of maximum height 23 m, with up to 9.3 m above MSL. The floater will consist of four columns – three located on the outside (forming a triangular shape) and one centrally. The maximum distance between outer columns will be 39 m with each outer column measuring a maximum of 5.05 m diameter.

44. For the purposes of allision modelling, these dimensions have been used to form an all-encompassing equilateral triangle shape of 71.93 m side length.

6.3 Mooring and Anchoring Systems

45. The floater will be attached to the seabed via a mooring and anchoring system. Up to six catenary or semi-taut mooring lines will be deployed of length 589 m. The mooring lines will connect to the floater 13.6 m below the sea surface with a shallowest rate of descent to the seabed of 20°. The overall footprint of the mooring lines will be around a 600 m radius centred on the floater.

46. Up to six anchors will be deployed (corresponding to the mooring lines) with drag anchor and pin piling under consideration.

6.4 Export Cable

47. A single export cable will carry the energy generated by the WTG to the platforms at the Culzean Gas Field, as shown in Figure 6-1. The export cable will be up to 2,500 m length with 500 m of this length present in the water column, split as 250 m at each end.

48. The static (on the seabed) portions of the export cable will be protected via trenching (subject to survey results) with a minimum target depth of lowering of at least 0.6 m. Where adequate protection cannot be achieved via trenching, additional external protection (e.g. rock berms) will be installed, rising to a maximum height of 1 m above the seabed.

49. The export cable will carry alternating current (AC).

6.5 Timescales and Project Vessel Movements

6.5.1 Construction

50. Construction and installation of the Project is anticipated to take around one month and is currently proposed for Q2 or Q3 2025.

51. Prior to construction, an application will be submitted for a 500 m safety zone around the under construction infrastructure (e.g., where project vessels are present and works are ongoing), and 50 m around the incomplete structure (e.g., the installed foundation without the WTG) and pre commissioning.

52. It is noted that an assembly and integration facility has not yet been selected at the time of undertaking this NRA.

53. A breakdown of construction vessel movements is provided in Table 6.2.

Table 6.2 Breakdown of Construction Vessel Movements

Activity	Vessel Type	Number of Vessels	Transit Days	Working Days
Pre-lay surveys	Remotely Operated Vehicle (ROV) loaded on Light Construction Vessel (LCV)	1	2	1
Mooring line pre-lay	Anchor Handling Control Vessel (AHCV) with ROV capability	1	1	12
Mooring line hook up to floating substructure	AHCV with ROV capability	1	1	10
	Anchor handling tug	2	4	10
Export cable hook up to floating substructure and initial cable lay	LCV with installation cable reel and ROV capability	1	1	5
Completion of cable lay and hook up at Culzean J-Tube	LCV with installation cable reel and ROV capability	1	1	5
	Trenching vessel	1	2	8
Cable trenching and remediation	Fall pipe vessel	1	2	2
Post installation survey	ROV loaded on LCV	1	2	1
Total			**16**	**54**

6.5.2 Operation and Maintenance

54. The design life of the Project is between 5 and 10 years, although it is possible that an extension may be considered.

55. During the operation and maintenance phase, routine and unscheduled maintenance may be undertaken with the strategy for such activities expected to reply upon the ERRV associated with the nearby Culzean Oil Field.

6.5.3 Decommissioning

56. It is anticipated that all structures above and below the seabed will be completely removed, although the anchoring scour protection may be left in situ. A final

decision on removal of structures will be made at the time of decommissioning with consideration of the best environmental options.

57. Furthermore, a Decommissioning Programme will be developed prior to the start of decommissioning works, with the nature of said works determined by the legislation and guidance at the time.

6.6 Maximum Design Scenario

58. The MDS for each shipping and navigation hazard is provided in Table 6.3 and is based on the parameters described in the previous subsections.

Table 6.3 Maximum Design Scenario by Hazard

Hazard	Phase	Maximum Design Scenario	Justification
Vessel displacement	Construction / decommissioning	▪ Construction and installation over around one month; ▪ WTG and export cable installation at the locations shown in Figure 6-1; ▪ Presence of 500 m construction safety zones and 50 m pre commissioning safety zones around the WTG; ▪ One export cable of 2,500 m length; and ▪ Up to three construction / decommissioning vessels on-site simultaneously, up to 16 transit days and 54 working days on-site.	Presence of the infrastructure and associated project vessel activities maximising the extent of displacement for third-party vessels.
	Operation and maintenance	▪ Design life of between 5 and 10 years; ▪ WTG and export cable installed at the locations shown in Figure 6-1; ▪ Presence of 500 m safety zones during major maintenance around the WTG; and ▪ One operation and maintenance vessel on-site (ERRV for Culzean Oil Field).	
Collision risk (third-party to third-party)	Construction / decommissioning	▪ Construction and installation over around one month; ▪ WTG and export cable installation at the locations shown in Figure 6-1; ▪ Presence of 500 m construction safety zones and 50 m pre commissioning safety zones around the WTG; ▪ One export cable of 2,500 m length; and ▪ Up to three construction / decommissioning vessels on-site simultaneously, up to 16 transit days and 54 working days on-site.	Presence of the infrastructure and associated project vessel activities maximising the reduction in navigable sea room and subsequently increasing the likelihood of encounters and collision risk.
	Operation and maintenance	▪ Design life of between 5 and 10 years; ▪ WTG and export cable installed at the locations shown in Figure 6-1; ▪ Presence of 500 m safety zones during major maintenance around the WTG; and ▪ One operation and maintenance vessel on-site (ERRV for Culzean Oil Field).	

Hazard	Phase	Maximum Design Scenario	Justification
Collision risk (third-party to project)	Construction / decommissioning	▪ Construction and installation over around one month; ▪ WTG and export cable installation at the locations shown in Figure 6-1; ▪ Presence of 500 m construction safety zones and 50 m pre commissioning safety zones around the WTG; ▪ One export cable of 2,500 m length; and ▪ Up to three construction / decommissioning vessels on-site simultaneously, up to 16 transit days and 54 working days on-site.	Presence of project vessel activities maximising the likelihood of encounters and collision risk involving a project vessel.
	Operation and maintenance	▪ Design life of between 5 and 10 years; ▪ WTG and export cable installed at the locations shown in Figure 6-1; and ▪ Presence of 500 m safety zones during major maintenance around the WTG; and ▪ One operation and maintenance vessel on-site (ERRV for Culzean Oil Field).	
Allision risk	Construction / decommissioning	▪ Construction and installation over around one month; ▪ WTG installation at the location shown in Figure 6-1; and ▪ Maximum floater dimensions of 71.93 m (side length of equilateral triangle shape).	Presence of the WTG with maximum possible associated dimensions resulting in maximum exposure to allision risk for third-party vessels.
	Operation and maintenance	▪ Design life of between 5 and 10 years; ▪ WTG installed at the location shown in Figure 6-1; and ▪ Maximum floater dimensions of 71.93 m (side length of equilateral triangle shape).	
Loss of station	Operation and maintenance	▪ Design life of between 5 and 10 years; ▪ WTG installed at the location shown in Figure 6-1; ▪ Maximum floater dimensions of 71.93 m (side length of equilateral triangle shape); and ▪ Up to six catenary mooring lines.	Presence of the WTG with maximum possible associated dimensions resulting in maximum exposure should the WTG go off station.

Hazard	Phase	Maximum Design Scenario	Justification
Vessel interaction with export cable and mooring lines	Operation and maintenance	▪ Design life of between 5 and 10 years; ▪ WTG and export cable installed at the locations shown in Figure 6-1; ▪ One export cable of 2,500 m length; ▪ Target burial depth for export cable of at least 0.6 m; ▪ Maximum height of protection for export cable of 1 m above the seabed; ▪ Up to six catenary or semi-taut mooring lines each of 589 m length; ▪ Mooring line connection point with floater at 13.6 m below sea surface; and ▪ Shallowest rate of descent for mooring lines of 20° with overall footprint of 600 m radius centred on the floater.	Presence of infrastructure below the sea surface with the maximum associated footprint resulting in maximum exposure to interaction risk for third-party vessels.
Reduction of emergency response capability	Operation and maintenance	▪ Design life of between 5 and 10 years; ▪ WTG and export cable installed at the locations shown in Figure 6-1; and ▪ One operation and maintenance vessel on-site (ERRV for Culzean Oil Field).	Presence of the infrastructure and associated project vessel activities maximising the likelihood of a need for an emergency response.

7 Navigational Features

59. A plot of navigational features in proximity to the WTG is presented in Figure 7-1. A zoomed version of the same features is presented in Figure 7-2. Each of the features shown is discussed in the following subsections and has been identified using the most detailed UKHO Admiralty Charts available.

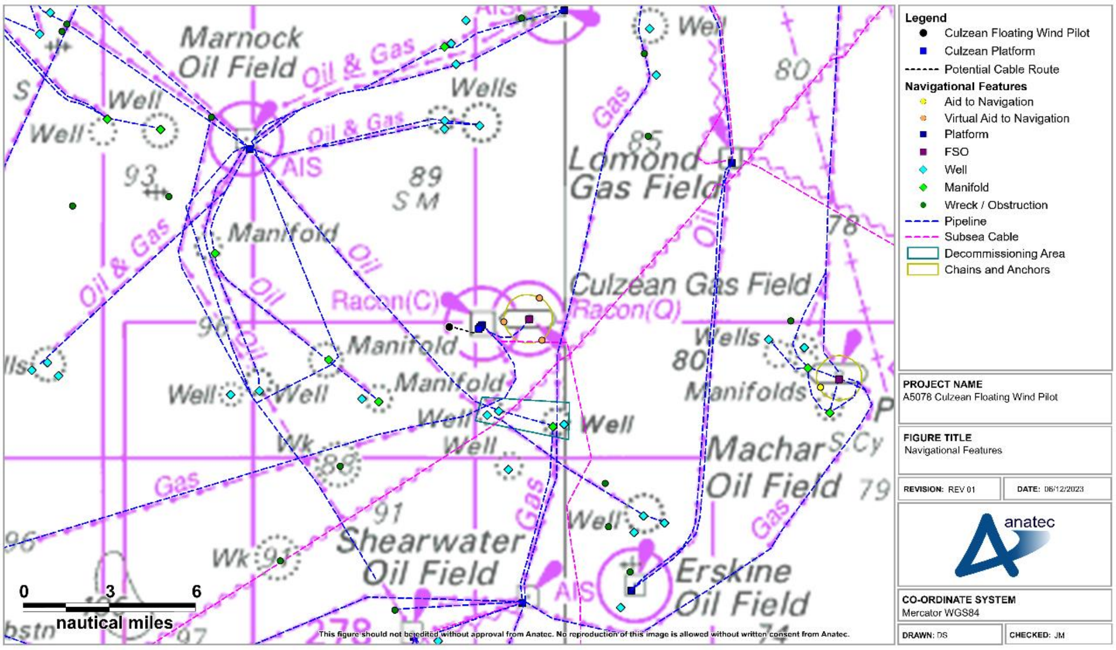


Figure 7-1 Navigational Features

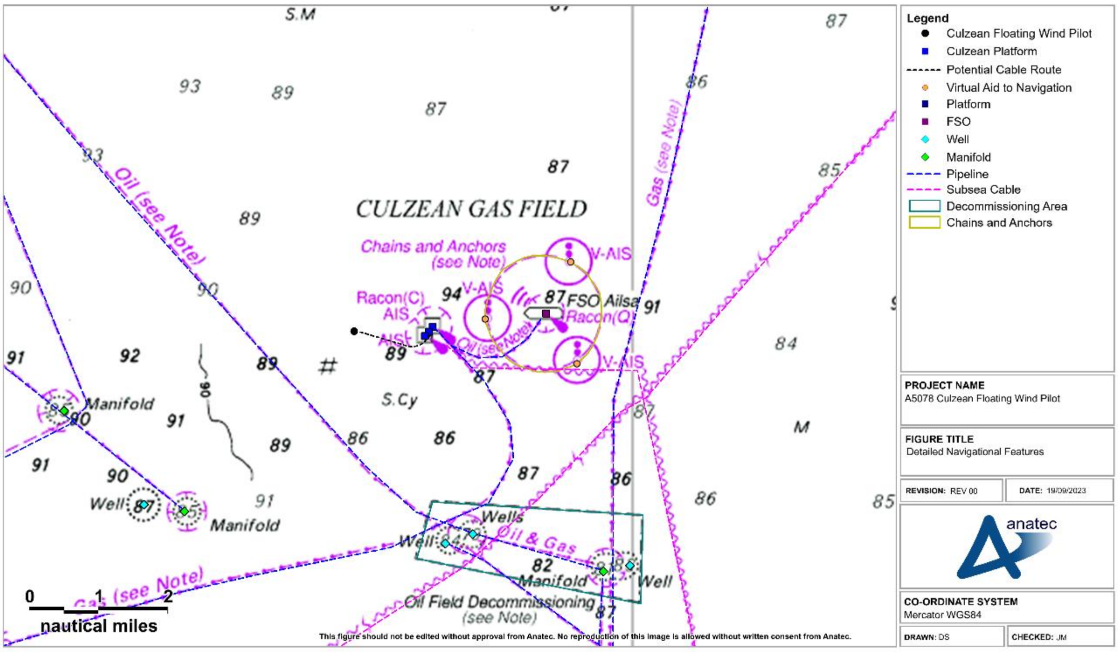


Figure 7-2 Detailed Navigational Features

7.1 Aids to Navigation

60. There is a single dedicated Aid to Navigation (AtoN) in the area, located approximately 13 nm to the east at the Pierce Oil Field. This is positioned to the west of the oil field and is a lit spherical buoy ensuring vessels safely avoid the Haewene Brim Floating Production Storage and Offloading (FPSO). Additionally, there are three virtual AtoNs situated at the Culzean Gas Field indicating the position of the Ailsa floating storage and offloading (FSO). The closest of these virtual AtoNs is positioned 1.9 nm to the east of the WTG.

7.2 Oil and Gas Infrastructure

61. The sea area surrounding the WTG includes various oil and gas fields, their surface and subsea infrastructure, and associated 500 m safety zones marked on charts. The WTG is situated within the Culzean Gas Field, with the nearest installation situated approximately 1 nm to the east (Culzean ULQ Platform). To the east of the Culzean platforms, approximately 2.8 nm from the WTG, is the stationary and anchored Ailsa FSO.

62. The Marnock Oil Field is situated approximately 9.3 nm to the north-west of the WTG. This oil field contains the Eastern Trough Area Project (ETAP) platform which connects to eight other smaller oil and gas fields in the Central North Sea. Other smaller ETAP fields in proximity include the Mirren, Monan, Mungo, Heron, Egret, Machar, Skua, and Madoes fields all of which are within 14 nm of the WTG. Of these fields, in addition to the ETAP platform, only the Mungo Oil Field has a surface piercing structure (the Mungo platform) while the others consist of sub-surface wells and manifolds.

63. Larger oil fields, such as Shearwater and Erskine, are situated approximately 9.9 nm and 11.1 nm to the south, respectively, each with their associated surface platforms. The Lomond Gas Field platform is situated approximately 11.3 nm to the north-east and the Pierce Oil Field FSO approximately 13.7 nm to the east. Directly south of the Culzean Gas Field is the Scoter and Merganser Fields which are not in production and have commenced the decommissioning process.

64. It is noted that both the Maersk Ailsa FSO and Haewene Brim FPSO, are surrounded by chains and anchors which extend beyond the respective 500 m safety zones. These are marked on charts with mariners advised to avoid.

7.3 Wrecks and Obstructions

65. There are no charted wrecks or obstructions located in close proximity to the WTG. The nearest charted wreck is situated 6.1 nm to the south-west.

7.4 Subsea Cables and Pipelines

66. There are a number of pipelines in proximity to the WTG, two of which are associated with the Culzean Gas Field. A pipeline passes 1.2 nm to the south-west between the Marnock Oil Field and the Merganser and Scoter Fields.

67. Two subsea cables are noted in the vicinity; a power cable passes between the Culzean Gas Field and the Judy Oil Field while a telecommunications cable is situated 3.6 nm to the south-east and runs between Cambois Bay (UK) and Boknafjorden (Norway).

8 Emergency Response and Historical Incidents

68. This section summarises the existing SAR resources in the region, and issues being considered in relation to the Project.

8.1 Search and Rescue Helicopters

69. In July 2022, the Bristow Group were awarded a new 10-year contract by the MCA (as an executive agency of the DfT) beginning in September 2024 to provide helicopter SAR operations in the UK. Bristow have been operating the service since April 2015.

70. The SAR helicopter service is currently operated out of 10 base locations around the UK, with two bases at similar distances from the WTG. These are at Sumburgh (UK) (approximately 190 nm to the north-west) and Inverness (UK) (approximately 194 nm to the west). Two Sikorsky S-92 helicopters are operated out of Sumburgh and two AgustaWestland AW189 helicopters are operated out of Inverness.

71. 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 2023.

72. The locations of SAR helicopter taskings within the Study Area are presented in Figure 8-1, colour-coded by tasking type.

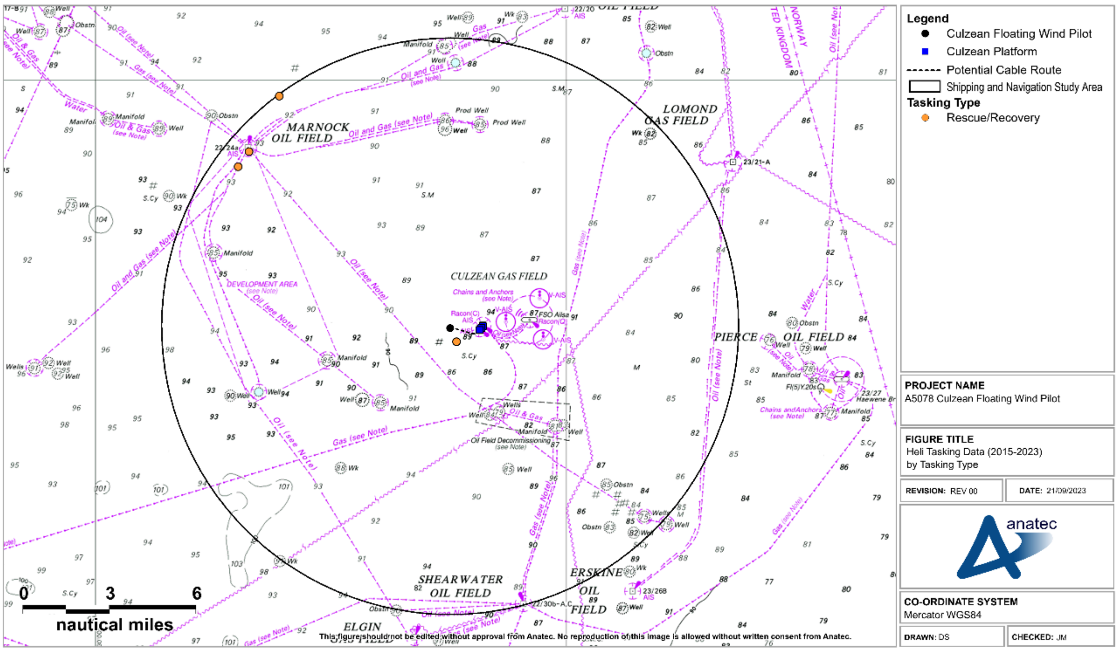


Figure 8-1 Heli Tasking Data (2015 to 2023) by Tasking Type

73. There were four unique SAR incidents within the Study Area between April 2015 and March 2023. Three of these incidents were responded to from Inverness, with the remaining incident responded to from Sumburgh. All four incidents featured a

rescue / recovery. One of these incidents was located 0.5 nm south-east of the WTG.

8.2 Royal National Lifeboat Institution

74. The RNLI is organised into six divisions, with the relevant region for the Project being 'Scotland'. Based out of more than 230 stations around the UK, there are over 400 active lifeboats across the RNLI fleet, including both all-weather lifeboats (ALB) and inshore lifeboats (ILB). RNLI lifeboats are available on a 24-hour basis throughout the year.

75. The closest RNLI station to the WTG is at Peterhead (UK), located approximately 120 nm to the west, where an ALB is in use. It is noted that the RNLI have a strategic performance standard of reaching casualties up to a maximum of 100 nm offshore. Therefore, the Project is considered too far offshore to be accessible by the RNLI. This is reflected in the RNLI incident data which indicated no returns of service within the Study Area in the period 2013 to 2022.

8.3 Maritime Rescue Coordination Centres and Joint Rescue Coordination Centres

76. 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).

77. 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.

78. The closest MRCC to the Study Area is the Aberdeen MRCC, located approximately 129 nm to the west.

8.4 Global Maritime Distress and Safety System

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

80. There are three GMDSS sea areas around the UK, with the Project located within an A2 sea area, as shown in Figure 8-2.

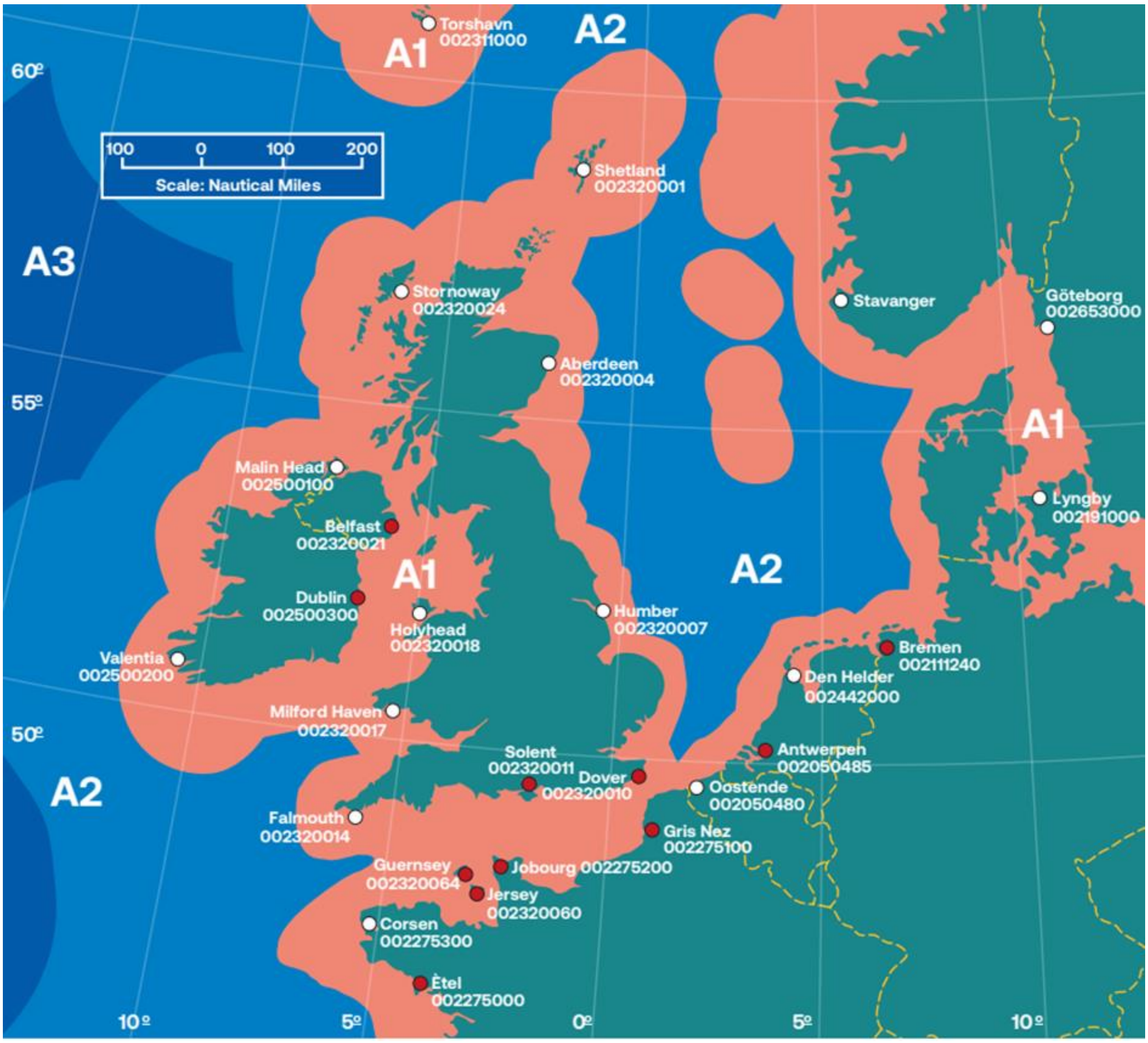


Figure 8-2 GMDSS Sea Areas (MCA, 2021)

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

8.5 Marine Accident Investigation Branch

8.5.1 Data between 2012 and 2021

82. All UK flagged vessels and non-UK flagged vessels in UK territorial waters (12 nm), 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, covering the ten-year period between 2012 and 2021.

83. There were no incidents recorded within the MAIB data between 2012 and 2021 within the Study Area.

8.5.2 Data between 2002 and 2011

84. A high-level review of an additional 10 years of MAIB incident data covering between 2002 and 2011 has also been undertaken given the lack of incidents for the most recent 10-year period.

85. A total of two incidents were recorded by the MAIB within the area between 2002 and 2011. Both incidents featured commercial vessels, one of which was a standby safety vessel. The closest was an accident to person recorded 3.9 nm to the south-east of the WTG where a crew member of an Emergency Response and Rescue Vessel (ERRV) was injured during deployment of a daughter craft and required evacuation to hospital by helicopter.

9 Vessel Traffic Movements

86. This section presents an overview of vessel traffic movements within the Study Area, recorded via AIS over 12-months (see Section 5).

87. A number of vessel tracks recorded during the 12-month period were classified as temporary (non-routine), such as survey vessels, guard vessels, temporary structures such as jack-up platforms and their associated vessels, and offshore daughter craft. These are presented in Figure 9-1 but are thereafter excluded from the characterisation of the vessel traffic baseline.

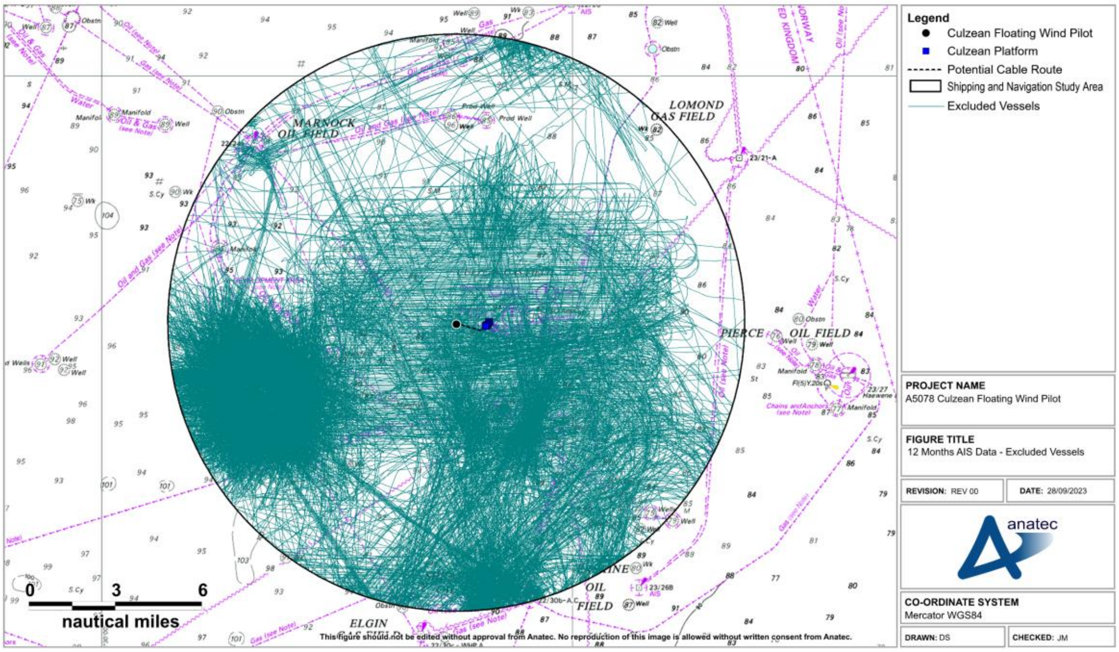


Figure 9-1 12 Months AIS Data – Excluded Vessels

88. Figure 9-2 presents the vessels recorded (excluding temporary traffic) throughout the 12-month period within the Study Area, colour-coded by vessel type. Following this, Figure 9-3 presents the corresponding vessel density.

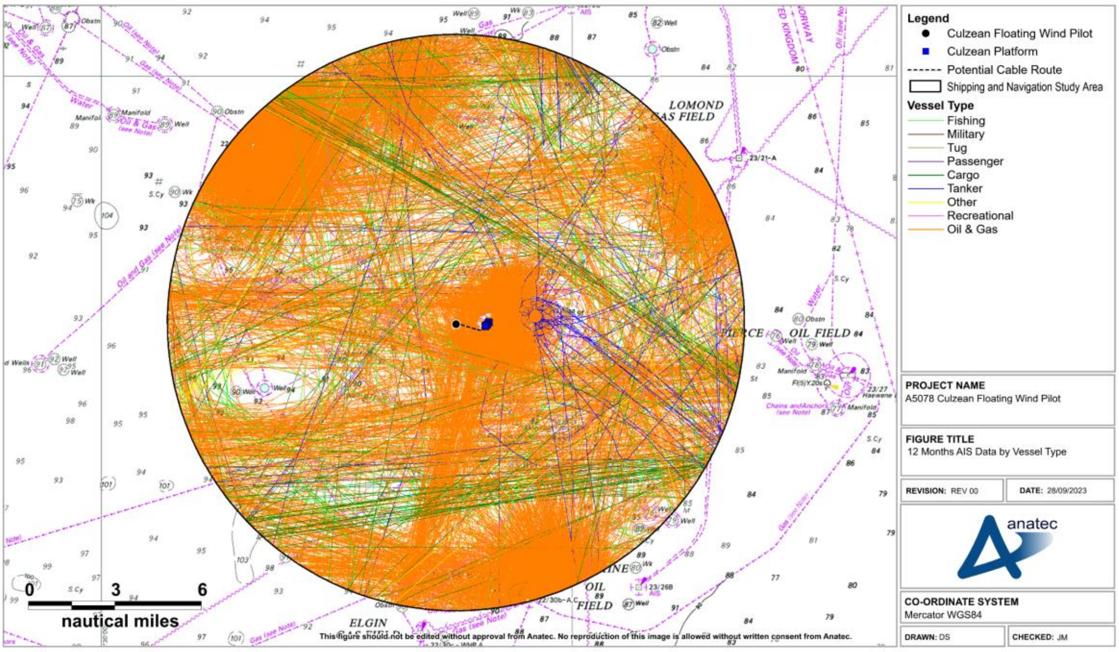


Figure 9-2 12 Months AIS Data by Vessel Type

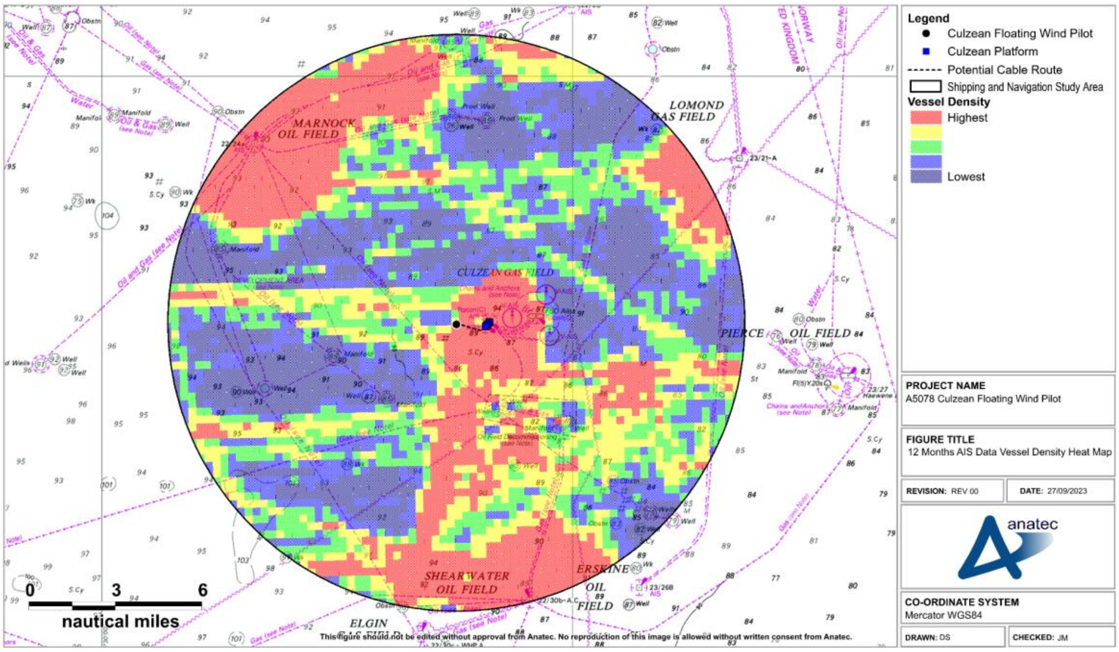


Figure 9-3 12 Months AIS Data Vessel Density Heat Map

89. From Figure 9-2 and Figure 9-3, oil and gas vessels are prominent in the area, with the highest density locations within the Study Area associated with where such vessels are operating around oil and gas installations.

9.1 Vessel Count

90. The average number of unique vessels per day for each month of the data period within the Study Area is presented in Figure 9-4.

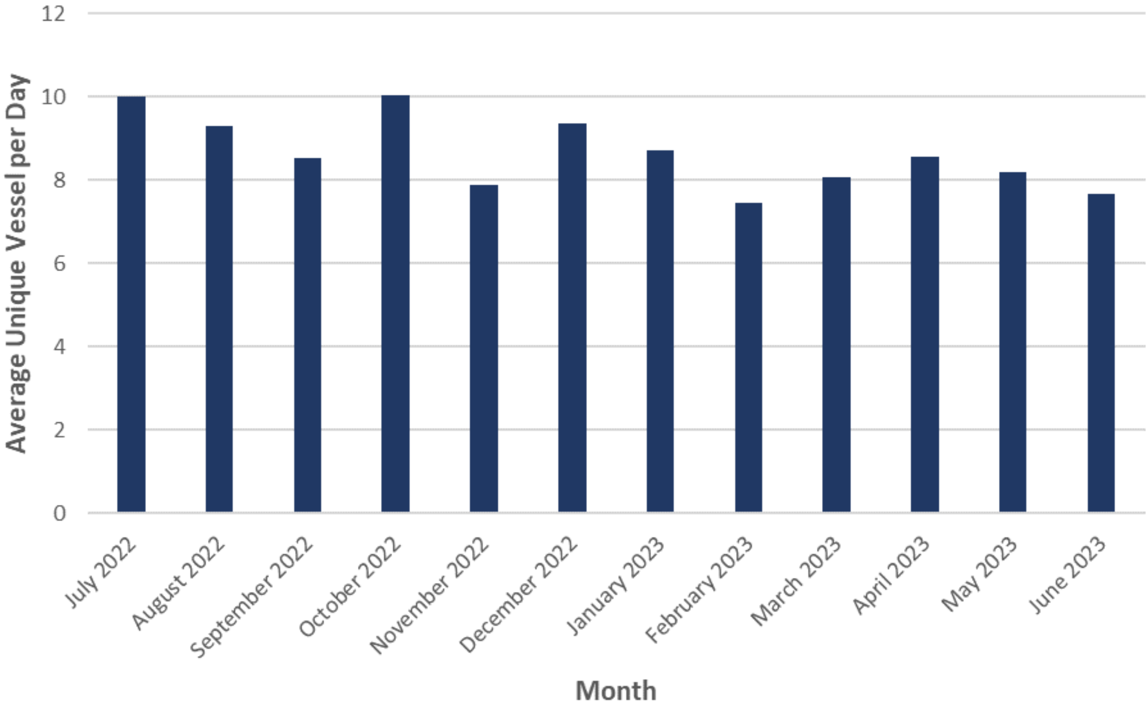


Figure 9-4 Average Unique Vessels per Day per Month

91. Overall, an average of eight unique vessels per day was recorded within the Study Area, with limited variance across the 12-month period.

92. The busiest day recorded during the 12-month period within the Study Area was the 12th November 2022, when 16 unique vessels were recorded.

93. The quietest days recorded during the 12-month period within the Study Area were four days across November 2022, January 2023, and June 2023 when three unique vessels were recorded.

94. An average of three vessels per week were recorded crossing the export cable.

9.2 Vessel Type

95. The percentage distribution of the main vessel types recorded passing within the Study Area, during the 12-month period, is presented in Figure 9-5. Vessel types recorded contributing less than 1% of traffic have been incorporated into the 'All Other' category[3].

[3] The 'All Other' category includes military vessels, passenger vessels, recreational vessels and other vessels.

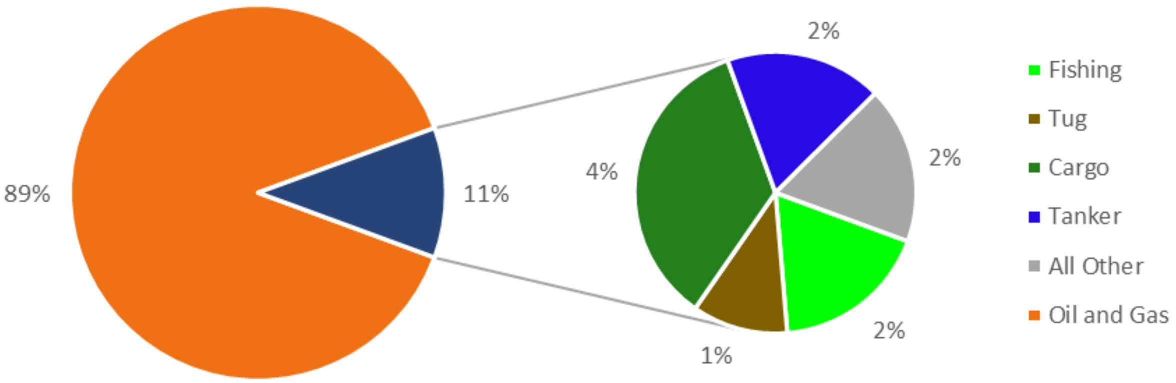


Figure 9-5 Vessel Type Distribution

96. The main vessel type recorded throughout the 12-month period within the Study Area was oil and gas (89%). No other vessel type accounted for more than 5% of vessel traffic, with the next highest contributors being cargo vessels (4%), tankers (2%) and fishing vessels (2%).

97. All vessels crossing the export cable were oil and gas vessels.

98. The following subsections consider each of the main vessel types in detail.

9.2.1 Oil and Gas Vessels

99. Figure 9-6 presents oil and gas vessels recorded within the Study Area during the 12-month period colour-coded by vessel destination.

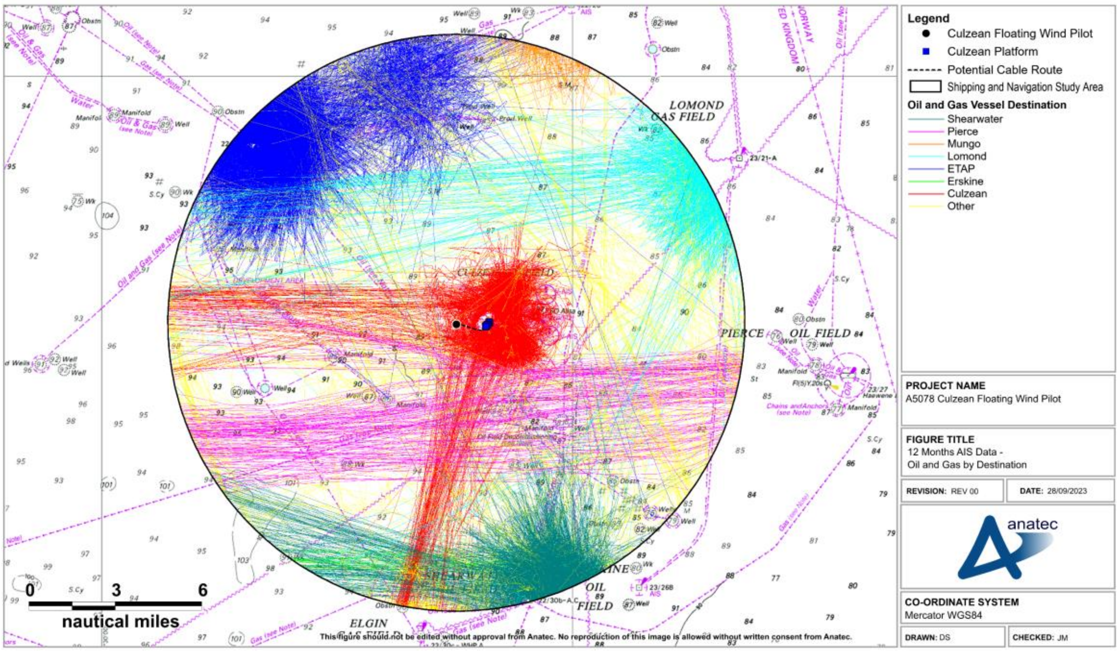


Figure 9-6 12 Months AIS Data - Oil and Gas Vessels by Destination

100. An average of eight unique oil and gas vessels per day were recorded within the Study Area during the 12-month period.

101. The majority of oil and gas support vessels were recorded visiting the oil and gas installations within or close to the Study Area. The ETAP / Marnock (24%), Culzean (21%) and Shearwater (20%) Fields were among the most common destinations broadcast by oil and gas vessels on AIS. It is noted that this includes oil and gas vessels operating at the fields and not only passing traffic.

9.2.2 Cargo Vessels

102. Figure 9-7 presents cargo vessels recorded within the Study Area during the 12-month period.

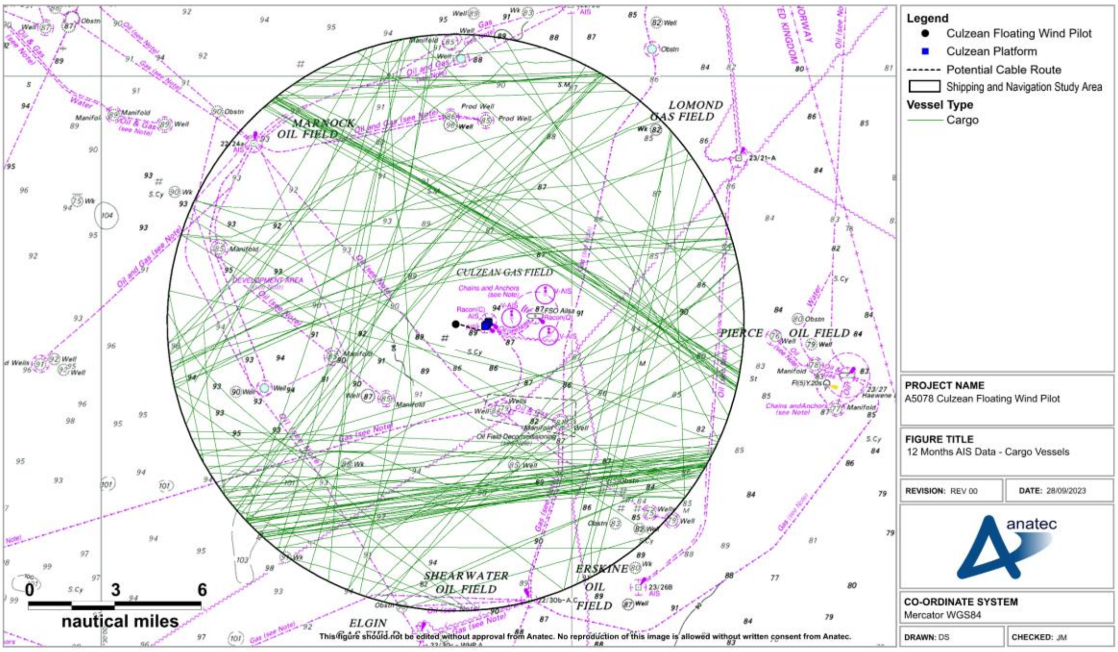


Figure 9-7 12 Months AIS Data – Cargo Vessels

103. An average of two to three unique cargo vessels per week were recorded within the Study Area during the 12-month period.

104. Common destinations of cargo vessels broadcast on AIS included Esbjerg (Denmark), Aberdeen (UK) and Montrose (UK), in addition to a number of Danish, Swedish and Norwegian ports. Key routes are located to the south of the WTG, heading east-west from Montrose to various Scandinavian ports, as well as a route located to the north of the WTG, heading north-west to south-east, with Esbjerg being the most common destination on this route. The main commercial routes are identified in Section 10.

9.2.3 Tankers

105. Figure 9-8 presents tankers recorded within the Study Area during the 12-month period.

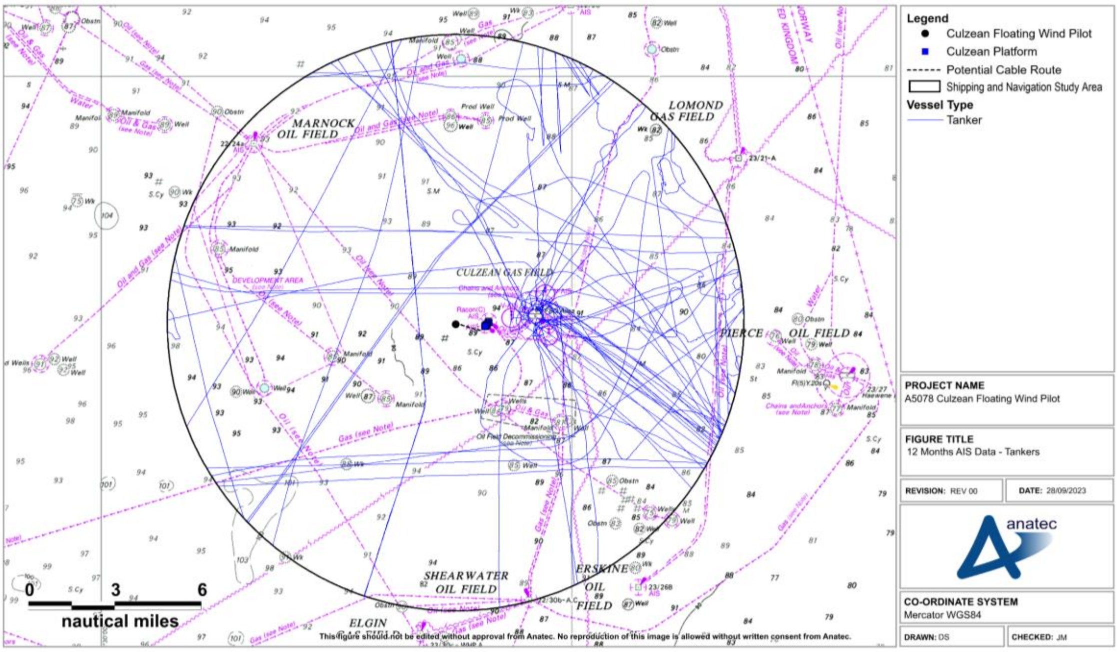


Figure 9-8 12 Months AIS Data - Tankers

106. An average of one to two unique tankers per week were recorded within the Study Area during the 12-month period.

107. The majority of tankers recorded within the Study Area were associated with the Ailsa FSO located at the Culzean Field. Tankers were also recorded visiting a number of other installations in the North Sea, including Pierce, Triton and Mungo. Tankers were also recorded on passage featuring varied destinations such as Le Havre (France), Brunsbüttel (Germany) and Hull (UK).

9.2.4 Commercial Fishing Vessels

108. Figure 9-9 presents commercial fishing vessels recorded within the Study Area during the 12-month period colour-coded by average speed.

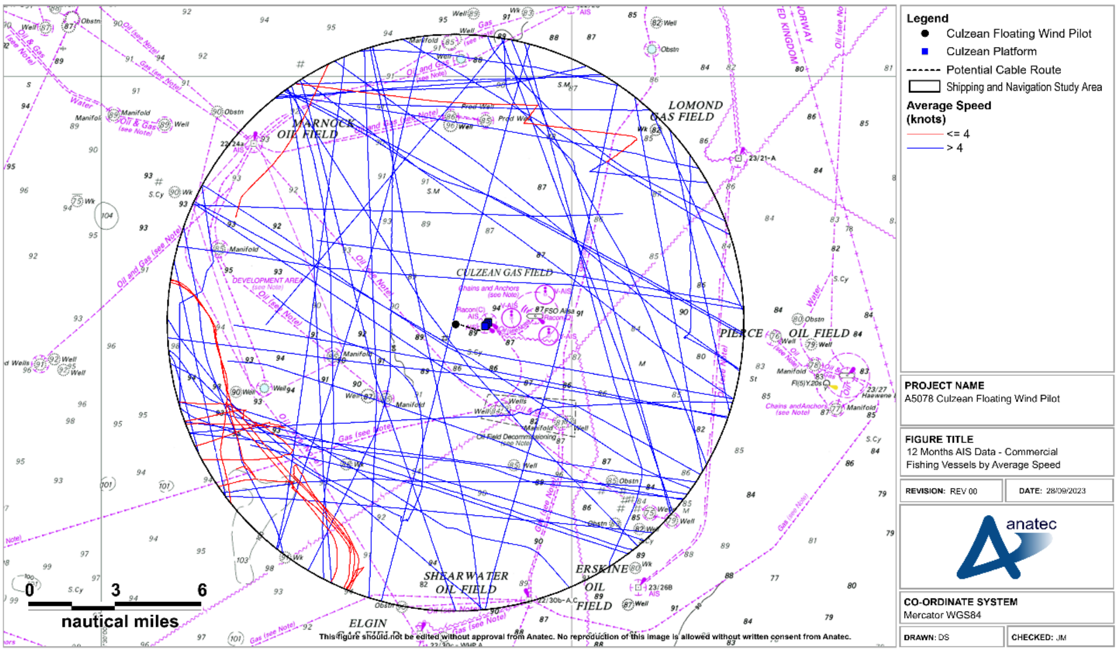


Figure 9-9 12 Months AIS Data – Commercial Fishing Vessels by Average Speed

109. An average of one to two unique commercial fishing vessels per week were recorded within the Study Area during the 12-month period.

110. Based on track behaviour and average speeds recorded, the commercial fishing vessel activity recorded in the Study Area was generally characteristic of transiting, rather than active fishing. A small number of tracks to the south-west of the WTG were recorded at average speeds below 4 knots (kt), which may be indicative of active fishing.

111. A variety of vessel nationalities were noted over the 12-month data period. Figure 9-10 presents the fishing vessels colour-coded by nationality. Nationalities included in the 'Other / Unspecified' category included Sweden and Lithuania.

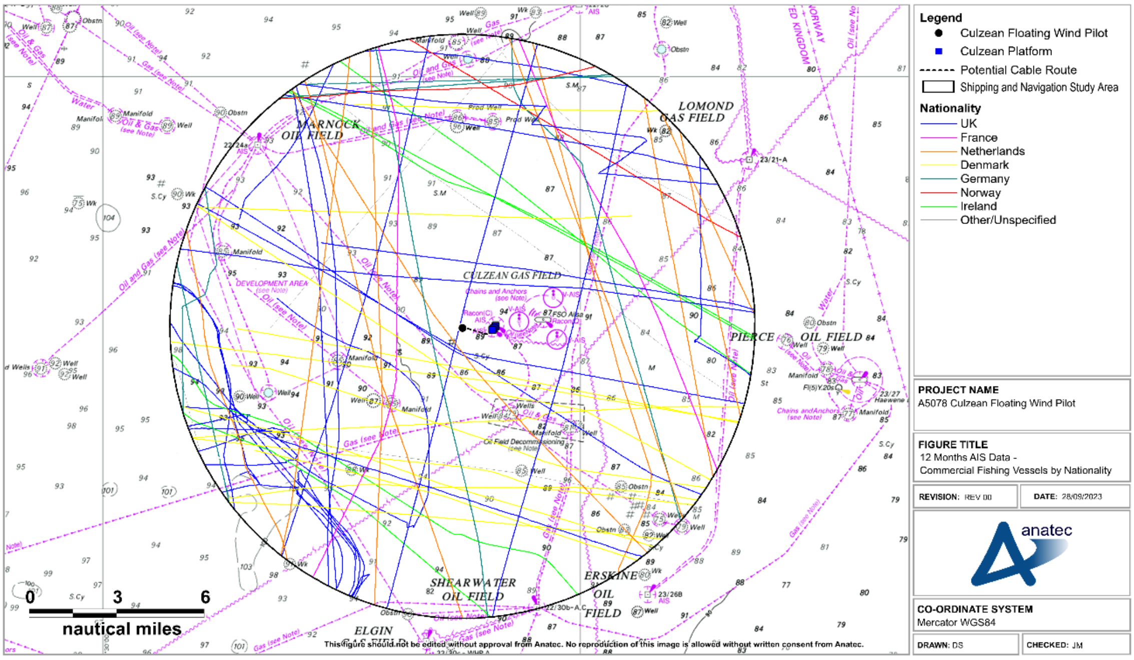


Figure 9-10 12 Months AIS Data – Commercial Fishing Vessels by Nationality

112. In addition to the AIS data, VMS data is available for the Study Area. VMS is a satellite tracking system for fishing vessels and its use is required for fishing vessels over 12 m length. A plot of VMS data covering 2022 is presented in Figure 9-11.

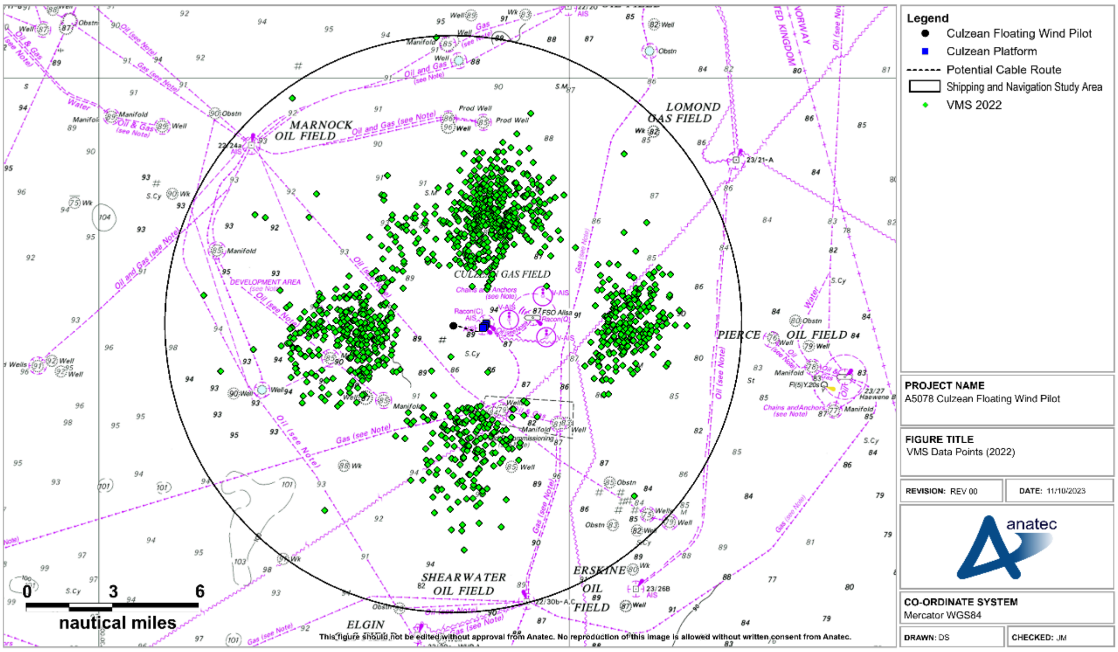


Figure 9-11 VMS Data Points (2022)

113. The VMS data recorded during 2022 in the Study Area focuses on specific areas but on all sides of the WTG. Data points were not typically recorded in close proximity to the WTG.

9.2.5 Recreational Vessels

114. Figure 9-12 presents recreational vessels recorded within the Study Area during the 12-month period.

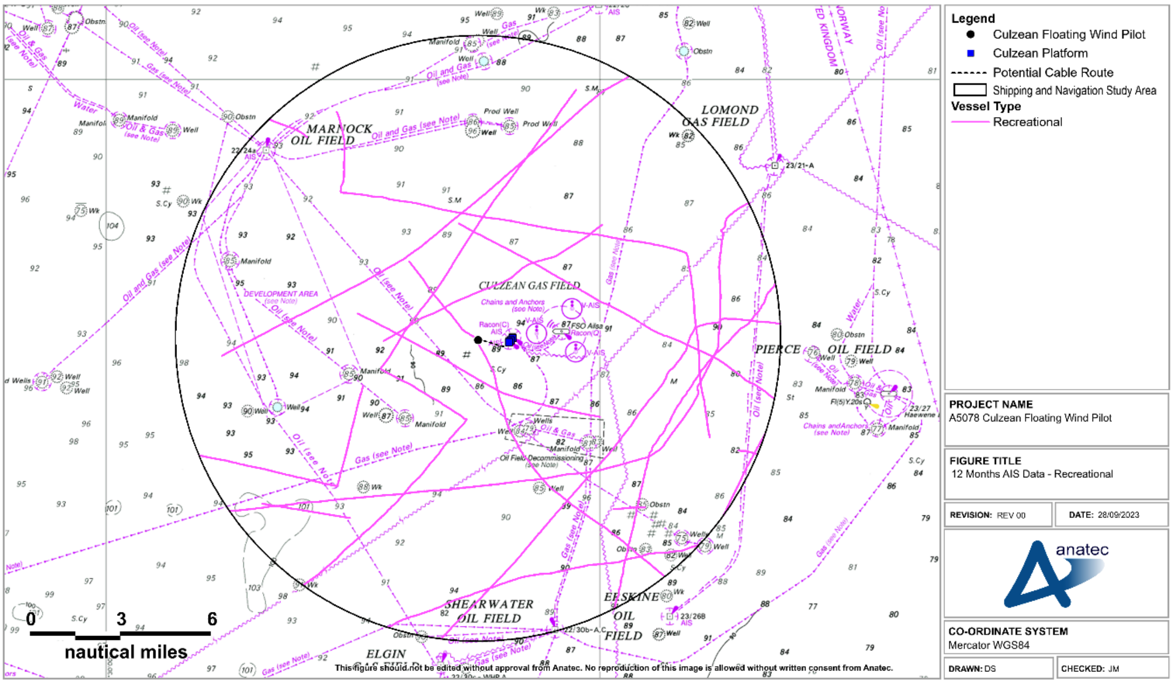


Figure 9-12 12 Months AIS Data – Recreational Vessels

115. An average of one unique recreational vessel every month was recorded during the 12-month period within the Study Area. Recreational vessels were typically recorded during the summer months, with the sparse volumes overall indicative of the distance offshore.

116. During the Hazard Workshop, RYA Scotland noted that recreational routeing between Peterhead and the Baltic may be expected; this may be represented by the AIS data (noting that destination information was not broadcast by recreational vessels).

9.2.6 Anchored Vessels

117. Vessels which travelled at an average speed of less than 1 kt for more than 30 minutes are assumed to possibly be at anchor. Such cases have therefore been identified and checked for likely anchoring activity along with vessel track behaviour and navigational status information broadcast via AIS. After applying the criteria no vessels were deemed to be at anchor during the 12-month period within the Study Area.

9.3 Vessel Size

9.3.1 Vessel Length

118. Vessel length was available for approximately 99% of vessels recorded during the 12-month period.

119. Figure 9-13 presents the vessels recorded throughout the 12-month period within the Study Area, colour-coded by vessel length. Following this, Figure 9-14 presents the distribution of vessel length.

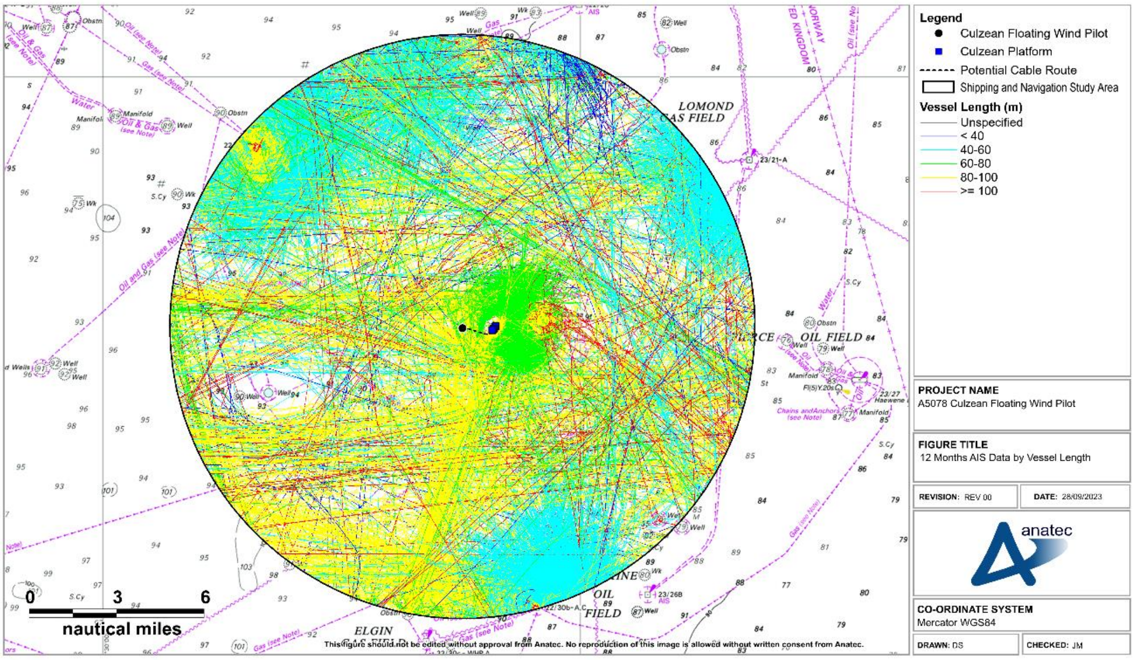


Figure 9-13 12 Months AIS Data by Vessel Length

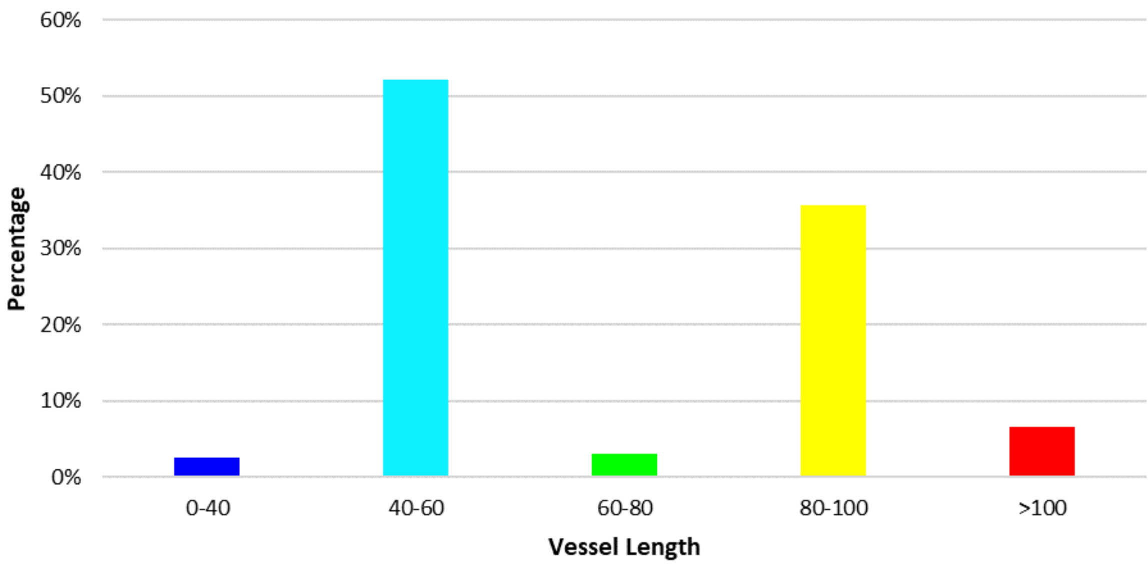


Figure 9-14 Vessel Length Distribution

120. The average length of all vessels (excluding unspecified) was 72 m. The largest vessel recorded was a 292 m bulk carrier, which passed approximately 3 nm to the east of the WTG. The smallest vessel recorded was a 9 m yacht passing approximately 4 nm to the north-east of the Study Area.

121. For vessels crossing the export cable, the average length was 81 m, and the greatest was 93 m.

9.3.2 Vessel Draught

122. Vessel draught was available for approximately 99% of vessels recorded during the 12-month period.

123. Figure 9-15 presents the vessels recorded throughout the 12-month period within the Study Area, colour-coded by vessel draught. Following this, Figure 9-16 presents the distribution of vessel draught.

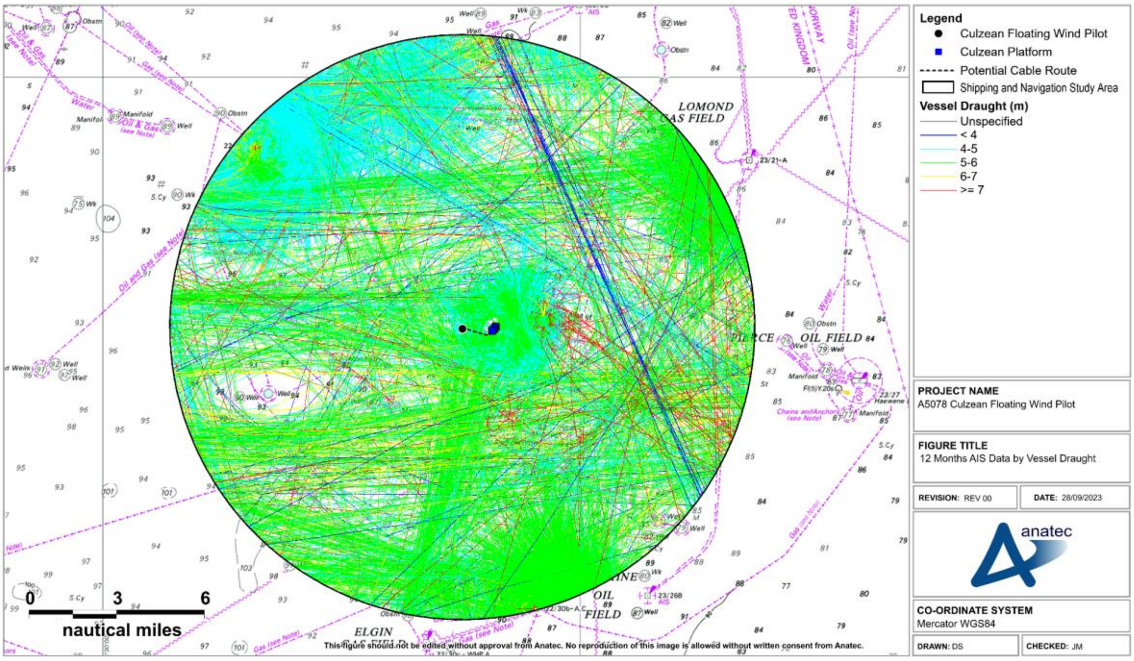


Figure 9-15 12 Months AIS Data by Vessel Draught

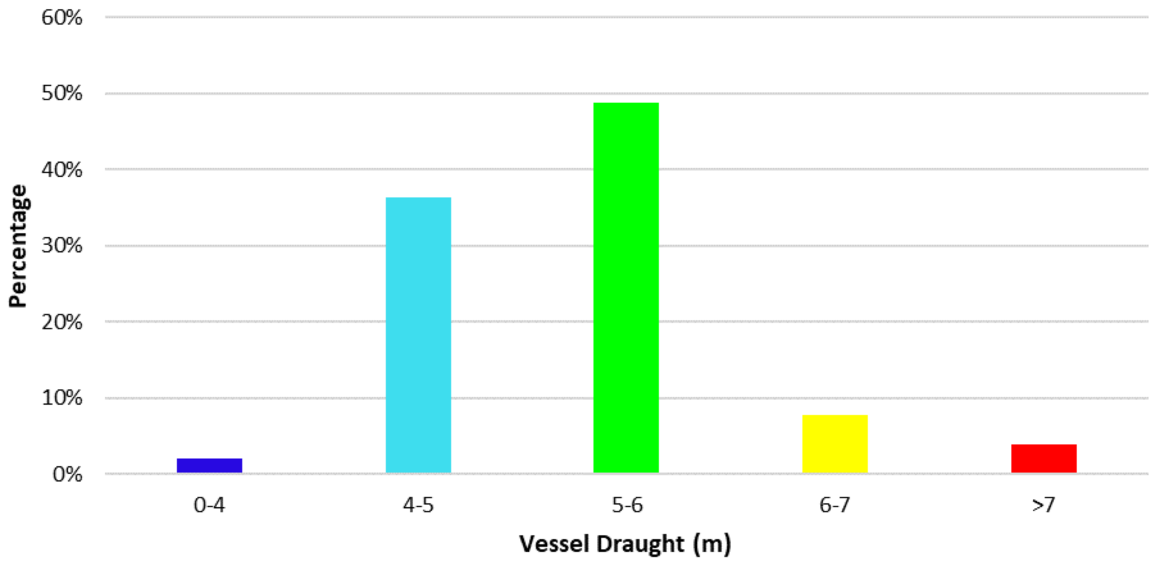


Figure 9-16 Vessel Draught Distribution

124. The average draught of all vessels (excluding unspecified) was 5.3 m. The deepest draught recorded was 12.4 m, associated with a bulk carrier on passage to Brofjorden (Sweden), passing 3 nm to the north of the WTG.

125. For vessels crossing the export cable, the average draught was 5.3 m, and the deepest was 5.8 m.

10 Base Case Vessel Routeing

10.1 Definition of a Main Commercial Route

126. Main commercial routes have been identified using the principles set out in MGN 654 (MCA, 2021). Vessel traffic data are assessed and vessels transiting at similar headings and locations are identified as a main route. To help identify main routes, vessel traffic data can also be interrogated to show vessels (by name and / or operator) that frequently transit those routes. The route width is then calculated using the 90th percentile rule from the mean line of the potential shipping route as shown in Figure 10-1.

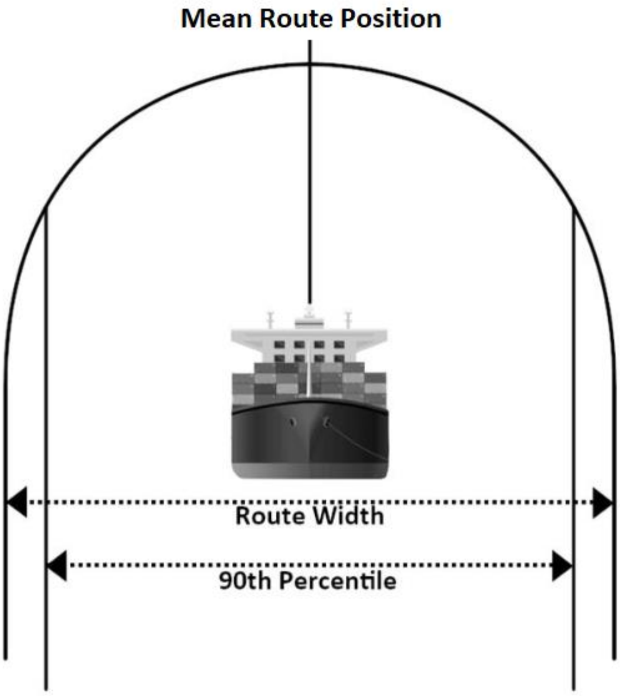


Figure 10-1 Illustration of Main Route Calculation

10.2 Pre Wind Turbine Generator Main Commercial Routes

127. A total of 11 main commercial routes were identified within the Study Area from the 12-month period. These routes and corresponding 90th percentiles are shown relative to the Project in Figure 10-2.

128. Following this, relevant details of each route are given in Table 10.1. This includes key destinations; however, it should be considered that these are based on the most common destinations transmitted via AIS by vessels on those routes and therefore it should not be assumed that the destination for a given transit will be to one of those listed.

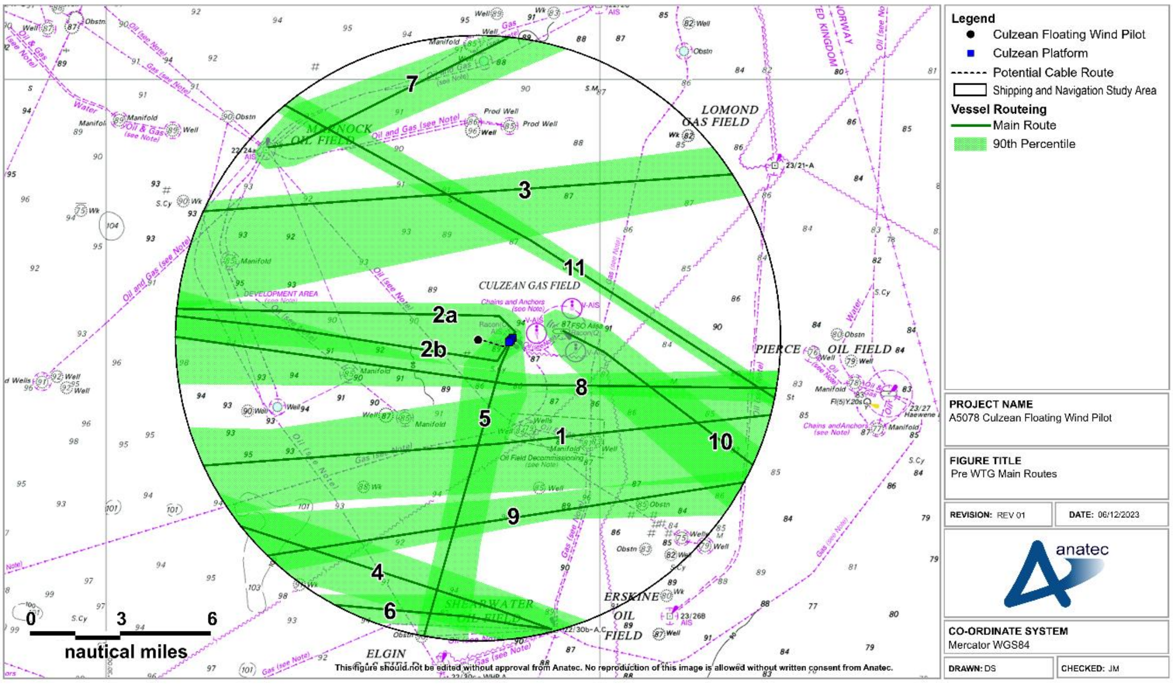


Figure 10-2 Pre WTG Main Commercial Routes

Table 10.1 Main Commercial Route Details

Route	Key Destinations	Average Vessel per Week	Vessel Type Breakdown
1	Aberdeen (UK)–Pierce Oil Field	2 to 3	Oil and gas vessels (100%).
2	Aberdeen (UK)–Culzean Gas Field	2	Oil and gas vessels (100%). Alternative approaches are noted with Route 2a passing to the north of the WTG, while Route 2b passes to the south.
3	Aberdeen (UK)–Lomond Gas Field	2	Oil and gas vessels (100%).
4	Aberdeen (UK)–Shearwater Oil Field	2	Oil and gas vessels (100%).
5	Elgin Field–Culzean Gas Field	1 to 2	Oil and gas vessels (100%).
6	Aberdeen (UK)–Shearwater Oil Field	1 to 2	Oil and gas vessels (100%).
7	ETAP / Marnock Oil Field–Mungo Oil Field	1	Oil and gas vessels (100%).
8	Aberdeen (UK)–Pierce Oil Field	0 to 1	Oil and gas vessels (100%).
9	Montrose (UK)–Kattegat	0 to 1	Cargo vessels (100%).
10	Brunsbüttel (Germany)–Culzean Gas Field	0 to 1	Tankers (100%).
11	Scottish west coast to Esbjerg (Denmark)	0 to 1	Cargo vessels (100%). In one direction only, towards Esbjerg.

10.3 Adverse Weather Routeing

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

130. From the vessel traffic data (noting that the data accounts for seasonality), no alternative routeing was observed in adverse weather in proximity to the WTG. Additionally, no concerns were raised in relation to adverse weather routeing during the Hazard Workshop.

131. Therefore, also noting the scale of the Project, it is not anticipated that the presence of the Project will have any notable effect on adverse weather routeing.

11 Navigation, Communication and Position Fixing Equipment

132. As per the requirements of MGN 654 (MCA, 2021) historical research, lessons learnt from existing offshore wind farms and expert opinion have been considered in the review of risks to navigation, communication or position fixing equipment due to the presence of the Project. This includes MGN 654 as well as the following sources:

- *Results of the Electromagnetic Investigations* (MCA and QinetiQ, 2004);
- *Offshore Wind Farm Helicopter Search and Rescue Trials Undertaken at the North Hoyle Wind Farm* (MCA, 2005);
- *Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind Farm* (BWEA, 2007);
- *Atlantic Array Offshore Wind Farm Draft Environmental Statement Annex 18.3: Noise and Vibration (Anthropogenic Receptors): Predictions of Operational Wind Turbine Noise Affecting Fishing Vessel Crews* (Atlantic Array, 2012); and
- *Horns Rev 3 Offshore Wind Farm – Technical Report No. 12: Radio Communication and Radars* (Energinet, 2014).

133. Following consideration of the sources and guidance available, Table 11.1 outlines the sensitivity of each type of navigation, communication or position fixing equipment and whether it is screened in or out of the risk assessment.

Table 11.1 Communication and Position Fixing Equipment Sensitivity and Risk Assessment Screening

Topic		Sensitivity	Risk Assessment Screening
Type	**Specific**		
Communication	Very High Frequency (VHF)	Following consideration of the research reports and the scale of the Project there are not anticipated to be any risks to VHF.	Screened out
Communication	VHF Direction Finding (DF)	As per VHF, there are not anticipated to be any risks to VHF DF.	Screened out
Communication	AIS	No significant issues with interference to AIS transmission from operational offshore wind farms has been observed or reported to date and given the scale of the Project there are not anticipated to be any risks to AIS.	Screened out
Communication	Navigation Telex (NAVTEX)	Although no specific trials have been undertaken, no significant risk to NAVTEX has been reported to date at operational developments and given the scale of the Project there are not anticipated to be any risks to NAVTEX.	Screened out
Communication	Global Position System (GPS)	No significant issues with interference to GPS from operational offshore wind farms has been observed or reported to date and given the scale of the Project there are not anticipated to be any risks to GPS.	Screened out
Electromagnetic interference	Export cable	The export cables will carry AC, with studies indicating that AC does not emit an EMF significant enough to impact marine magnetic compasses (Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), 2008).	Screened out
Electromagnetic interference	WTG	No problems with respect to magnetic compasses have been reported to date in any of the trials undertaken (inclusive of SAR helicopters) nor at any operational offshore wind farms.	Screened out
Marine Radar	Marine Radar	Given the scale of the Project there are not anticipated to be any further risks upon Radar use.	Screened out
Sound Navigation and Ranging (SONAR)	SONAR	No evidence has been found to date with regard to existing offshore wind farms to suggest that SONAR systems produce any kind of SONAR interference which is detrimental to the fishing industry, or to military systems. No risk is therefore anticipated in relation to the Project.	Screened out

Topic		Sensitivity	Risk
Noise	Underwater	No evidence has been found to date with regard to existing offshore wind farms to suggest that prescribed noise signals are in any way impacted by acoustic noise produced by the development.	Screened out
	Surface		Screened out

134. Since all elements of navigation, communication and position fixing equipment are screened out of the risk assessment, the hazard as a whole is screened out of the risk assessment.

12 Future Case Vessel Traffic Movements

135. This section gives consideration to potential future case vessel traffic, in terms of changes to volume and movements in the presence of the Project. Assumptions made in this section have been fed into the collision and allision risk modelling (see Section 13) and are considered throughout the risk assessment (see Section 14).

12.1 Traffic Volume Changes

136. There is uncertainty associated with long-term predictions of vessel traffic growth given the limited reliable information on future trends. Therefore, a conservative assumption of a 10% increase in vessel traffic movements has been assumed for the future case across the design life of the Project.

137. This assumption incorporates all vessel types including commercial vessels, commercial fishing vessels, and recreational vessels. In the case of oil and gas vessels, the increasing focus on decommissioning of existing assets may lead to a long-term decrease in volumes, although the 10% increase serves as a worst case parameter, noting that activity is heavily influenced by the needs of each individual field asset.

12.2 Commercial Traffic Routeing

12.2.1 Methodology

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

- All routes maintain a minimum mean distance of 1 nm from surface piercing offshore installations; and
- All mean routes take into account sandbanks, aids to navigation and known routeing preferences.

139. The conservative 1 nm passing distance assumption reflects internal and external studies undertaken by Anatec on behalf of the UK Government and offshore wind farm developers which indicate that vessels do pass consistently and safely within 1 nm of established developments.

12.2.2 Main Commercial Route Deviations

140. Of the 11 main commercial routes identified in Section 10, 10 do not pass in close proximity to the WTG. Route 2, between Aberdeen (UK) and the Culzean Gas Field, passes in proximity to the WTG and has been deviated in the future routeing to achieve a 1 nm setback from the WTG as shown in Figure 12-1.

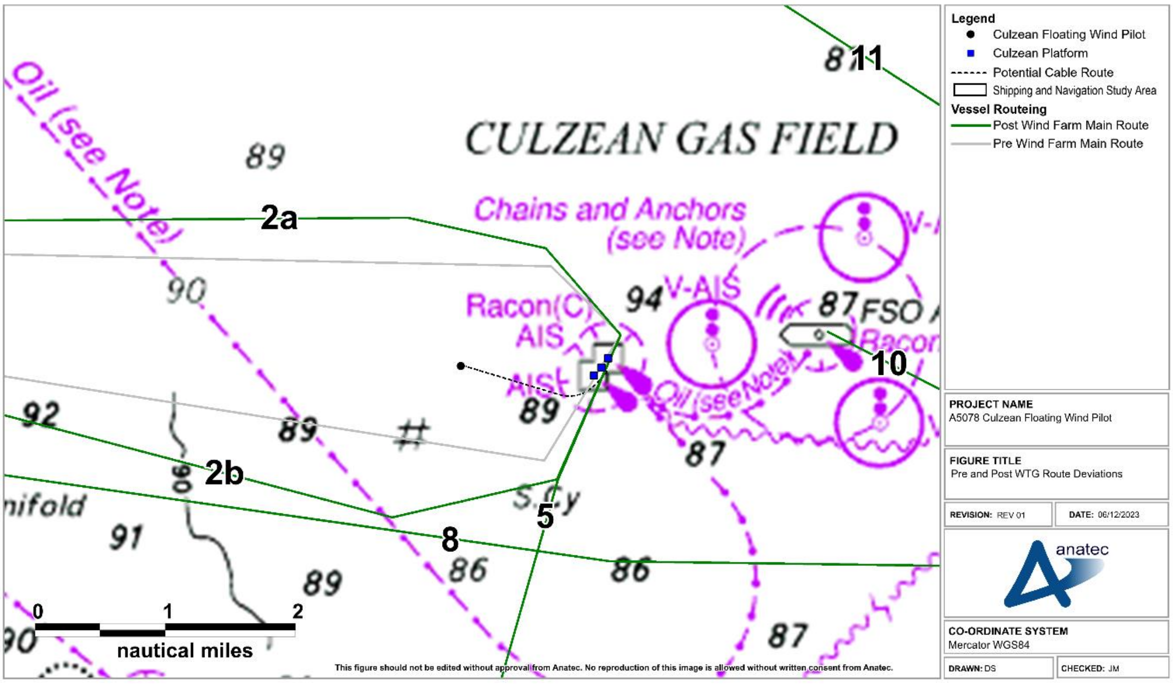


Figure 12-1 Pre and Post WTG Route Deviations

141. The deviation associated with Route 2a (passing north of the WTG) is approximately 0.11 nm and with Route 2b (passing south of the WTG) is approximately 0.33 nm. The worst case across both variants of Route 2 corresponds to a 0.34% increase in total route length.

142. The vessel traffic on Route 2 is wholly associated with the Culzean Gas Field and already passes within 1 nm of existing infrastructure in the base case. Therefore, the deviations assumed for the future case are considered highly conservative.

13 Collision and Allision Risk Modelling

143. To inform the risk assessment, a quantitative review of the major hazards associated with collisions and allisions that may arise as a result of the Project has been undertaken using Anatec's COLLRISK modelling suite. The following subsections outline the inputs and methodology used for the collision and allision risk modelling, followed by the results.

13.1 Hazards Under Consideration

144. Hazards considered in the quantitative collision and allision risk modelling assessment are as follows[4]:

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

145. The pre WTG assessment has been informed by the vessel traffic data (see Section 9) in combination with the outputs of consultation (see Section 4) and other baseline data sources (such as Anatec's ShipRoutes database). Conservative assumptions have then been made with regards to route deviations and future shipping growth over the design life of the Project (see Section 12).

13.2 Scenarios Under Consideration

146. For each element of the quantitative assessment, both a pre and post WTG scenario with base and future case vessel traffic levels have been considered. This means the following four distinct scenarios have been modelled:

- Pre WTG with base case vessel traffic levels;
- Pre WTG with future case vessel traffic levels;
- Post WTG with base case vessel traffic levels; and
- Post WTG with future case vessel traffic levels.

147. Sections 13.4 and 13.5 provide the risk results for base case traffic levels in detail, with the risk results for the future case traffic levels provided in Section 13.6.

13.3 Meteorological Ocean Data

148. This subsection presents meteorological and oceanographic statistics local to the Project. The data presented in this subsection has been used as input to the collision and allision risk modelling.

[4] Offshore wind farm NRAs undertaken by Anatec typically also model the creation of fishing vessel to structure allision risk. However, this model focuses on internal navigation which is not applicable to the Project since there is only one surface piercing structure.

13.3.1 Wind Direction

149. Based on Anatec's in-house wind direction data, the proportion of wind direction within each 30-degree interval for this data is presented in Figure 13-1. Winds are predominantly from the south-west.

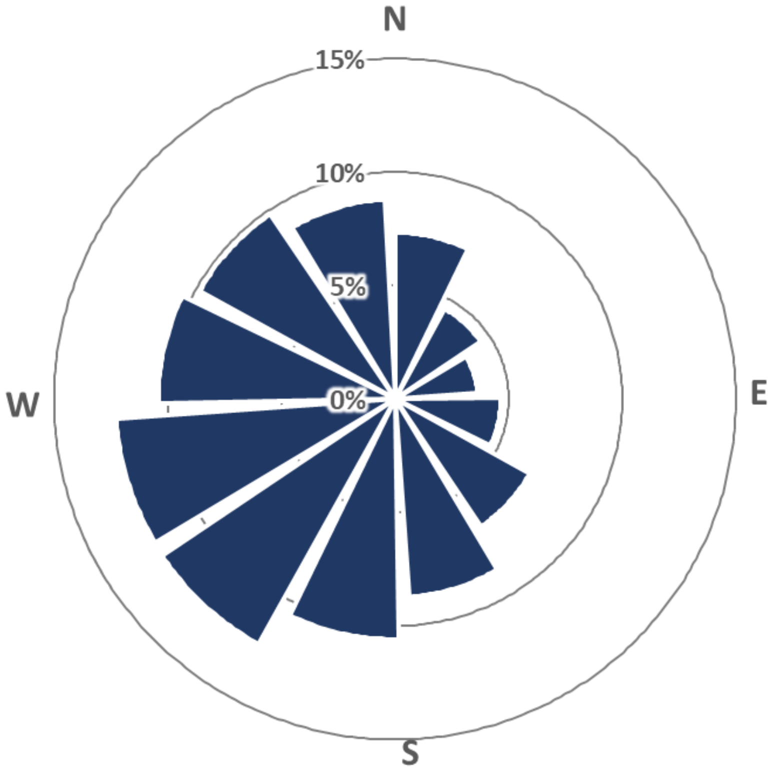


Figure 13-1 Wind Direction Distribution

13.3.2 Sea State

150. Based on Anatec's in-house significant wave height data, the proportion of the sea state within each of the three defined ranges has been defined and is presented in Table 13.1. This data has been validated with significant wave height data provided by the Applicant.

Table 13.1 Sea State Data

Sea State	Proportion (%)
Calm (<1 m)	19.1
Moderate (1–5 m)	76.7
Severe (>5 m)	4.3

13.3.3 Visibility

151. 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 kilometre (km)) is 3%. This is based upon the *Admiralty Sailing Directions* (UKHO, 2021).

13.3.4 Tide

152. Tidal data to be used as input to the collision and allision modelling is based upon UKHO Admiralty Charts (see Section 5), with the maximum tidal speed and corresponding direction for both flood and ebb tides provided in Table 13.2.

Table 13.2 Tidal Data

Tide	Maximum Tidal Speed (kt)	Direction (°)
Flood	0.6	019
Ebb	0.7	195

153. Based upon the available data and the scale of the Project, no hazards are expected at high water that would not also be expected at low water, and vice versa. The WTG is not expected to result in any additional risk on the existing tidal stream in relation to its effect on existing shipping and navigation users.

13.4 Pre Wind Turbine Generator Modelling

13.4.1 Encounters

154. An assessment of current vessel to vessel encounters in proximity to the Project has been undertaken by replaying the vessel traffic data at high speed. The model defines an encounter as two vessels passing within 1 nm of each another within the same minute. This helps to identify areas where existing shipping congestion is highest, and therefore where offshore developments could potentially increase the risk of encounters and collisions. No account has been given as to whether the encounters are head on or stern to head; only close proximity is accounted for.

155. Figure 13-2 presents a density heat map based upon the locations of vessel encounters. Following this, the number of encounters recorded per month is presented in Figure 13-3.

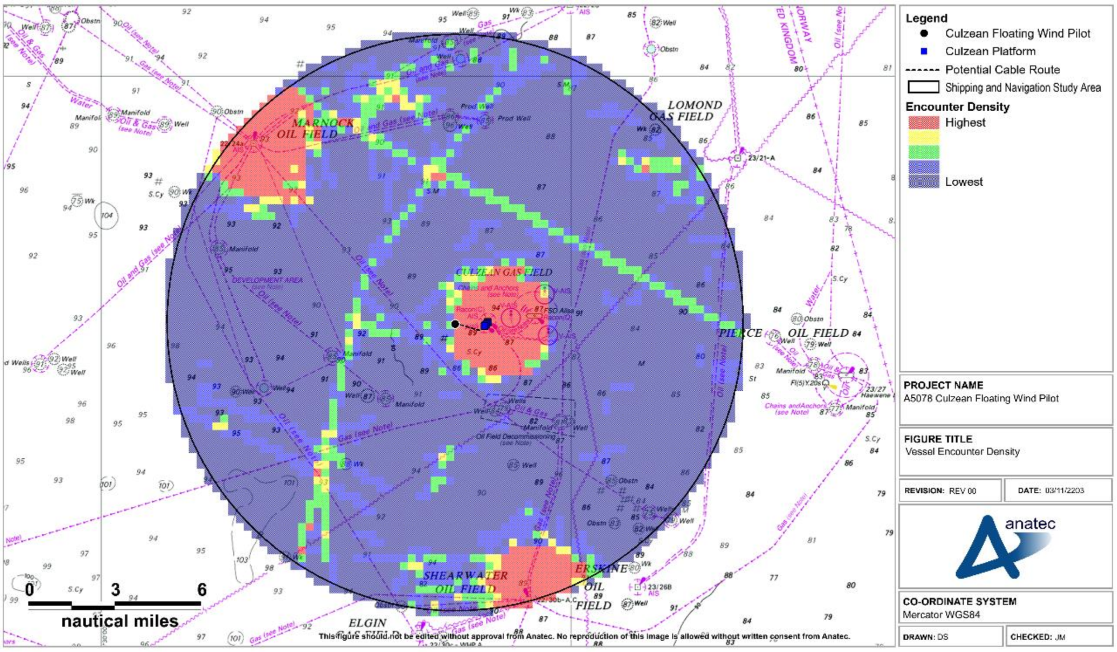


Figure 13-2 Vessel Encounter Density

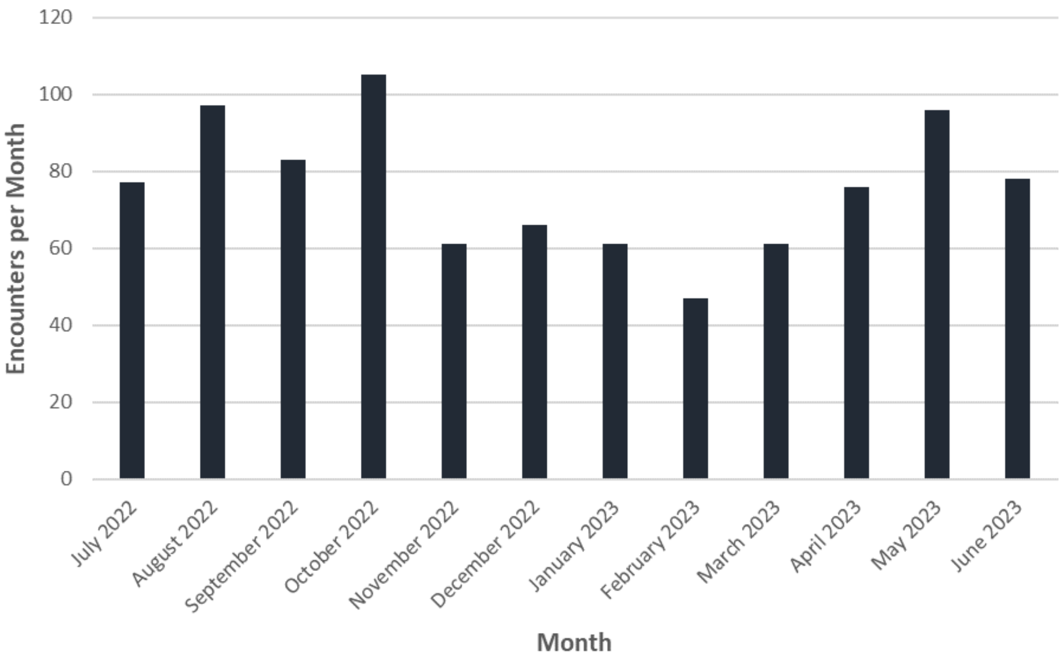


Figure 13-3 Encounters per Month

156. There was an average of two to three encounters per day within the Study Area throughout the 12-month period, with the majority associated with vessels operating at the oil and gas fields in the area.

157. The busiest month was October 2022 when 105 encounters were recorded, while the quietest month was February 2023 when 47 encounters were recorded. The winter months generally featured fewer encounters.

158. The majority of vessels involved in encounters were oil and gas vessels, accounting for 95% of the total encounters, this is followed by tankers with 3% of the total. Encounters involving smaller vessel types were limited, noting that the dataset is limited to those vessels broadcasting on AIS.

13.4.2 Vessel to Vessel Collision Risk

159. Using the pre WTG vessel routeing as input, Anatec's COLLRISK model has been run to estimate the vessel to vessel collision risk within the Study Area.

160. Figure 13-4 presents a density heat map for the geographical distribution of collision risk for the pre WTG base case.

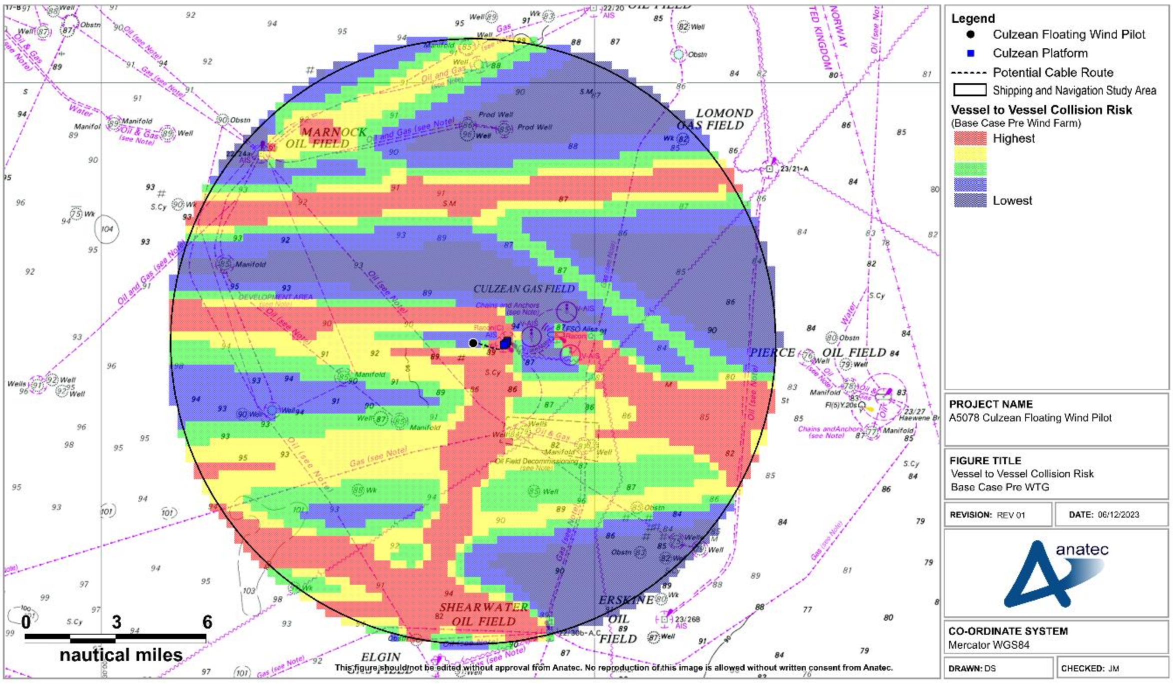


Figure 13-4 Vessel to Vessel Collision Risk – Base Case Pre WTG

161. Assuming base case traffic levels, the annual collision frequency pre WTG was calculated to be 9.59×10^{-6}, corresponding to a return period of one in 104,000 years. This is a very low return period compared to that estimated in the pre WTG scenario for other UK offshore wind farm developments and is reflects the low volume of vessel traffic in the area. 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 effects.

162. The most significant areas of risk are the routes associated with oil and gas infrastructure in the area, including to / from the Culzean, Elgin, Lomond, Pierce and Shearwater Fields.

13.5 Post Wind Turbine Generator Modelling

13.5.1 Vessel to Vessel Collision Risk

163. Using the post WTG routeing as input, Anatec's COLLRISK model has been run to estimate the vessel to vessel collision risk within the Study Area.

164. Figure 13-5 presents a density heat map for the geographical distribution of collision risk for the post WTG base case.

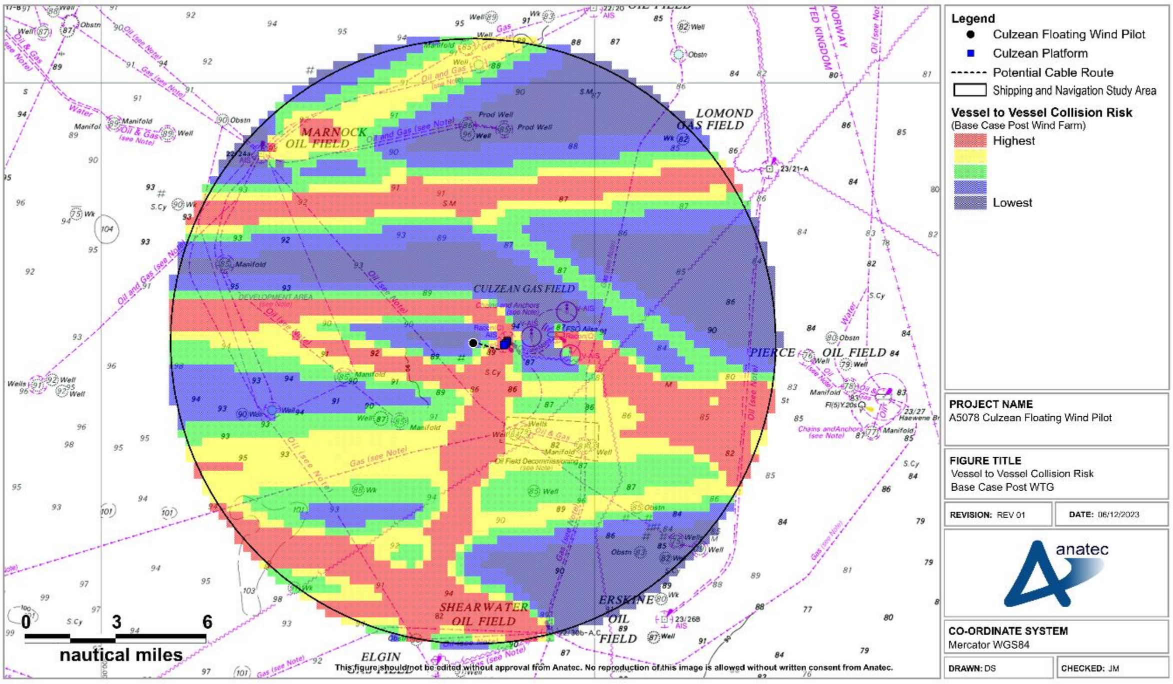


Figure 13-5 Vessel to Vessel Collision Risk – Base Case Post WTG

165. Assuming base case traffic levels, the annual collision frequency post WTG was calculated to be 9.75×10^{-6}, corresponding to a return period of one in 102,000 years. This represents a 1.7% change in collision frequency compared to the pre WTG scenario.

166. The change in collision risk is limited to around Route 2, since this was the only route affected by the presence of the WTG. The region of lower collision risk between the two variants of Route 2 in the approaches to the WTG is increased, but the regions of higher collision risk where the route is present are also increased.

167. The most significant areas of risk are the routes associated with oil and gas infrastructure in the area, including to / from the Culzean, Elgin, Lomond, Pierce and Shearwater Fields.

13.5.2 Powered Vessel to Structure Allision Risk

168. Based upon the vessel routeing identified in the Study Area, the anticipated change in routeing due to the Project, the mitigations in place, and levels of allision incidents to date associated with UK offshore wind farms, the frequency of an errant vessel under power deviating from its route to the extent that it comes into proximity with the WTG is considered to be low.

169. From consultation with the shipping industry, it is also assumed that commercial vessels would be highly unlikely to navigate between offshore structures due to the restricted sea room and will instead be directed by the aids to navigation located in the region. For the Project, this assumption applies to navigation between the WTG and the existing platforms for the Culzean Gas Field. AtoNs will primarily consist of lighting and marking of the WTG but also of the existing platforms.

170. Using the post WTG routeing as input, together with the WTG position and metocean data, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with the WTG whilst under power. Assuming base case traffic levels, the annual powered allision frequency was estimated to be 1.48×10^{-5}, corresponding to a return period of one in 67,000 years.

13.5.3 Drifting Vessel to Structure Allision Risk

171. Using the post WTG routeing as input, together with the WTG position and metocean data, Anatec's COLLRISK model was run the estimate the likelihood of a drifting commercial vessel alliding with the WTG. 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 error cause by human actions.

172. The exposure times for a drifting scenario are based upon the vessel hours spent in proximity to structure. These have been estimated based upon the post WTG routeing. The exposure is divided by vessel type and size to ensure these factors, which based upon analysis of historical incident data have been shown to influence incident rates, are accounted for within the modelling.

173. Using this information, the overall rate of mechanical failure within proximity to the WTG was estimated. The probability of a vessel drifting towards a structure and the drift speed are dependent upon the prevailing wind, wave, and tidal conditions at the time of the accident. Therefore, three drift scenarios were modelled, each using the metocean data outlined in Section 13.3:

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

174. The probability of vessel recovery from drift is estimated based upon the speed of drift and hence the time available before reaching the WTG. 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.

175. After modelling the three drift scenarios, it was established that the weather dominant scenario produced the worst case results. Assuming base case traffic levels, the annual drifting allision frequency was estimated to be negligible[5].

13.6 Risk Results Summary

176. As per Section 13.2, both pre and post WTG scenarios with base case and future traffic levels have been modelled. Table 13.3 summarises the results of these four scenarios.

Table 13.3 Risk Results Summary

Collision / Allision Scenario	Base Case			Future Case		
	Pre WTG	Post WTG	Change	Pre WTG	Post WTG	Change
Vessel to vessel collision	9.59×10^{-6} (1 in 104,000 years)	9.75×10^{-6} (1 in 102,000 years)	1.60×10^{-7}	1.17×10^{-5} (1 in 86,000 years)	1.19×10^{-5} (1 in 84,000 years)	1.93×10^{-7}
Powered vessel to structure allision	N/A	1.48×10^{-5} (1 in 67,000 years)	1.48×10^{-5}	N/A	1.64×10^{-5} (1 in 61,000 years)	1.64×10^{-5}
Drifting vessel to structure allision	N/A	Negligible	Negligible	N/A	Negligible	Negligible
Total	**9.59×10^{-6} (1 in 104,000 years)**	**2.46×10^{-5} (1 in 41,000 years)**	**1.50×10^{-5}**	**1.17×10^{-5} (1 in 86,000 years)**	**2.84×10^{-5} (1 in 35,000 years)**	**1.67×10^{-5}**

13.7 Consequences Assessment

177. A quantitative assessment of the potential consequences of a collision or allision incident has been undertaken based on the collision and allision risk results presented in the previous subsections and historical data regarding collision and allision incidents and oil pollution.

13.7.1 Fatality Risk

178. The details of over 11,000 accidents, injuries and hazardous incidents reported to the MAIB between 2002 and 2021 involving over 13,000 vessels have been analysed to identify collision and allision incidents and associated fatality cases. For collision incidents (vessel to vessel), a total of 504 incidents featuring five fatalities

[5] For the purposes of quantitative modelling, annual frequencies of less than 1.0×10^{-6} is considered negligible.

were reported to the MAIB between 2002 and 2021. For contact incidents (vessel to non-vessel structure), a total of 119 incidents was reported to the MAIB between 2002 and 2021 featuring no fatalities.

179. This data has been interrogated further to obtain a fatality probability for each main vessel category (commercial, fishing and recreational) based upon vessel type and People on Board (POB) information provided in the MAIB incident data. The findings are summarised in Table 13.4.

Table 13.4 Collision Incident Fatality Probability by Vessel Category (2002 to 2021)

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability	Time Period[6]
Commercial	Dry cargo, passenger, tanker, tug, oil and gas, etc.	1	32,198	3.1×10^{-5}	1997 to 2021 (25 years)
Fishing	Trawler, potter, dredger, etc.	2	927	2.2×10^{-3}	2002 to 2021 (20 years)
Pleasure craft	Yacht, small commercial motor yacht, etc.	3	1,023	2.9×10^{-3}	2002 to 2021 (20 years)

180. The fatality risk is higher by two orders of magnitude for POB small craft compared to larger commercial vessels.

181. Using an estimated average number of POB for the vessels operating in proximity to the WTG, the collision and allision risk modelling results and the estimated fatality probability for each vessel category, the annual increase in Potential Loss of Life (PLL) due to the WTG for the base case is estimated to be 1.29×10^{-5} and for the future case is estimated to be 1.42×10^{-5}. The change is dominated by commercial vessels, which reflects the heavy presence of oil and gas vessels passing in close proximity to the WTG.

182. Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the annual change for commercial vessels for the base case is estimated to be 4.67×10^{-11} and for the future case is estimated to be 5.16×10^{-11}. These are negligible values compared to the background risk level for the UK sea transport industry of 1.02×10^{-4} per year.

[6] The time period for commercial vessels has been extended since there were no fatalities in the most recent 20-year period. This extension allows a meaningful and conservative probability to be captured in the assessment.

183. The annual change for commercial fishing vessels for the base case is estimated to be 3.92×10^{-7} and for the future case is estimated to be 4.31×10^{-7}. These are negligible values compared to the background risk level for the UK sea fishing industry of 1.74×10^{-2}.

13.7.2 Pollution Risk

184. From research undertaken as part of the UK's DfT Marine Environment High Risk Areas (MEHRAs) project (DfT, 2001), 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 (i.e., tankers).

185. For fuel oil spills, and considering 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. For cargo oil spills, International Tanker Owners Pollution Federation (ITOPF) data suggests that 52% of spill are between seven and 700 tonnes with 31% less than seven tonnes and 17% greater than 700 tonnes. Therefore, an average spill size of 400 tonnes is considered a conservative assumption.

186. Such data on oil spill probability and size is not comprehensively available for commercial fishing vessels or recreational vessels and so it is conservatively assumed that 50% of all collisions involving these vessel types will lead to an oil spill with an average spill size of five tonnes for commercial fishing vessels and one tonne for recreational vessels.

187. Using these probabilities and the collision and allision risk modelling results, the annual increase in oil spilled due to the WTG for the base case is estimated to be 4.74×10^{-3} tonnes and for the future case is estimated to be 5.21×10^{-3} tonnes. In both scenarios this value is in the majority produced by commercial vessels (in particular oil and gas vessels) with negligible contribution from the other vessel types. Overall, these are negligible values compared to the annual average of 16,111 tonnes of oil spilled in UK waters due to maritime incidents reported by the MEHRAs research between 1989 and 1998.

13.8 Mooring Lines and Export Cable

188. This subsection considers the mooring lines and export cable associated with the floater relative to baseline traffic volumes and draughts to determine the potential risk associated with under keel interaction. The outputs have been fed into the qualitative risk assessment of under keel interaction undertaken in Section 14.6.

189. Based on operational experience of existing offshore developments and feedback received during the Hazard Workshop, it is likely that most third-party vessels will deviate to avoid the WTG. On this basis, and considering the vessel types recorded in proximity to the WTG location (see Section 9), the key vessel type which must be considered is oil and gas vessels.

13.8.1 Vessel Draught

190. The distribution of oil and gas vessel draughts recorded via AIS within 1 nm of the WTG and crossing the export cable during the 12-month period is presented in Figure 13-6.

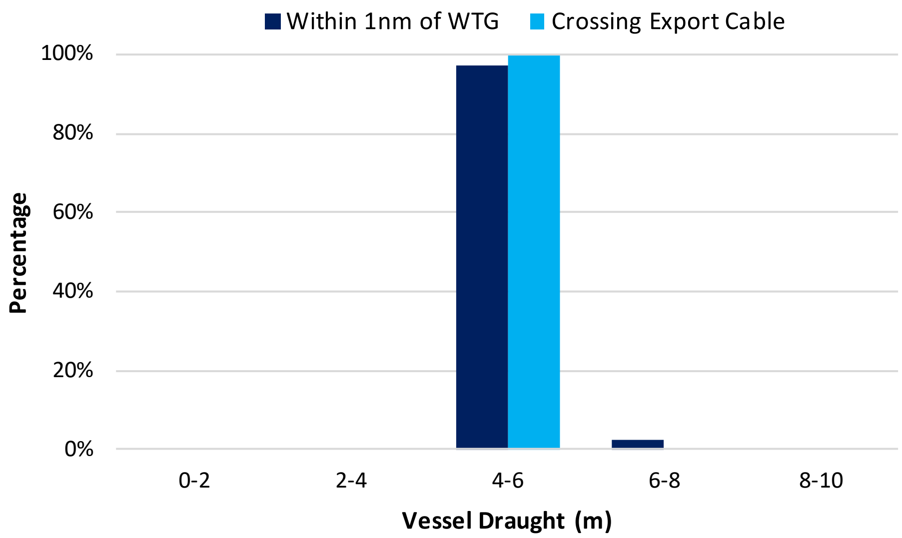


Figure 13-6 Vessel Draught Distribution of Oil and Gas Vessels within 1 nm of WTG

191. The maximum draught recorded was 7.2 m, associated with an oil and gas vessel within 1 nm of the WTG. For export cable crossings, the maximum draught recorded was 5.8 m.

192. The average draught for oil and gas vessels within 1 nm of the WTG was 5.2 m and for oil and gas vessels crossing the export cable was 5.3 nm. As shown, the vast majority of oil and gas vessels within 1 nm of the WTG had draughts of between 4 and 6 m, and all oil and gas vessels crossing the export cable had draughts of between 4 and 6 m.

13.8.2 Mooring Line Interaction

193. As part of the MDS, the mooring lines are assumed to connect to the floater 13.6 m below the sea surface. Assessment in this subsection assumes a rate of descent of 46° against a shallowest rate of descent of 20° in the MDS. This difference is qualified below.

194. On the basis of a connection 13.6 m below the sea surface and rate of descent of 46°, the approximate descent of the mooring lines is shown in Figure 13-7. The average and maximum draughts recorded within 1 nm of the WTG are shown for reference. It is noted that the values detailed above have been assumed for the purposes of this interaction assessment and it will be necessary to assess final under keel clearance available post installation.

195. The assessment has been undertaken up to 600 m from the WTG, noting that this is the maximum distance of the mooring line terminus from the WTG.

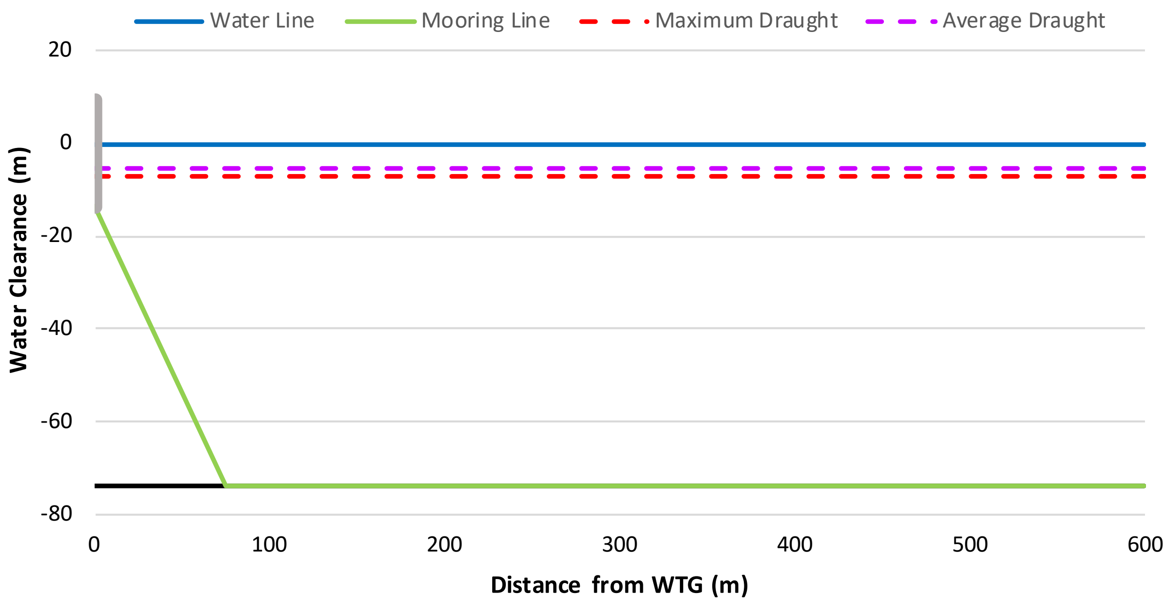


Figure 13-7 Mooring Line Relative to Maximum and Average Vessel Draught for Oil and Gas Vessels within 1 nm of WTG

196. As shown, an oil and gas vessel with the maximum draught recorded (7.2 m) should avoid an under keel interaction since the mooring line will always be located below the vessel in the water column. Subsequently, the shallowest rate of descent as given in the MDS (20°) will give the same result.

13.8.3 Export Cable Interaction

197. As part of the MDS, 500 m of the export cable may be present in the water column (split as 250 m at each end), with 2,000 m of the total 2,500 m length on the seabed.

198. On this basis, the approximate descent / ascent of the export cable is shown in Figure 13-8.

199. The assessment has been undertaken up to 2,500 m from the WTG, noting that this is the maximum length of the export cable between the WTG and Culzean Oil Field connection point.

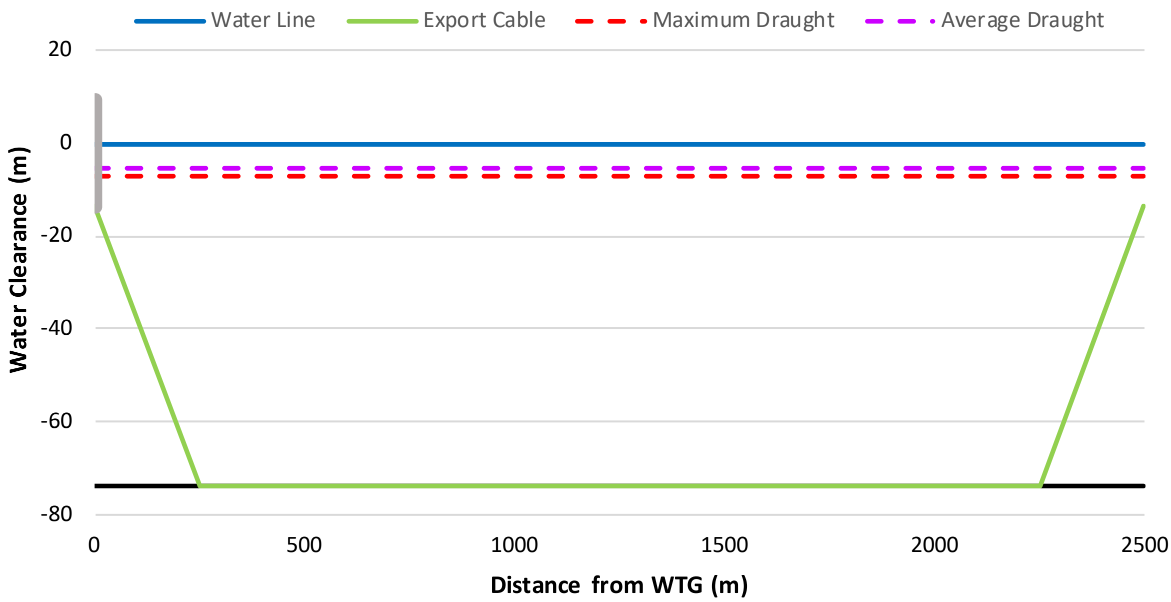


Figure 13-8 Export Cable Relative to Maximum and Average Vessel Draught for Oil and Gas Vessels within 1 nm of WTG

200. As shown, and similarly to the mooring lines, an oil and gas vessel with the maximum draught recorded (5.8 m) should avoid an under keel interaction since the export cable will always be located below the vessel in the water column.

13.8.4 Approach to Risk Assessment

201. The potential for interaction with the mooring lines and export cable has been assessed within the risk assessment in Section 14.6. The potential that the mooring system will fail leading to a loss of station incident is assessed in Section 14.5. It is noted that the relevant hazards have been assessed for the operation and maintenance phase noting the risk is managed via construction and decommissioning mitigation during those phases.

14 Risk Assessment

14.1 Vessel Displacement (All Phases)

202. *Vessels may be displaced from their existing routes due to activities associated with the Project or due to the presence of the Project.*

203. Main commercial routes have been identified within the Study Area using 12 months of AIS data and applying the principles of MGN 654 (MCA, 2021). From the 11 main commercial routes identified, only one may require a deviation due to the presence of the Project. This is Route 2 – featuring oil and gas vessels transiting between Aberdeen (UK) and the Culzean Gas Field – which requires a deviation of up to 0.33 nm to achieve a 1 nm setback of the mean position from the WTG. This deviation will apply across all phases, and therefore the remainder of the assessment for this hazard accounts for all phases.

204. This is a small deviation and reflects the small-scale nature of the Project. Additionally, vessels on this route are already familiar and comfortable navigating in proximity to existing offshore developments in the region and will have good familiarity with the additional presence of the Project given the links to the Culzean Gas Field. The MCA agreed in the Hazard Workshop that disruption to vessels on this route is not a concern, and this has been reiterated by Vroon, the main operator of oil and gas vessels on this route. It is also not anticipated that the additional presence of the Project will affect use of existing aids to navigation in the region given the scale of the Project.

205. For other commercial routeing, no disruption is anticipated, with the MCA noting in the Hazard Workshop that given the existing presence of offshore infrastructure in the region (specifically in relation to the Culzean Gas Field), commercial vessels are already clearly avoiding the sea area where the WTG will be located, and this is unlikely to change in the future case.

206. For small craft, low volumes of activity are noted in the region and, similar to the MCA, RYA Scotland indicated in the Hazard Workshop that the existing presence of offshore infrastructure means that there is no additional concern. Any issue would likely occur in adverse weather conditions, although the likelihood of a recreational vessel navigating as far offshore as the Project in inclement weather is very low.

207. RYA Scotland did note that recently there have been delays in UKHO Admiralty charts being updated but other forms of mitigation should raise awareness. In addition to the charting of infrastructure, the promulgation of information relating to the Project has been identified as an embedded mitigation, including via Notifications to Mariners and Kingfisher Bulletins, with RYA Scotland encouraging recreational users to utilise Kingfisher.

208. The most likely consequence of the hazard is that there is no effect on journey times and distances for third-party vessels. As a worst case, there could be limited effects on journey times and distances for oil and gas vessels navigating in proximity, but no safety risks are identified.

14.1.1 Embedded Mitigation Measures

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

- Charting of infrastructure;
- Decommissioning Programme; and
- Promulgation of information.

14.1.2 Potential Significance of Risk

210. The frequency of occurrence is considered to be **reasonably probable** for all phases and the severity of consequence is considered to be **negligible** for all phases. Therefore, the significance of risk is deemed to be **Broadly Acceptable** for all phases.

14.2 Collision Risk (Third-Party to Third-Party) (All Phases)

211. *Displaced vessels may lead to increased traffic densities in certain areas and a subsequent increase in encounters and collision risk between third-party vessels.*

212. Given that encounters and collision risk arise from the reduction in navigable sea room and subsequent need for vessels to deviate, the assessment of vessel displacement (see Section 14.1) is considered for this hazard, and thus the remainder of the assessment for this hazard accounts for all phases.

213. Based on the collision modelling undertaken, the collision frequency was estimated to be one in 102,000 years for base case traffic levels, representing a 1.7% change compared to the pre WTG scenario. The change is similar when applying future case traffic levels. Since only Route 2 is anticipated to require a deviation due to the presence of the Project, the change is wholly attributable to this main commercial route.

214. Therefore, this hazard is local in nature and given the proximity to the endpoint of the route (i.e., the Culzean Gas Field), it is expected that mariners will be particularly aware of other vessels in the area, thus further minimising the likelihood of an encounter situation.

215. In the unlikely event of an encounter situation, the vessels involved are expected to take collision avoidance action as appropriate in line with the COLREGs, thus ensuring the situation does not develop into a collision incident. This is supported by experience at under construction and operational offshore wind farms, where no collision incidents involving two third-party vessels have been reported.

216. Additionally, stakeholders raised no concerns in relation to third-party collision risk during the Hazard Workshop.

217. The most likely consequence of the hazard is that the number of encounters occurring in the region increases but with no safety risks arising. As a worst case, a collision event could occur involving vessel damage, PLL, and pollution, although this is considered highly unlikely. Nevertheless, should such an incident occur, project vessels and vessels associated with nearby offshore developments (including the ERRV for the Culzean Gas Field) may attend the incident under SOLAS obligations (IMO, 1974) and the Marine Pollution Contingency Plan may be implemented in liaison with the MCA.

14.2.1 Embedded Mitigation Measures

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

- Charting of infrastructure;
- Decommissioning Programme;
- ERRV;
- Marine coordination for project vessels;
- Pollution planning;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

14.2.2 Potential Significance of Risk

219. The frequency of occurrence is considered to be **extremely unlikely** for all phases and the severity of consequence is considered to be **moderate** for all phases. Therefore, the significance of risk is deemed to be **Broadly Acceptable** for all phases.

14.3 Collision Risk (Third-Party to Project) (All Phases)

220. *The presence of project vessels may increase the likelihood of vessel to vessel encounters and subsequently increase the collision risk between third-party and project vessels. This includes the potential for encounters and collision risk with towage activities.*

221. Historically, there has been one instance of a third-party vessel colliding with a project vessel associated with a UK offshore wind development (during any phase), resulting in moderate vessel damage but no harm to persons. The incident occurred in 2011, and awareness of offshore wind developments has improved considerably in the interim, with no further collision incidents reported since.

222. Project vessel movements will be limited given the scale of the Project. More project vessels are expected to be on-site during the construction and decommissioning phases, although both of these phases will be short in duration.

223. Project vessels will be managed by marine coordination, and this is expected to include clear communication with the Culzean Gas Field and any ongoing activities. Project vessels will also carry AIS and comply with international marine regulations including the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974). When on-site, project vessels are expected to remain local to the location of the Project and an application will be made for a safety zone around the WTG for construction and major maintenance activities. Therefore, interaction with third-party activities other than those related to the Culzean Gas Field is likely to be minimal.

224. During towage operations for the WTG / floater (associated with any phase), there will be multiple project vessels present given the dynamic and restricted manoeuvrability associated with the operation; there will be a main tug but also a supporting vessel in the event of an issue arising, which could include an encounter between the towing operation and a third-party vessel.

225. All activities associated with the Project (including towage operations) will be promulgated via Notifications to Mariners and Kingfisher Bulletins, thus maximising third-party awareness and allowing passage planning to take account of activities.

226. The most likely consequences of the hazard are analogous to that identified for third-party collision risk (see Section 14.2). As a worst case, a collision event could occur during towage operations, resulting in vessel damage, PLL, pollution, and the foundering or drifting of the WTG / floater. In such circumstances, the ERCoP would be implemented including in relation to wreck response, as requested by NLB during the Hazard Workshop.

14.3.1 Embedded Mitigation Measures

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

- Application for safety zones;
- Charting of infrastructure;
- Compliance with MGN 654;
- Decommissioning Programme;
- ERRV;
- Marine coordination for project vessels;
- Pollution planning;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

14.3.2 Potential Significance of Risk

228. The frequency of occurrence is considered to be **extremely unlikely** for the construction and decommissioning phases and **negligible** for the operation and maintenance phase. The severity of consequence is considered to be **moderate** for all phases. Therefore, the significance of risk is deemed to be **Broadly Acceptable** for all phases.

14.4 Allision Risk (All Phases)

229. *Partially complete and completed structure could create an allision risk (powered or drifting) to passing traffic.*

230. There are two distinct forms of allision risk which are each considered for this hazard – powered and drifting allision risk.

231. Based on the powered allision modelling undertaken, the allision frequency was estimated to be one in 67,000 years for base case traffic levels. The change is similar when applying future case traffic levels. This low likelihood reflects the localised nature of allision risk (a vessel must be in close proximity to a surface structure for the hazard to exist), the scale of the Project, and the low volume of commercial traffic passing in proximity to the WTG.

232. Historically there have been two reported instances of a third-party vessel alliding with a UK offshore wind farm structure (in the Irish Sea and Southern North Sea). Both of these incidents involved a fishing vessel, with a RNLI lifeboat attending on both occasions and a helicopter deployed in one case.

233. As discussed for the vessel displacement hazard (see Section 14.1), the MCA noted in the Hazard Workshop that given the existing presence of offshore infrastructure in the region (specifically in relation to the Culzean Gas Field), commercial vessels are already clearly avoiding the sea area where the WTG will be located and this is unlikely to change in the future case.

234. For small craft, it is again acknowledged that there are low volumes of activity in the region and, similarly to the MCA, RYA Scotland indicated in the Hazard Workshop that the existing presence of offshore infrastructure means that there is no additional concern.

235. For all vessels the charting of infrastructure will assist with passage planning to ensure safe navigation when in the region, and this will be further assisted by the promulgation of information relating to the Project, including via Notifications to Mariners and Kingfisher Bulletins. Furthermore, the WTG will be lit and marked in agreement with NLB and in accordance with IALA Recommendation O-139 (IALA, 2021a) and Guideline G1162 (IALA, 2021b), whether by temporary or operational lighting. In particular, NLB confirmed during the Hazard Workshop that the WTG should be marked as an isolated structure.

236. In the unlikely event of a powered allision situation developing, the ERRV or on-site project vessels (if present) may initiate contact with the third-party vessel to advise of the need to take immediate action, particularly where a safety zone is active.

237. Based on the drifting allision modelling undertaken, the allision frequency was estimated to be negligible for base case traffic levels. The change is also negligible when applying future case traffic levels. This low likelihood again reflects the nature of allision risk, scale of the Project, and low volume of commercial traffic passing in proximity to the WTG. Additionally, a vessel adrift may only develop into an allision situation if the wind and / or tide directs the vessel towards the WTG.

238. In the exceptionally unlikely event of a drifting allision situation developing, the third-party vessel may take action to prevent an allision occurring. For a powered vessel, the ideal and likely solution would be to regain power prior to reaching the WTG (i.e., by rectifying any faulty). Failing this, the vessel's emergency response procedures would be implemented which may include an emergency anchoring event following a check of the relevant UKHO Admiralty charts to ensure the deployment of the anchor will not lead to other risks (such as anchor snagging on a subsea cable or pipeline), or the use of thrusters (depending upon availability and power supply).

239. For an unpowered vessel, the ERRV and / or project vessels may be able to render assistance in liaison with the MCA and line with SOLAS obligations (IMO, 1974). This response would be managed by HMCG. It is noted that the likelihood of an unpowered vessel navigating at the distance offshore of the Project is very low.

240. For sailing vessels with a mast, the allision risk also extends to a blade allision event. However, the minimum blade tip clearance of the WTG will be at least 22 m above MSL, and it will be ensured that there is also compliance with MGN 654 (22 m above MHWS), noting this also aligns with the RYA's recommendation (RYA, 2019). Additionally, no negative effects such as wind shear, masking, and turbulence associated with sailing vessels navigating in proximity to the WTG are expected noting that none have been reported to date.

241. The most likely consequence of the hazard is unsafe passing distance resulting in a need for late adjustments to speed and / or course, but with no long-term effects. As a worst case, an allision event could occur involving vessel damage, PLL, and pollution, although this is considered highly unlikely. Given that a drifting vessel is likely to be moving at a lower speed than a powered vessel, the consequences are likely to be less severe for a drifting allision. Similarly to a collision event, should an allision event occur, project vessels and vessels associated with nearby offshore developments (including the ERRV for the Culzean Gas Field) may attend the incident under SOLAS obligations (IMO, 1974) and the Marine Pollution Contingency Plan may be implemented in liaison with the MCA.

14.4.1 Embedded Mitigation Measures

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

- Application for safety zones;
- Charting of infrastructure;
- Compliance with MGN 654;
- Decommissioning Programme;
- ERRV;
- Lighting and marking;
- Marine coordination for project vessels;
- Minimum blade tip clearance;
- Pollution planning;
- Project vessel compliance with international marine regulations; and
- Promulgation of information.

14.4.2 Potential Significance of Risk

243. The frequency of occurrence is considered to be **extremely unlikely** for all phases and the severity of consequence is considered to be **moderate** for all phases. Therefore, the significance of risk is deemed to be **Broadly Acceptable** for all phases.

14.5 Loss of Station (Operation and Maintenance Phase)

244. *A mooring system failure could cause the floating structure to lose station and create a hazard to navigation.*

245. The Project will comply with the MCA's *Regulatory Expectations on Mooring for Floating Wind and Marine Devices* (MCA and HSE, 2017). This includes the arrangement of third-party verification (TPV) of the mooring system by an independent and competent person or body as a '*continuous activity*', i.e., additional TPV will be required should any modifications be made to the mooring system or if new information becomes available relating to reliability.

246. On this basis, the likelihood of a loss of station is considered to be very low, noting that for a total loss of station all moorings would have to fail.

247. The Regulatory Expectations also require the provision of continuous monitoring either by GPS or other suitable means. The Applicant will put such a system in place, with the floater continuously monitored, and with capability of being tracked via AIS in the event of a loss of station as detailed in MGN 654 (MCA, 2021). The WTG will also have an alarm system in place, whereby an alert will be provided to the Applicant in the event that the floater leaves a pre-defined ringfenced alarm zone. This means in the unlikely event that the floater suffers total loss of station and drifts outside of its alarm zone, the Applicant would be made aware and able

to track its position and make necessary arrangements, including promulgating details of the floater's movements via Notifications to Mariners and Kingfisher Bulletins. Additionally, operational lighting associated with the floater may assist mariners with identifying the presence of the floater, thus minimising the likelihood of an interaction.

248. The most likely consequence of the hazard is a singular mooring failure which increases the maximum excursion of the floater but with limited safety risks. As a worst case, a total loss of station could occur, resulting in the floater drifting, potentially encountering a third-party vessel or the platforms associated with the Culzean Gas Field, depending upon the wind and / or tide. This could result in an allision event involving vessel damage, damage to a platform, PLL, and significant pollution, although this is considered exceptionally unlikely. Nevertheless, should such an incident occur, the Marine Pollution Contingency Plan may be implemented in liaison with the MCA.

14.5.1 Embedded Mitigation Measures

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

- Compliance with floating foundation guidance;
- ERRV;
- Lighting and marking;
- Pollution planning; and
- Promulgation of information.

14.5.2 Potential Significance of Risk

250. The frequency of occurrence is considered to be **extremely unlikely** and the severity of consequence is considered to be **moderate**. Therefore, the significance of risk is deemed to be **Broadly Acceptable**.

14.6 Vessel Interaction with Export Cable and Mooring Lines (Operation and Maintenance Phase)

251. *The presence of the mooring lines and export cable associated with the Project may increase the likelihood of anchor interaction for third-party vessels or impact under keel clearance.*

14.6.1 Anchor Interaction

252. There are three distinct forms of anchor interaction which are each considered for this hazard – planned anchoring, unplanned anchoring, and anchor dragging.

253. No vessels were deemed to be at anchor during the 12-month period within the Study Area (see Section 9.2.6). Therefore, the risk of a planned anchoring or anchor

dragging interaction with a mooring line or the export cable is very low. For emergency anchoring, traffic volumes in proximity to the WTG and export cable are low given the existing infrastructure in the region, and so the likelihood of such a scenario arising is also very low. This is compounded by the water depths and expectation that mariners will account for the presence of the mooring lines and export cables on appropriate UKHO Admiralty charts prior to dropping the anchor in line with Regulation 34 of SOLAS (IMO, 1974).

254. For the export cable, the burial of the cable and use of external rock protection – as informed by the cable burial risk assessment – will minimise the likelihood of an interaction occurring should a vessel drop anchor in proximity. Such mitigation does not apply to the sections of the export cable in the water column, nor the mooring lines. However, these will be in proximity to the WTG, and as per Section 14.1, vessels are not expected to navigate in such proximity.

255. The most likely consequence of the hazard is that a vessel drops anchor close to or over the export cable but no interaction occurs given the burial / protection of the cable. As a worst case, a snagging incident could occur and / or the vessel's anchor could be damaged, with potential for loss of stability for a smaller vessel. However, this is highly unlikely to occur given the water depths which will inhibit a smaller vessel from anchoring. For an interaction with a mooring line or the export cable in the water column, a further consequence could be the breaking of the mooring line or export cable, which may then have implications for the stability of the floater.

14.6.2 Under Keel Clearance and Cable Protection

256. If necessary to deploy, the maximum height of rock protection above the seabed will be 1 m. This compares against a water depth of 89 m below CD for the location of the export cable.

257. The requirements of MGN 654 in relation to cable protection will apply, namely that cable protection will not change the charted water depth by more than 5% unless appropriate mitigation is agreed with the MCA. This also 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 (b)).

258. Accounting for the rock protection height and charted water depth, it is not anticipated that the presence of cable protection associated with the export cable will reduce charted water depth by more than 5%.

259. The most likely consequence of the hazard is that a vessel navigates over the location of cable protection but no under keel interaction occurs. As a worst case, an underwater allision could occur but this is considered exceptionally unlikely in this area.

14.6.3 Under Keel Clearance and Mooring Lines / Export Cable

260. Section 13.8 provides a draught assessment for oil and gas vessels navigating in proximity to the WTG and export cable. This assessment found that there is substantial clearance between the largest draught vessels and the mooring lines and export cable where these are in the water column. The under keel interaction risk would be greatest close to the WTG where the mooring lines and export cable are highest in the water column; however, as per Section 12.2, third-party vessels are expected to maintain a safe passing distance from the WTG and thus the under keel interaction risk is minimal. This particularly holds true given that the connection point for the mooring lines and export cable to the floater is substantially below the sea surface.

261. Nevertheless, it will be necessary to confirm the available under keel clearance from the mooring lines and export cable post installation. The confirmed available clearance should be discussed with the MCA and NLB post installation to determine if any additional mitigation is required.

262. The most likely consequence of the hazard is that a vessel passes close to or over a mooring line or the export cable but no interaction occurs given the depth of the mooring line / export cable. As a worst case, an interaction event could occur with potential for loss of stability for a smaller vessel and the breaking of the mooring line or export cable, which may then have implications for the stability of the floater.

14.6.4 Embedded Mitigation Measures

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

- Cable burial risk assessment;
- Charting of infrastructure;
- Compliance with floating foundation guidance;
- Compliance with MGN 654; and
- Promulgation of information.

14.6.5 Potential Significance of Risk

264. The frequency of occurrence is considered to be **extremely unlikely** and the severity of consequence is considered to be **moderate**. Therefore, the significance of risk is deemed to be **Broadly Acceptable**.

14.7 Reduction of Emergency Response Capability (Operation and Maintenance Phase)

265. *The presence of the Project may result in an increased number of incidents requiring emergency response associated with work vessels or third-party vessels. Also, the*

presence of the structure may reduce access for SAR responders, such as helicopters.

266. Given the scale of the Project, any associated SAR operation is likely to cover a small spatial extent and is not expected to be impeded by the presence of the Project. In particular, the distance between the WTG and closest platform associated with the Culzean Gas Field is approximately 1 nm which is sufficient to allow a SAR helicopter asset to navigate between them.

267. Given the distance offshore of the Project and historical incident data, the RNLI are unlikely to respond to an incident occurring on-site. Instead, a SAR helicopter from the Sumburgh or Inverness base is likely to be the first responder from shore. It is likely that a project vessel (including the ERRV for the Culzean Gas Field) or a vessel supporting another offshore development in the region will be well equipped to assist an incident under SOLAS obligations (IMO, 1974). Such a response would occur in liaison with the MCA.

268. From historical incident data (MAIB and DfT), there is a very low rate of incidents in the region, with the likelihood of an incident relating to the Project occurring simultaneously exceptionally unlikely.

269. The most likely consequence of the hazard is that there are no limitations on the capability of emergency responders should an incident occur. As a worst case, there could be a delay to a response request leading to vessel damage, PLL, and pollution.

14.7.1 Embedded Mitigation Measures

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

- Compliance with MGN 654;
- ERRV;
- Lighting and marking;
- Marine coordination;
- Pollution planning; and
- Project vessel compliance with international marine regulations.

14.7.2 Potential Significance of Risk

271. The frequency of occurrence is considered to be **extremely unlikely** and the severity of consequence is considered to be **serious**. Therefore, the significance of risk is deemed to be **Tolerable with Mitigation**.

15 Embedded Mitigation Measures

272. The risk assessment undertaken in Section 14 introduces a number of mitigation measures which are embedded into the Project and included to reduce the significance of risk for relevant hazards. Details of these embedded mitigation measures are provided in Table 15.1.

273. It is noted that the deployment of construction buoyage is not included as an embedded mitigation measure; NLB confirmed during the Hazard Workshop that no such marking of the WTG is required given the other mitigation in place.

Table 15.1 Embedded Mitigation Measures

Embedded Mitigation Measure	Details
Cable burial risk assessment (CBRA)	Cables will be protected by trenching at a minimum target depth of lowering determined by a cable burial risk assessment with additional external protection (e.g. rock berms) applied where sufficient protection is not provided by trenching. It is currently assumed that the minimum target depth of lowering will be 0.6 m. Cable protection will be suitably installed and monitored throughout the design life, with any damage, destruction or decay of the protection/cables which may pose a hazard to other sea users notified to MCA, NLB, Kingfisher and UKHO no later than 24 hours after discovered. Repairs will be conducted as necessary, and as soon as is practicable.
Charting of infrastructure	Infrastructure associated with the Project (and below the sea surface) will be marked on appropriately scaled UKHO Admiralty Charts.
Compliance with floating foundation guidance	The Applicant will ensure compliance with the *Regulatory Expectations on Mooring for Floating Wind and Marine Devices* (MCA and HSE, 2017).
Compliance with MGN 654	The Applicant will ensure compliance with MGN 654 (MCA, 2021) and its annexes, where applicable.
Decommissioning Programme	A Decommissioning Programme will be developed prior to decommissioning.
ERRV	The ERRV serving the Culzean Gas Field will support the Project including undertaking guard duties.
Lighting and marking	Lighting and marking of the Project will be deployed in agreement with NLB and in accordance with IALA Recommendation O-139 (IALA, 2021a) and Guideline G1162 (IALA, 2021b). Further details will be developed within the Lighting and Marking Plan (LMP).
Marine coordination for project vessels	Marine coordination will be implemented to manage project vessels during construction, maintenance and decommissioning activities.
Minimum blade tip clearance	The minimum blade tip clearance of the WTG will be at least 22 m above MSL.
Pollution planning	A Marine Pollution Contingency Plan will be developed outlining the procedures to protect personnel working and to safeguard the marine environment. Aligns with the Environmental Management Plan (EMP).

Embedded Mitigation Measure	Details
Project vessel compliance with international marine regulations	Project vessels will ensure compliance with Flag State regulations including the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS) and Safety of Life at Sea (SOLAS).
Promulgation of information	Information relating to the Project will be promulgated via Notifications to Mariners and Kingfisher Bulletins.

16 Risk Control Log

274. Table 16.1 presents a summary of the risk assessment of shipping and navigation hazards. This includes (per hazard) the proposed embedded mitigation measures, frequency of occurrence, severity of consequence, and resulting significance of risk.

Table 16.1 Risk Control Log

Hazard	Phase	Embedded Mitigation Measures (Where Appropriate Across Phases)	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
Vessel displacement	Construction	▪ Charting of infrastructure; ▪ Decommissioning Programme; and ▪ Promulgation of information.	Reasonably Probable	Negligible	**Broadly Acceptable**	None identified	**Broadly Acceptable**
	Operation and maintenance		Reasonably Probable	Negligible	**Broadly Acceptable**		**Broadly Acceptable**
	Decommissioning		Reasonably Probable	Negligible	**Broadly Acceptable**		**Broadly Acceptable**
Collision risk (third-party to third-party)	Construction	▪ Charting of infrastructure; ▪ Decommissioning Programme; ▪ ERRV; ▪ Marine coordination for project vessels; ▪ Pollution planning; ▪ Project vessel compliance with international marine regulations; and ▪ Promulgation of information.	Extremely Unlikely	Moderate	**Broadly Acceptable**	None identified	**Broadly Acceptable**
	Operation and maintenance		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
	Decommissioning		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
Collision risk (third-party to project)	Construction	▪ Application for safety zones; ▪ Charting of infrastructure; ▪ Compliance with MGN 654; ▪ Decommissioning Programme; ▪ ERRV; ▪ Marine coordination for project vessels; ▪ Pollution planning; ▪ Project vessel compliance with	Extremely Unlikely	Moderate	**Broadly Acceptable**	None identified	**Broadly Acceptable**
	Operation and maintenance		Negligible	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
	Decommissioning		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**

Hazard	Phase	Embedded Mitigation Measures (Where Appropriate Across Phases)	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
		international marine regulations; and ▪ Promulgation of information.					
Allision risk	Construction	▪ Application for safety zones; ▪ Charting of infrastructure; ▪ Compliance with MGN 654; ▪ Decommissioning Programme; ▪ ERRV; ▪ Lighting and marking; ▪ Marine coordination for project vessels; ▪ Minimum blade tip clearance; ▪ Pollution planning; ▪ Project vessel compliance with international marine regulations; and ▪ Promulgation of information.	Extremely Unlikely	Moderate	**Broadly Acceptable**	None identified	**Broadly Acceptable**
	Operation and maintenance		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
	Decommissioning		Extremely Unlikely	Moderate	**Broadly Acceptable**		**Broadly Acceptable**
Loss of station	Operation and maintenance	▪ Compliance with floating foundation guidance; ▪ ERRV; ▪ Lighting and marking; ▪ Pollution planning; ▪ Promulgation of information.	Extremely Unlikely	Moderate	**Broadly Acceptable**	None identified	**Broadly Acceptable**
Vessel interaction with export cable and	Operation and maintenance	▪ Cable burial risk assessment; ▪ Charting of infrastructure; ▪ Compliance with floating foundation guidance;	Extremely Unlikely	Moderate	**Broadly Acceptable**	None identified	**Broadly Acceptable**

Hazard	Phase	Embedded Mitigation Measures (Where Appropriate Across Phases)	Frequency of Occurrence	Severity of Consequence	Significance of Risk	Additional Mitigation Measures	Residual Risk
mooring lines		▪ Compliance with MGN 654; ▪ Promulgation of information.					
Reduction of emergency response capability	Operation and maintenance	▪ Compliance with MGN 654; ▪ ERRV; ▪ Lighting and marking; ▪ Marine coordination; ▪ Pollution planning; and ▪ Project vessel compliance with international marine regulations.	Extremely Unlikely	Serious	**Tolerable with Mitigation**	None identified	**Tolerable with Mitigation**

17 Through Life Safety Management

275. Quality, Health, Safety and Environment (QHSE) documentation including a Safety Management System (SMS) will be in place and continually updated throughout the development process. Table 17.1 provides an overview of various documentation and how it will be maintained and reviewed with reference, where required, to specific marine documentation.

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

Table 17.1 Summary of QHSE Documentation

Documentation	Details
Incident reporting	An incident report will be completed following any incidents, including near misses. A review will then be undertaken to determine any possible need for operational changes, be it corrective or preventive action. Where appropriate, the designed person (noted within the ERCoP) should inform the MCA of any exercise or incidents including any implications on emergency response, with the MCA invited to participate in debriefs.
Review of documentation	The Project will be responsible for reviewing and updating all documentation including the risk assessments, ERCoP, SMS and, if required, will convene a review panel of stakeholders to quantify risk. A review of potential risks and response procedures will be undertaken annually.
Inspection of resources	All vessels, facilities, and equipment necessary for marine operations are to be subject to appropriate inspection and testing to determine fitness for purpose and availability in relation to their performance standards, including aids to navigation relative to the performance standards specified by NLB.
Audit of performance	Audits will be undertaken periodically to evaluate the efficiency of the marine safety documentation and possible corrective actions should be undertaken in accordance with standard procedures with audit results and reviews brought to the attention of responsible personnel.
SMS	An integrated SMS will be established to ensure the safety and environmental impact of activities undertaken are ALARP. This includes the use of remote monitoring and switching for aids to navigation to ensure that a quick fix for a faulty light can be instigated, thus ensuring IALA availability requirements are satisfied.
Cable monitoring	The export cable will be subject to periodic inspection post installation to monitor cable depths of lowering and protection. If the export cable is exposed or ineffective cable protection measures are identified, these would be promulgated to relevant sea users including via Notifications to Mariners and Kingfisher Bulletins and if there was deemed to be an immediate risk additional temporary measures may be deployed until such time as the risk is permanently mitigated.
Hydrographic surveys	As required by MGN 654, detailed and accurate hydrographic surveys will be undertaken periodically at intervals agreed with the MCA.

Documentation	Details
Decommissioning Programme	A Decommissioning Programme will be developed. For shipping and navigation, this will include consideration of the scenario where upon decommissioning and completion of removal operations, an obstruction is left on-site which is considered a danger to safe navigation and has not been possible to remove.

18 Summary

277. Using baseline data, exert opinion, outputs of the Hazard Workshop, stakeholder concerns, and lessons learnt from existing offshore developments, hazards relating to shipping and navigation have been identified due to the presence of the Project for all phases (construction, operation and maintenance, and decommissioning). These has been fed into the risk assessment – which follows the FSA approach – undertaken in Section 14.

18.1 Consultation

278. A number of stakeholders have been consulted via dedicated meetings including a Hazard Workshop. These include:

- MCA;
- NLB;
- UK Chamber of Shipping;
- RYA Scotland; and
- SWFPA.

279. Additionally, input has been provided by MD-LOT and SFF and has been sought from the Cruising Association and Vroon.

18.2 Baseline Characterisation

18.2.1 Navigational Features

280. There is a single dedicated AtoN in the area, situated approximately 13 nm to the east at the Piece Oil Field. Additionally, there are three virtual AtoNs situated at the Culzean Gas Field indicating the position of the Ailsa FSO, the closest of which is positioned 1.9 nm to the east.

281. The sea area surrounding the WTG includes various oil and gas fields, and their surface and subsea infrastructure. The WTG is situated within the Culzean Gas Field, with the nearest installation situated approximately 1 nm to the east (Culzean ULQ Platform).

282. There are a number of pipelines in proximity to the WTG, two of which are associated with the Culzean Gas Field. A pipeline passes 1.2 nm to the south-west. Two subsea cables are noted in the vicinity, one passes between the Culzean Gas Field and the Judy Oil Field while the other is situated 3.6 nm to the south-east.

18.2.2 Emergency Response and Incidents

283. The Sumburgh and Inverness SAR bases are located approximately 190 nm and 194 nm from the WTG, respectively. There were four unique SAR incidents within

the Study Area between April 2015 and March 2023, all featuring a rescue / recovery with one of the incidents located 0.5 nm south-east of the WTG.

284. The closest RNLI station to the WTG is at Peterhead, located approximately 120 nm to the west. It is noted that the RNLI have a strategic performance standard of reaching casualties up to a maximum of 100 nm offshore. Therefore, the WTG and surrounding area is considered too far offshore to be accessible by the RNLI. This is reflected in the RNLI incident data which indicated no returns of service within the Study Area in the period 2013 to 2022.

285. There were no incidents recorded within the MAIB incident data between 2012 and 2021 within the Study Area. For the previous 10-year period (2002 to 2011), there were two incidents. Both featured commercial vessels with the closest an accident to person recorded 3.9 nm to the south-east of the WTG.

18.2.3 Vessel Traffic Movements

286. Overall, there was an average of nine unique vessels recorded per day within the Study Area during the 12-month period.

287. The main vessel type recorded was oil and gas vessels (89%). The majority of oil and gas vessels were recorded visiting the oil and gas installations within or close to the Study Area including the ETAP / Marnock (24%), Culzean (21%), and Shearwater (20%) Fields.

288. Cargo vessels and tankers were also recorded routeing within the Study Area, albeit in much lower volumes. Applying the principles of MGN 654 (MCA, 2021), a total of 11 main commercial routes were identified within the Study Area featuring up to an average of two to three vessels per week.

289. The commercial fishing vessel activity recorded in the Study Area was generally characteristic of transiting, rather than active fishing. A small number of tracks to the south-west of the WTG were recorded with average speeds below 4 kt, which may be indicative of active fishing. Recreational vessels were typically recorded during the summer months but in low volumes.

18.3 Future Case Vessel Traffic

290. There is uncertainty associated with long-term predictions of vessel traffic growth given the limited reliable information on future trends. Therefore, a conservative assumption of a 10% increase in vessel traffic movements has been assumed for the future case across the design life of the Project, applying to all vessel types.

291. Of the 11 main commercial routes identified, ten do not pass in close proximity to the WTG. The route heading between Aberdeen (UK) and the Culzean Gas Field passes in proximity to the WTG and is conservatively anticipated to require a

deviation of approximately 0.11 nm (for vessels passing north of the WTG) or 0.33 nm (for vessels passing south of the WTG).

18.4 Collision and Allision Risk Modelling

292. Assuming base case traffic levels, it was estimated that a vessel would be involved in a collision once every 102,000 years post WTG. This represents a negligible change in collision frequency compared to the pre WTG.

293. Assuming base case traffic levels, it was estimated that a vessel would allide with the WTG whilst under power once every 67,000 years.

294. After modelling three distinct drift scenarios, it was established that the weather dominant scenario produced the worst case results. Assuming base case traffic levels, the likelihood of a drifting vessel alliding with the WTG was estimated to be negligible.

18.5 Risk Statement

295. Using the baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns, and lessons learnt from existing offshore developments, shipping and navigation hazards have been risk assessed in line with the FSA methodology. The full risk control log including details of hazards, embedded mitigation measures, and significance of risk is presented in Section 16.

296. The significance of risk has been determined as **Broadly Acceptable** or **Tolerable with Mitigation** for all shipping and navigation hazards assessed. No additional mitigation measures were identified, and therefore the residual risk is also **Broadly Acceptable** or **Tolerable with Mitigation** for all shipping and navigation hazards.

19 References

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Supplementary Material A Marine Guidance Note 654 Checklist

297. 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.

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

Table A.1 MGN 654 Checklist for Main Document

Issue	Compliance	Reference and Notes
Site and Installation Co-ordinates. Developers are responsible for ensuring that formally agreed coordinates for the OREI structure 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 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.		
The Vessel Traffic Data. Includes:		
All vessel types	✓	**Section 9: Vessel Traffic Movements** All vessel types are considered with specific breakdowns provided.
At least 28 days duration, within either 12 or 24 months prior to submission of the ES.	✓	**Section 5: Data Sources** A total of 12-months of AIS data between July 2022 and June 2023 has been assessed within the Study Area.
Multiple data sources	✓	**Section 5: Data Sources** In addition to the AIS data, Anatec's ShipRoutes database, VMS data, and consultation feedback has been used to characterise vessel traffic movements.
Seasonal variations	✓	**Section 5: Data Sources** The AIS data covers 12-months AIS to account for seasonal variation.
MCA consultation	✓	**Section 4: Consultation** The MCA have been consulted including via the Scoping Report, a dedicated meeting, and the Hazard Workshop.
General Lighthouse Authority (GLA) consultation	✓	**Section 4: Consultation** The NLB have been consulted including via the Scoping Report and the Hazard Workshop.
UK Chamber of Shipping consultation	✓	**Section 4: Consultation** NLB have been consulted including via the Hazard Workshop.

Issue	Compliance	Reference and Notes
Recreational and fishing vessel consultation	✓	**Section 4: Consultation** RYA Scotland have been consulted including via Hazard Workshop.
Port and navigation authorities consultation, as appropriate	✓	**Section 4: Consultation** Given the distance offshore of the Project, port and navigation authorities have not been consulted.
Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	✓	**Section 9: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed. **Section 14: Risk Assessment** The hazards due to the Project have been assessed for each phase.
ii. Numbers, types and sizes of vessels presently using such areas.	✓	**Section 9: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed and includes breakdowns of daily count, vessel type and vessel size.
iii. Non-transit uses of the area, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, personal watercraft etc.	✓	**Section 9: Vessel Traffic Movements** Non-transit activity in proximity to the Project has been analysed and includes fishing and anchoring activity.
iv. Whether these areas contain transit routes used by coastal or deep-draught or international scheduled vessels on passage.	✓	**Section 9: Vessel Traffic Movements** Main commercial routes have been identified using the principles set out in MGN 654 in proximity to the Project with these routes taking into account coastal, deep-draught and internationally scheduled vessels.
v. Alignment and proximity of the site relative to adjacent shipping routes.	✓	**Section 9: Vessel Traffic Movements** Main commercial routes have been identified using the principles set out in MGN 654 in proximity to the Project.
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	✓	**Section: Navigational Features** There are no IMO routeing measures or precautionary areas in proximity to the Project.
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** There are no designated anchorage areas or pilot boarding stations in proximity to the Project. **Section 9: Vessel Traffic Movements** No safe havens in proximity to the Project have been identified.
viii. Whether the site lies within the jurisdiction of a port and / or navigation authority.	✓	**Section 7: Navigational Features** The Project does not lie within the jurisdiction of a port or navigation authority.

Issue	Compliance	Reference and Notes
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	**Section 9: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed and includes consideration of commercial fishing vessels.
x. Proximity of the site to offshore firing / bombing ranges and areas used for any marine military purposes.	✓	**Section 7: Navigational Features** There are no military practice and exercise areas charted in proximity to the Project.
xi. Proximity of the site to existing or proposed submarine cables or pipelines, offshore oil / gas platform, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Area or other exploration / exploitation sites.	✓	**Section 7: Navigational Features** Charted wrecks in proximity to the Project have been identified. Submarine cables, pipelines, oil / gas platforms, or other sites in proximity to the Project have been identified.
xii. Proximity of the site to existing or proposed OREI developments, in cooperation with other relevant developers, within each round of lease awards.	✓	**Section 3: Navigational Risk Assessment Methodology** Other offshore wind farm developments have identified in proximity to the Project.
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping grounds.	✓	**Section 7: Navigational Features** No spoil or foul grounds were identified 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** Aids to navigation in proximity to the Project have been identified.
xv. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of ‘choke points’ in areas of high traffic density and nearby or consented OREI sites not yet constructed.	✓	**Section 13: Collision and Allision Risk Modelling** Collision and allision risk modelling has been undertaken in proximity to the Project.

Issue	Compliance	Reference and Notes
xvi. With reference to xv. above, the number and type of incidents to vessels which have taken place in or near to the proposed site of the OREI to assess the likelihood of such events in the future and the potential impact of such a situation.	✓	**Section 8: Emergency Response and Historical Incidents** Historical vessel incident data published by DfT, RNLI and MAIB in proximity to the Project have been considered.
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area.	✓	**Section 9: Vessel Traffic Movements** Non-transit activity in proximity to the Project has been analysed and includes (limited) recreational activity.
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 12: Future Case Vessel Traffic Movements** A methodology for post WTG routeing is outlined and includes consideration of the minimum passing distance for main commercial routes.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	There are no corridors in the layout of the Project.
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 14: Risk Assessment** The risk due to the Project has been assessed and includes consideration of the WTG, floater, mooring and anchoring system, and export cable.
b. Clearances of fixed or floating wind turbine blades above the sea surface are not less than 22 m (above Mean High Water Springs (MHWS) for fixed). Floating turbines allow for degrees of motion.	✓	**Section 15: Embedded Mitigation Measures** The minimum blade tip clearance of the WTG will be at least 22 m above MSL.

Issue	Compliance	Reference and Notes
c. Underwater devices: i. Changes to charted depth; ii. Maximum height above seabed; and iii. Under keel clearance.	✓	**Section 6: Project Description** The specifications for the mooring system and export cable are provided. **Section 14: Risk Assessment** The risk due to the Project of the reduction in under keel clearance has been assessed.
d. Whether structure block or hinder the view of other vessels or other navigational features.	✓	**Section 14: Risk Assessment** The risk due to the Project of the prevention of use of existing aids to navigation has been considered.
The effects 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** The range of water depths in proximity to the Project is provided. **Section 13: Collision and Allision Risk Modelling** Peak flood and ebb tidal data local to the Project is provided and used as input to the collision and allision risk modelling. **Section 14: Risk Assessment** The risk due to the Project of the reduction in under keel clearance has been assessed.
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 13: Collision and Allision Risk Modelling** Peak flood and ebb tidal data local to the Project is provided and used as input to the collision and allision risk modelling.
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 13: Collision and Allision Risk Modelling** Peak flood and ebb tidal data local to the Project is provided and used as input to the collision and allision risk modelling. The drifting allision model also considers 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 13: Collision and Allision Risk Modelling** No risks are anticipated.

Issue	Compliance	Reference and Notes
g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the wind farm area or adjacent to the area.	✓	**Section 15: Embedded Mitigation Measures** The minimum blade tip clearance of the WTG will be at least 22 m above MSL.
h. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	✓	**Section 9: Vessel Traffic Movements** Recreational activity in proximity to the Project has been analysed. **Section 13: Collision and Allision Risk Modelling** Weather and visibility data local to the Project is provided and used as input to the collision and allision risk modelling.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	**Section 14: Risk Assessment** The risks due to the Project on allision have been assessed and include consideration of wind masking, turbulence or sheer 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 13: Collision and Allision Risk Modelling** The drifting allision model takes into account weather and tidal conditions and considers whether machinery failure could cause vessels to be set into danger.
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 10: Base Case Vessel Routeing** Adverse weather routeing has been considered. **Section 13: Collision and Allision Risk Modelling** Weather and visibility data local to the Project is provided and used as input to the collision and allision risk modelling. **Section 14: Risk Assessment** The risks due to the Project of vessel displacement and allision have been assessed.
ii. For specified vessel types, operations and / or sizes.	✓	
iii. In all directions or areas.	✓	
iv. In specified directions or areas.	✓	
v. In specified tidal, weather or other conditions.	✓	
b. Navigation in and / or near the site should be prohibited or restricted:		
i. For specified vessel types, operations and / or sizes.	✓	**Section 15: Embedded Mitigation Measures** An application will be submitted prior to construction for safety zones including up to 500 m around the under construction infrastructure, 50 m around the incomplete structure / pre commissioning, and 500 m around major maintenance activities.
ii. In respect of specific activities.	✓	
iii. In all areas or directions.	✓	

<table>
<tr><th>Issue</th><th>Compliance</th><th>Reference and Notes</th></tr>
<tr><td>iv. Prohibited in specified areas or directions.</td><td>✓</td><td rowspan="2"></td></tr>
<tr><td>v. In specified tidal or whether conditions.</td><td>✓</td></tr>
<tr><td>c. Where it is not feasible for vessels to access or navigate through the site it could cause navigational, safety or routeing problems for vessels operating in the area e.g. by preventing vessels from responding to calls for assistance from persons in distress.</td><td>✓</td><td>Section 14: Risk Assessment
The risks due to the Project of vessel displacement and disruption to emergency response have been assessed.</td></tr>
<tr><td>d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered.</td><td>✓</td><td>Section 12: Future Case Vessel Traffic Movements
A methodology for post WTG routeing is outlined and includes consideration of the minimum passing distance for main commercial routes.</td></tr>
<tr><td colspan="3">SAR, maritime assistance service, counter pollution and salvage incident response.</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td>a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI.</td><td>✓</td><td rowspan="3">Section 15: Embedded Mitigation Measures
Compliance with the requirements of MGN 654, which includes the provision of an ERCoP, will be ensured.</td></tr>
<tr><td>b. The MCA's guidance document Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response (MCA, 2018) for the design, equipment and operation requirements will be followed.</td><td>✓</td></tr>
<tr><td>c. A SAR checklist will be completed to record discussions regarding the requirements, recommendations and considerations outlined in Annex 5 (to be agreed with MCA).</td><td>✓</td></tr>
</table>

Issue	Compliance	Reference and Notes
Hydrography. In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:		
Pre construction: The proposed generating assets area and proposed cable route.	✓	**Section 15: Embedded Mitigation Measures** Compliance with the requirements of MGN 654, which includes the stated hydrographic surveys, will be ensured.
ii. On a pre-established periodicity during the life of the development.	✓	
ii. Post construction: Cable route(s).	✓	
iii. 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 11: Navigation, Communication and Position Fixing Equipment** Potential hazards relating to the different communication and position fixing equipment used in and around offshore wind farms are considered.
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 11: Navigation, Communication and Position Fixing Equipment** Potential hazards relating to the different communication and position fixing equipment used in and around offshore wind farms are considered including Radar interference,
ii. Vessel to shore	✓	
iii. VTS Radar to vessel	✓	
iv. Racon to / from vessel	✓	

Issue	Compliance	Reference and Notes
c. The structures and generators might produce SONAR interference affecting fishing, industrial or military systems used in the area.	✓	SONAR interference, noise and electromagnetic interference.
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	
e. Generators and the seabed cabling within the site onshore might produce Electromagnetic Fields (EMF) affecting compasses and other navigation systems.	✓	
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, Chapter V of SOLAS (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 15: Embedded Mitigation Measures** information relating to the Project including project vessel routes, timings and locations will be promulgated via Notifications to Mariners and Kingfisher Bulletins.
ii. Continuous watch by multi-channel VHF, including DSC.	✓	**Section 15: Embedded Mitigation Measures** Marine coordination will be implemented to manage project vessels.
iii. Safety Zones of appropriate configuration, extent and application to specified vessels[7].	✓	**Section 15: Embedded Mitigation Measures** An application will be submitted prior to construction for safety zones including up to 500 m around the under construction infrastructure, 50 m around the incomplete structure / pre commissioning, and 500 m around major maintenance activities.
iv. Designation of the site as an area to be avoided (ATBA)	✓	
v. Provision of aids to navigation as determined by the GLA.	✓	**Section 15: Embedded Mitigation Measures** Lighting and marking of the Project will be in agreement with NLB and in accordance with IALA Recommendation O-139 (IALA, 2021) and Guideline G1162 (IALA, 2021).
vi. Implementation of routeing measures within or near to the development.	✓	It is not planned to implement any new routeing measures in proximity to the Project.

[7] 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
vii. Monitoring by Radar, AIS, Closed Circuit Television (CCTV) or other agreed means.	✓	**Section 15: Embedded Mitigation Measures** Compliance with the requirements of MGN 654, which includes consideration of monitoring means, will be ensured
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of Safety Zones.	✓	**Section 15: Embedded Mitigation Measures** An application will be submitted prior to construction for safety zones including up to 500 m around the under construction infrastructure, 50 m around the incomplete structure / pre commissioning, and 500 m around major maintenance activities.
ix. Creation of an ERCoP with the MCA's SAR branch for the construction phase onwards.	✓	**Section 15: Embedded Mitigation Measures** Compliance with the requirements of MGN 654, which includes the provision of an ERCoP, will be ensured.
x. Use of guard vessels, where appropriate.	✓	**Section 15: Embedded Mitigation Measures** A guard vessel (the ERRV for the Culzean Gas Field) will be used as required by risk assessment.
xi. Update NRAs every two years, e.g. at testing sites.	✓	It is assumed that this is not required for the Project.
xii. Device-specific or array-specific NRAs.	✓	**Section 6: Project Description** All elements of the Project have been considered in this NRA including the WTG, floater, mooring and anchoring system, and export cable.
xiii. Design of OREI structures to minimise risk to contacting vessels or craft.	✓	**Section 15: Embedded Mitigation Measures** The minimum blade tip clearance of the WTG will be at least 22 m above MSL.
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	**Section 15: Embedded Mitigation Measures** Mitigation measures embedded into the Project to reduce the significance of risk of hazards are detailed.

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 14: Risk Assessment** The risk assessment provides a risk claim for a range of hazards based on a number of inputs including baseline data, expert opinion, outputs of the Hazard Workshop, stakeholder concerns and lessons learnt from existing offshore developments.
Description of the marine environment.	✓	**Section 7: Navigational Features** Navigational features in proximity to the Project have been described including (but not limited to) oil and gas infrastructure, subsea cables, key aids to navigation, and charted wrecks.

Item	Compliance	Comments
SAR overview and assessment.	✓	**Section 8: Emergency Response and Historical Incidents** Existing SAR resources in proximity to the Project are summarised including the UK SAR operations contract and RNLI stations.
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 WTG, floater, mooring and anchoring system, and export cable.
Analysis of the vessel traffic, including base case and future traffic densities and types.	✓	**Section 9: Vessel Traffic Movements** Vessel traffic data in proximity to the Project has been analysed and includes vessel density and breakdowns of vessel type.
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. **0: 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 1.2: Guidance and Legislation** MGN 654 and the IMOs FSA guidelines are the primary guidance documents used for the assessment. **Section 13: Collision and Allision Risk Modelling** Provides quantification of collision and allision risk resulting from the future case vessel traffic including deviated main commercial routes. Numerical and graphical results are provided, where appropriate.
Risk control log	✓	**Section 16: 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 embedded mitigation measures, frequency of occurrence, severity of consequence, and significance of risk, per hazard.

Supplementary Material B Hazard Log

299. The complete hazard log, produced following the Hazard Workshop and updated following feedback received from stakeholders, is presented in Table B.1. The Hazard Workshop methodology, including the approach to the hazard log, is provided in Section 3.3.

Table B.1 Final Hazard Log

Hazard	Cause(s)	Phase(s)	User	Embedded Mitigation Measures (Full Descriptions Provided in Section 15)	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Additional Comments / Further Mitigation
						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	
Vessel displacement due to construction and / or installation activities or the presence of the Project	▪ Presence of wind turbine, mooring lines and export cable ▪ Presence of project vessels which are RAM ▪ Adverse weather	Construction / decommissioning	Commercial vessels	▪ Charting on UKHO Admiralty charts ▪ Compliance with MGN 654 and its annexes ▪ Decommissioning Programme ▪ Lighting and marking ▪ Promulgation of information ▪ Use of a guard vessel as required	Vessel displaced from existing routeing/passage with no effects on schedule or safety risks	3	1	1	1	1	1.0	Broadly Acceptable	Vessel displaced from existing routeing/passage with limited effects on schedule and limited safety risks	2	1	2	1	2	1.5	Broadly Acceptable	RYA Scotland note that recently there have been delays in UKHO Admiralty charts being updated but other mitigation including notifications to mariners and Kingfisher should raise awareness. MCA noted that routeing by commercial vessels clearly avoids the existing infrastructure at the Culzean Field and therefore there are no concerns and slight deviations for oil and gas routeing are not an issue.
			Oil and gas vessels			4	1	1	1	1	1.0	Broadly Acceptable		3	1	2	1	2	1.5	Broadly Acceptable	
			Commercial fishing vessels			2	1	1	1	1	1.0	Broadly Acceptable		2	1	1	1	1	1.0	Broadly Acceptable	
			Recreational vessels			2	1	1	1	1	1.0	Broadly Acceptable		2	1	2	1	2	1.0	Broadly Acceptable	
		Operation and maintenance	Commercial vessels			3	1	1	1	1	1.0	Broadly Acceptable		2	1	2	1	2	1.5	Broadly Acceptable	
			Oil and gas vessels			3	1	1	1	1	1.0	Broadly Acceptable		2	1	2	1	2	1.5	Broadly Acceptable	
			Commercial fishing vessels			2	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	1	1.0	Broadly Acceptable	
			Recreational vessels			2	1	1	1	1	1.0	Broadly Acceptable		1	1	1	1	1	1.0	Broadly Acceptable	
Increased vessel to vessel collision risk between third-party vessels due to vessel displacement	▪ Presence of wind turbine, mooring lines and export cable ▪ Presence of project vessels which are RAM ▪ Adverse weather	Construction / decommissioning	Commercial vessels	▪ Charting on UKHO Admiralty charts ▪ Compliance with MGN 654 and its annexes ▪ Decommissioning Programme ▪ Lighting and marking ▪ Promulgation of information ▪ Use of a guard vessel as required	Increased encounters resulting in potential for low impact collision to occur	2	1	1	1	1	1.0	Broadly Acceptable	Increased encounters resulting in potential for high impact collision involving vessel damage, PLL, and/or pollution	1	2	4	3	3	3.0	Broadly Acceptable	RYA Scotland note that recently there have been delays in UKHO Admiralty charts being updated but other mitigation including notifications to mariners and Kingfisher should raise awareness.
			Oil and gas vessels			3	1	1	1	1	1.0	Broadly Acceptable		2	3	3	3	3	3.0	Broadly Acceptable	
			Commercial fishing vessels			1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	3	4	3.3	Broadly Acceptable	
			Recreational vessels			1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	3	1	2.5	Broadly Acceptable	
		Operation and maintenance	Commercial vessels			2	1	1	1	1	1.0	Broadly Acceptable		1	2	4	3	3	3.0	Broadly Acceptable	
			Oil and gas vessels			2	1	1	1	1	1.0	Broadly Acceptable		2	3	3	3	3	3.0	Broadly Acceptable	

Hazard	Cause(s)	Phase(s)	User	Embedded Mitigation Measures (Full Descriptions Provided in Section 15)	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Additional Comments / Further Mitigation
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	
			Commercial fishing vessels			1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	3	4	3.3	Broadly Acceptable	
			Recreational vessels			1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	3	1	2.5	Broadly Acceptable	
Vessel to vessel collision risk between a third-party vessel and a project vessel including infrastructure being towed to site	▪ Project vessel in transit and / or towing floater to / from site ▪ Lack of third-party awareness	Construction / decommissioning	Commercial vessels	▪ Application for safety zones ▪ Charting on UKHO Admiralty charts ▪ Decommissioning Programme ▪ Lighting and marking ▪ Marine coordination for project vessels ▪ Promulgation of information	Increased encounters resulting in potential for low impact collision to occur	2	1	1	1	1	1.0	Broadly Acceptable	Increased encounters resulting in potential for high impact collision involving vessel damage, PLL, and/or pollution	1	2	4	3	3	3.0	Broadly Acceptable	RYA Scotland note that recently there have been delays in UKHO Admiralty charts being updated but other mitigation including notifications to mariners and Kingfisher should raise awareness.
			Oil and gas vessels			3	1	1	1	1	1.0	Broadly Acceptable		2	3	3	3	3	3.0	Broadly Acceptable	
			Commercial fishing vessels			1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	3	4	3.3	Broadly Acceptable	
			Recreational vessels			1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	3	1	2.5	Broadly Acceptable	
		Operation and maintenance	Commercial vessels			2	1	1	1	1	1.0	Broadly Acceptable		1	2	4	3	3	3.0	Broadly Acceptable	
			Oil and gas vessels			2	1	1	1	1	1.0	Broadly Acceptable		2	3	3	3	3	3.0	Broadly Acceptable	
			Commercial fishing vessels			1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	3	4	3.3	Broadly Acceptable	
			Recreational vessels			1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	3	1	2.5	Broadly Acceptable	
Vessel to structure allision risk	▪ Presence of wind turbine ▪ Human / navigation error ▪ Mechanical / technical failure ▪ Adverse weather ▪ Aid to navigation failure	Construction / decommissioning	Commercial vessels	▪ Application for safety zones ▪ Charting on UKHO Admiralty charts ▪ Compliance with MGN 654 and its annexes ▪ Decommissioning Programme ▪ Lighting and marking ▪ Minimum blade tip clearance of	Vessel passes at an unsafe distance from wind turbine resulting in a need for a late adjustment to course/speed	1	1	1	1	2	1.3	Broadly Acceptable	Allision event occurs (powered or drifting) involving vessel damage, PLL, and/or pollution	1	2	4	3	4	3.3	Broadly Acceptable	RYA Scotland note that recently there have been delays in UKHO Admiralty charts being updated but other mitigation including notifications to mariners and Kingfisher should raise awareness. SWPFA noted that the area is generally quiet for fishing vessels
			Oil and gas vessels			2	1	1	1	1	1.0	Broadly Acceptable		1	3	3	3	4	3.3	Broadly Acceptable	
			Commercial fishing vessels			1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	2	4	3.0	Broadly Acceptable	
			Recreational vessels			1	1	1	1	1	1.0	Broadly Acceptable		1	4	2	2	1	2.3	Broadly Acceptable	
		Operation and maintenance	Commercial vessels			1	1	1	1	2	1.3	Broadly Acceptable		1	2	4	3	4	3.3	Broadly Acceptable	
			Oil and gas vessels			2	1	1	1	1	1.0	Broadly Acceptable		1	3	3	3	4	3.3	Broadly Acceptable	

Hazard	Cause(s)	Phase(s)	User	Embedded Mitigation Measures (Full Descriptions Provided in Section 15)	Most Likely Consequences	Realistic Most Likely Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Worst Case Consequences	Realistic Worst Case Consequences: Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk	Additional Comments / Further Mitigation
			Commercial fishing vessels	22m above MSL ■ Promulgation of information ■ Use of a guard vessel as required		2	1	1	1	1	1.0	Broadly Acceptable		1	4	2	2	4	3.0	Broadly Acceptable	with movements predominantly transits close to existing infrastructure. RYA Scotland noted that given the presence of existing infrastructure there are no increased concerns. If an issue were to arise it would most likely be in bad weather.
			Recreational vessels			2	1	1	1	1	1.0	Broadly Acceptable		1	4	2	2	1	2.3	Broadly Acceptable	
Loss of station	■ Damage to or failure of mooring line(s)	Operation and maintenance	Commercial vessels	■ Compliance with MCA regulatory expectations for floating devices ■ Lighting and marking ■ Promulgation of information ■ Use of a guard vessel as required	Failure of a single mooring line leading to a temporary increase in maximum excursion of the floater but without a full loss of station	3	1	1	1	1	1.0	Broadly Acceptable	Total failure of mooring system leading to drifting of floater with subsequent allision risk	1	2	4	3	4	3.3	Broadly Acceptable	
			Oil and gas vessels			3	1	1	1	1	1.0	Broadly Acceptable		1	3	3	3	4	3.3	Broadly Acceptable	
			Commercial fishing vessels			3	1	1	1	1	1.0	Broadly Acceptable		1	4	2	2	4	3.0	Broadly Acceptable	
			Recreational vessels			3	1	1	1	1	1.0	Broadly Acceptable		1	4	2	2	1	2.3	Broadly Acceptable	
Vessel interaction with export cable and mooring lines associated with the Project	■ Reduced navigable water depth due to presence of mooring lines,	Operation and maintenance	Commercial vessels	■ Cable burial risk assessment ■ Charting on UKHO Admiralty charts ■ Compliance with MCA regulatory	Vessel transits close to or over a mooring line, export cable, or cable protection but no interaction	3	1	1	1	1	1.0	Broadly Acceptable	Direct vessel interaction occurs with mooring line, export cable, or cable protection resulting in vessel	1	3	4	2	3	3.0	Broadly Acceptable	
			Oil and gas vessels			4	1	1	1	1	1.0	Broadly Acceptable		1	3	3	2	3	2.8	Broadly Acceptable	
			Commercial fishing vessels			4	1	1	1	1	1.0	Broadly Acceptable		1	3	2	2	2	2.3	Broadly Acceptable	

Hazard	Cause(s)	Phase(s)	User	Embedded Mitigation Measures (Full Descriptions Provided in Section 15)	Most Likely Consequences	Realistic Most Likely Consequences							Worst Case Consequences	Realistic Worst Case Consequences							Additional Comments / Further Mitigation
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk	
	export cable, and / or cable protection ▪ Anchoring over a mooring line or export cable (human / navigational error) ▪ Mechanical or technical failure resulting in drifting ▪ Adverse weather		Recreational vessels	expectations for floating devices ▪ Compliance with MGN 654 and its annexes ▪ Promulgation of information	occurs	3	1	1	1	1	1.0	Broadly Acceptable	damage, injury to person, and/or pollution Anchor interaction occurs with mooring line or export cable resulting in damage to the mooring line/export cable and/or anchor	1	3	2	2	1	2.0	Broadly Acceptable	RYA Scotland note that recently there have been delays in UKHO Admiralty charts being updated but other mitigation including notifications to mariners and Kingfisher should raise awareness.
Interference with marine navigation equipment	▪ Presence of wind turbine and / or export cable ▪ Human error relating to adjustment of Radar controls	Operation and maintenance	All third-party vessels	▪ Cable burial risk assessment	No material effect upon Radar, communications, and navigation equipment on a vessel	4	1	1	1	1	1.0	Broadly Acceptable	Minor level of Radar and/or EMF interference due to the wind turbine and/or export cable, respectively	3	1	1	1	1	1.0	Broadly Acceptable	
Reduction of emergency response capability due to increased incident rates and/or reduced access for SAR responders	▪ WTG impedes access to existing infrastructure ▪ Limited resource capability ▪ Adverse weather	Operation and maintenance	Emergency responders	▪ Compliance with MGN 654 and its annexes ▪ Lighting and marking ▪ Marine coordination for project vessels ▪ Promulgation of information	No effect on emergency response	3	1	1	1	1	1.0	Broadly Acceptable	Delay to emergency response request leading to vessel damage, injury to person, PLL, and/or pollution	1	5	5	4	5	4.8	Broadly Acceptable	NLB noted that should the floater sink then it may present a navigational risk and protocol for wreck response should be considered for the ERCoP.