Morecambe Offshore Windfarm: Generation Assets

Environmental Statement

Volume 5

Appendix 14.1 Navigation Risk Assessment (Tracked)

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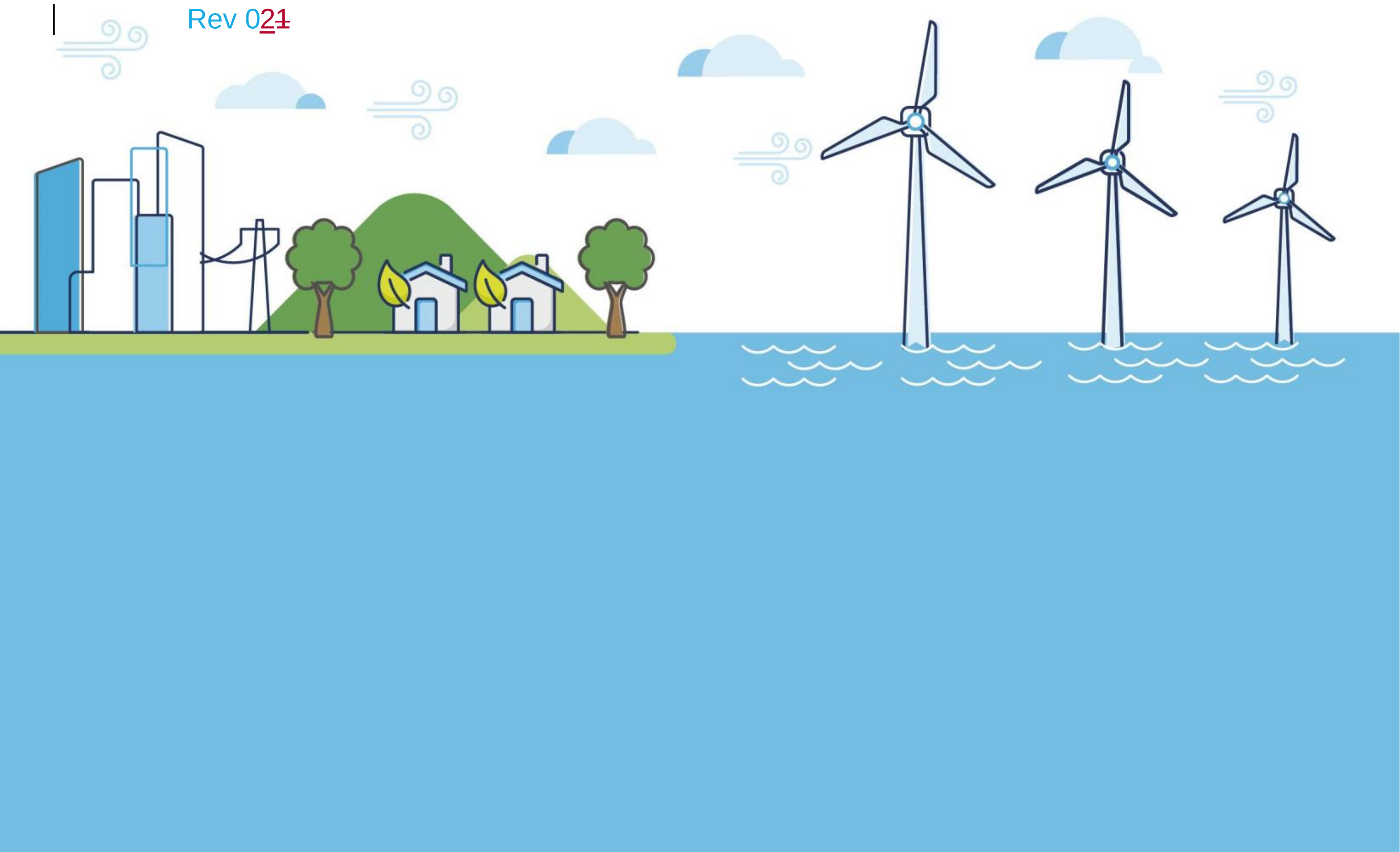

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MORECAMBE OFFSHORE WINDFARM: GENERATION ASSETS

Navigation Risk Assessment

Morecambe Offshore Windfarm Ltd

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NASH MARITIME LTD, 2-4 CANUTE ROAD, SOUTHAMPTON, HAMPSHIRE, SO14 3FH, UNITED KINGDOM.

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APPENDICES

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Abbreviations

Abbreviation	Definition
ABP	Associated British Ports
AC	Alternating Current
AfL	Agreement for Lease
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
AtoN	Aid to Navigation
BAS	Burial Assessment Study
BWEA	British Wind Energy Association (now RenewableUK)
CBRA	Cable Burial Risk Assessment
CCS	Carbon Capture and Storage
CGOC	Coastguard Operations Centre
CHA	Competent Harbour Authority
CO^2	Carbon Dioxide
COLREGs	International Convention for the Prevention of Collision at Sea
CoS	Chamber of Shipping
CPP	Central Processing Platform
CTV	Crew Transfer Vessel
DECC	Department of Energy & Climate Change
Defra	Department for Environment, Food and Rural Affairs
DCO	Development Consent Order
DfT	Department for Transport
DIO	Defence Infrastructure Organisation
DSC	Digital Selective Calling
EIA	Environmental Impact Assessment
ERCOP	Emergency Response and Cooperation Plan
ERRV	Emergency Rescue and Recovery Vessel
FFO	Fixed or Floating Object
FSA	Formal Safety Assessment
GBS	Gravity Based Structures
GLA	General Lighthouse Authority
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HAT	Highest Astronomical Tide

Abbreviation	Definition
HMCG	His Majesty's Coastguard
HSE	Health and Safety Executive
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICW	In Collision With
IGOMO	International Guidance for Offshore Marine Operations
IHO	International Hydrographic Office
IMO	International Maritime Organization
IoM	Isle of Man
IoMHC	Isle of Man Harbours and Coastguard
IoMSPC	Isle of Man Steam Packet Company
IPC	International Planning Commission
IPS	Intermediate Peripheral Structure
IWRAP	IALA Waterway Risk Assessment Program
LOA	Length Overall
LPS	Local Port Service
LW	Low Water
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MGN	Marine Guidance Note
MMO	Marine Management Organisation
MoD	Ministry of Defence
MOWL	Morecambe Offshore Wind Limited
MSL	Mean Sea Level
NASH	NASH Maritime Ltd
NPS	National Policy Statement
NRA	Navigation Risk Assessment
NSIP	Nationally Significant Infrastructure Project
O&M	Operation and Maintenance
OREI	Offshore Renewable Energy Installation
OSP	Offshore Substation Platform
OTNR	Offshore Transmission Network Review
OWF	Offshore Windfarm
PEIR	Preliminary Environmental Impact Report
PEXA	Practice and Exercise Area

Abbreviation	Definition
PIANC	World Association for Waterborne Transport Infrastructure
PMSC	Port Marine Safety Code
PPE	Personal Protective Equipment
PLB	Personal Locator Beacons
PSV	Platform Supply Vessel
QHSE	Quality, Health, Safety and Environment
REWS	Radar Early Warning System
REZ	Renewable Energy Zone
RNLI	Royal National Lifeboat Institute
RYA	Royal Yachting Association
SOLAS	Safety of Life at Sea
SAR	Search and Rescue
SBM	Single Buoy Mooring
SHA	Statutory Harbour Authority
SIRA	Simplified IALA Risk Assessment
SPS	Signification Peripheral Structure
SRRA	Search and Rescue Response Assessment
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
TEU	Twenty-foot Equivalent Unit
TH	Trinity House
TSS	Traffic Separation Scheme
UNCLOS	United Nations Convention on the Law of the Sea
UKC	Under Keel Clearance
UKHO	United Kingdom Hydrographic Office
UKSARH	United Kingdom Search and Rescue Helicopter
UXO	Unexploded Ordnance
VHF	Very High Frequency
VMS	Vessel Monitoring System
VTMP	Vessel Traffic Management Plan
VTS	Vessel Traffic Service
WFSV	Windfarm Service Vessel
WODS	West of Duddon Sands
WTG	Wind Turbine Generator

Units

Unit	Definition
kJ	Kilojoule
kt	Knot (unit of speed equal to nautical mile per hour, approximately 1.15 mph)
kV	Kilovolt
M	Metre
m/s	Metres Per Second
MW	Megawatt
nm	Nautical Mile

1. INTRODUCTION

1.1 PROJECT BACKGROUND

1.1.1.1.1 NASH Maritime Ltd (NASH) has been commissioned by Morecambe Offshore Windfarm Ltd (MOWL) (the "Applicant") to undertake a Navigation Risk Assessment (NRA) for the Morecambe Offshore Windfarm (OWF) Generation Assets ("the Project"). This NRA presents information on the proposed development relative to the baseline and futurecase navigational activity and forms an annex to Chapter 14 Shipping and Navigation (Document Reference 5.2.14). The windfarm site is located approximately 30km from the Lancashire coast and the Project will comprise of up to 35 fixed bottom foundation wind turbine generators (WTGs), inter-array cabling, and up to two offshore substation platforms (OSP) with possible platform link cables, all of which will be contained within the windfarm site.

1.1.1.1.2 The scope of the assessment and content of this report are provided in **Section 1.2.**

1.1.1.1.3 The Project relates only to the Generation Assets of the Morecambe OWF (i.e. the WTGs, inter-array cables, OSPs, and possible platform link cables). A separate consent for the Transmission Assets associated with the Morecambe OWF and the Morgan Offshore Wind Project (another proposed windfarm to be located in the Irish Sea) is being sought. This follows the UK Government publishing in 2022 the Pathway to 2030 Holistic Network Design documents which set out the approach to connecting 50GW of offshore wind to the UK electricity network. This concluded that Morecambe OWF should work collaboratively with the Morgan Offshore Wind Project in connecting the windfarms to the National Grid at Penwortham in Lancashire. Accordingly, the Transmission Assets, which will enable export of electricity from both the Morecambe OWF and the Morgan Offshore Wind Project to the National Grid connection point, will be subject to consent under a separate Development Consent Order (DCO) application.

1.1.1.1.4 In June 2022, a Scoping Report for the Project was submitted by the Applicant to request a formal Scoping Opinion from the Planning Inspectorate on the information to be included in an Environmental Impact Assessment (EIA). The Scoping Opinion was subsequently provided by the Planning Inspectorate in August 2022. Non-statutory consultation events were held (both in-person and online) in November/December 2022 to help communities and other stakeholders understand the Project proposals.

1.1.1.1.5 The Project Preliminary Environmental Information Report (PEIR) was published for statutory consultation in April - June 2023. As part of the PEIR, an NRA was undertaken for the Project to identify and assess the hazards and risks affecting shipping and navigation. A cumulative regional navigation risk assessment (CRNRA) was also undertaken as part of the PEIR to consider the navigational hazards and risks associated with the proposed Project and the Mona Offshore Wind Project, and Morgan Offshore Wind Project Generation Assets. The PEIR NRA determined that the impacts of the Project individually would result in hazards that are Tolerable if As Low

As Reasonably Practicable (ALARP). Cumulatively, the CRNRA determined that considering the three projects together would result in unacceptable risks to navigation and significant impacts to lifeline ferry schedules.

1.1.1.1.6 Since the publication of the PEIR, all three projects have collectively made a number of changes (including boundary changes) to address these unacceptable cumulative risks. The design commitments made by the Project to reduce these impacts were as follows:

- Realignment of the Project's western boundary extent to minimise course changes (and deviation distance) for vessels navigating north-south between the Project and the Mona Offshore Wind Project, and between the Project and Morgan Offshore Windfarm Generation Assets and existing the Walney Offshore Windfarm
- Commitment to two lines of orientation in the layout of surface structures within the Project's windfarm site

1.1.1.1.7 This document updates the Project NRA and assesses whether all risks have been reduced to either Broadly Acceptable or Tolerable if as Low as Reasonably Practicable (ALARP) based on the additional Project commitments listed above. The CRNRA has also been updated to include the Morgan and Morecambe Offshore Windfarms Transmission Assets and to assess whether all cumulative risks have been reduced to either Broadly Acceptable or Tolerable if ALARP based on the additional commitments (including the boundary changes) of all projects Appendix 14.2 Cumulative Regional Navigational Risk Assessment (Document Reference 5.2.14.2). **Section 10** of this report summarises the outcomes of the updated CRNRA.

1.2 PURPOSE AND SCOPE OF THE NAVIGATION RISK ASSESSMENT

1.2.1.1.1 The Project is seeking a consent application under the Planning Act 2008 (as amended). As the Project is over 100MW capacity it is considered a Nationally Significant Infrastructure Project (NSIP) and will apply for a Development Consent Order (DCO) from the Secretary of State.

1.2.1.1.2 The windfarm site has the potential to impact upon the safety and navigation of vessels transiting through or within the vicinity of the Project development. The NRA is an important requirement for the consent process for OWF developments and identifies the potential effects and impacts of the windfarm site on shipping and navigation.

1.2.1.1.3 The NRA follows the requirements of the Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 654 and accompanying methodology within Annex 1. The scope and objectives of this assessment are as follows:

- Review of relevant policy, guidance and legislation (**Section 2**)
- Description of the assessment methodology (**Section 3**)
- Description of the Project (**Section 4**)
- Description of the baseline environment (**Section 5**)

- Description of the baseline vessel traffic and risk profile (**Section 6**)
- Determination of the likely future traffic profile (**Section 7**)
- Identification and assessment of the potential impacts of the windfarm site on shipping and navigation (**Section 8**)
- Description of the NRA that identifies and assesses hazards during construction, operation and maintenance, and decommissioning phases of the development (**Section 9**)
- Identification of risk controls in relation to the Project hazards to reduce the risk to ALARP (Section 4.9 and Section 9.8)
- Consideration of the potential cumulative impacts on shipping and navigation (**Section 10**)
- Provide recommendations in relation to the safety of the development and co-existence of users with regards to shipping and navigation (**Section 11**)

2. POLICY, GUIDANCE AND LEGISLATION

2.1 Legislation and national policy

2.1.1 UNCLOS

2.1.1.1.1 The United Nations Convention on the Law of the Sea (UNCLOS) (United Nations, 1982) is an international agreement that establishes a legal framework for all marine and maritime activities. Article 60 of the convention concerns artificial islands, installations and structures in the exclusive economic zone. Article 60(7) states that "Artificial islands, installations and structures and the safety zones around them may not be established where interference may be caused to the use of recognized sea lanes essential to international navigation." As per Article 22(4), "The coastal state shall clearly indicate such sea lanes and traffic separation schemes on charts to which due publicity shall be given".

2.1.1.1.2 The requirement not to interfere with the use of recognised sea lanes essential to international navigation is also contained within S36B of the Electricity Act 1989.

2.1.2 National Policy Statement

2.1.2.1.1 National Policy Statements (NPSs) set out UK Government policy on different types of national infrastructure developments, i.e. NSIPs. This NRA has been undertaken in accordance with the instructions and guidance provided within the NPS for Renewable Energy Infrastructure (EN-3) (Department for Energy Security & Net Zero, 2023). **Table 1** provides a summary of the guidance provided by NPS EN-3 that is relevant to shipping and navigation.

Table 1: Relevant shipping and navigation assessment requirements from NPS EN-3

NPS Requirement	NRA Reference
Offshore wind farms and offshore transmission will occupy an area of the sea or sea bed. For offshore wind farms in particular it is inevitable that there will be an impact on navigation in and around the area of the site. This is relevant to both commercial and recreational users of the sea who may be affected by disruption or economic loss because of the proposed offshore wind farm and/or offshore transmission. **[Paragraph 2.8.178]**	Impact on vessel routeing in **Section 8.2** and **Section 8.3** for ferries and other commercial shipping respectively. This includes routeing in typical and adverse weather conditions. Impacts on recreational craft are described throughout **Section 8.4.4** and **Section 8.5.4**.

NPS Requirement	NRA Reference
To ensure safety of shipping applicants should reduce risks to navigational safety to ALARP, as described in Section 2.8.321. **[Paragraph 2.8.179]**	Impacts to navigation are described in **Section 8** and the guidance and process for producing this NRA set out in **Section 9**.
There is a public right of navigation over navigable tidal waters and in International Law, foreign vessels have the right of innocent passage through the UK's territorial waters. **[Paragraph 2.8.180]**	A summary of key legislation and policy is contained in **Section 2.1**.
Beyond the seaward limit of the territorial sea, shipping has the freedom of navigation although offshore infrastructure and the imposition of safety zones can hinder this. **[Paragraph 2.8.181]**	A summary of key legislation and policy is contained in **Section 2.1**. Applied risk controls, including safety zones, are described in **Section 4.9**. Additional risk control options are identified in **Section 9.8**.
Impacts on navigation can arise from the wind farm or other infrastructure and equipment creating a physical barrier during construction and operation. **[Paragraph 2.8.182]**	Impact on vessel routeing in **Section 8.2** and **Section 8.3** for ferries and other commercial shipping respectively. This includes routeing in typical and adverse weather conditions. Impacts on recreational craft are described throughout **Section 8.4.4** and **Section 8.5.4**.
There may be some situations where reorganisation of shipping traffic activity might be both possible and desirable when considered against the benefits of the wind farm and/or offshore transmission application and such circumstances should be discussed with the Government officials, including Secretary of State and MCA, and other stakeholders, including Trinity House, as The General Lighthouse Authority consultee, and the commercial shipping sector. It should be recognised that alterations might require national endorsement and international agreement and that the negotiations involved may take considerable time and do not have a guaranteed outcome. **[Paragraph 2.8.183]**	Stakeholder consultation is summarised in **Section 3.5.1**. A Marine Navigation Engagement Forum (MNEF) was established for the three Irish Sea Round 4 offshore wind projects (see **Section 3.5.1**). A hazard workshop was undertaken including stakeholders to inform this

NPS Requirement	NRA Reference
Applicants should engage with interested parties in the navigation sector early in the pre-application phase of the proposed offshore wind farm or offshore transmission to help identify mitigation measures to reduce navigational risk to ALARP, to facilitate proposed offshore wind development. This includes the MMO or NRW in Wales, MCA, the relevant General Lighthouse Authority, such as Trinity House, the relevant industry bodies (both national and local) and any representatives of recreational users of the sea, such as the Royal Yachting Association (RYA), who may be affected. This should continue throughout the life of the development including during the construction, operation and maintenance, and decommissioning phases. **[Paragraph 2.8.184]**	NRA and is described in **Section 9.3**.
Engagement should seek solutions that allow offshore wind farms, offshore transmission and navigation and shipping users of the sea to successfully co-exist. **[Paragraph 2.8.185]**	
The presence of the wind turbines can also have impacts on communication and shipborne and shore-based radar systems. See section 5.5 in EN-1 for further guidance. **[Paragraph 2.8.186]**	Impacts on shipborne and shorebased navigation, communications and positioning systems are described in **Section 8.8**.
Prior to undertaking assessments applicants should consider information on internationally recognised sea lanes, which is publicly available. **[Paragraph 2.8.187]**	Location of sea lanes are presented in **Section 5** and impact on vessel routeing measures in **Section 8**.
Applicants should refer in assessments to any relevant, publicly available data available on the Maritime Database. **[Paragraph 2.8.188]**	Datasets used to undertake this assessment are described in **Section 3.5**.
Applicants must undertake a Navigational Risk Assessment (NRA) in accordance with relevant government guidance prepared in consultation with the MCA and the other navigation stakeholders listed above. **[Paragraph 2.8.189]**	The guidance and process followed in producing this NRA is described in **Section 9**.

NPS Requirement	NRA Reference
The navigation risk assessment will for example necessitate: • **A survey of vessel traffic in the vicinity of the proposed wind farm** • **A full NRA of the likely impact of the wind farm on navigation in the immediate area of the wind farm in accordance with the relevant marine guidance** • **Cumulative and in-combination risks associated with the development and other developments (including other wind farms) in the same area of sea.** **[Paragraph 2.8.190]**	Three 14-day vessel traffic surveys were conducted in compliance with the requirements under MGN654, survey findings are presented in **Section 6.3**. This included a summer, winter and top-up winter survey. The NRA is presented in **Section 9** and has been produced in accordance with MGN654. The cumulative impacts of the Project on vessel routeing, collision and contact, in combination with multiple developments, are examined in **Section 10**.
In some circumstances, applicants may seek declaration of a safety zone around wind turbines and other infrastructure. Although these might not be applied until after consent to the wind farm has been granted. **[Paragraph 2.8.191]**	Applied risk controls, including safety zones, are described in **Section 4.9**. Additional risk control options are identified in **Section 9.8**.
The declaration of a safety zone excludes or restricts activities within the defined sea areas including navigation and shipping. **[Paragraph 2.8.192]**	
Where there is a possibility that safety zones will be sought applicant assessments should include potential effects on navigation and shipping. **[Paragraph 2.8.193]**	
Where the precise extents of potential safety zones are unknown, a realistic worst-case scenario should be assessed. Applicants should consult the MCA for advice on maritime and safety and refer to the government guidance on safety zones as a part of this process. **[Paragraph 2.8.194]**	

NPS Requirement	NRA Reference
Applicants should undertake a detailed NRA, which includes Search and Rescue Response Assessment and emergency response assessment prior to applying for consent. The specific Search and Rescue requirements will then be discussed and agreed post-consent. **[Paragraph 2.8.195]**	Impacts on Search and Rescue (SAR) are described in **Section 8.6**.
Mitigation measures will include site configuration, lighting and marking of projects to take account of any requirements of the General Lighthouse Authority. **[Paragraph 2.8.259]**	Applied risk controls, are described in **Section 4.9**.

Table 2: Relevant shipping and navigation International Planning Commission (IPC) decision making requirements from NPS EN-3

NPS Requirement	NRA Reference
The Secretary of State should not grant development consent in relation to the construction or extension of an offshore wind farm if it considers that interference with the use of recognised sea lanes essential to international navigation is likely to be caused by the development. **[Paragraph 2.8.326]**	Relevant International Maritime Organisation (IMO) routeing measures, including the Liverpool Bay Traffic Separation Scheme (TSS), are considered in relation to the Project and presented in **Section 5.3.3**.
The use of recognised sea lanes essential to international navigation means: **a) anything that constitutes the use of such a sea lane for the purposes of article 60(7) of the United Nations Convention on the Law of the Sea 1982** **b) any use of waters in the territorial sea adjacent to Great Britain that would fall within paragraph (a) if the waters were in a REZ.** **[Paragraph 2.8.327]**	
The Secretary of State should be satisfied that the site selection has been made with a view to avoiding or minimising disruption or economic loss to the shipping and navigation industries with particular regard to approaches to ports and to strategic routes essential to regional, national and international trade, lifeline ferries and recreational users of the sea. **[Paragraph 2.8.328]**	Impact on vessel routeing is described in **Section 8.2** and **Section 8.3** for ferries and other commercial shipping respectively. This includes routeing in typical and adverse weather conditions.
Where after carrying out a site selection, a proposed development is likely to adversely affect major commercial navigation routes, for instance by causing appreciably longer transit times, the Secretary of State should give these adverse effects substantial weight in its decision making. **[Paragraph 2.8.329]**	
Where a proposed offshore wind farm is likely to affect less strategically important shipping routes, the Secretary of State should take a pragmatic approach to considering proposals to minimise negative impacts. **[Paragraph 2.8.330]**	
The Secretary of State should be satisfied that risk to navigational safety is ALARP. It is Government policy that wind farms and all types of offshore transmission should not be consented where they would pose	Impacts to navigation are described in **Section 8** and the guidance and process for producing this NRA set out in **Section 9**. The

NPS Requirement	NRA Reference
unacceptable risks to navigational safety after mitigation measures have been adopted. **[Paragraph 2.8.331]**	cumulative impacts of the Project are examined in **Section 10.** It is demonstrated that there are no unacceptable risks to navigation.
The Secretary of State should be satisfied that the scheme has been designed to minimise the effects on recreational craft and that appropriate mitigation measures, such as buffer areas, are built into applications to allow for recreational use outside of commercial shipping routes. **[Paragraph 2.8.332]**	Impacts on recreational craft are described throughout **Section 8.4.4** and **Section 8.5.4**.
In view of the level of need for energy infrastructure, where an adverse effect on the users of recreational craft has been identified, and where no reasonable mitigation is feasible, the Secretary of State should weigh the harm caused with the benefits of the scheme. **[Paragraph 2.8.333]**	
The Secretary of State should make use of advice from the MCA, who will use the NRA described in paragraphs 2.8.179 and 2.8.180 above. **[Paragraph 2.8.334]**	Relevant stakeholders have been consulted throughout, including the MCA. A summary of the key issues raised during consultation activities, the consultee and the consultation activity undertaken is provided in **Section 3.5.1**. An MNEF was established (see **Section 3.5.1**). A hazard workshop was undertaken and is described in **Section 9.3**. Impacts to navigation are described in **Section 8** and the guidance and process for producing this NRA set out in **Section 9**.
The Secretary of State should have regard to the extent and nature of any obstruction of or danger to navigation which (without amounting to interference with the use of such sea lanes) is likely to be caused by the development in determining whether to grant consent for the construction, or extension, of an offshore wind	Impacts to navigation are described in **Section 8** and the guidance and process for producing this NRA set out in **Section 9**.

NPS Requirement	NRA Reference
farm, and what requirements to include in such a consent. **[Paragraph 2.8.335]**	
The Secretary of State may include provisions, compliant with national maritime legislation and UNCLOS, within the terms of a development consent as respects rights of navigation so far as they pass through waters in or adjacent to Great Britain which are between the mean low water mark and the seaward limits of the territorial sea. **[Paragraph 2.8.336]**	Applied risk controls, including safety zones, are described in **Section 4.9**. Additional risk control options are identified in **Section 9.8**.
The provisions may specify or describe rights of navigation which: **Are extinguished** **Are suspended for the period that is specified in the DCO** **Are suspended until such time as may be determined in accordance with provisions contained in the DCO** **Are exercisable subject to such restrictions or conditions, or both, as are set out in the DCO.** **[Paragraph 2.8.337]**	
The Secretary of State should specify the date on which any such provisions are to come into force, or how that date is to be determined. **[Paragraph 2.8.338]**	
The Secretary of State should require the applicant to publish any provisions that are included within the terms of the DCO, in such a manner as appears to the Secretary of State to be appropriate for bringing them, as soon as is reasonably practicable, to the attention of persons likely to be affected by them. **[Paragraph 2.8.339]**	
The Secretary of State should include provisions as respects rights of navigation within the terms of a DCO only if the applicant has requested such provision be made as part of their application for development consent. **[Paragraph 2.8.330]**	

2.1.3 North West Inshore and North West Offshore Marine Plan

2.1.3.1.1 NPS EN-3 indicates that the decision-maker should take account of the policies and plans in the area, as relevant. The North West Marine Plan, published by the Department for Environment, Food and Rural Affairs (Defra) in 2021, has been considered in this assessment.

2.1.3.1.2 **Table 3** provides a summary of the key guidance from the North West Marine Plan relevant to shipping and navigation.

Table 3: North West Inshore and North West Offshore Marine Plan guidance relevant to shipping and navigation

Policy Code	Key Provisions	NRA Reference
NW-DD-1	In line with the NPS for Ports, sustainable port and harbour development should be supported. Only proposals demonstrating compatibility with current port and harbour activities will be supported. Proposals within statutory harbour authority areas, or their approaches that detrimentally and materially affect safety of navigation, or the compliance by statutory harbour authorities with the Open Port Duty or the Port Marine Safety Code (PMSC), will not be authorised, unless there are exceptional circumstances. Proposals that may have a significant adverse impact upon future opportunity for sustainable expansion of port and harbour activities, must demonstrate that they will, in order of preference: ▪ avoid ▪ minimise ▪ mitigate adverse impacts so they are no longer significant If it is not possible to mitigate significant adverse impacts, proposals should state the case for proceeding.	Impacts to commercial vessel routes into ports and harbours is assessed throughout **Section 8**.
NW-DD-2	Proposals that require static sea surface infrastructure, or that significantly reduce under-keel clearance, must not be authorised within, or encroaching upon, International Maritime Organization (IMO) routeing systems, unless there are exceptional circumstances.	Location of IMO adopted routeing measures outlined in **Section 5.3.3** and impacts on vessel traffic routeing in **Section 8.2** and **Section 8.3**.
NW-DD-3	Proposals that require static sea surface infrastructure, or that significantly reduce under-keel clearance, which encroaches upon high density navigation routes, strategically important navigation	Impacts on ferry traffic routeing in **Section 8.2**.

Policy Code	Key Provisions	NRA Reference
	routes, or that pose a risk to the viability of passenger services, must not be authorised, unless there are exceptional circumstances.	
NW-DD-4	Proposals promoting or facilitating sustainable coastal and/or short sea shipping, as an alternative to road, rail or air transport, will be supported, where appropriate.	Future case traffic profile presented in **Section 7**.

2.2 PRIMARY GUIDANCE

2.2.1 MGN 654

2.2.1.1.1 The principal guidance document for a NRA is the MCA's MGN 654 (2021a). MGN 654 describes the potential shipping and navigation issues which should be considered by developers when proposing offshore renewable energy installations (OREIs). Annex 1 (2021b) of the MGN provides a detailed methodology for assessing the marine navigational safety risks of OREIs. In particular, by following the methodology, the NRA should be:

- Proportionate to the scale of the development and magnitude of risks
- Based on the risk assessment approach of the Formal Safety Assessment (FSA)
- Capable of utilising techniques and methods which produce results which are acceptable to the Government
- Compare the base case and future case risks in the study area, before predicting the impacts of the OREIs on that risk, through a hazard log
- Determine which risk controls should be put in place to minimise the risks to ALARP

2.2.1.1.2 Several annexes are associated with MGN 654 and have been utilised to support this NRA:

- Annex 1 provides a standardised format of submission, which is described in **Table 4**
- Annex 2 provides guidance on windfarm shipping route interactions
- Annex 3 provides guidance on Under Keel Clearance (UKC)
- Annex 4 provides hydrography guidelines
- Annex 5 contains guidance on requirements, guidance and operational considerations for search and rescue and emergency response (MCA, 2021c)
- An MGN 654 checklist is provided in Annex 6, which is included as **Appendix A**.

Table 4: MGN 654 Annex 1 Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations

The following content is included:	Compliant	The following content is included:
A risk claim is included supported by a reasoned argument and evidence	Yes	The risk assessment conducted in **Section 9** and is supported by: ▪ Data analysis (**Section 6**) ▪ Consultation (**Section 3.5.1**) ▪ Review and discussion of impacts (**Section 8**) Therefore, a risk claim is made in **Section 11.**
Description of the marine environment	Yes	A description of the baseline marine environment is provided in **Section 5.**
Description of the OREI development and how it changes the marine environment	Yes	A description of the OREI development is provided in **Section 4**. Potential impacts are described in **Section 8**.
Analysis of the Marine Traffic	Yes	A detailed analysis of the baseline vessel traffic is provided in **Section 6.4**. **Section 7** presents the future baseline traffic profile. The impacts of the OREIs on that traffic is contained within **Section 8**.
Status of the hazard log	Yes	The NRA is provided in **Section 9**. The hazard log is provided in **Appendix D.**
Navigation Risk Assessment	Yes	The NRA is provided in **Section 9**.
Search and Rescue overview and assessment	Yes	Existing Search and Rescue (SAR) provision is described in **Section 5.6**. An assessment of impacts of the windfarm site to SAR and emergency response is provided in **Section 8.6**.
Emergency Response Overview and Assessment		
Status of Risk control log	Yes	Embedded mitigation is contained within **Section 4.9**. Additional risk controls are provided in **Section 9.8**.
Major Hazards Summary	Yes	A summary of the principal impacts of the Project are contained within **Section 8** and an NRA reported in **Section 9**.
Statement of Limitation	Yes	Any limitations or assumptions of this assessment are reported in their relevant sections.
Through Life Safety Management	Yes	Embedded mitigation is contained within **Section 4.9**. Additional risk controls are provided in **Section 9.8**.

2.2.2 Formal Safety Assessment process and methodology

2.2.2.1.1 The IMO Formal Safety Assessment (FSA) process has been applied within this NRA. The guidelines for FSA were approved in 2002 and were most recently amended in 2018 by MSC-MEPC.2/Circ.12/Rev.2.

2.2.2.1.2 The FSA is a structured and systematic methodology, aimed at enhancing maritime safety, including protection of life, health, the marine environment and property, by using risk analysis and, if appropriate, cost-benefit assessment. The IMO FSA guidance defines a hazard as "a potential to threaten human life, health, property or the environment", the realisation of which results in an incident or accident. The potential for a hazard to be realised (i.e. likelihood) can be combined with an estimated, or known, consequence of outcome and this combination is termed "risk". There are five steps within the FSA process.

- Step 1: Identification of hazards
- Step 2: Risk analysis
- Step 3: Risk control options
- Step 4: Cost-benefit assessment (if applicable)
- Step 5: Recommendations for decision making

2.3 ADDITIONAL GUIDANCE AND LESSONS LEARNT

2.3.1.1.1 Additional guidance is available and has been used to inform this NRA, which is summarised in **Table 5** and **Table 6**.

Table 5: Summary of additional relevant guidance

Guidance	Description
MGN 372: OREIs: Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA, 2008).	Issues to be taken into account when planning and undertaking voyages near offshore renewable energy installations off the UK coast.
International Association of Lighthouse Authorities (IALA) G1162 The Marking of Offshore Man-Made Structures (IALA, 2021).	Guidance on the lighting and marking arrangements for OWFs.
RYA Position of Offshore Renewable Energy Developments: Wind Energy (RYA, 2019).	Describes key impacts of OWFs on recreational activities.
World Association for Waterborne Transport Infrastructure (PIANC) WG161 Interaction Between Offshore Windfarms and Maritime Navigation (PIANC, 2018).	Provides guidelines and recommendations on impacts on mitigations for shipping routes near OWFs.

Guidance	Description
Nautical Institute (2013) The Shipping Industry and Marine Spatial Planning	Guidance on benefits and risks of marine spatial planning for shipping and navigation.
G+ IOER (2019) Good practice guidelines for offshore renewable energy developments	Guidance on emergency response for OWFs.

Table 6: Lessons learnt and supporting studies

Guidance	Description
MCA and QinetiQ (2004) Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle windfarm by QinetiQ and the Maritime and Coastguard Agency	Reporting of trial on impacts of OWF on shipboard equipment.
MCA (2005) Offshore Windfarm Helicopter Search and Rescue Trials Undertaken at the North Hoyle Wind Farm Reporting of trial on impacts of OWF on SAR equipment and activities.	Reporting of trial on impacts of OWF on SAR equipment and activities.
British Wind Energy Association (BWEA) (2007). Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Windfarm	Reporting of trial on impacts of OWF on shipboard equipment.
MCA (2019) MCA report following aviation trials and exercises in relation to offshore windfarms	Reporting of trial on impacts of OWF on SAR equipment and activities and the implications on OWF design.
Rawson and Brito (2021) Assessing the validity of navigation risk assessments: a study of offshore windfarms in the UK	Analysis of historical incidents in UK OWFs.
Ocean Studies Board's Division on Earth and Life Studies (2022). Wind Turbine Generator Impacts to Marine Vessel Radar	Review of impacts of OWFs on marine radar.
Walney Extension Offshore Windfarm Application (c.2013)	Documents associated with application for Walney Extension offshore windfarm.
Rhiannon Offshore Windfarm Scoping Report (2012).	Documents associated with application for Rhiannon offshore windfarm.
Awel Y Mor Offshore Windfarm Application (c. 2021)	Documents associated with application for Awel Y Mor offshore windfarm.

Guidance	Description
Anatec (2016). Influence of UK Offshore Windfarm Installation on Commercial Vessel Navigation	Analysis of impact of offshore windfarms on ship routes from historical data.
Mona Offshore Wind Project PEIR (2023)	Preliminary findings of the impacts of the projects and how they could be mitigated
Morgan Offshore Wind Project Generation Assets PEIR (2023)	
Morgan and Morecambe OWFs: Transmission Assets PEIR (2023)	

3. NRA METHODOLOGY AND DATA SOURCES

3.1 METHODOLOGY

3.1.1.1.1 The NRA has been produced in accordance with MGN 654 (see **Section 2.2.1**) and follows the IMO's FSA approach (**Section 2.2.2**). This assessment considers all identified impacts of the Project on shipping and navigation receptors. **Figure 2** provides a workflow of the FSA approach as is applied within this NRA. The FSA defines a risk as "the combination of frequency and the severity of the consequence" (IMO, 2018). Therefore, the likelihood and consequence of these impacts are assessed through the collection of significant datasets and consultation. Details on the risk criteria and matrix methodology are contained within **Section 9**.

3.2 DEFINITION OF STUDY AREA

3.2.1.1.1 The study area for the NRA is defined as an area 10 nautical miles (nm) around the windfarm site and presented in **Figure 1**. The proposed study area is industry best practice for shipping and navigation assessment chapters.

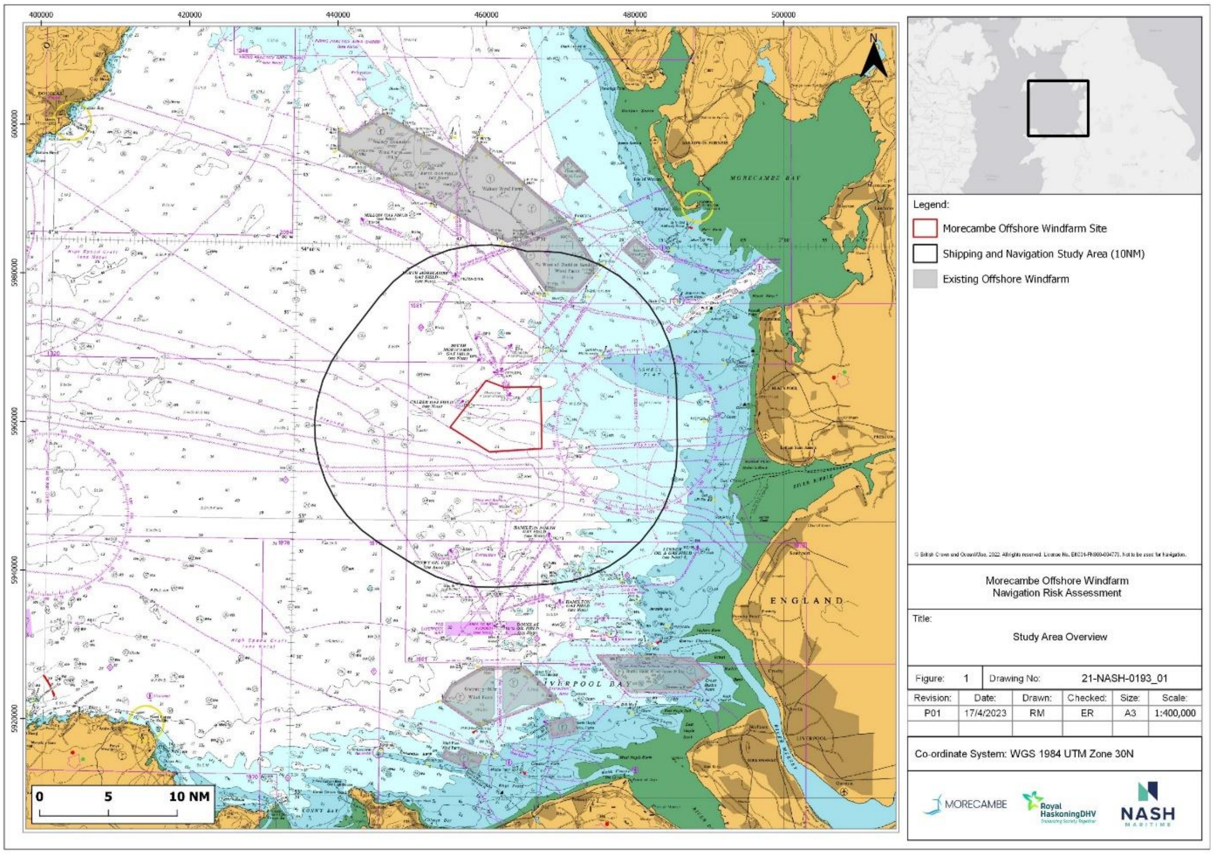


Figure 1: Study area

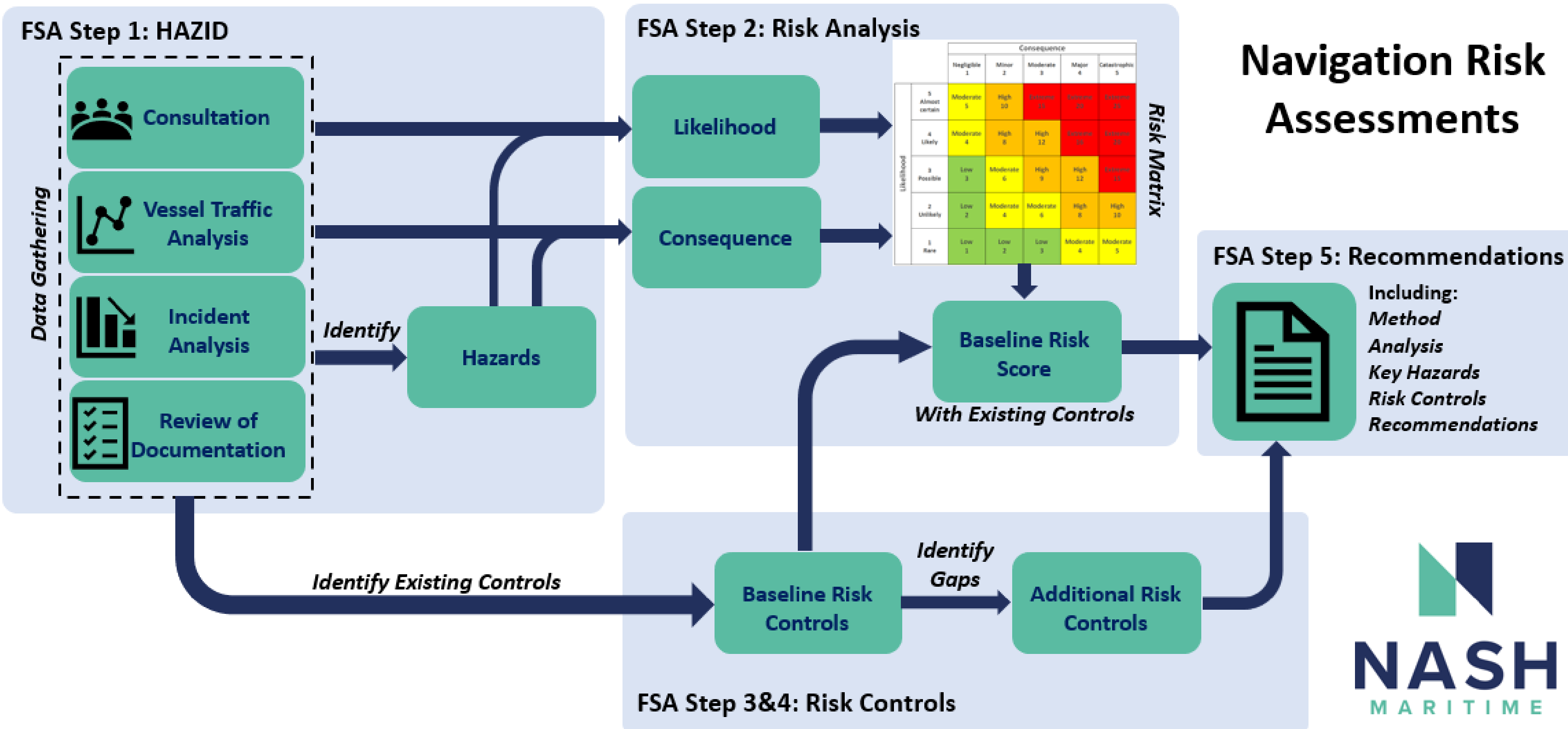


Figure 2: NRA methodology

3.3 IALA RISK MANAGEMENT TOOLS

3.3.1 Qualitative risk assessment – SIRA

3.3.1.1.1 The IALA Simplified IALA Risk Assessment method (SIRA) follows the FSA process and allows Competent Authorities (and other organisations) to assess maritime and navigation risk in their waters, so that they can meet their obligations for the management of navigation safety (e.g. obligations under international conventions such as SOLAS, national domestic legislation, etc.).

3.3.1.1.2 Details of the overarching methodology are provided in the following IALA Guidance:

- Guideline 1018 - Risk Management
- Guideline 1138 - The Use Of The Simplified IALA Risk Assessment Method

3.3.2 Quantitative risk modelling - IWRAP

3.3.2.1.1 The IALA Waterway Risk Assessment Program (IWRAP Mk II) is a quantitative tool for calculating the frequency of collisions, groundings and allisions for navigating vessels in a given waterway. The tool was developed by IALA to support coastal states in conducting risk assessments to address obligations under Safety of Life at Sea (SOLAS) Chapter V. The tool has been presented at the IMO (e.g. NAV 52/17/2 and SN.1/Circ.296) and used by Coastal States (including UK, Denmark and Sweden) to support the assessment of new routeing measures (e.g. NCSR 5/INF.3). The tool has also had widespread use in assessing risk for OREI, both in the UK, Norway and elsewhere.

3.3.2.1.2 IALA (2017) Guideline G1123 contains guidance on implementing the tool and the underlying mechanics are presented in Friis-Hansen (2008).

3.4 CUMULATIVE NRA APPROACH

3.4.1.1.1 A separate cumulative regional NRA (CRNRA) has been produced in collaboration between the developers of the Morgan Offshore Wind Project Generation Assets, Mona Offshore Wind Project, Morecambe Offshore Windfarm Generation Assets, and Morgan and Morecambe Offshore Windfarms Transmission Assets. The purpose of this collaborative approach is to assess the relevant potential cumulative effects of the infrastructure of all four Projects on shipping and navigation receptors. The objectives are to provide a focused assessment of the key cumulative effects associated with the four Projects, and in particular, the safety of navigation through the routes formed between and around them and other surface piercing structures (principally existing OWFs and oil and gas platforms) during the operational and maintenance phase of the projects. The focus of the CRNRA was to enable a detailed assessment of the key concerns of stakeholders, principally the formation of routes between the windfarm sites.

3.4.1.1.2 This assessment dovetails with the individual NRAs undertaken for each of the four offshore windfarm projects. The findings of the CRNRA are summarised in **Section 10** and the full report available in Appendix 14.2 Cumulative Regional Navigational Risk Assessment (Document Reference 5.2.14.2).

3.5 SUMMARY OF DATA SOURCES AND INFORMATION GATHERED

3.5.1 Consultation and engagement

3.5.1.1.1 Consultation meetings were undertaken prior to, and during, the NRA to interface with stakeholders at an early stage and as part of assessing risk during the NRA.

3.5.1.1.2 **Table 7** summarises consultation undertaken as part of the NRA, which has included a range of forums and stakeholder responses to submissions. These were:

- MNEF (2021-2024), a shipping and navigation engagement forum was established in 2021. The purpose was to enable developers to regularly update stakeholders on plans and progress of the Morecambe Offshore Windfarm and the Morgan and Mona Offshore Wind Projects, and for stakeholders to express views or concern on the impacts of the projects for discussion and, where possible, resolution (**Appendix B**).
- Consultation with stakeholders between February 2022 and April 2022 to introduce the Project, and for stakeholders to express views or concern on the impacts of the Project.
- Hazard workshops held in Liverpool on 11 October 2022 and 29 September 2023 (details of which are summarised in **Section 9.3**).
- Full bridge simulator sessions conducted with ferry operators at HR Wallingford throughout 2022 and 2023 (details of which are contained in Appendix E of Appendix 14.2 Cumulative Regional Navigational Risk Assessment (Document Reference 5.2.14.2).
- Scoping Opinion responses (details of which are summarised in Chapter 14 Shipping and Navigation).
- Section 42 [of Planning Act, 2008] consultation responses (details of which are summarised in Chapter 14 Shipping and Navigation).

Table 7: Consultation summary

Date	Consultees	Source	Purpose and Issues Raised	Response to Issues within this NRA
2021 - 2024	MNEF Consultees (see **Appendix B**)	Engagement Meeting Forum	To disseminate information regarding the Morecambe, Morgan and Mona projects within a wide stakeholder forum and to identify and discuss any key navigational concerns.	Issues raised associated with cumulative risk were addressed by undertaking a detailed CRNRA (**Section 10**).
07-Feb-22	Seatruck Ferries Stena Line Isle of Man Steam Packet Company (IoMSPC)	Meeting	Initial meeting with ferry companies to provide an overview of the Project and identify key impacts. All ferry operators agreed that the cumulative impact of the developments was the most significant issue, especially in relation to Morgan/ Mona sites. Ferry operators were keen to be seen as a body of stakeholders, not individual companies as the Project progresses.	Issues raised associated with cumulative risk were addressed by undertaking a detailed CRNRA (**Section 10**). Further consultation with ferry operators was undertaken as a group with the Morgan and Mona projects.
09-Feb-22	Chamber of Shipping (CoS) IoMSPC	Meeting	Initial meeting to provide an overview of the Project and identify key impacts. CoS questioned how an NRA will be delivered with so many other projects running concurrently and that it is not a project that can be assessed in isolation. Other concerns were raised over scheduling and timetabling of ferries and other logistics, time commitment and expenditure for consultation, and scheduling of HAZID workshops prior to completion of the summer vessel traffic survey. CoS suggested that analysis of Automated Information Systems (AIS) data would aid the identification of regular users of the area as key consultees.	Issues raised associated with cumulative risk posed by multiple projects were addressed by undertaking a detailed CRNRA with Morgan, Mona and Morecambe OWFs (**Section 10**). Impacts to scheduling and timetabling of ferries and other vessels is contained within **Section 8.2.3**. The hazard workshops were rescheduled to enable inclusion

Date	Consultees	Source	Purpose and Issues Raised	Response to Issues within this NRA
				of the summer vessel traffic data. Detailed analysis of full fidelity AIS data was undertaken and shared with stakeholders.
03-Mar-22	MCA	Meeting	Initial meeting to provide an overview of the Project and identify key impacts. MCA noted if Morgan, Mona and Morecambe projects are to go ahead, there will need to be changes to the Red Line Boundaries, commenting although MCA appreciate the windfarm site needs to consider capacity, all projects are concerning to the ferry companies.	Issues raised associated with cumulative risk posed by multiple projects were addressed by undertaking a detailed CRNRA with Morgan, Mona and Morecambe OWFs (**Section 10**).
09-Mar-22	Defence Infrastructure Organisation (DIO)	Meeting	Initial meeting to provide an overview of the Project and identify key impacts. DIO suggested the Project completes a pre-application to determine the impact of the Project to Ministry of Defence (MoD) activities to determine potential impacts of the development to line of sight and highlight major MoD activity in the area.	The Project undertook a pre-application request from DIO (**Section 8.8**).
10-Mar-22	Peel Ports Associated British Ports (ABP) Isle of Man Harbours and Coastguard (IoMHC)	Meeting	Initial meeting to provide an overview of the Project and identify key impacts. The cumulative impact of Morecambe with Morgan and Mona projects was raised as a significant concern. Further comments were made on the potential impacts to radar, and freight, cargo and passenger services.	Issues raised associated with cumulative risk posed by multiple projects were addressed by undertaking a detailed CRNRA with Morgan, Mona and Morecambe OWFs (**Section 10**). The impact to shipping routes for the combined projects is detailed in **Section 7.2, 7.3** and **7.4** of the CRNRA.

Date	Consultees	Source	Purpose and Issues Raised	Response to Issues within this NRA
12-May-22	RYA	Meeting	Initial meeting to provide an overview of the Project and identify key impacts. RYA noted the timing of the early August summer vessel traffic survey. RYA considers mid-July to mid-August as optimum period as organised recreational events tend to decline after this. RYA suggested the Project benchmark survey data with pre-COVID AIS data to ascertain recreational craft seasonality. RYA highlighted the need to consider Morgan, Mona and Morecambe projects together, in particular impacts on recreational craft, ferry routes and increase in space conflict with between maritime users. RYA commented on the south-eastern area of the windfarm site, which is a moderately used area for recreational craft, suggesting a further understanding of recreational use in the area would be beneficial.	Benchmark of data was undertaken based on the 2019 AIS data. Following the PEIR, a 2022 AIS dataset has been obtained to provide greater recency for the analysis. Issues raised associated with cumulative risk posed by multiple projects were addressed by undertaking a detailed CRNRA with Morgan, Mona and Morecambe OWFs (**Section 10**). Summer survey analysis and 2019 AIS data was used to determine magnitude of recreational vessel traffic activity, particularly to the south-east of the site. The summer survey was conducted in late July to mid-August 2022 to align with feedback received during consultation with the RYA.
09-Aug-22	Seatruck Ferries Stena Line IoMSPC CoS MCA Trinity House (TH)	Meeting	Follow up meeting to provide an update of the shipping and navigation Project timeline, including survey, consultation and HAZID, present ferry operator passage plans alongside full-year AIS ferry track data and other vessel types and refine understanding of passage planning and adverse weather routing. Key issues raised:	Issues raised associated with cumulative risk posed by multiple projects were addressed by undertaking a detailed CRNRA with Morgan, Mona and Morecambe OWFs (**Section 10**).

Date	Consultees	Source	Purpose and Issues Raised	Response to Issues within this NRA
			- Difficulties of providing comment on individual projects without knowing the cumulative effect of other schemes both planned and unplanned in the area (Seatruck Ferries) - How future vessel traffic can be understood in the cumulative assessment (IoMSPC) - Impact of the Project to Liverpool to Belfast ferry route, with concerns over safety and sea miles (Stena Line) - Decommissioning schedules for fixed assets and platforms in the Irish Sea should be considered in the PEIR (CoS) - Increase in passenger traffic on IoMSPC routes, with an additional vessel confirmed transiting the Liverpool/Douglas route (IoMSPC) - Displacement of vessels leading to vessel-to-vessel interaction (CoS) - Increase in tug and service vessels with risk increasing due to the concentration of vessels in one place (Seatruck Ferries) - Future adverse weather routing is dependent on the outcome of other projects in the area (Seatruck Ferries)	Impacts to ferry routes and operations are described in **Section 8.2**). Oil and Gas decommissioning and expected change in vessel traffic associated with oil and gas activity is described in **Section 7.3**. Future vessel traffic is addressed in **Section 7**. Adverse weather routing for ferries is addressed in **Section 8.2.3**.
12-October-2022	Workshop Attendees	Workshop	A hazard workshop was undertaken to inform the PEIR NRA, during which stakeholders raised a number of key navigation issues (see Appendix C).	Issues raised associated with cumulative risk posed by multiple projects were addressed by undertaking a detailed CRNRA with Morgan, Mona and Morecambe OWFs (**Section 10**).

Date	Consultees	Source	Purpose and Issues Raised	Response to Issues within this NRA
23-25 May 2023	Stena Line	Workshop	Update to navigation bridge simulations considering Project site boundary and layout changes.	A summary of the navigation simulations is provided in **Section 3.5.5**.
22-23 June 2023	Seatruck	Workshop	Update to navigation bridge simulations considering Project site boundary and layout changes.	A summary of the navigation simulations is provided in **Section 3.5.5**.
13-15 September 2023	IoMSPC	Workshop	Update to navigation bridge simulations considering Project site boundary and layout changes.	A summary of the navigation simulations is provided in **Section 3.5.5**.
29 September 2023	Workshop Attendees	Workshop	This hazard workshop followed an identical structure and methodology to the first workshop (held in October 2022) to consider site boundary and layout changes made for the Project, and for Mona and Morgan projects. The workshop was attended by many of the same stakeholder groups.	Issues raised associated with cumulative risk posed by multiple projects were addressed by undertaking a detailed CRNRA with Morgan, Mona and Morecambe OWFs (**Section 10**). Details of the Project hazard workshop, attendees, the issues raised by stakeholder concerns and the workshop results are contained in **Section 9.3** and **Appendix C.** Cumulative impacts are assessed in **Section 10**.
07 December 2023	Seatruck	Meeting	Review of engagements and assessments to date. Identification of potential increases in risk to vessels and residual impacts on commercial operations. Cumulative impacts associated with Mooir Vannin Offshore Wind Farm.	A summary of engagement is provided in **Section 3.5.1**. Impacts to navigational safety are described in **Section 8**. Impacts to ferry routes are described in **Section 8.2**. Cumulative impacts are assessed in **Section 10**.

Date	Consultees	Source	Purpose and Issues Raised	Response to Issues within this NRA
11 December 2023	IoMSPC	Meeting	Review of engagements and assessments to date. Identification of potential increases in risk to vessels and residual impacts on commercial operations. Cumulative impacts associated with Mooir Vannin Offshore Wind Farm.	A summary of engagement is provided in **Section 3.5.1**. Impacts to navigational safety are described in **Section 8**. Impacts to ferry routes are described in **Section 8.2**. Project impacts are assessed in **9**. Cumulative impacts are assessed in **Section 10**.
13 December 2023	Stena Line	Meeting	Review of engagements and assessments to date. Identification of potential increases in risk to vessels and residual impacts on commercial operations. Cumulative impacts associated with Mooir Vannin Offshore Wind Farm.	A summary of engagement is provided in **Section 3.5.1**. Impacts to navigational safety are described in **Section 8**. Impacts to ferry routes are described in **Section 8.2**. Project impacts are assessed in **9**. Cumulative impacts are assessed in **Section 10**.
18 December 2023	Trinity House	Meeting	Review of engagements and assessments to date. Identification of potential increases in risk to vessels and residual impacts on commercial operations. Cumulative impacts associated with Mooir Vannin Offshore Wind Farm.	A summary of engagement is provided in **Section 3.5.1**. Impacts to navigational safety are described in **Section 8**. Impacts to ferry routes are described in **Section 8.2**. Project impacts are assessed in **9**. Cumulative impacts are assessed in **Section 10**.
19 December 2023	MCA	Meeting	Review of engagements and assessments to date, and review of findings of the shipping and navigation assessments. Cumulative impacts associated with Mooir Vannin Offshore Wind Farm.	A summary of engagement is provided in **Section 3.5.1**. Impacts to navigational safety are described in **Section 8**.

Date	Consultees	Source	Purpose and Issues Raised	Response to Issues within this NRA
				Project impacts are assessed in **9**. Cumulative impacts are assessed in **Section 10**.

3.5.2 Vessel traffic datasets

3.5.2.1.1 Vessel traffic data from several sources was utilised to determine baseline conditions:

- High fidelity AIS data for 2019 and 2022 for study area (Source: MarineTraffic);
- Vessel traffic surveys of the study area (see **Appendix E** for survey reports):
- Survey 1: 14 day winter vessel traffic survey (09-Feb-22 to 26-Feb-22[1]) collecting AIS, radar and visual observations
- Survey 2: 14 day summer vessel traffic survey (30-July-22 to 13-Aug-22[1]) collecting AIS, radar and visual observations
- Survey 3: 14 day winter vessel traffic survey (27-Nov-23[1] to 13-Dec-23) collecting AIS, radar and visual observations[2]
- MMO 2019 anonymised AIS data
- RYA Coastal Atlas
- UK Vessel Monitoring Systems (VMS) 2020 Data
- Department for Transport (DfT) Shipping Statistics (2000 to 2022)

3.5.3 Incident datasets

3.5.3.1.1 Three accident datasets were utilised to support this assessment:

- Marine Accident Investigation Branch (MAIB) accidents database (1992-2022)
- Royal National Lifeboat Institute (RNLI) incident data (2008-2022)
- DfT SAR Helicopter taskings (2015-2022)

3.5.4 Other datasets

3.5.4.1.1 Other datasets utilised to support this assessment include:

- Marine Aggregate Dredging Licenses (Crown Estate 2023)
- Offshore Renewables Lease Areas (Crown Estate 2023)
- Oil and Gas Activity, Location and Status (Oil and Gas Authority, 2023)
- Admiralty Charts (2023)
- Admiralty Sailing Directions (NP40 Irish Coast Pilot, 2019 and NP37 West Coasts of England and Wales Pilot, 2022)

[1] Survey duration includes periods of weather downtime.
[2] Additional survey data collected to validate Survey 1 baseline data

- Tidal Data (Admiralty Total Tide)
- MetOcean Data (Sailing Directions) (NP40 Irish Coast Pilot 2019)

3.5.5 Full bridge simulations

3.5.5.1.1 Full bridge simulations of ferry passages through the Irish Sea were commissioned for the Morecambe, Mona and Morgan projects to assess the PEIR windfarm site (array) boundaries in 2022 and the revised ES windfarm site boundaries in 2023. The aim of the simulations was to understand, in more detail, potential navigation impacts of the projects on existing commercial ferries and to test the viability and safety of commercial ferry transits between and around the projects in normal and adverse weather conditions.

3.5.5.1.2 The simulations were administered by HR Wallingford at their UK Ship Simulation Centre, following initial engagement in which the scope of the simulations, simulation scenarios and assessment criteria were agreed together with verification of the ship models being tested. Each simulation session was attended by ferry masters and officers and is summarised in **Table 8**.

3.5.5.1.3 The assessment criteria and simulation scenarios used within the simulations were developed and agreed with the ferry companies prior to each simulator run. Realistic traffic scenarios, emergency situations and normal/adverse weather conditions were determined based off the analysis contained within this NRA, and consultation with ferry operators. A detailed report of the findings of the simulations has been produced (Appendix E of Appendix 14.2 Cumulative Regional Navigational Risk Assessment (Document Reference 5.2.14.2)).

Table 8: Simulation sessions

Operator	Model Verification Session	PEIR Session (Mona / Morgan Only)	ES Session (Mona, Morgan, Morecambe)
IoMSPC	21-22 July-2022	16-19 Aug-2022	12-14 Jun-2023 (project teams only) 13-15 Sep-2023
Stena Line	11-12 Aug-2022	23-25 Aug-2022	23-25 May 2023
Seatruck Ferries	Previously agreed with HR Wallingford	08-09 Sep-2022	22-23 Jun-2023
P&O (Project team only)	N/A	26-Aug-2022	N/A

3.5.5.1.4 The 2022 PEIR simulations resulted in numerous failed runs, particularly during adverse weather and with complex traffic situations. The Morecambe windfarm site was not included in these simulations as it did not affect the adverse weather routeing being tested.

3.5.5.1.5 As part of the updated CRNRA, considering the amended Morgan, Mona and Morecambe project boundaries, the Navigation Simulations were repeated between May and September 2023 with a total of 35 additional runs carried out. The key findings of the updated navigation simulations were as follows:

- The ES boundaries significantly improved navigation over the 2022 PEIR boundaries
- Collision risk whilst navigating between and around the Mona, Morgan and Morecambe arrays was manageable with existing operational procedures in complex, worst credible traffic situations. These were in full compliance with COLREGs and the practice of good seamanship
- Routes remain susceptible to adverse weather, which necessitate longer deviations with Mona, Morgan and Morecambe in place
- Vessels operating near or within the offshore windfarms were apparent by radar and visual means and any collision risk situation could be determined by the passing ferries
- During emergency situations, there remained some optionality for Masters to best position their vessel to respond
- None of the simulated scenarios were appreciably more challenging at night than during the day

3.5.5.1.6 The full findings of the Session 2 simulations conducted in 2023 are reported in Appendix E of Appendix 14.2 Cumulative Regional Navigational Risk Assessment (Document Reference 5.2.14.2).

4. PROJECT DESCRIPTION

4.1 INTRODUCTION

4.1.1.1.1 This section provides an overview of the Project by setting out its main components, as outlined within the ES project description. It also gives an overview of the main activities that will be undertaken during construction, operation and maintenance, and decommissioning.

4.2 GENERATION ASSETS

4.2.1 Layout

4.2.1.1.1 The WTG and OSP positions within the windfarm site will be refined following further data gathering and analysis, and finalised post-consent in consideration of design rules.

4.2.1.1.2 The WTG layout can be described in general terms at this stage. It would have some form of regularity in plan (two lines of orientation), i.e. WTGs would be set out in a regular pattern such that they were aligned in two straight, intersecting rows. In-row spacing is the distance separating WTGs in the main rows, which are generally orientated perpendicular to the prevailing wind, or as close to this as is practicable. Inter-row spacing is the distance between the main rows.

4.2.1.1.3 It should also be noted there may be locations within the regular grid of WTGs left unoccupied. This could be due to less favourable ground conditions or exclusion distances from existing infrastructure.

4.2.1.1.4 A layout plan will be submitted to the MCA and TH for review prior to installation. The required lighting and navigational markings will also be agreed post consent.

4.2.2 Wind turbine generators

4.2.2.1.1 Parameters for WTGs have been considered for a range of sizes, with a number of foundation options under consideration. Given the range in WTG sizes, two WTG scenarios have been used to encompass the Project Design Envelope (PDE):

- More (35) smaller WTGs
- Fewer (30) larger WTGs

4.2.2.1.2 The current wind turbine design envelope for the windfarm site is outlined in **Table 9**.

Table 9: Wind turbine generator design envelope (also see Figure 3).

Wind Turbine Generator Parameter	Range to be considered	
	Smaller WTGs	Larger WTGs
Maximum number of WTGs	35	30
Rotor diameter (m)	260	280
Maximum blade tip height (m) above highest astronomical tide (HAT)	290	310
Maximum hub height (m above HAT)	160	170
Minimum rotor clearance above sea level (m above HAT)	25	
Indicative rotor speed range (rotations per minute (RPM))	8.42	7.09
Maximum rotor swept area for total windfarm site (km^2)	1.858	
Minimum separation between WTGs (m) in-row	1,060	1,260
Minimum separation between WTGs (m) inter-row	1,410	1,680

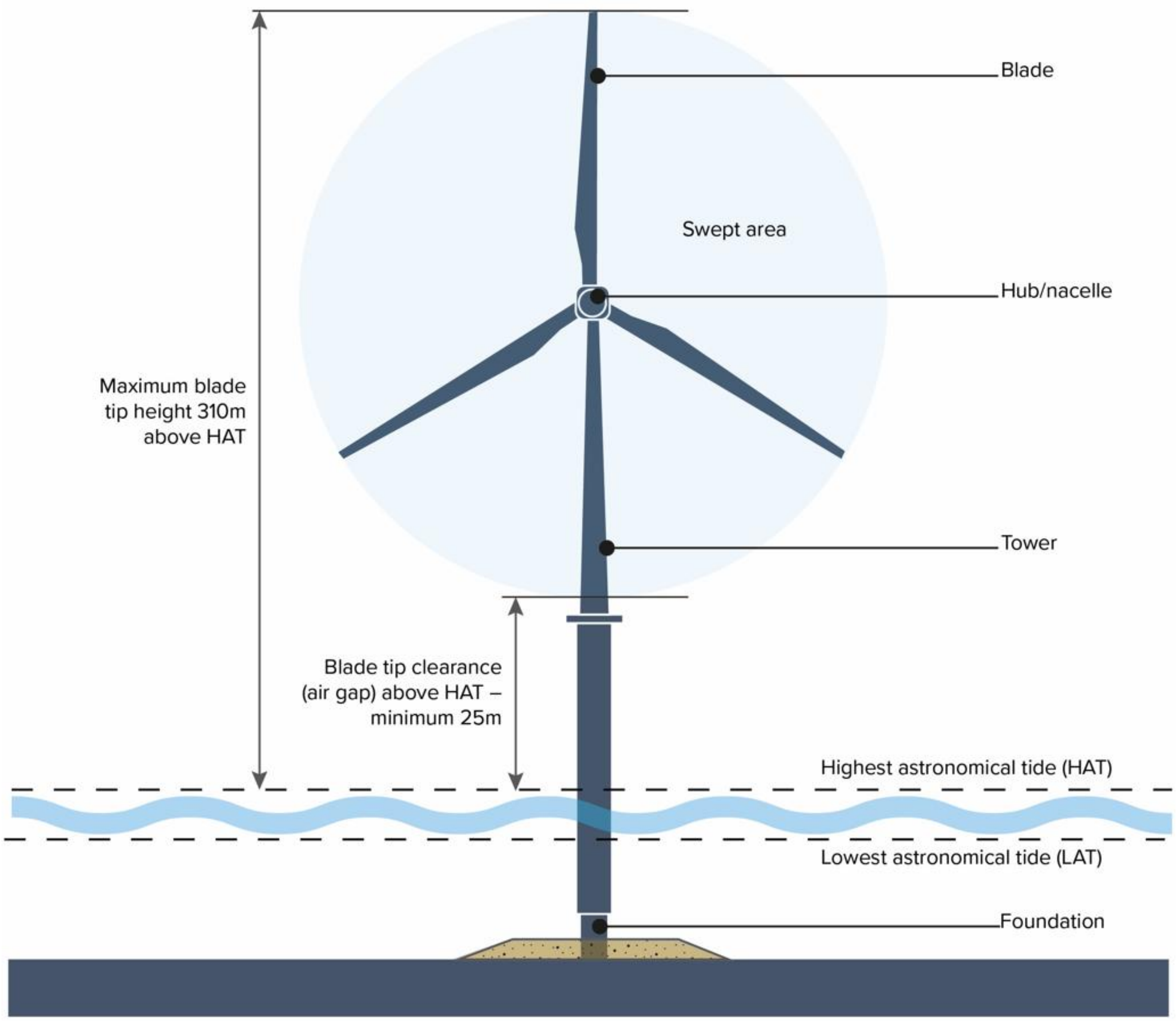


Figure 3: Wind turbine design envelope

4.2.3 Offshore substation platform(s)

4.2.3.1.1 The cables from WTGs will be brought to an offshore substation platform (OSP). Up to two OSPs may be required, depending on the electrical system voltage and final layout. At the OSP(s), the generated power will be transformed to a higher AC voltage suitable for transporting power to the onshore electrical transmission network. This higher voltage will be determined by detailed studies. The OSP(s) will be situated within the windfarm site.

4.2.3.1.2 The design of the OSP(s) will include a platform 'topside', supported above sea level on a foundation structure. The typical plan footprint of the OSP(s) will be a maximum of 50m by 50m, with the topsides comprised of several layers/decks stacked on top of another, as required. The highest point of topsides above HAT, including/excluding helideck and lightning protection, will be 50m/70m respectively. It is anticipated that OSP(s) will be installed prior to the WTGs.

4.2.4 WTG and OSP foundations

4.2.4.1.1 WTGs and OSP(s) will be fixed to the seabed with foundation structures. Potential WTG/OSP foundation types being considered are (options are illustrated in **Figure 4**):

- Gravity Base Structures (GBS)
- Multi-legged pin-piled jacket (four-legged[3])
- Monopile
- Multi-legged suction bucket jacket (three-legged jackets)

[3] There is a three-legged option, however the foundation design envelope is encompassed by the four-legged option.

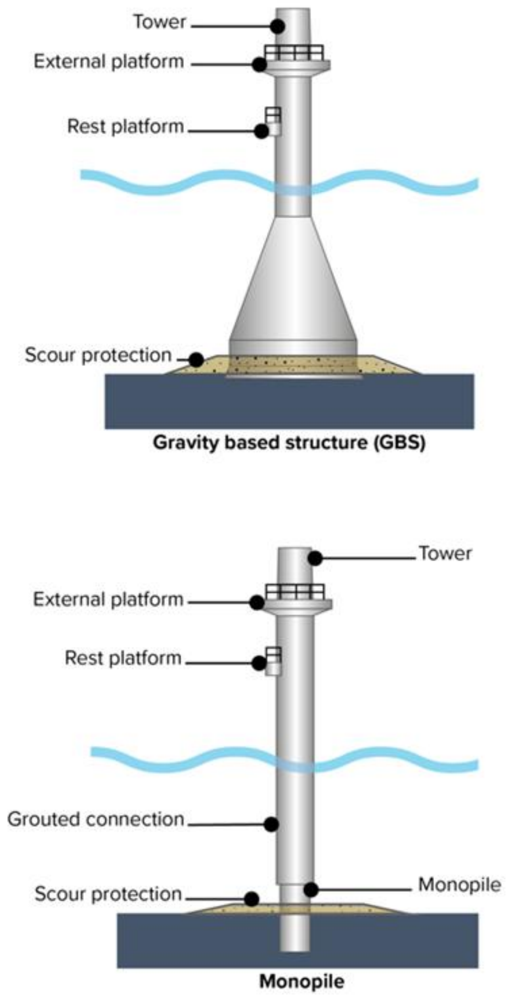


Figure 4: WTG/OSP foundation options

4.2.4.1.2 The foundation parameters are listed in **Table 10**. Seabed levelling may be required for the installation of all foundations.

Table 10: WTG/OSP foundation design envelope

Offshore Foundation Types	Parameter	Maximum
Gravity Base Structures	Maximum base slab diameter (m)	65
	Maximum cone bottom diameter (m)	55
	Maximum cone top/shaft diameter (m)	15
	Maximum cone height (m)	40
	Maximum footprint on the seabed per WTG/OSP (m²)	3,318

Offshore Foundation Types	Parameter	Maximum
	Maximum footprint on the seabed for all WTGs/OSPs (m²)	122,766
Multi-legged pin-piled jacket (four-legged)	Maximum legs per jacket foundation	4
	Maximum pile diameter (m)	3
	Maximum leg spacing at seabed (m)	35
	Maximum footprint on the seabed, pile-edge to pile-edge, per WTG/OSP (m²)	28.5
	Maximum footprint on the seabed for all WTGs/OSPs (m²)	1,055
	Maximum pile penetration depth (m)	56
Monopile	Maximum pile diameter (m)	12
	Maximum footprint on the seabed per WTG/OSP (m²)	114
	Maximum footprint on the seabed for total WTGs/OSPs (m²)	3,648
	Maximum pile penetration depth (m)	56
Multi-legged suction bucket jacket (three-legged jacket)	Maximum legs per suction bucket (jacket) foundation	3
	Maximum bucket diameter (m)	20
	Maximum leg spacing at seabed (m)	35
	Maximum footprint on the seabed per WTG/OSP (m²)	945
	Maximum footprint on the seabed for all WTGs/OSPs (m²)	34,965
	Maximum bucket penetration depth (m)	25

4.2.5 Inter-array and platform link cables

4.2.5.1.1 Array cables connect the WTGs to each other and to the OSP(s). The array cables are expected to be 66kV to 132kV alternating current (AC). The length of each array cable will depend on the final layout.

4.2.5.1.2 Should the windfarm site require two OSPs, platform link cables will be required to connect each of the OSPs to enable transfer of generated power from one side of the windfarm site to the other, and to ensure that electricity transmission can continue in the event of one cable failing.

4.2.5.1.3 Where possible, inter-array and platform link cables will be buried, with depth of burial expected to be between 0.5 and 3m, and a target burial of 1.5m, and can be buried via several techniques depending on the seabed conditions along the route. It is anticipated that approximately 10% of the inter-array and platform link cable length will require additional cable protection due to ground conditions, noting that the burial depth and technique will be determined by a Burial Assessment Study (BAS) and a Cable Burial Risk Assessment (CBRA). The installation techniques include ploughing and trenching (including jetting and mechanical cutting). Where cable burial is not possible, alternative cable protection measures could be used. This includes rock placement and concrete mattresses.

4.2.5.1.4 Cable crossings will also be required where inter-array and platform link cables pass over other cables and/or pipelines.

4.3 OFFSHORE EXPORT CABLE

4.3.1.1.1 As described in **Section 1.1**, the Project and the Morgan Offshore Wind Project were scoped into the Pathways to 2030 workstream under the Offshore Transmission Network Review (OTNR). The output of this process concluded that both projects should work collaboratively in connecting the offshore windfarms to the National Grid at Penwortham, in Lancashire. Therefore, a separate joint consent application is being made for the shared offshore export cable corridors to landfall and shared onshore export cable corridors to onshore substations and grid connection point. The offshore export cable route associated with the Project is therefore not within the scope of this NRA and will be subject to a separate NRA for the joint Transmission Assets. Transmission Assets have been considered in the CRNRA (**Section 10**).

4.4 CONSTRUCTION

4.4.1 Construction Vessels

4.4.1.1.1 The number and specification of vessels employed during the construction of the Project will be determined by the marine contractor and the construction strategy, following successful consent to construct the Project. It is anticipated that several types of construction vessel could work in parallel during the construction period. During construction, it is estimated there will be up to 2,583 annual return vessel trips to deliver and install the main components to the windfarm site, to undertake cable installation and for support and crew vessels. Overall, a maximum number of 37 vessels are expected on site at any one time.

4.4.1.1.2 The final selection of the port facilities required to construct and operate the Project has not yet been determined, however it is assumed the construction port will be in the United Kingdom (UK) and the operational port will be within 50km of the windfarm site.

4.4.2 Unexploded ordnance clearance

4.4.2.1.1 Micro-siting of Project infrastructure will be adopted to avoid unexploded ordnance (UXO) where possible. Where avoidance is not possible for any reason, clearance activities may be required to safely remove or detonate any UXO that present a hazard to the construction activities, or the ongoing operation of the windfarm. Such clearance techniques could involve detonation, relocation or retrieval, with the implementation of appropriate safety zones. Low impact clearance techniques will be used where possible, e.g. low order deflagration.

4.4.2.1.2 Consent for UXO removal will be sought in a future Marine Licence application, when geophysical survey data of suitable spatial resolution is available to identify and quantify UXO risk.

4.4.3 Seabed preparation

4.4.3.1.1 Some form of seabed preparation may be required prior to installation of Project infrastructure. Seabed preparation includes seabed levelling, ground reinforcement, cutting and removal of any out of service cables, and removing surface and subsurface debris, such as boulders, fishing nets, lost anchors etc. If debris are present below the seabed, then excavation may be required for access and removal. Management of UXO is described in **Section 4.4.2**.

4.4.4 Marine construction and installation activities

4.4.4.1.1 The type of WTG/OSP foundation to be installed is yet to be determined and will depend on survey data, metocean data and the selected generator type. The foundations will be fabricated onshore, shipped from the designated loadout port to be marshalled, assembled with other components, and transported to the offshore site.

4.4.4.1.2 GBS will be lifted from barge and lowered to a prepared area of seabed, or adjusted buoyancy of floating foundation and sink to a prepared area of seabed.

4.4.4.1.3 Jacket foundations are anchored to the seabed by using single pin piles at each leg. Depending on seabed soil properties, pre-drilling at pile locations may be required to allow piles to achieve their target penetrations.

4.4.4.1.4 Monopiles can be installed with monohull floating, or jack-up, construction vessels. The monopile will be up-ended by crane to a vertical position and lowered to seabed through a pile guide. A piling rig will be added to the tip of the pile to drive it to the design target depth. Pre-drilling at pile locations may be required to allow piles to achieve their target penetrations.

4.4.4.1.5 It is expected that the WTG components will be lifted onto the installed foundation substructure by a jack-up vessel, typically with four or six legs. Similarly, the OSP substation topsides will be installed onto the OSP foundations using a crane vessel.

4.4.4.1.6 It is assumed that the cable lay vessel will use dynamic positioning for the installation of the inter-array and platform link cables.

4.4.4.1.7 Offshore cables will be buried for protection purposes at depths of between 0.5m and 3m, with a target depth of 1.5m. The length and depth of burial will be determined by a BAS and a CBRA.

4.5 OPERATIONS AND MAINTENANCE ACTIVITIES

4.5.1.1.1 Across the operational life of the windfarm site, operation and maintenance (O&M) activities can be split into three main categories as follows:

- Scheduled maintenance
- Unscheduled maintenance
- Emergency/special maintenance (in the event of major equipment breakdown and repairs)

4.5.1.1.2 The windfarm site will be maintained from shore using a number of varying O&M vessels (e.g. crew transfer vessels, supply vessels). An offshore base, for example a mother ship (a large offshore service vessel) may also be used. Helicopters are anticipated to be used only in exceptional circumstances.

4.5.1.1.3 A number of vessel visits to each WTG/OSP would be required each year to allow for scheduled and unscheduled maintenance. Up to three support vessels are expected on site at any one time during a standard year, with up to ten support vessels expected on site during a 'heavy maintenance' year. A further one jack-up barge may also be required approximately biennially (once every other year). Overall, a maximum of 384 return vessel trips during a standard year and 832 return vessel trips during a heavy maintenance year (expected to be every fifth year) are expected annually, including operational support vessels and those supporting maintenance activities.

4.5.1.1.4 The strategy for O&M will be finalised based on the location of a suitable port, which is yet to be defined. In choosing a suitable port, there will be requirements to ensure sufficient access to a fleet of vessels with the capabilities to complete any required O&M activities. The overall O&M strategy will also reflect the technical specification, once known, including WTG type, electrical transmission design and the final Project layout. At this stage, the high-level offshore activities will include, but not be limited to, the following:

- Inspections of cables, foundations, transition pieces, blades, safety equipment offshore substation equipment (including geophysical surveys to inspect subsea assets)
- Inspection and survey of cable and scour protection (including geophysical surveys to inspect subsea assets)
- System performance assessments and fault-finding
- Replacement of lubricants, oils and filters

- Grout and corrosion inspection and works (including cathodic protection and anode inspection, grouting core samples and re-grouting)
- Replacement of WTG parts, including bearings, gearboxes, generators, nacelles, transformers and blades
- Minor repairs and replacements
- Inspection of marine growth and removal of marine growth and guano
- Structural surveys
- Replenishment of cable and scour protection
- Recovery of dropped objects
- Transport and transfer of staff
- Inspection, maintenance and certification of lifting and lifesaving equipment
- Inspection and maintenance of equipment e.g. metocean equipment, communications systems, coating systems, electrical equipment, navigations aids, design generators, accommodation areas

4.5.1.1.5 Although it is not anticipated that large components would require replacement during the operational phase, it is a possibility. Should this be required, large jack-up vessels may need to operate continuously for significant periods to carry out these major maintenance activities. Replacement of a foundation would require a separate marine licence.

4.5.1.1.6 During O&M activities, the Project would seek to agree appropriate safety zones with the MCA around WTGs and work areas to be applied.

4.6 DECOMMISSIONING

4.6.1.1.1 At the end of the operational lifetime of the windfarm site, provisionally anticipated to be a minimum of 35 years, the decommissioning process will be undertaken in reverse of the construction sequence, involving similar types and numbers of vessels and equipment.

4.6.1.1.2 It is expected that the WTGs will be removed and the remaining foundations below the seabed may be left in a safe and fully buried condition. Any scour protection may also be left in-situ. The removal of OSPs is expected to be undertaken in two distinct stages; first, the topside will be removed from the foundation and transported to shore for onshore decommissioning, and second, the foundations will be removed in a similar manner to that of the WTG foundations. Inter-array and platform link cables may either be left in-situ, the entire cable network removed, or specific sections of the subsea cables could be removed.

4.6.1.1.3 At this stage, the full detail of the required decommissioning activities is not currently known. A decommissioning programme will be prepared and will be refined during the Project's lifetime and as decommissioning approaches. To reflect future best practice and new technologies, the approach and methodologies of the decommissioning activities will be compliant with the relevant legislation, guidance and policy requirements at the time of decommissioning.

4.7 MAXIMUM DESIGN SCENARIO

4.7.1.1.1 Based on a review of the Project description, the Maximum Design Scenario (MDS) used in this NRA is summarised in **Table 11.**

Table 11: MDS for the NRA

Parameter	Value
Project Boundaries	ES Boundary (87km^2) (**Figure 1**)
Operational Life	35 years
Maximum Number of WTGs/OSPs	Between 30 'larger' or 35 'smaller' WTGs, and up to two OSPs
Minimum Spacing Between Turbines (defined by the smaller WTGs)	1,060m in row 1,410m inter-row
Lines of Orientation	Two
Construction/ Decommissioning Base and Activities	Construction: 2.5 years duration Up to 2,583 return vessel movements/year Maximum of 37 vessels on site at any one time Port facilities yet to be determined
O&M Base and Activities	Assume NW England for O&M Base Maximum of 384 return vessel trips during a standard year with up to 3 vessels on site at any one time Maximum of 832 return vessel trips during a heavy maintenance year (expected to be every 5th year) with up to 10 vessels on site at any one time
WTG Size and Parameters	Maximum rotor diameter: 280m Maximum blade tip height: 310m above HAT Minimum blade tip clearance: 25m above HAT

4.8 NAVIGATIONAL MARKERS, LIGHTING AND CHARTING

4.8.1.1.1 Marking and lighting requirements for man-made offshore devices are described in IALA Recommendation G1162 (IALA, 2021) (previously O-139 2013). An Aids to Navigation (AtoN) Plan will be developed in agreement with the General Lighthouse Authority and MCA.

4.8.1.1.2 G1162 outlines the following specific recommendations made for offshore wind turbines (see **Figure 5**):

- Isolated WTGs, met masts and other structures are recommended to be:
- Marked with a white light flashing Mo (U) ≤15s, and with a nominal range of 10nm
- Have AtoN mounted below the lowest point of the arc of any rotor blades. They shall ideally be located at a height of at least six metres above HAT
- Have AtoN that comply with IALA recommendations and have an availability of not less than 99.0% (IALA Category 2)
- **Lettering:** It is recommended that each structure, displays identification panels with black letters or numbers one metre high on a yellow background visible in all directions
- **Painting:** Fixed structures should be painted yellow all around from the level of HAT up to at least 15m
- **Hazard Warning Signals:** Consideration may also be given to the provision of hazard warning signals, where appropriate, taking into account the prevailing visibility and vessel traffic conditions. The range of such a hazard warning signals should not be less than two nm
- **AIS/Racons:** Where there is a requirement to remotely identify a particular structure a radar beacon (racon) and/or an AIS AtoN may be fitted
- **A Significant Peripheral Structure (SPS)** will include the structures on the corners/periphery of an OWF as determined by the competent authority. It is recommended that:
- These lights display a Special Mark characteristic, flashing yellow, with a minimal nominal range of five nm
- The competent authority (AtoN) may consider the synchronization of all SPS of the same light characteristic
- In the case of a large or extended OWF, the distance between SPS should not normally exceed three nm

- On large windfarms, consideration should be given to using different light characteristics for marking SPS on corners of windfarms to those marking structures along the periphery of the windfarm
- SPS - lights visible from all directions in the horizontal plane. It is recommended to synchronize these lights in order to display a Special Mark characteristic, flashing yellow, with a range of not less than five nm
- **Intermediate Peripheral Structures (IPS)** may be considered selected on the periphery of an OWF:
- Are marked with flashing yellow lights
- The flash character of these lights shall be distinctly different from those displayed on the SPS, with a nominal range of two nm
- Have a lateral distance between IPS or the nearest SPS which will not normally exceed two nm
- Intermediate structures on the periphery of an OWF other than the SPS - marked with flashing yellow lights which are visible to the mariner from all directions in the horizontal plane with a flash character distinctly different from those displayed on the SPS and with a range of not less than two nm
- **Promulgation:** Notices to Mariners and the relevant Hydrographic Office must be informed of the marking, location and extent of any man-made structure, to permit the appropriate marking

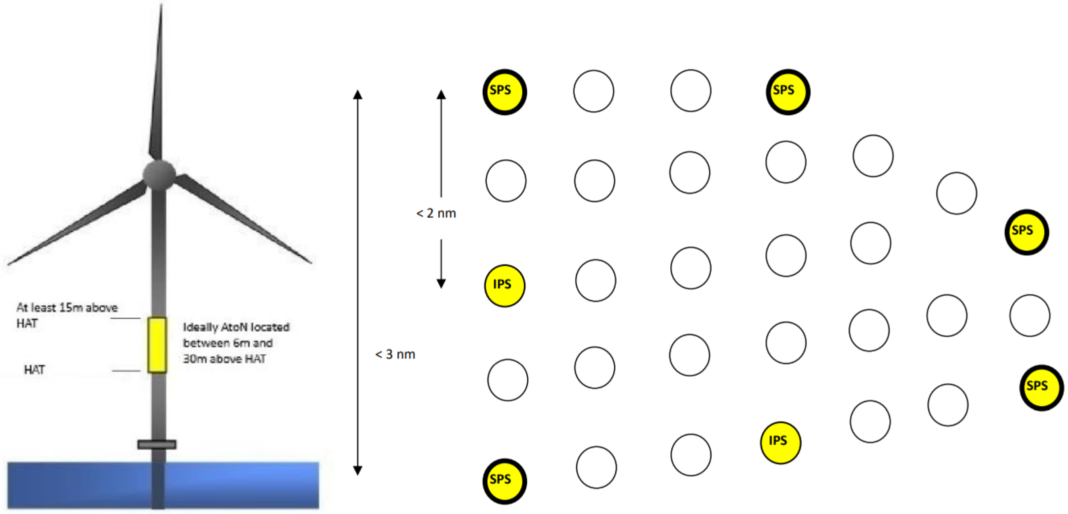


Figure 5: IALA G1162 OWF marking recommendations

4.9 EMBEDDED RISK CONTROLS

4.9.1.1.1 **Table 12** describes industry standard risk controls that the Project considers "embedded" in the project plans and design.

Table 12: Embedded risk controls

ID	Title	Description	Risks mitigated	Requirement
Promulgation and Awareness (PROM)				
PROM1	Notice to Mariners	To ensure that the appropriate authorities are informed of works being carried out in waters adjacent to the Projects. To include: • United Kingdom Hydrographic Office (UKHO) • MCA • Kingfisher • Trinity House • RYA • Local Ports and Harbours • Oil and Gas operators • MMO	All direct impacts of Project.	Typical licence condition
PROM2	Site Marking and Charting	Site is marked on nautical charts including an appropriate chart note.	All direct impacts of Project.	Typical licence condition
PROM3	Safety Zone	Application and use of safety zones of up to 500m measured from the outer edge of the surface infrastructure during construction/major maintenance and decommissioning phases. Safety zones shall be of appropriate configuration, extent and application to specified vessels of identified primary risk of sub-sea equipment to fishing and snagging hazard.	Risk of allision with structures.	Application under Electricity Regulations 2007

ID	Title	Description	Risks mitigated	Requirement
PROM4	Fisheries Liaison and Co-existence Plan	Provision of detailed Project information to fishermen, such as site location for upload into chart plotters	Fishing hazards, including snagging of cables.	Typical licence condition
PROM5	Continued Engagement	• Maintain the MNEF to facilitate information sharing and management/identification of additional risk controls: • Identify near misses and investigate incidents, disseminating learnings. • Coordinate construction activities.	Risk of allision or collision	Project commitment
PROM6	Recreational/Fishing Liaison	Ensure nominated persons are able to coordinate and communicate Project activities to recreational and fishing user groups. This includes during specific events (regattas).	Risk of allision, collision or cable snagging	Project commitment
Emergency Response (EMER)				
EMER1	Emergency Response Co-Operation Plan (ERCOP)	ERCOP with agreement of MCA.	Reduction of consequences of incidents.	Typical licence condition
EMER2	Marine Pollution Contingency Plan	Measures will be adopted to ensure that the potential for release of pollutants from construction, operation and maintenance activities is minimised, which will include planning for accidental spills and responding to all potential contaminant releases.	Reduction of consequences of incidents.	Typical licence condition
EMER3	Periodic Exercises	Periodic emergency management and response exercises will be run by developer, in conjunction with Coastguard Operations Centre (CGOC)/SAR.	Reduction of consequences of incidents.	Industry best practice

ID	Title	Description	Risks mitigated	Requirement
EMER4	Incident Investigation and Reporting	There are statutory incident reporting requirements and expectations: • MAIB (Merchant Shipping Act) • Health, Safety and Environment (HSE) (RIDDOR) • Harbour Authority under Port Marine Safety Code Risk assessments to be reviewed following incidents, and additional risk controls identified if appropriate.	Reduction of likelihood of incident reoccurrence.	Industry best practice
Site Design (DES)				
DES1	Aids to Navigation	Suitable (AtoN) lighting and marking the OWF site shall be undertaken complying with IALA Recommendations G1162 (IALA, 2021), to be finalised and approved in consultation with MCA and TH through an Aids to Navigation Management Plan. Review use of fog horns to alert vessels to the position of structures when visibility is poor. WTG informal naming/associated markings shall not interfere with formal AtoN's. AIS transponders to be placed on periphery corner WTGs.	Risk of allision with structures.	Typical licence condition
DES2	Buoyed Construction Area	Buoys deployed around construction work in windfarm site in line with TH requirements and may include a combination of cardinal and/or safe water marks. To be finalised and approved in consultation with MCA and TH through an Aids to Navigation Management Plan.	Risk of allision with structures or collision with construction vessels.	Typical licence condition

ID	Title	Description	Risks mitigated	Requirement
DES3	Hydrographic Surveys	MGN 654 requires that hydrographic surveys should fulfil the requirements of the International Hydrographic Organisation (IHO) Order 1a standard, with the final data supplied as a digital full density data set, and survey report to the MCA Hydrography Manager and the UKHO. Further information can be found in MGN 654 Annex 4 supporting document titled 'Hydrographic Guidelines for Offshore Developers', available on website.	Risk of grounding or snagging of cables.	Typical licence condition
DES4	Cable Burial Risk Assessment and periodic validation surveys	CBRA to be undertaken pre-construction, including consideration of under keel clearance. All subsea cables will be either fully buried (where ground conditions permit and burial tool performance allows), partially buried (buried but not to target depth) with rock protection, or surface laid with rock protection. Selected methods will be based on the risk assessment and the protection will be periodically monitored and maintained as practicable. No more than 5% reduction in water depth (referenced to Chart Datum) will occur at any point on the cable route without prior written approval from the MCA.	Risk of grounding or snagging of cables.	Typical licence condition
DES5	Air Draught Clearance	Wind turbine blades will have at least 22m clearance above water level and allow for anticipated range of motion (pitch, roll, yaw, heave, surge and sway), as appropriate.	Risk of allision/contact with structures.	Typical licence condition/MGN 654 recommendation
DES6	Layout Plan and Lines of Orientation	WTG layout plan to be agreed with MCA and TH prior to construction and maintain two lines of orientation.	Risk of allision/contact with structures and ensuring access for SAR.	Typical licence condition

ID	Title	Description	Risks mitigated	Requirement
DES7	Electromagnetic interference minimisation	A Cable Specification, Installation and Monitoring Plan will be prepared. This will include the technical specification of offshore electrical circuits, and a desk-based assessment of attenuation of electro-magnetic field strengths, shielding and cable burial depth in accordance with industry good practice.	Impact on navigation and communications equipment.	Industry best practice
DES8	Layout Design	To increase manoeuvring space and reduce impact on operators, project boundaries have been revised comprising realignment of western boundary to minimise impact to passage plan routes of ferries and commercial vessels, minimise course changes for vessels navigating north south.	Impact of windfarm site on ferry and commercial vessel routeing. Risk of allision or collision Impact on visual navigation.	Project commitment
Operational Management (OPS)				
OPS1	Construction Method Statement and Programme and Decommissioning Method Statement	Construction programme and plan to be submitted to MCA and TH for consultation. Where possible, construction to follow linear progression avoiding disparate construction sites across the windfarm site.	Risk of allision with structures or collision with vessels.	Typical licence condition
OPS2	Marine Operating Guidelines	Project vessels to follow Marine Operating Guidelines during construction and operation and maintenance activities to ensure Project vessels do not present unacceptable risks to each other or third parties. Project marine traffic coordination plans to be made available to all maritime users. Information and warnings will be distributed via Notices to Mariners and other appropriate media (e.g. Admiralty Charts and fishermen's awareness charts) to enable vessels and operators to effectively and safely navigate around the windfarm site and activities during the offshore cable corridor construction.	Risk of allision with structures or collision with vessels.	Typical licence condition

ID	Title	Description	Risks mitigated	Requirement
OPS3	Vessel Standards	All work vessels operating on behalf of Project will have: • MCA vessel coding. • Appropriate insurance. • Crewed by suitably trained/qualified personnel. • AIS (Class A/B). • Very High Frequency (VHF) (Ch16). • Appropriate Mooring arrangements.	Risk of allision with structures or collision with vessels.	Industry best practice
OPS4	Personal Protective Equipment (PPE)	All personnel will wear the correct PPE suitable for the location and role at all times, as defined by the relevant Quality, Health, Safety and Environment (QHSE) documentation. This will include the use of Personal Locator Beacons (PLB's).	Minimising risk of loss of life.	Industry best practice
OPS5	Guard Vessels	Provision of guard vessel in vicinity of windfarm site during construction or major maintenance to monitor third party vessel traffic and intervene with warnings as necessary.	Risk of allision with structures or collision with construction vessels.	MGN 654 recommendation
OPS6	Inspection and Maintenance Programme	Regular maintenance regime by developer to check the Project infrastructure, its fittings and any signs of wear and tear. This should identify any areas which might result in a failure.	Minimising risk of Project asset failure.	Industry best practice
OPS7	Training	Developers are responsible for ensuring that all staff engaged on operations are competent to carry out the allocated work.	Minimising risk of loss of life.	Industry best practice

ID	Title	Description	Risks mitigated	Requirement
OPS8	Compliance with International, UK and Flag State Regulations inc. IMO conventions	Compliance from all vessels associated with the proposed Project with international maritime regulations as adopted by the relevant flag state (e.g. International Convention for the Prevention of Collision at Sea (COLREGS) (IMO, 1972) and SOLAS (IMO, 1974)	Risk of allision with structures or collision with vessels.	Industry best practice
OPS9	Vessel health and safety requirements	As industry standard mitigation, the Applicant will ensure that all Project related vessels meet both IMO conventions for safe operation as well as HSE requirements, where applicable. This shall include the following good practice: • Windfarm associated vessels will comply with International Maritime Regulations; • All vessels, regardless of size, will be required to carry AIS equipment on board; • All vessels engaged in activities will comply with relevant regulations for their size and class of operation and will be assessed by the Project on whether they are "fit for purpose" for activities they are required to carry out; • All marine operations will be governed by operational limits, tidal conditions, weather conditions and vessel traffic information; • Walk to work solutions will be utilised.	Minimising risk of loss of life.	Industry best practice
Site Monitoring (MON)				
MON1	Continuous Watch	Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC).	Responding to incidents swiftly.	MGN 654 recommendation

ID	Title	Description	Risks mitigated	Requirement
MON2	Vessel Traffic Monitoring	Continuous monitoring during construction and immediate period post construction to MCA approval	Identification of unanticipated Project impacts.	Typical licence condition
MON3	Vessel Traffic Management Plan (VTMP)	Development of a VTMP covering aspects of vessel management during the construction phase to set out the measures required to mitigate traffic and transport-related effects resulting from the construction.	Risk of allision with structures or collision with construction vessels.	Typical licence condition
MON4	CTV (Crew Transfer Vessel) Passage Planning	Develop coordinated passage plans for CTVs that minimises impact on other traffic, could include: • Specified passage plans; • Agreed passing protocols/CPA for interactions with commercial shipping (e.g. no crossing within 5nm ahead of commercial vessel underway); • Reporting protocols to be established prior to crossing corridors; • Dissemination of passage plans and operations to regular runners and ferry services; and • Restricted visibility protocols.	Risk of collision between Project vessels and any other vessels	Project commitment

5. OVERVIEW OF THE BASELINE ENVIRONMENT

5.1 ADMIRALTY CHARTS

5.1.1.1.1 The study area is well charted and covered by Admiralty Chart 1826-0.

5.2 METOCEAN CONDITIONS

5.2.1 Wind and wave climate

5.2.1.1.1 MetOcean conditions are described for the study area for the wind and wave climate, tide and currents, and visibility.

5.2.1.1.2 MetOcean information for the area has been provided by Admiralty Sailing Directions West Coasts of England and Wales Pilot, NP37, 21st Edition, 2022. The closest station to the windfarm site is located at Blackpool (53° 46’ N 003° 02’ W), 10m above Mean Sea Level (MSL) with information presented in **Figure 6**.

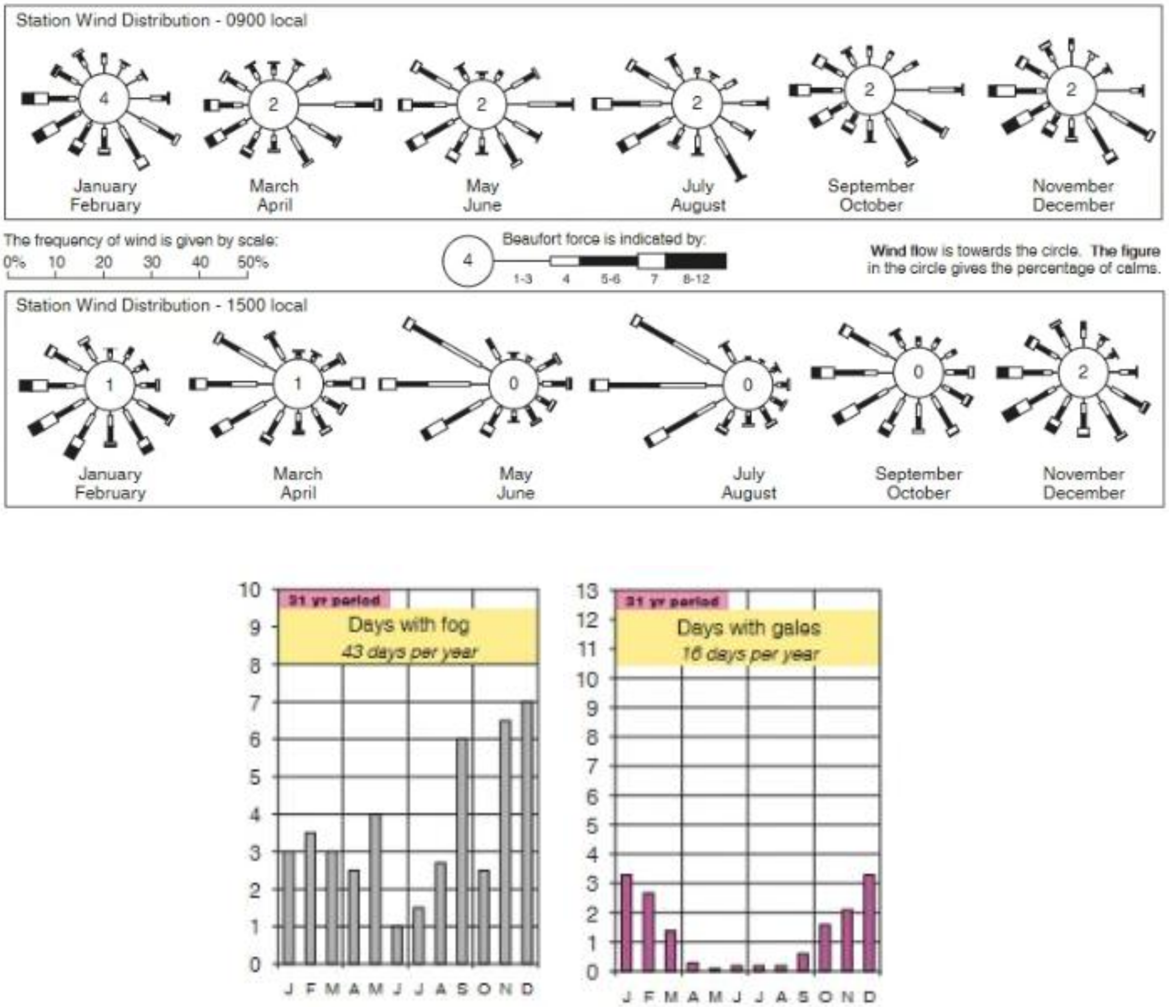


Figure 6: MetOcean conditions – Blackpool

5.2.1.1.3 The most frequent waves across the windfarm site approach from the west southwest (see **Figure 7**). Fetch lengths from this direction are relatively short, due to the presence of Ireland, Isle of Man and Anglesey land masses. Nearshore wave conditions are modified by the presence of sandbanks, such as Cockerham Sands, Sunderland Bank, Shell Flat and the Shoulder of Lune. The Lune Deep protects the northern Fleetwood coast by refracting severe waves northwards[4].

[4] Morecambe Offshore Windfarm Scoping Report – Generation Assets. Document code: FLO-MOR-REP-0007, version 3.0, June 2022.

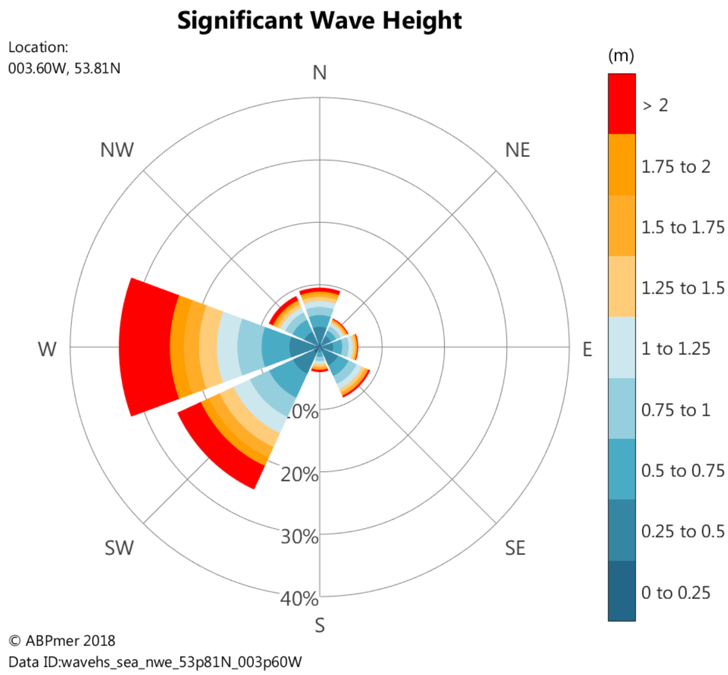


Figure 7: Dominant wave direction rose diagram at the windfarm site (ABPmer, 2018)

5.2.2 Tides and currents

5.2.2.1.1 Tidal current flows across the windfarm site are from the east/north-east on a flood tide, and to the west or south-west on an ebb tide. Mean spring tidal current speeds of 0.45-0.75m/s (0.87-1.46kts) occur at the windfarm site on a flood tide and 0.45-0.60m/s (0.87-1.17kts) on an ebb tide. The Lune Deep is subject to strong tidal currents. Tidal current speeds in the deep-water channel are approximately 0.90-1.05m/s (1.75-2.04kts) (flood tide) and 1.05-1.35m/s (2.04-2.62kts) (ebb tide). Tidal current speeds decrease closer to the coastline[5].

5.2.2.1.2 Tidal diamond M (53° 54.0 N, 003° 44.6 W) from Admiralty Chart 1826-0, located 3nm of the windfarm site, is presented in **Table 13**, providing context of tidal current rates and directions in spring and neap tidal cycle conditions. There are no tidal limitations at the windfarm site.

[5] Morecambe Offshore Windfarm Scoping Report – Generation Assets. Document code: FLO-MOR-REP-0007, version 3.0, June 2022.

Table 13: Details for tidal diamond M on Admiralty Chart 1826-0.

Hours		Tidal Stream	Rate at spring tide (kn)	Rate at neap tide (kn)
Before High Water	6	024°	0.4	0.2
	5	067°	0.7	0.4
	4	078°	1.1	0.6
	3	082°	1.4	0.7
	2	086°	1.3	0.7
	1	101°	0.9	0.4
High Water (HW)		174°	0.5	0.2
After High Water	1	231°	0.9	0.5
	2	251°	1.4	0.8
	3	263°	1.5	0.8
	4	277°	1.2	0.6
	5	297°	0.8	0.4
	6	347°	0.4	0.2

5.2.3 Visibility

5.2.3.1.1 The Admiralty Sailing Directions reports fog between 43 days/year (Blackpool) and 12 days/year (Crosby).

5.3 PRINCIPAL NAVIGATIONAL FEATURES

5.3.1 Key Features

5.3.1.1.1 Key relevant features relating to management of vessels and safety of navigation are described in this section and shown in **Figure 8** and **Figure 9.**

5.3.2 Responsible authorities – MCA

5.3.2.1.1 The study area is in a region of general navigation in UK waters with the MCA as the responsible authority for safe navigation.

5.3.3 IMO routeing/reporting measures and recommended channels

5.3.3.1.1 There are no IMO routeing/reporting measures or recommended channels in the study area.

5.3.3.1.2 The Liverpool Bay TSS is the closest routeing measure, located approximately 12.4nm south of the windfarm site (see **Figure 8**). This TSS deconflicts vessel traffic on passage to/from the Mersey ports and maintains a safe distance between vessels, the oil and gas infrastructure to the north and the Gwynt-Y-Mor windfarm to the south. The area surrounding the Douglas Oil Field infrastructure is charted as an Area to be Avoided with the accompanying note: 'The IMO-adopted Area to be Avoided should only be entered by authorised vessels to access the Douglas Oil Field'.

5.3.4 Aids to navigation

5.3.4.1.1 AtoNs located in the study area are shown in **Figure 8**. There are AtoNs marking oil and gas infrastructure located within the study area, with one platform charted adjacent to the western boundary of the windfarm site (Calder 110/7a marked with a white light displaying morse 'U'). There are nine other locations in the study area where oil and gas infrastructure is marked with either AtoN on the structure, buoyage or both. It is noted that the DP3 110/8 structure, located in the windfarm site, is charted as having four cardinal marks. The DP3 110/8 structure has been fully decommissioned and removed and as well as all associated cardinals have been removed.

5.3.4.1.2 AtoNs marking the West of Duddon Sands (WODS) windfarm and the Walney windfarm are present to the north of the study area. These AtoN comprise of cardinal marks indicating the safe water to the south and east of the WODS windfarm and marking of SPS for both windfarms.

5.3.4.1.3 The Morecambe westerly cardinal mark is located 5nm northeast of the windfarm site, marking the western extent of Shell Flat on the southern approaches to Lune Deep.

5.3.4.1.4 A Single Buoy Mooring (SBM) for mooring vessels transferring oil from Douglas oil field is located 4nm south of the windfarm site.

5.3.5 Pilotage

5.3.5.1.1 Pilot boarding stations for ports in the area with Competent Harbour Authority (CHA) status are shown on **Figure 8.** Pilot stations and their proximity to the windfarm site are provided in **Table 14.** There are no pilot boarding stations within the study area.

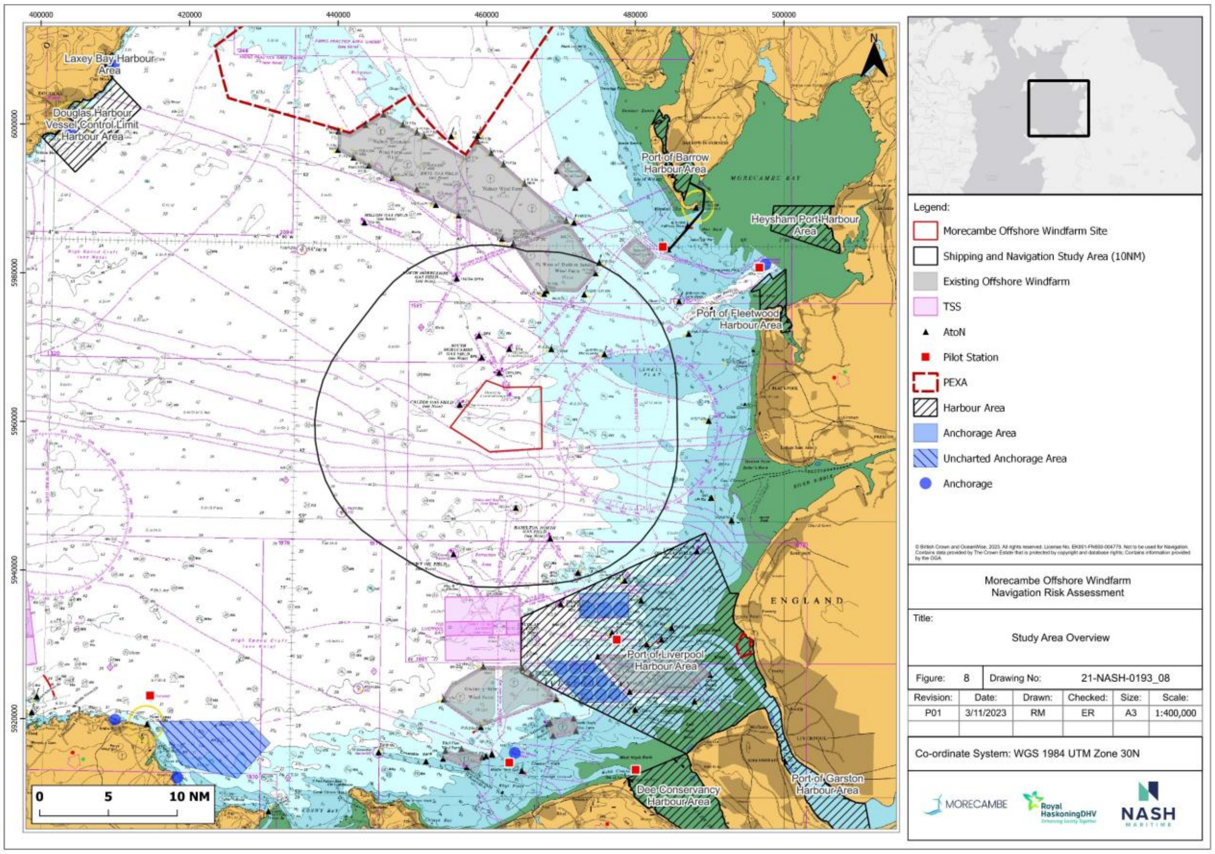


Figure 8: Navigational features in the study area

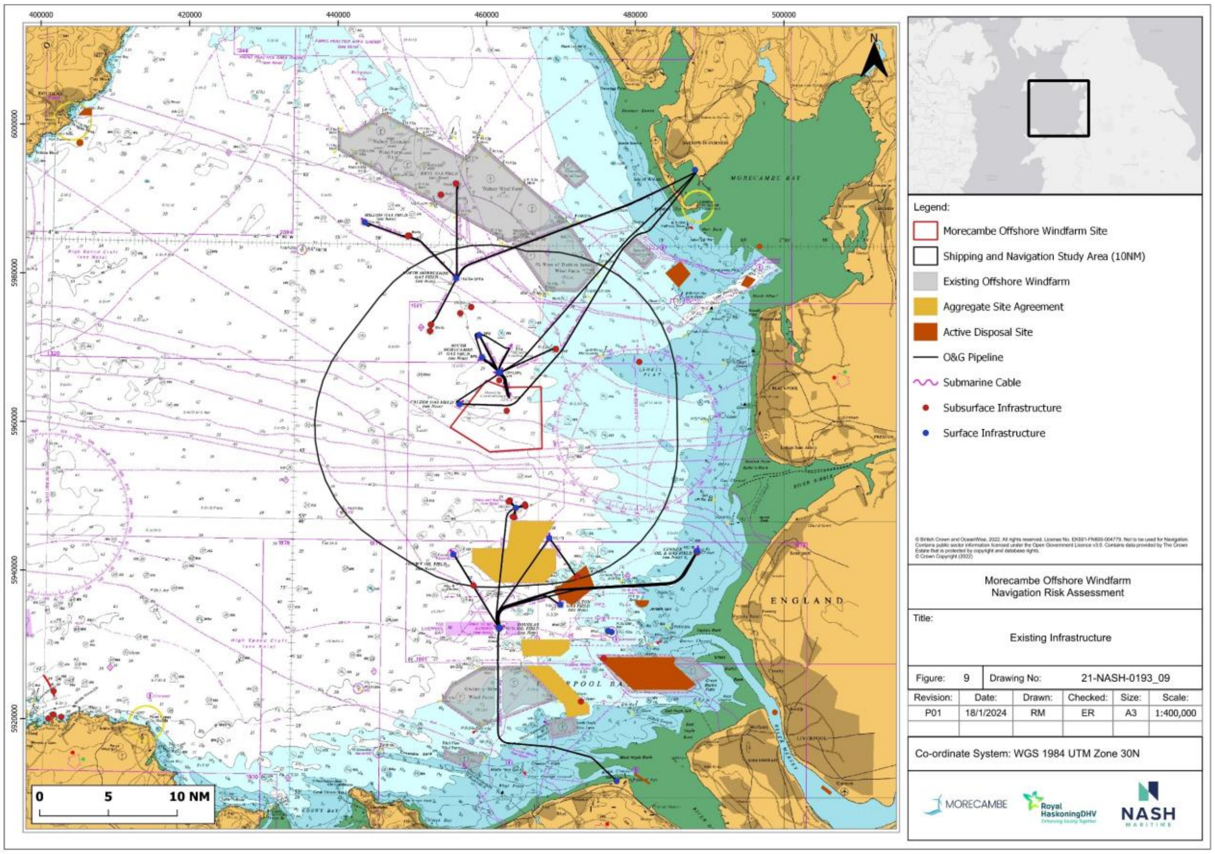


Figure 9: Existing offshore activities and infrastructure

Table 14: Pilot boarding stations

Boarding Station	Distance from windfarm site
Barrow	13nm northeast
Liverpool	15nm southeast
Fleetwood and Heysham	18nm northeast
Mostyn Outer	23nm south
Mostyn	24nm southeast
Point Lynas (Liverpool heavy weather)	29nm southwest
Douglas Port (pilot boarding stations for Liverpool)	35nm northwest

5.4 VESSEL TRAFFIC SERVICE

5.4.1.1.1 The windfarm site and study area are outside of any Vessel Traffic Service (VTS) or Local Port Service (LPS) areas. The closest VTS is Liverpool to the southeast of the study area. The VTS covers the Liverpool Statutory Harbour Authority (SHA) area monitoring vessel traffic through AIS and radar.

5.5 LOCAL PORTS AND HARBOURS

5.5.1.1.1 Nearby ports and harbours are shown in **Figure 8** and **Table 15**.

Table 15: Ports and harbours

Port	Type	Distance from windfarm site
English Ports		
Port of Barrow (England)	Commercial port	19nm northeast
Port of Fleetwood (England)	Fishing and recreational port	18nm northeast
Heysham Port (England)	Commercial port	24nm northeast
Port of Liverpool (England)	Major west coast commercial port	25nm southeast
Isle of Man Ports		
Douglas Port	Main port for the Isle of Man. Commercial port	35nm northwest
Laxey Port	Fishing and recreational port	36nm northwest
Castletown Harbour (Isle of Man)	Fishing and recreational port	38nm northwest
Port Erin (Isle of Man)	Fishing and recreational port	43nm northwest
Port St Mary (Isle of Man)	Fishing and recreational port	41nm northwest
Peel (Isle of Man)	Fishing and recreational port	44nm northwest
Welsh Ports		
Port of Mostyn (Wales)	Commercial port	27nm southeast
Conwy Harbour (Wales)	Fishing and recreational port	29nm south
Holyhead (Wales)	Commercial port	42nm southwest

5.6 SEARCH AND RESCUE

5.6.1.1.1 His Majesty's Coastguard's (HMCG) Aviation Branch provides aviation-based search and rescue via the UK Search and Rescue Helicopter (UKSARH) programme. The nearest HMCG helicopter base is located at Caernarfon Airport, Gwynedd and is 47nm southwest of the windfarm site. The Caernarfon Facility provides a 24-hour search and rescue service, with two Sikorsky S-92 helicopters.

5.6.1.1.2 There are 12 RNLI lifeboat stations within the region, as detailed in **Table 16** and shown in **Figure 10**.

Table 16: RNLI stations in the east Irish Sea

ID	Facility	Resources	Distance from windfarm site
1	**Blackpool**	Lifeboat station with three inshore lifeboats, including an Atlantic 85 and two D class lifeboats.	16nm east
2	**Lytham St Annes**	Shannon class all-weather lifeboat and a D class inshore boat. Lifeboats are housed in Lytham and St Annes.	16nm east
3	**Fleetwood**	Shannon and D class lifeboats.	18nm northeast
4	**Barrow**	Tamar class and D class lifeboats.	19nm northeast
5	**Hoylake**	Shannon class lifeboat.	24nm southeast
6	**West Kirby**	D class lifeboat.	26nm southeast
7	**Rhyl**	Shannon class all-weather lifeboat and a D class inshore boat.	26nm south
8	**Llandudno**	Shannon class all-weather lifeboat and a D class inshore boat.	27nm south
9	**Morecambe**	D class and Hover class lifeboats.	27nm northeast
10	**Douglas (Isle of Man)**	Mersey class lifeboat. There are also RNLI stations located in Port Erin, Port St. Mary and Peel in the Isle of Man.	36nm northwest
11	**Moelfre**	Tamar class and D class lifeboats.	32nm southwest
12	**New Brighton**	Operates a B class Atlantic 85 lifeboat.	25nm southeast

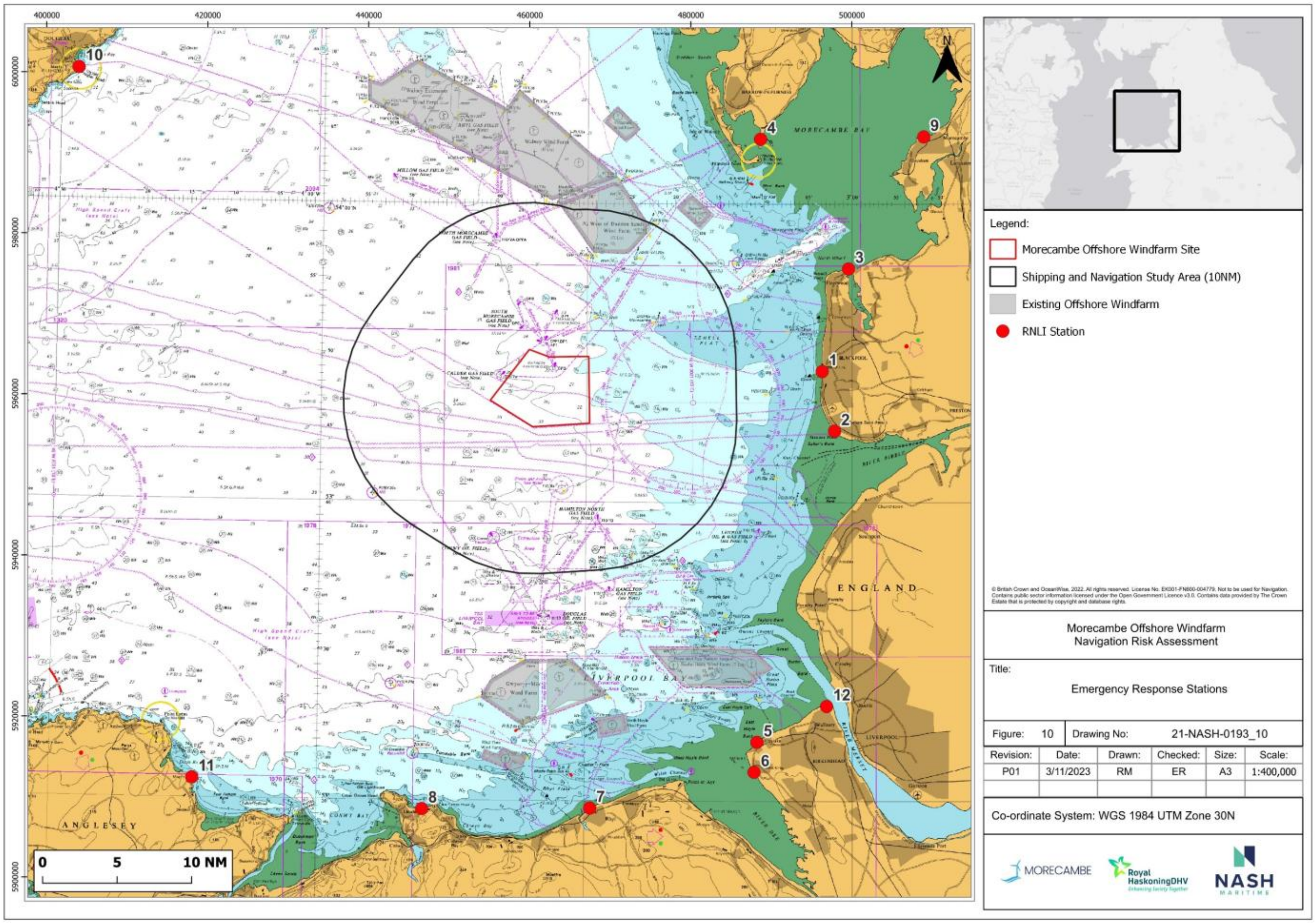


Figure 10: Emergency response stations

5.7 OTHER OFFSHORE ACTIVITIES

5.7.1 Oil and gas

5.7.1.1.1 The study area overlaps with the South Morecambe gas field, North Morecambe gas field and the Calder gas field. South Morecambe gas field is owned and operated by Spirit Energy. Calder 110/7a is owned by Harbour Energy and operated by Spirit Energy, with the pipeline between the Calder CA1 platform and the onshore facility at Barrow running through the windfarm site. These fields are supported by offshore infrastructure (platforms, pipelines, cables and wells) and onshore facilities for extracting, transporting and processing reserves. Some wells and pipelines associated with these fields overlap with the windfarm site.

5.7.1.1.2 The closest gas platforms to the Project windfarm site are the Calder CA1 platform located 0.9km (0.5nm) to the west of the site, and the South Morecambe Central Processing Complex (CPC) located 1.6km (0.9nm) to the north of the site. CPC is comprised of three bridge linked platforms including an accommodation platform (AP1), central production platform (CPP1) and drilling platform (DP1). AP1 and CPP1 combined are referred to as CPC-1. Oil and gas infrastructure within proximity of the windfarm site is listed in

5.7.1.1.3 **Table** 17 and shown in **Figure 9**.

Table 17: Oil and gas fields in the east Irish Sea

Name	Type	Distance from windfarm site	Status
Calder gas field	Normally unmanned	0.2nm west	Producing. Decommissioning expected, but timeline not fully established.
South Morecambe gas field	Manned	0.6nm north	Producing. Decommissioning of two drilling platforms (DP3 and DP4) commenced in 2021, with the decommissioning of these platforms and jackets completed in 2023. Decommissioning of DP6, DP8 and CPP1 is planned but timeline not fully established.
North Morecambe gas field	Manned	7.4nm north	Producing
Hamilton North gas field	Normally unmanned	6.3nm south	Producing
Conwy Oil field	Manned	7.4nm south	Producing
Hamilton gas field	Normally unmanned	11.2nm south	Producing
Millom gas field	Normally unmanned	14.2nm northwest	Producing
Douglas Oil field	Manned	12.4nm south	Producing
Lennox Oil and gas field	Normally unmanned	13.3nm southeast	Producing

5.7.2 Subsea cables

5.7.2.1.1 The Irish Sea has a significant number of cables, primarily telecommunication connections between the UK and the Isle of Man and Ireland, along with numerous export cables from existing offshore windfarms.

5.7.2.1.2 In the windfarm site there are power cables suppling the oil and gas infrastructure at the Calder Gas Field and South Morecambe gas field, along with the GTT/Hibernia Atlantic cable traversing the windfarm site in a west-east direction (see **Figure 9**). The telecommunications cable Lanis 1, owned by Vodafone, runs along the southern boundary of the windfarm site.

5.7.2.1.3 In the wider study area, to the south of the windfarm site, there are five telecommunications cables running from either Blackpool or Southport to either the Republic of Ireland or the Isle of Man. North of the windfarm site, there is one power interconnector between Douglas and Blackpool, along with the inter-array cabling and export cables for the other windfarms in the study area. There is also one power cable passing through the south-west of the study area, between Birkenhead and Ardneil Bay, West Kilbride, Scotland.

5.7.3 Aggregates

5.7.3.1.1 There are no aggregate extraction areas in the windfarm site. The closest active aggregate extraction area to the windfarm site is Area 457, in Liverpool Bay, to the south of the study area. All aggregate and extraction areas in the vicinity are detailed in **Table 18**.

Table 18: Aggregate and extraction areas

Name	Type	Distance from windfarm site
Area 457: Liverpool Bay	Extraction Area	5nm south
Area 1808: Liverpool Bay	The Crown Estate 2018/19 Marine Aggregates Tender	13.8nm south
Area 392/393: Hilbre Swash	Extraction Area	15.5nm south

5.7.4 Disposal sites

5.7.4.1.1 Disposal sites are shown in **Figure 9**. One licensed active disposal area is present within the study area. The distances of local active disposal areas to the windfarm site are presented in **Table 19**.

Table 19: Active disposal areas in vicinity of the study area

Disposal area	Distance from windfarm area
Site Y	9nm southeast
Barrow D	12.2nm northeast
Site Z	12.9nm southeast
Morecambe Bay: Lune Deep	16.3nm northeast
Burbo Bank Extension OWF	15.7nm southeast
Mersey	25.3nm southeast
Mostyn Deep	24.3nm southeast
Douglas Harbour	35nm northwest

Douglas	34nm northwest

5.7.5 Other offshore wind projects

5.7.5.1.1 The proximity of existing offshore wind infrastructure to the Project windfarm site is listed in **Table 20** and shown in **Figure 8**.

Table 20: Proximity of offshore windfarms to the Project windfarm site

Name	Type	Distance to windfarm site	Status
WODS Windfarm	Operational windfarm (389MW capacity)	7nm north	Operational since 2014
Walney Windfarm (including extensions)	Group of operational windfarms (total capacity of 1026MW)	10.1nm north	Operational since 2011, with extensions operational in 2012 and 2018
Barrow Windfarm	Operational windfarm (90MW capacity)	11.4nm northeast	Operational since 2006
Ormonde Windfarm	Operational windfarm (150MW capacity)	14.5nm north	Operational since 2012
Gwynt-y-Môr Windfarm	Operational windfarm (576MW capacity)	15.5nm south	Operational since 2015
Burbo Bank Windfarm (including extensions)	Operational windfarm (90MW plus 258MW extension)	15.6nm southeast	Operational since 2007, extension operational since 2017
North Hoyle Windfarm	Operational windfarm (60MW capacity)	19.5nm south	Operational since 2004
Rhyl Flats Windfarm	Operational windfarm (90MW capacity)	21.5nm south	Operational since 2009

5.7.6 Anchorages and offshore waiting areas

5.7.6.1.1 There are no charted anchorages within the study area. A SBM south of the windfarm site is used as an anchorage by tankers loading oil from the Douglas oil field.

5.7.6.1.2 **Figure 8** shows two charted anchorages located within the Port of Liverpool SHA area. One lies south of the approaches to Liverpool, between the Burbo Bank Extension and Gwynt y Mór windfarms. The other is located north of the approaches to the River Mersey.

5.7.6.1.3 Douglas Bay is used as an anchorage for vessels waiting to enter the Port of Douglas and for cruise vessels when undertaking tendering operations.

5.7.6.1.4 There is an anchorage called Rhyl North, used by vessels waiting for pilotage to the Port of Mostyn, located directly north of the Mostyn Pilot Boarding Station.

5.7.6.1.5 Heysham Port has a designated anchorage located in Lune Deep, adjacent to the Pilot Boarding Station.

5.7.7 Practice and exercise areas

5.7.7.1.1 There are no Practice and Exercise Areas (PEXA) located in the study area. Firing practice area D406 is the closest PEXA, located c. 15nm to the north of the windfarm site, as shown in **Figure 8**. No restrictions are placed on the right to transit the firing practice areas at any time. The firing practice area is operated using a clear range procedure, meaning that firing only takes place when the area is confirmed clear of all shipping.

6. DESCRIPTION OF EXISTING MARINE ACTIVITIES

6.1 INTRODUCTION

6.1.1.1.1 A description of existing marine activities in the study area is presented, based on the data collected, as listed in **Section 3.5**. The following section includes:

- Description of COVID effects
- Details of the vessel traffic surveys
- Analysis of full-year 2019 and 2022 vessel traffic by:
- Traffic types
- Determination of vessel routes
- During adverse weather
- Non-transit activity
- Analysis of historical maritime incidents

6.2 EFFECTS OF COVID-19

6.2.1.1.1 Since early 2020, the COVID-19 pandemic has substantially impacted recreational and commercial vessel movements both globally and locally. It is therefore possible that data collected between 2020 and 2022 may be influenced by the pandemic, although vessel traffic is expected to have largely returned to pre-pandemic levels. As such, and where appropriate, datasets have been used that precede the pandemic, including AIS data for 2019 for the whole Irish Sea. In addition, following the PEIR, a 2022 AIS dataset has been obtained to provide greater recency for the analysis.

6.3 VESSEL TRAFFIC SURVEYS

6.3.1.1.1 Vessel traffic surveys were conducted in compliance with requirements under MGN 654. Therefore, full coverage of all transits through the study area could be obtained using the following datasets:

- Commercial vessel traffic that are required to carry AIS under SOLAS are captured through the vessel traffic surveys
- Non SOLAS commercial, recreational and fishing vessels captured through AIS for those vessels with AIS transceivers and through radar for those that do not
- Visual observations to identify non-AIS vessel types

6.3.1.1.2 Details of the vessel traffic surveys are provided in **Table 21** and tracks of the survey vessels whilst deployed on the surveys are shown in **Figure 11** (see **Appendix E** for the survey reports).

6.3.1.1.3 Vessel traffic tracks collected as part of the surveys are presented in **Figure 12**.

Table 21: Vessel traffic survey details

Attributes	Winter 2022	Summer 2022	Winter 2023
Vessel	KARELLE (28m Fishing Vessel) 	MORNING STAR (23m Fishing Vessel) 	
Dates (Coordinated Universal Time (UTC))	09-Feb-22 to 26-Feb-22	30-Jul-22 to 13-Aug-22	27-Nov-23 to 13-Dec-23
Downtime (UTC)	18-Feb-22 00:10 to 19-Feb-22 06:29 20-Feb-22 06:53 to 21-Feb-22 15:00	08-Aug-22 10:00 to 09-Aug-22 03:40	06-Dec-23 10:30 to 08-Dec-14:59. 08-Dec-23 19:26 to 09-Dec-01:05
Survey Area	Windfarm site + 10nm study area	Windfarm site + 10nm study area	Windfarm site + 10nm study area
Total Vessels Recorded (study area)	355 (25.5/day)	460 (32.9/day)	348 (24.9/day)
Total Vessels Recorded (windfarm site)	31 (2.2/day)	35 (2.4/day)	41 (2.9/day)
Cargo	**Study area:** 13 (0.9/day) **Windfarm site:** 5 (0.4/day)	**Study area:** 7 (0.5/day) **Windfarm site:** 2 (0/day)	**Study area:** 13 (0.9/day) **Windfarm site:** 4 (0.3/day)
Fishing	**Study area:** 73 (5.2/day) **Windfarm site:** 1 (0.1/day)	**Study area:** 25 (1.8/day) **Windfarm site:** 1 (0.1/day)	**Study area:** 29 (2.1/day) **Windfarm site:** 4 (0.3/day)
Passenger	**Study area:** 168 (12/day) **Windfarm site:** 5 (0.4/day)	**Study area:** 240 (17.1/day) **Windfarm site:** 10 (0.7/day)	**Study area:** 181 (12.9/day) **Windfarm site:** 15(1.1/day)
Recreational	None	**Study area:** 12 (0.9/day) **Windfarm site:** 6 (0.4/day)	None
Tanker	**Study area:** 12 (0.9/day) **Windfarm site:** 6 (0.4/day)	**Study area:** 3 (0.2/day) **Windfarm site:** 2 (0.1/day)	**Study area:** 8 (0.6/day) **Windfarm site:** 0 (0/day)
Tug and Service	**Study area:** 89 (6.4/day) **Windfarm site:** 14 (1/day)	**Study area:** 173 (12.4/day) **Windfarm site:** 13 (0.9/day)	**Study area:** 117 (8.4/day) **Windfarm site:** 18 (1.3/day)

6.3.1.1.4 MGN 654 specifies that vessel traffic surveys should be undertaken within two years of Application. As the February 2022 winter survey will be outside the two-year window, an additional 14-day winter survey as per MGN 654 4.6b was undertaken in December 2023 to extend the data validity for a further 12 month period.

6.3.1.1.5 The findings of the winter 2023 survey are consistent with the previous vessel traffic surveys conducted in 2022, as well as the 2019 and 2022 AIS datasets. As such, no impact on the conclusions reached within the NRA have been identified. The datasets are concluded to be valid for a further 12 month period as per MGN654 4.6b (MCA, 2021a).

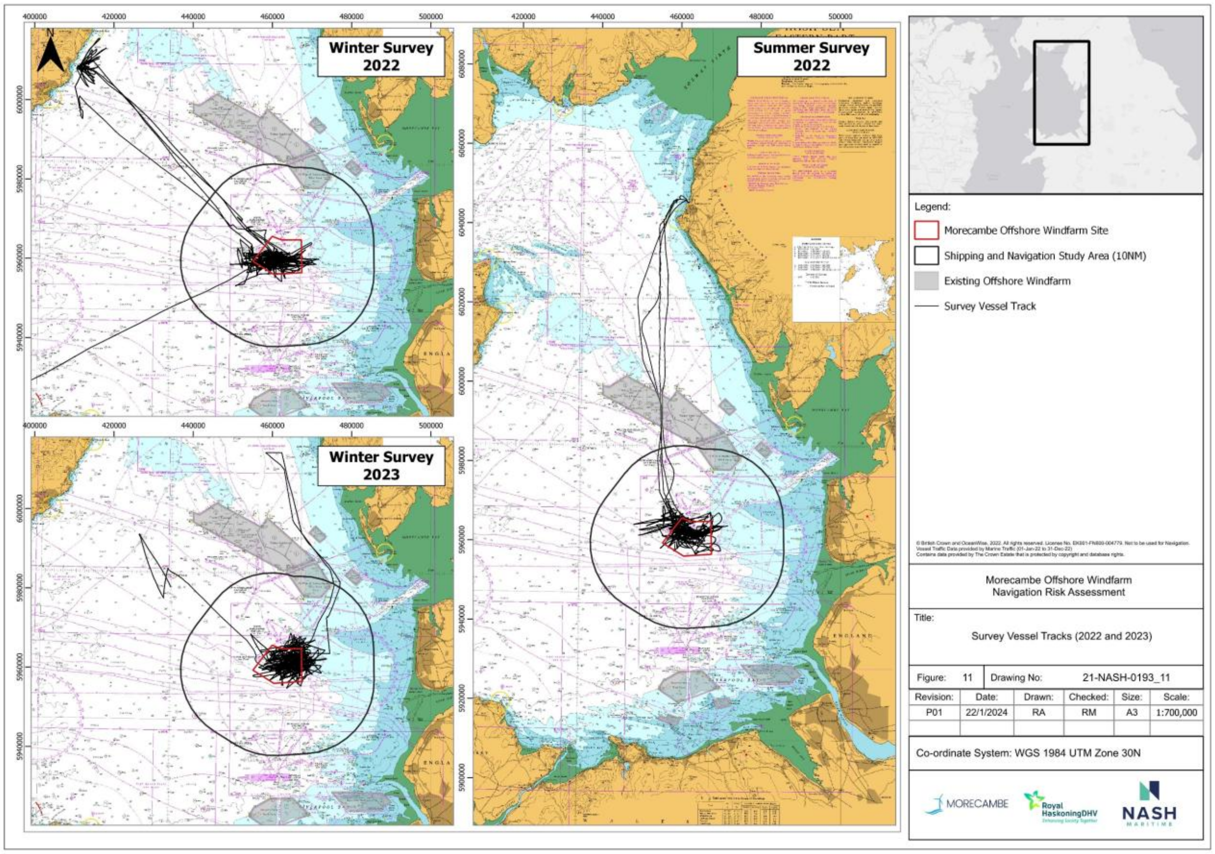


Figure 11: Track of survey vessel during winter and summer surveys

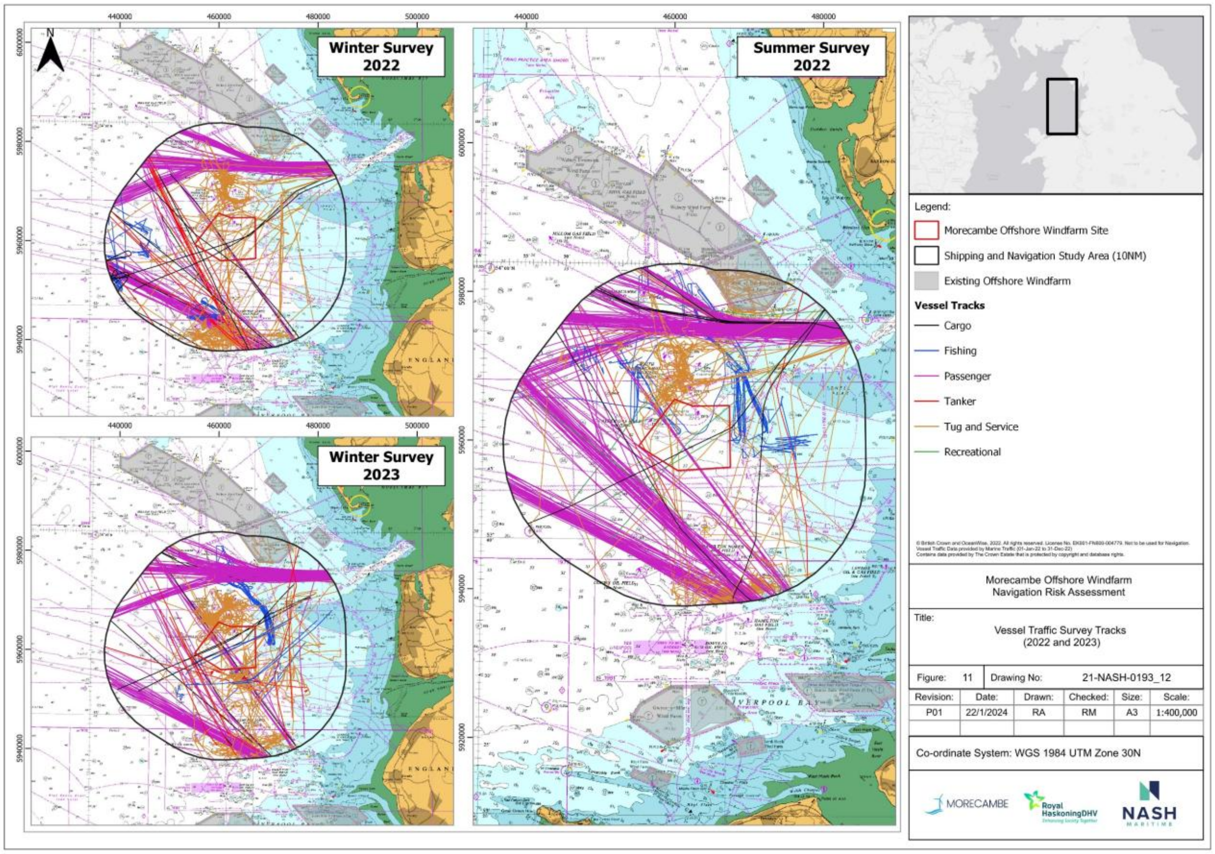


Figure 12: Winter and summer vessel tracks recorded during vessel traffic surveys

6.4 VESSEL TRAFFIC ANALYSIS

6.4.1 Overview

6.4.1.1.1 Annualised vessel traffic density for 2019 and 2022 (which shows the number of vessel transits through individual grid cells in the east Irish Seas) is presented in **Figure 13** and **Figure 14**, respectively, they show:

- Key vessel traffic routes run from Heysham and Liverpool, passing north and south-east of the windfarm site respectively
- Ferry routes intersecting the study area are between Liverpool-Belfast/Dublin and Liverpool-Douglas or between Heysham-Douglas and Heysham Dublin/Warrenpoint
- High vessel density to the north of the windfarm site is associated with oil and gas service vessel activity

- A difference plot for the change in vessel traffic density is presented in **Figure 15**. Although, much of the traffic follows similar routeing between the two years, there are notable changes. The plot shows a decrease in traffic transiting through the Liverpool TSS from 2019 to 2022. There are however more vessels transiting to/from the Liverpool TSS northwest to pass south of the Isle of Man. The change in activity around the Walney OWF is also present with a reduction in vessel activity in 2022.

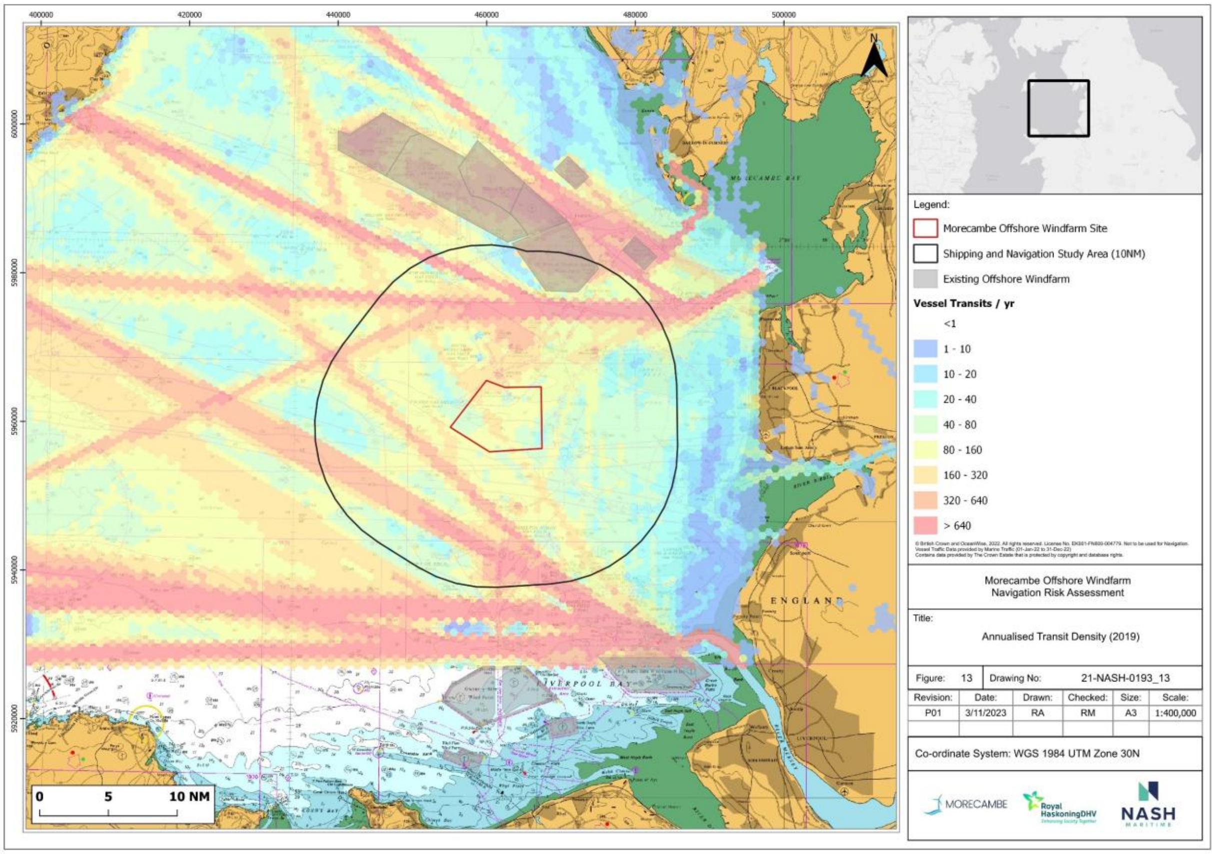


Figure 13: Annualised vessel transit density (2019)

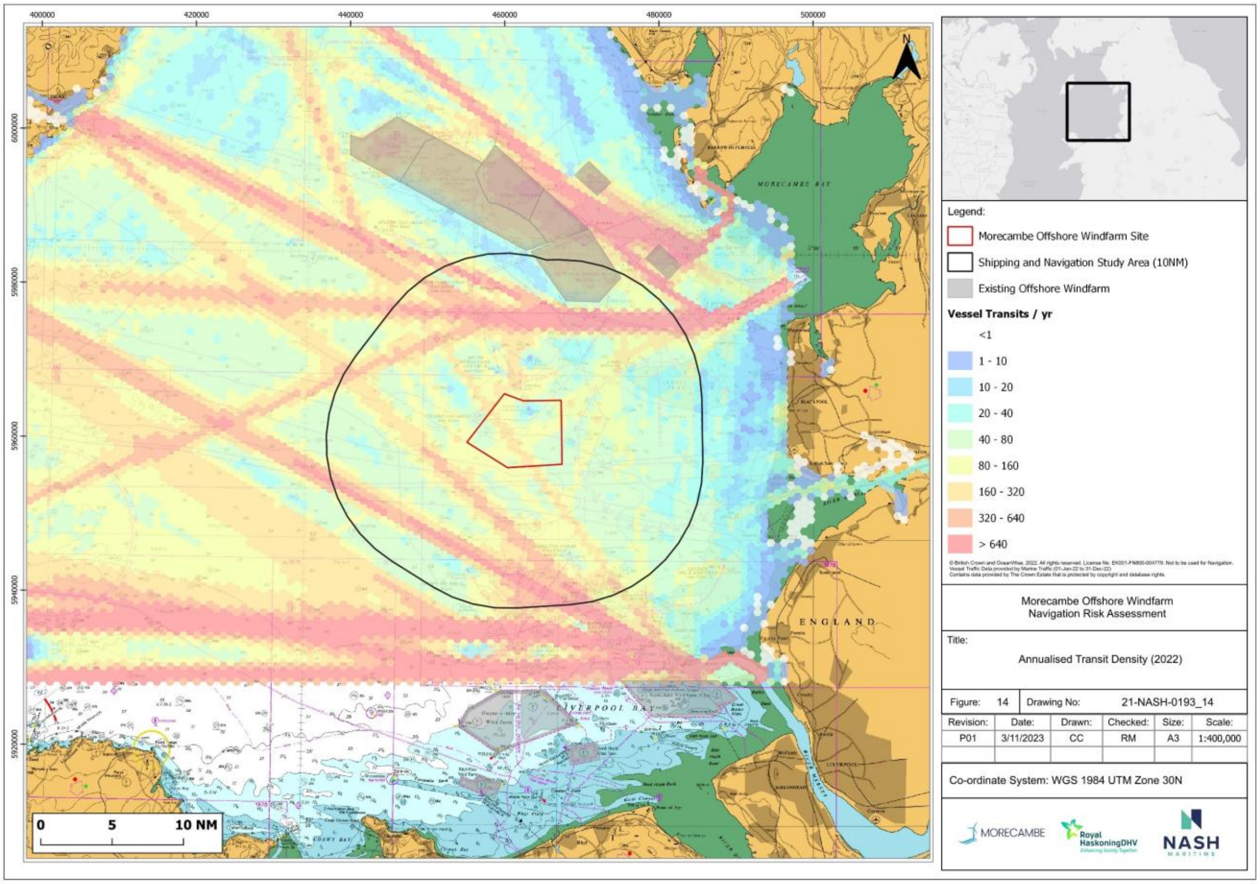


Figure 14: Annualised vessel transit density (2022)

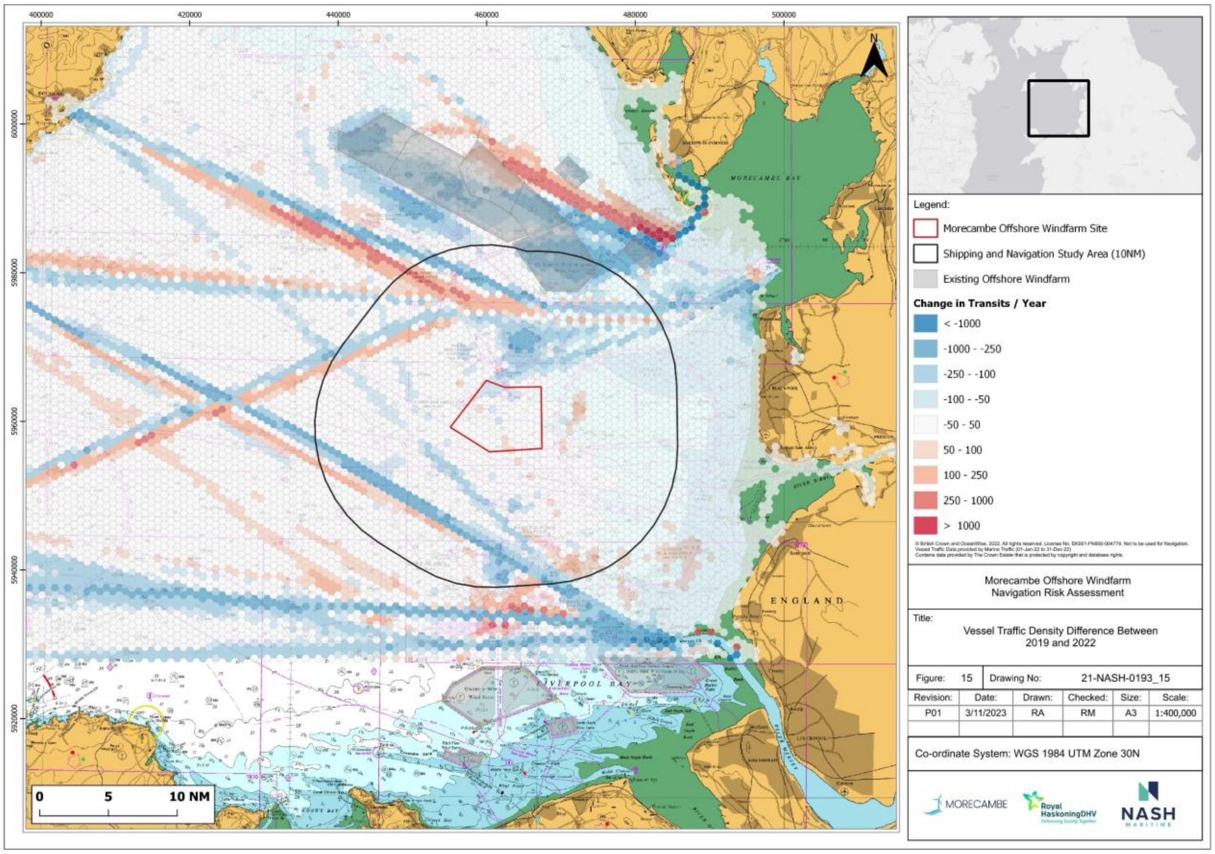


Figure 15: Difference between 2019 and 2022 annualised vessel transit density.

6.4.1.1.2 **Figure 16** shows vessel tracks by vessel length for 2019 and 2022. Vessels from all length groups navigate within the study area. Vessels over 250m use the Liverpool Bay TSS transiting south of the study area and either converge towards Liverpool or diverge on routes through the Irish Sea, dependent on their next port. There is also limited activity by vessels over 250m in the southern portion of the study area, which may be associated with the SBM for the Hamilton North Gas Field. Vessels >200m are also shown using the SBM to the south of the windfarm site.

6.4.1.1.3 Between 2019 and 2022 there is an increase in 200–250m vessels, and a decrease in those of 150–200m, transiting through the study area. This is largely explained by the ferry operator Stena replacing route services during this time. For example, in March 2020 the 215m Stena Edda replaced the 186.5m Stena Lagan, and in January 2021 the 186.5m Stena Mersey was replaced by the 215m Stena Embla. Tracks of vessels between 100-200m in length are predominantly ferries between Liverpool and Heysham to Dublin, Belfast and Douglas.

6.4.1.1.4 Commercial vessels between 100-150m transit east/west through the windfarm site between Barrow and Heysham, aligning with Off Skerries TSS. Vessels under 100m are shown throughout the windfarm site and north/south of the study area, primarily associated with support of oil and gas or windfarm operations.

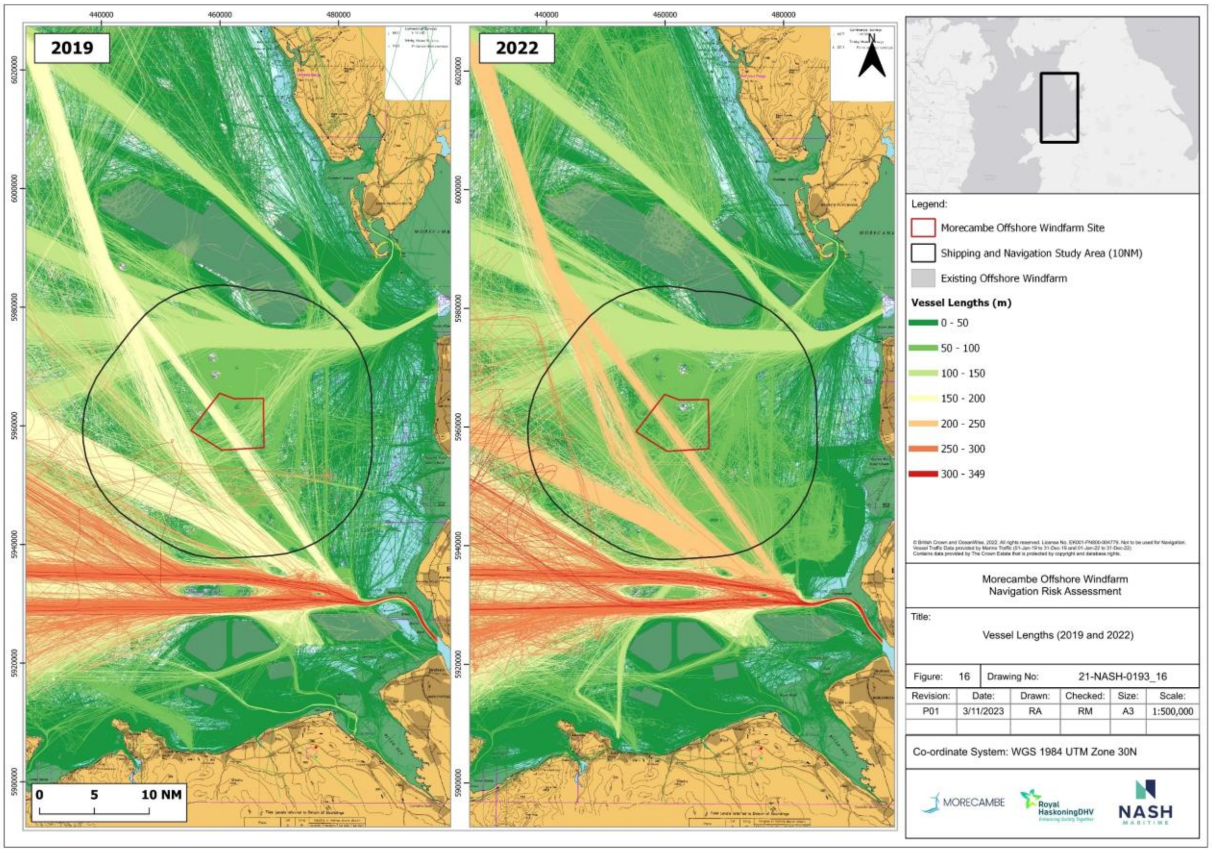


Figure 16: All vessel tracks by length (m)

6.4.1.1.5 **Figure 17** shows vessel tracks by vessel draught. Vessel traffic within the windfarm site largely comprises of vessels with a draught less than 7.5m. Deeper draught vessels over 10m typically navigate south of the study area, through Liverpool Bay TSS, with a small number transiting between Liverpool and Douglas, likely associated with the carrying over of Liverpool pilots during periods of adverse weather.

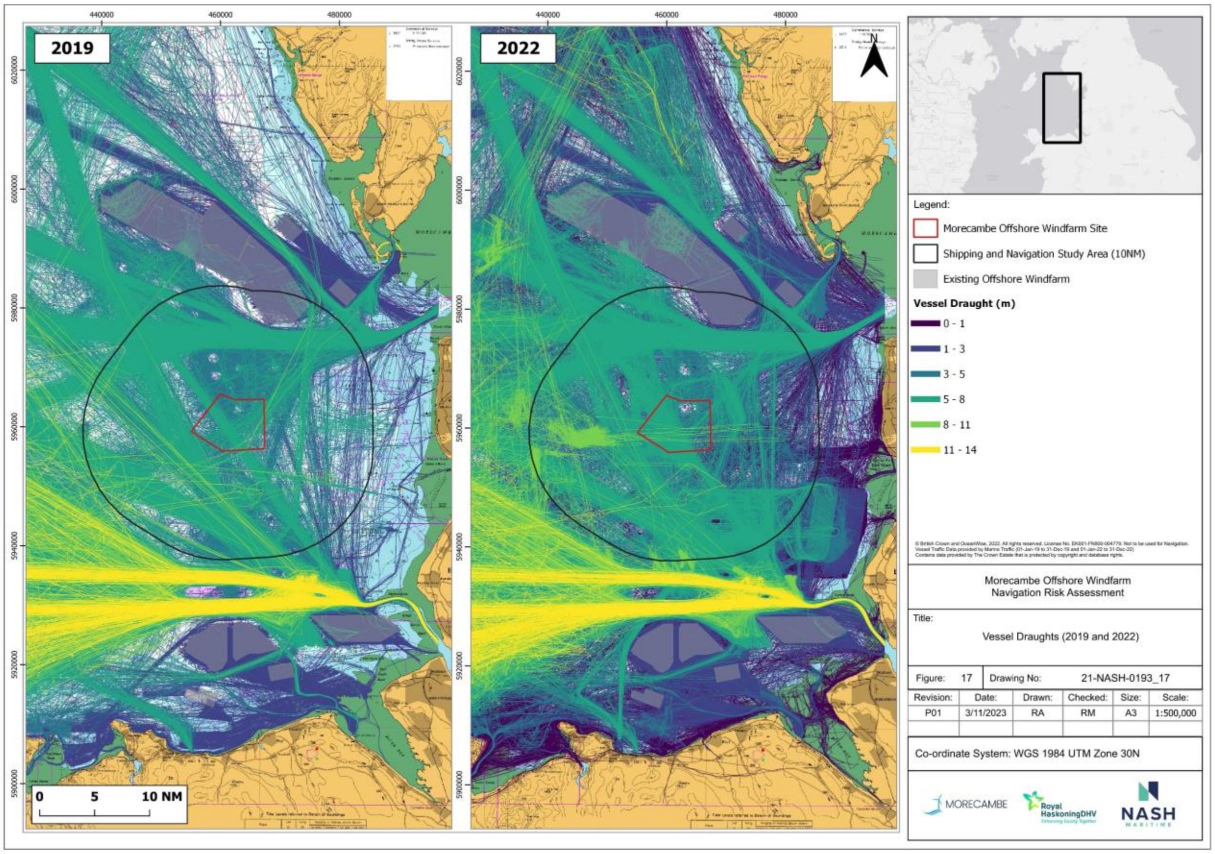


Figure 17: All vessel tracks by vessel draught (m)

6.4.2 Vessel traffic by type

6.4.2.1.1 The following sections consider the vessel traffic by type of vessel for AIS data obtained for the periods 01-Jan-2019 to 31-Dec-2019 and 01-Jan-2022 to 31-Dec-2022. The collection of radar and visual data during the 2 x 14-day traffic surveys in 2022 (validated with the winter 2023 survey data) was used to supplement the understanding of vessel traffic movements in the study area.

6.4.3 Commercial

6.4.3.1.1 The tracks of commercial vessels, namely dry cargo vessels and tankers, are shown in **Figure 18** and **Figure 19**, respectively.

6.4.3.1.2 There are three primary cargo vessel routes intersecting the windfarm site shown in **Figure 18**. Firstly, a route running southwest/northeast, through the centre of the windfarm site, to/from Heysham and Barrow, aligning with Off Skerries TSS. Secondly, a route running northwest/southeast, through the centre of the windfarm site, between Liverpool and Ireland/Scotland, passing 2nm east of the SBM south of the windfarm site. A third route runs west of the SBM through the centre of the windfarm, with vessels on passage between Liverpool and Ireland/Scotland. Each of these routes are considered to be low frequency, with <1 vessel/day.

6.4.3.1.3 Cargo vessel tracks passing through the wider study area primarily comprise vessels transiting between Dublin, Warrenpoint, Belfast or the Isle of Man and Heysham, Barrow or Liverpool. Routes of out Heysham and Barrow transit east-west between WODS and South Morecambe gas field. In total, there were 484 cargo vessel transits through the study area in 2019 and 269 in 2022, this is an average of 1.4/day and 0.7 per day, respectively. During the vessel traffic surveys, 20 cargo vessels were identified during the 28-day survey period (an average of 0.7 vessels/day). A total of 13 cargo vessels were observed during the 14-day winter 2023 survey period (an average of 1 vessel/day).

6.4.3.1.4 Tankers are shown in **Figure 19**. All tanker tracks that passed through the windfarm site in 2022 transited the southwestern corner. These tracks primarily comprise vessels transiting northwest/southeast, between Belfast or Larne and Liverpool. In total, seven tracks on this route intersected the windfarm site. Although the route was used frequently in 2019, there were no vessels that intersected the windfarm site. A less frequent tanker route is evident in an east/west direction, through the windfarm site between Barrow and Off Skerries TSS, and in 2019 vessels on this route transited the windfarm site nine times. This route does not a appear to have been used by tanker vessels in 2022.

6.4.3.1.5 For the wider study area, a north/south route between Larne/Belfast and Liverpool is located 5.2nm east of the windfarm site. A single vessel, Keewhit, transited this route in 2019, with 23 transits identified. This vessel is regularly used for bunkering of other vessels whilst they are in port. Keewhit was also the only tanker vessel using this route in 2022, however, the number of transits it completed increased to 64. On 19 of these occasions, Keewhit took a variation of this route, 1.5nm to the west of the primary route. This alternative route is 3.5nm east of the windfarm site. This less frequent route takes the tanker west of the Morecambe Q(9)15s cardinal mark and is likely done to avoid the Shell Flats at low tide.

6.4.3.1.6 There were 272 tanker vessel transits through the study area in 2019, and 166 in 2022, which equates to an average of 0.7 and 0.5 vessels/day respectively. The vessel traffic surveys identified 15 tanker transits during the 28-day survey period (an average of 0.5 vessels/day) and were observed to be utilising routes identified in the 2019 and 2022 data. A total of eight tankers were observed during the 14-day winter 2023 survey period (an average of 0.6 vessels/day).

6.4.3.1.7 Further detailed analysis of commercial shipping routes is contained in **Section 6.4.3**.

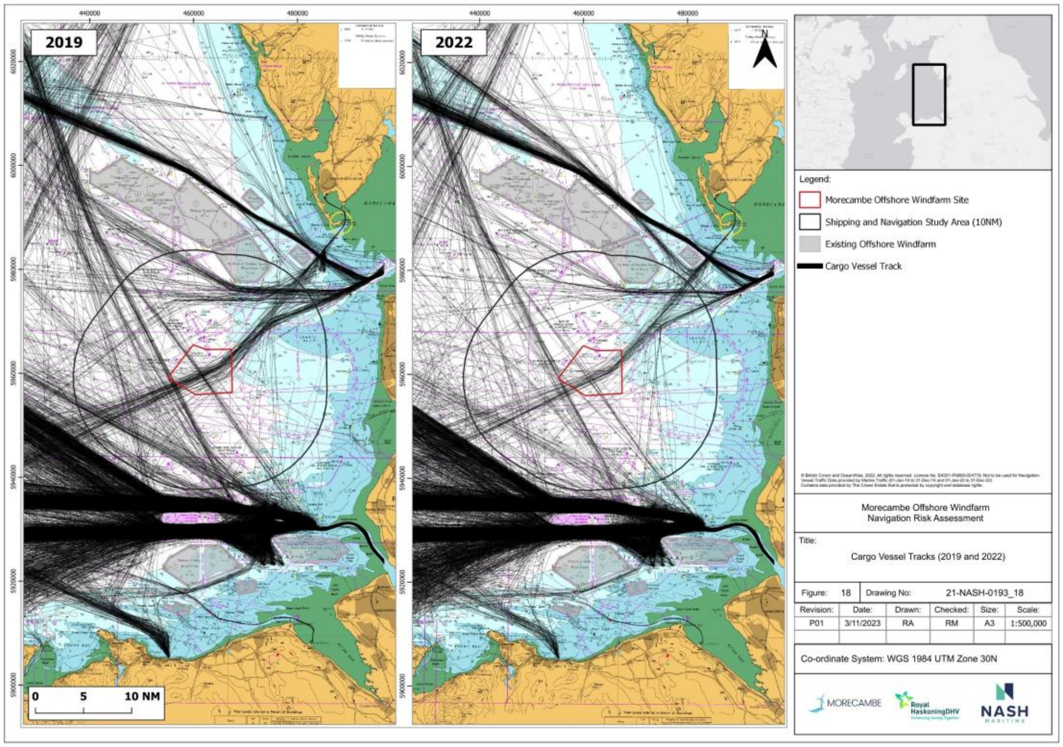


Figure 18: Cargo vessel tracks

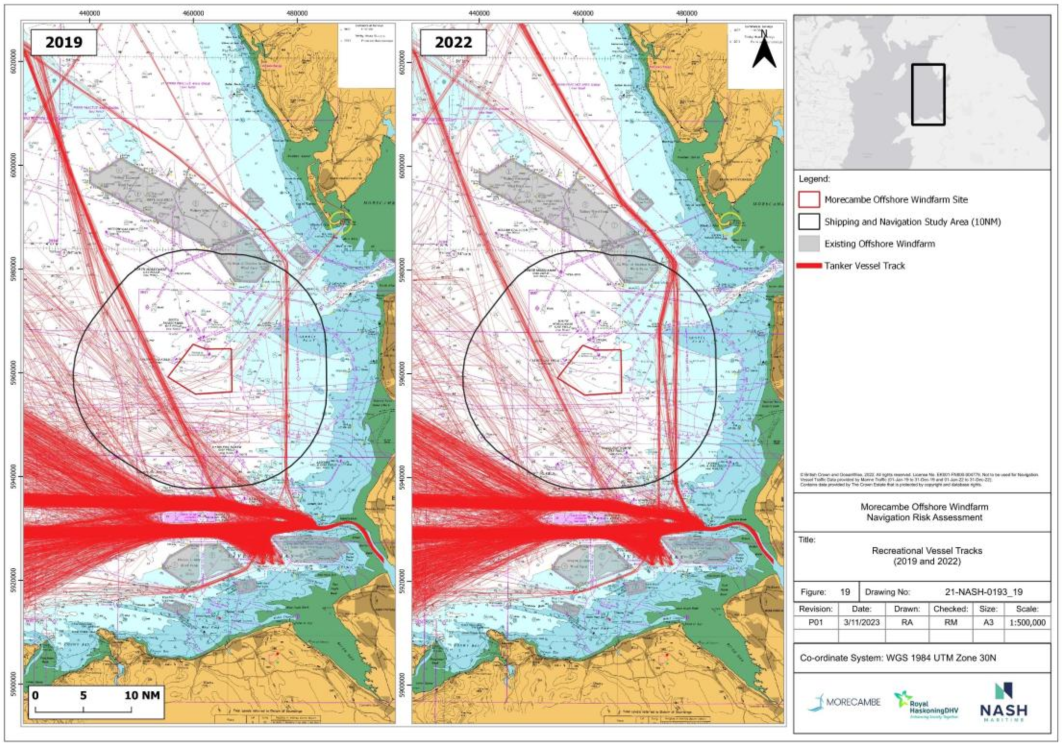


Figure 19: Tanker vessel tracks

6.4.4 Ferries

6.4.4.1.1 The tracks of ferries are shown in **Figure 20**, including passenger and freight services. Four principal operators are identified in the eastern Irish Sea. IoMSPC operate between Douglas, Liverpool and Heysham. Seatruck operate between Heysham, Liverpool, Warrenpoint and Dublin. Stena operate between Liverpool, Heysham and Belfast. Finally, P&O operate between Liverpool and Dublin.

6.4.4.1.2 During adverse weather, vessels use alternative routes where courses are used to reduce the effects of the prevailing wind and wave conditions. A detailed analysis of these routes is contained within **Section 6.4.12** and **Section 6.4.14.**

6.4.5 Cruise ships

6.4.5.1.1 The tracks of cruise ships are shown in **Figure 20**. Cruise vessel activity in the area is centred around the Port of Liverpool and Douglas. Liverpool has a cruise terminal, which has a regular cruise itinerary and provides turnaround services. Approximately 18 cruise ships were recorded transiting the study area in 2019, this number decreased to six in 2022. These vessels were on a southeast/northwest route and transited the southern region of the study area on voyage between Liverpool and Ireland or Douglas. A second route transiting the north of the study area is evident in 2022 and not 2019. All of these vessel tracks are the 90m cruise ship Corinthian visiting Barrow-in-Furness, and the vessel transited the study area on 10 occasions in 2022. The shortest distance between the Corinthian and the windfarm site was 4.7nm, recorded Jul-26th 2022. The majority of cruise ships in the Irish Sea are bound for Liverpool and pass outside of the shipping study area, principally between April and September.

6.4.5.1.2 No cruise ships were identified passing through the windfarm site in either 2019 or 2022. The closest passing cruise ship was Amadea (193m in length), passing 1.5nm southwest of the windfarm site on passage between Liverpool and Douglas (Sep-27th 2022).

6.4.5.1.3 The Corinthian cruise vessel was identified during the summer vessel traffic survey on two occasions to the north of the windfarm site on passage to Barrow-in-Furness.

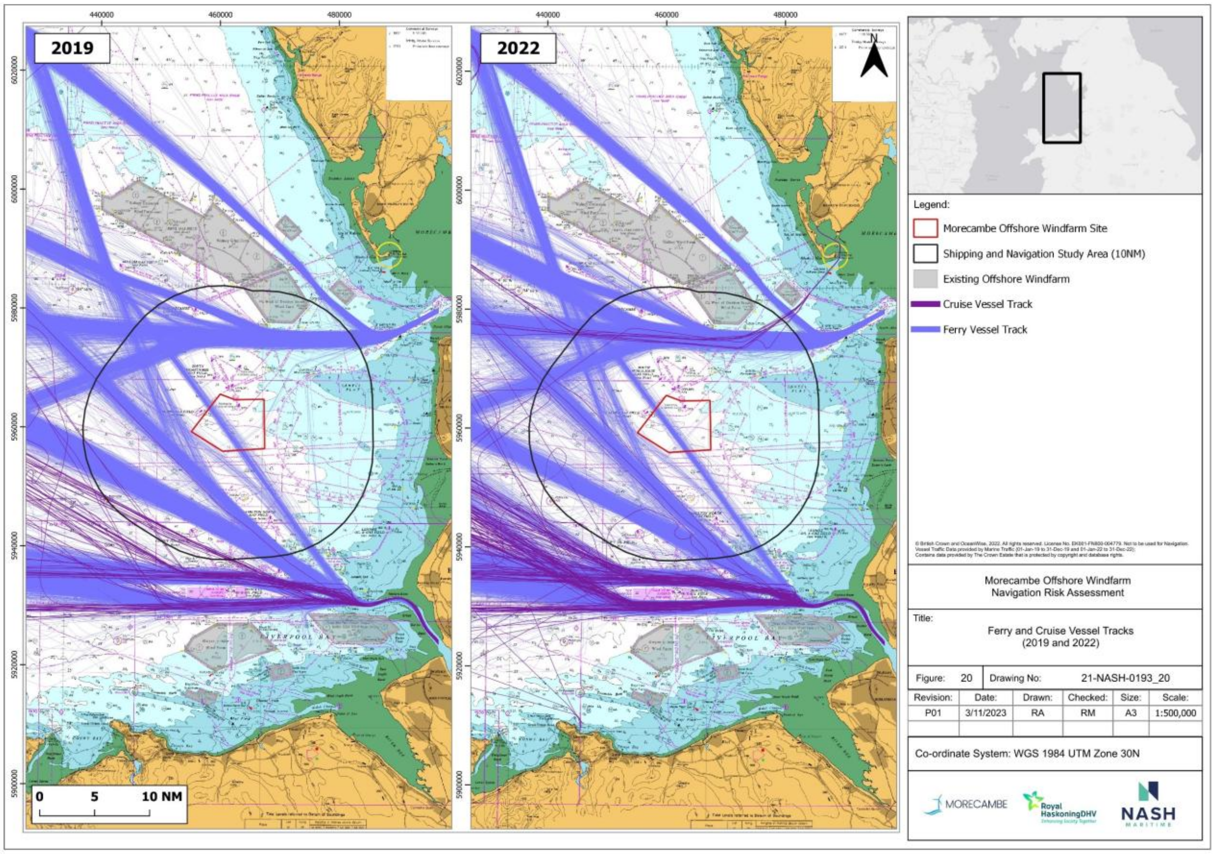


Figure 20: Ferry and cruise ship tracks

6.4.6 Recreational

6.4.6.1.1 The intensity of recreational activity within the study area is shown in **Figure 21**. Historical AIS data for 2019 and 2022, along with the RYA Coastal Atlas (2019), were combined to identify areas of increased recreational activity. The Morecambe windfarm site is characterised by reduced recreational activity. Most recreational vessels remain close to the coast, particularly along the entrance to Liverpool, and around Holyhead, Douglas, and Rhyl. Inshore cruising routes are clear of the Morecambe windfarm site. Low to moderate intensity is also evident within the study area, notably south of the windfarm site.

6.4.6.1.2 Offshore cruising routes are evident between Liverpool, Douglas, Menai Straights, and Morecambe Bay, running adjacent to the Morecambe windfarm site. Relatively few yachts were recorded during the 2021/2022 vessel traffic surveys, with 12 tracks recorded during the summer survey (six intersected the windfarm site) and none recorded during the winter survey. This suggests significant seasonality in recreational movements through the study area. Each identified track was attributed to a unique vessel, suggesting offshore cruising use rather than regular use of the area.

6.4.6.1.3 AIS data revealed that recreational vessels were occasionally transiting through the Morecambe windfarm site, with some vessels sailing offshore passages. **Figure 22** shows the recreational vessel tracks around the study area derived from 2022 AIS data. The study area is characterised by a reduced coverage of cruising vessel tracks, especially within the windfarm site. In total, 131 recreational tracks were detected crossing study area, with 26 tracks crossing the windfarm site. Five major cruising routes (shown in **Figure 22**) were also identified in the study area from the 2022 AIS data: (1) Conwy to Douglas, (2) Conwy to Morecambe, (3) Liverpool to Douglas, (4) Morecambe to Douglas, and (5) Whitechapel to Anglesey. The Morecambe windfarm site appears to be encased within a “triangle” of routes between Morecambe, Douglas, Liverpool, and Conwy, with few intersections between recreational vessel tracks and the Project site.

6.4.6.1.4 The cruising route Liverpool to Douglas runs adjacent to the southwest boundary of the windfarm site. This route is also used by vessels participating in the Isle of Man Midnight Race, organised by the Liverpool Yacht Club (LYC), which is the only relevant yacht race that crosses the study area, with approximately 10 vessels participating each year (40 vessels in 2019 due to 100th anniversary of race). Nevertheless, 88% of recreational vessels detected along this route did not sail through the windfarm site. Similarly, 80% of vessels on the route between Morecambe and Conwy avoided the windfarm site. All vessels detected sailing along the other identified routes (i.e., Conwy to Douglas, Morecambe to Douglas, and Whitechapel to Anglesey) did not cross the windfarm site.

6.4.6.1.5 Existing offshore windfarms can also serve as a reference for understanding how recreational craft respond when their routes intersect with offshore windfarms. For example, the route between Morecambe and Douglas is intersected by two offshore windfarms (Walney and WODS). About 79% of cruising vessels sailing along this route opted for a longer passage, to avoid crossing the existing windfarms. The majority of craft chose a southerly route around the windfarms, extending the shortest possible passage of 46nm by an additional 4nm, which can add up to one hour of passage time (depending on the vessel type and weather conditions). However, during consultation with the RYA, it was noted that recent evidence from AIS data suggests that yachts avoid transiting through an offshore windfarm less than previously thought, based on responses to surveys.

6.4.6.1.6 A challenge in analysing recreational vessel patterns using AIS data is that not all vessels, particularly the smaller crafts, transmit AIS signals. A 2014 RYA survey found that 37% of recreational vessels around the UK transmit AIS signals. This survey showed a potential bias, as vessel owners were more likely to participate in an AIS survey if already use AIS on their crafts. Previous RYA studies have concluded that between 10 to 30% of recreational crafts are transmitting AIS signals in the UK, though this varies greatly depending on the specific location. For comparison, 63% of vessels participating in the LYC Isle of Man Midnight Race in 2022 were transmitting AIS signals (81% in 2019).

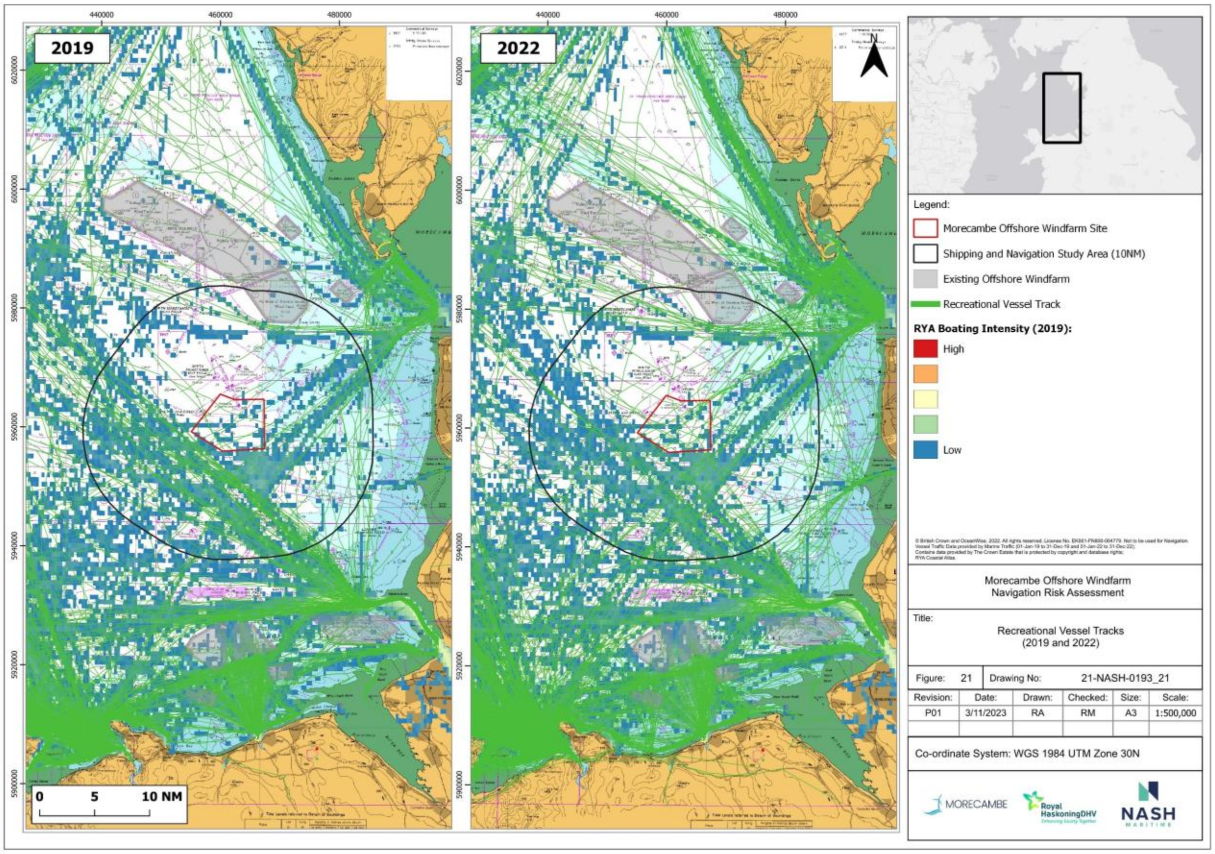


Figure 21: RYA Atlas recreational vessel density

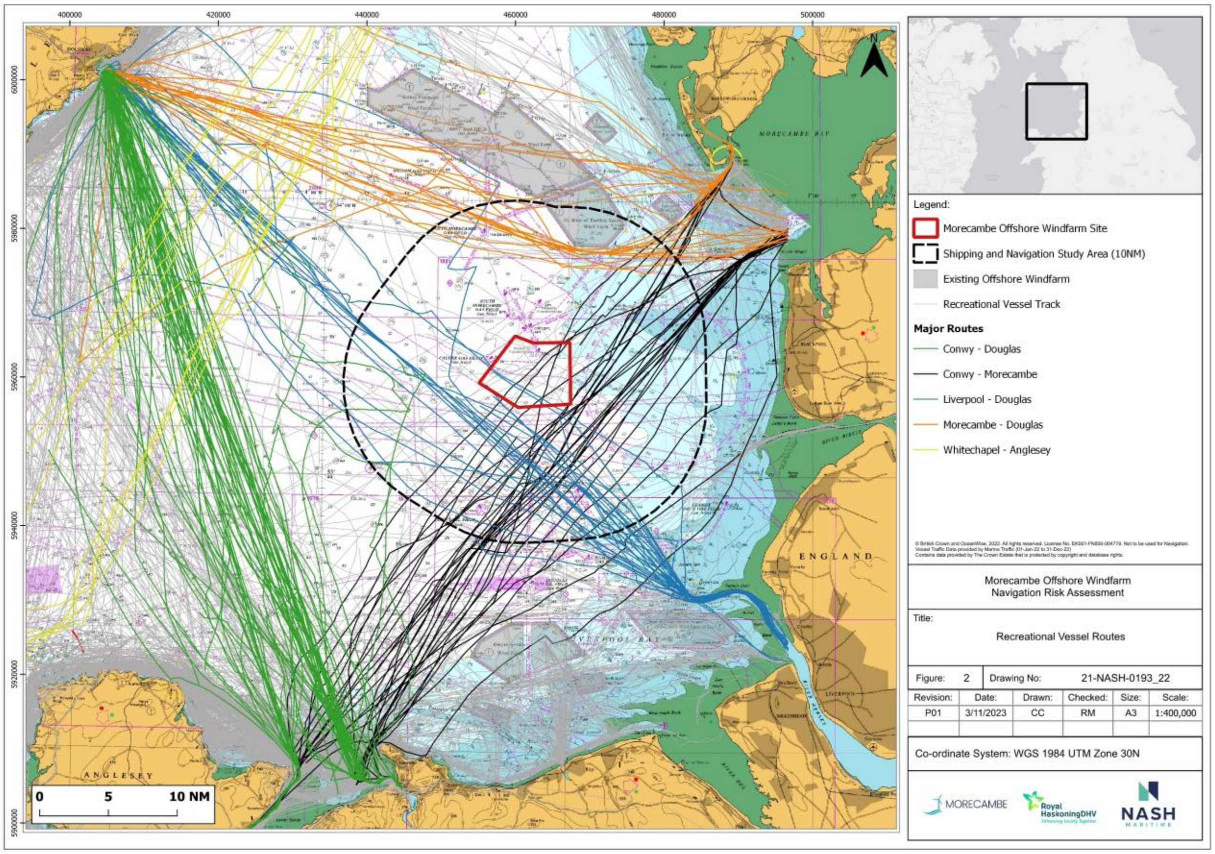


Figure 22: Recreational vessel tracks and routes

6.4.7 Fishing

6.4.7.1.1 Fishing vessel tracks during each season in 2019 and 2022 are shown in **Figure 23** and **Figure 24,** respectively. Fishing activity is undertaken across the study area throughout the year. There were 1,189 fishing vessels transits of the Study Area in 2019, and this number decreased to 549 in 2022. Autumn (Aug–Oct) was the busiest season in 2019, with 453 transiting fishing vessels, whilst in 2022, experiencing 214 transiting fishing vessels, Spring (Feb-Apr) was the busiest season. Winter was the quietest season of 2019, with 189 transits, while in 2022, only 87 transits passed through the study area in summer, making that the quietest season.

6.4.7.1.2 Spring was the most consistent season for both years, with 2022 only seeing 12.7% fewer transiting vessels than 2019. Whilst the vessels mostly occupied the same spaces in both years, Spring 2022 saw more vessels in the southeastern part of the study area, compared to 2019, when the vessels clustered further south-west. Another slight variation was in the central study area, where there were more vessels to the west of the windfarm site in Spring 2022 compared to 2019. There were also fewer vessels transiting in the northeast corner of the study area in Spring 2022. The winter season was also somewhat similar between the years in terms of the spatial distribution of transits, and saw just a 25% decrease in transits through the study area in 2022 compared to 2019. The main difference was a much greater clustering of vessels to the northeast, north and northwest of the windfarm site in 2019, compared to 2022.

6.4.7.1.3 The biggest difference between 2019 and 2022 was Autumn, when 2022 saw 76.6% fewer vessels compared to 2019. Most of the vessels within the study area during 2022 were clustered just northeast of the windfarm site, with some transiting in an east-west direction around 5.5nm north of the windfarm site and some transiting in a northeast-southwest direction, around 3.5nm southeast of the windfarm site. Whereas, in Autumn 2019, there were a lot more vessels transiting east-west, north of the windfarm site, and larger clusters of vessels to the west and to the south of the windfarm site. Summer also saw a significant (71.2%) drop in transiting vessels in 2022 compared to 2019, however, the spatial distribution was not too dissimilar, with a couple of the main clusters located approximately 3 nautical miles further west in 2022.

6.4.7.1.4 During the hazard workshop in 2023, it was discussed that the area is used primarily by vessels using static gear from ports in Wales and Fleetwood, with very little trawling activity. Belgium beam trawlers were noted as making periodic visits to the area. Some fishing vessels are engaged in guard vessel duties or other survey works and account for some of the concentrations around oil and gas installations.

6.4.7.1.5 Fishing vessel activity during vessel traffic surveys was concentrated to the south and southwest of the study area during winter and within the northern half of the study area during summer.

6.4.7.1.6 **Figure 25** shows the intensity of fishing activity as recorded by the MMO using VMS, required on fishing vessels over 15m. The area southwest of the windfarm site has been recorded as having over 10,000 hours of fishing time in 2020. Fishing intensity within the windfarm site is observed from the VMS data to be greatest to the southeast, with between 1,000 and 10,000 hours recorded in 2020.

6.4.7.1.7 Additional data and analysis on fishing activity is contained within the Project's Chapter 13 Commercial Fisheries chapter.

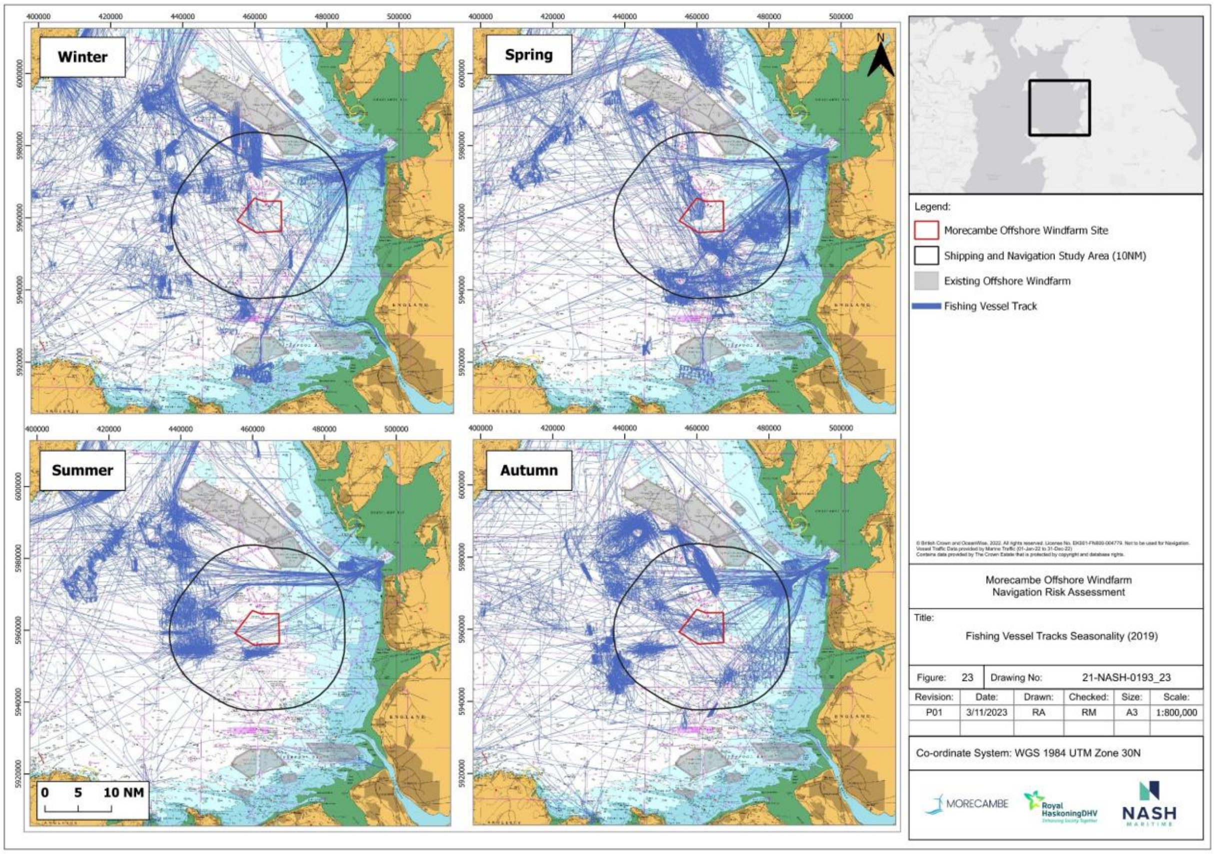


Figure 23: Fishing vessel seasonal activity (2019)

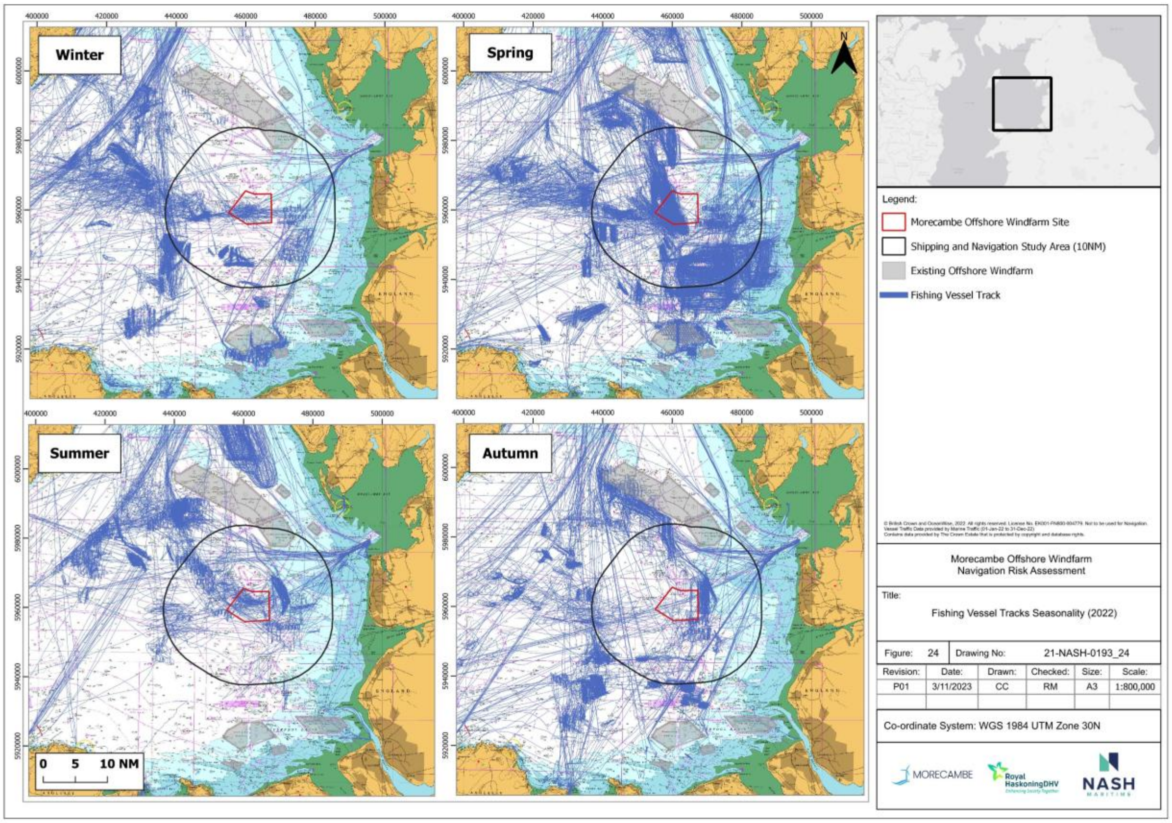


Figure 24: Fishing vessel seasonal activity (2022)

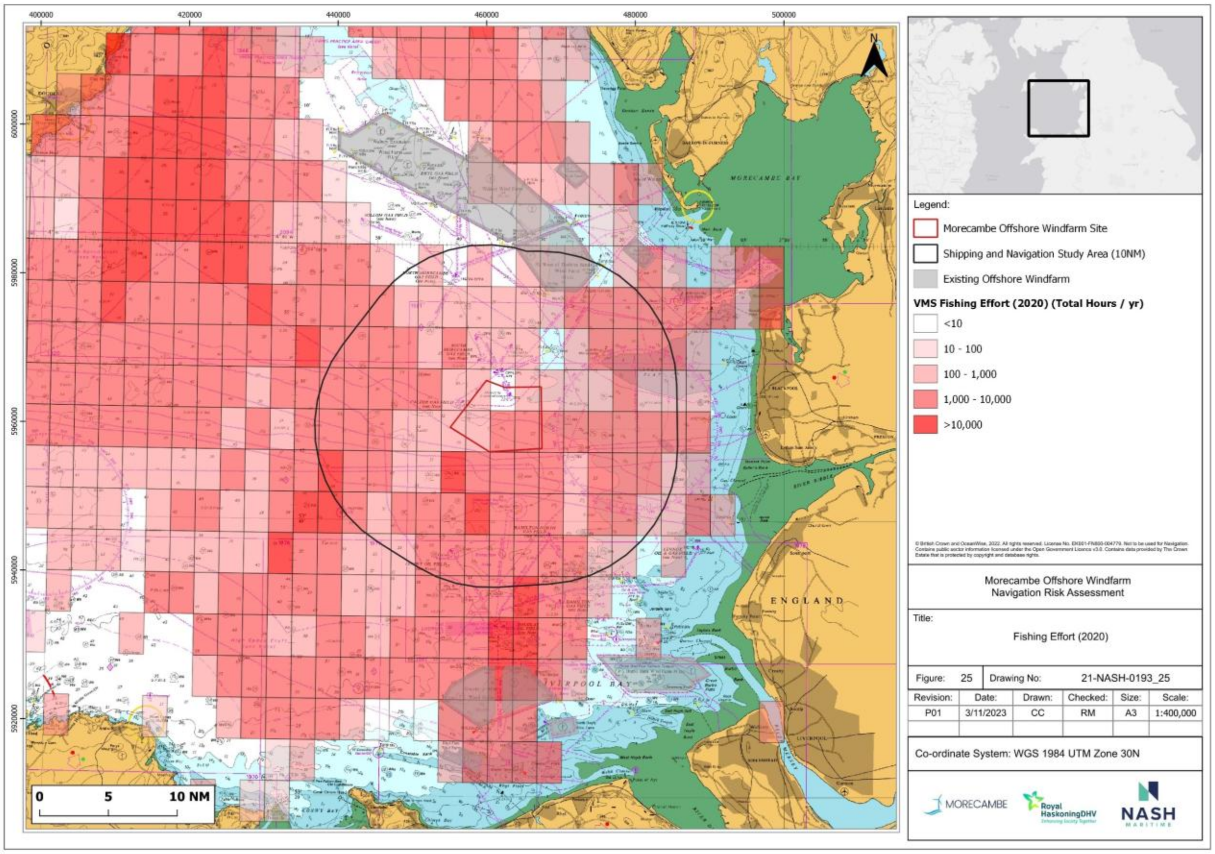


Figure 25: Fishing effort (VMS 2020)

6.4.8 Tug and Service

6.4.8.1.1 The tracks of tug and service vessels are shown in **Figure 26** and **Figure 27**. These have been subdivided into key categories.

6.4.8.1.2 CTVs operate between O&M bases and the existing OWFs to the north (Walney and WODS) and south (Burbo Bank and Gwynt y Mor) of the study area. 16 CTV tracks transited in a southeast-northwest direction through the windfarm site in 2019 travelling between Liverpool and the Walney Extension OWF. There were 22 CTV tracks that passed through the windfarm site, transiting southwest/northeast between Barrow and Off Skerries TSS. Transits through the eastern region of the study area passed north/south between Liverpool and the OWFs to the north, totalling 157 transits. 21 of these tracks passed within 1nm of the north-eastern corner of the windfarm site.

6.4.8.1.3 In 2022, 18 CTVs were recorded transiting the windfarm site in a southeast-northwest direction. Additionally, the number of CTVs transiting southwest-northeast decreased to two. The eastern region of the study area remained frequently transited by CTVs travelling north-south, though the 157 transits recorded in 2019 decreased to 71 in 2022.

6.4.8.1.4 Oil and gas associated supply ships and standby safety vessels have a high intensity within the windfarm site and study area where platforms are located. Oil and gas service vessels mostly operate out of Heysham or Liverpool. In 2019, approximately 1.5 vessels per day passed through the windfarm site and 11.5 vessels per day operated within the study area. In 2022, activity decreased with one vessel per day transiting the windfarm site, and 7.5 vessels per day entering the in the study area.

6.4.8.1.5 In both 2019 and 2022, the activities of dredgers and pilot vessels are concentrated to the east and south-east of the study area. A low-use route used by dredgers is present between Heysham and Off Skerries TSS. SAR vessels are dispersed throughout the study area.

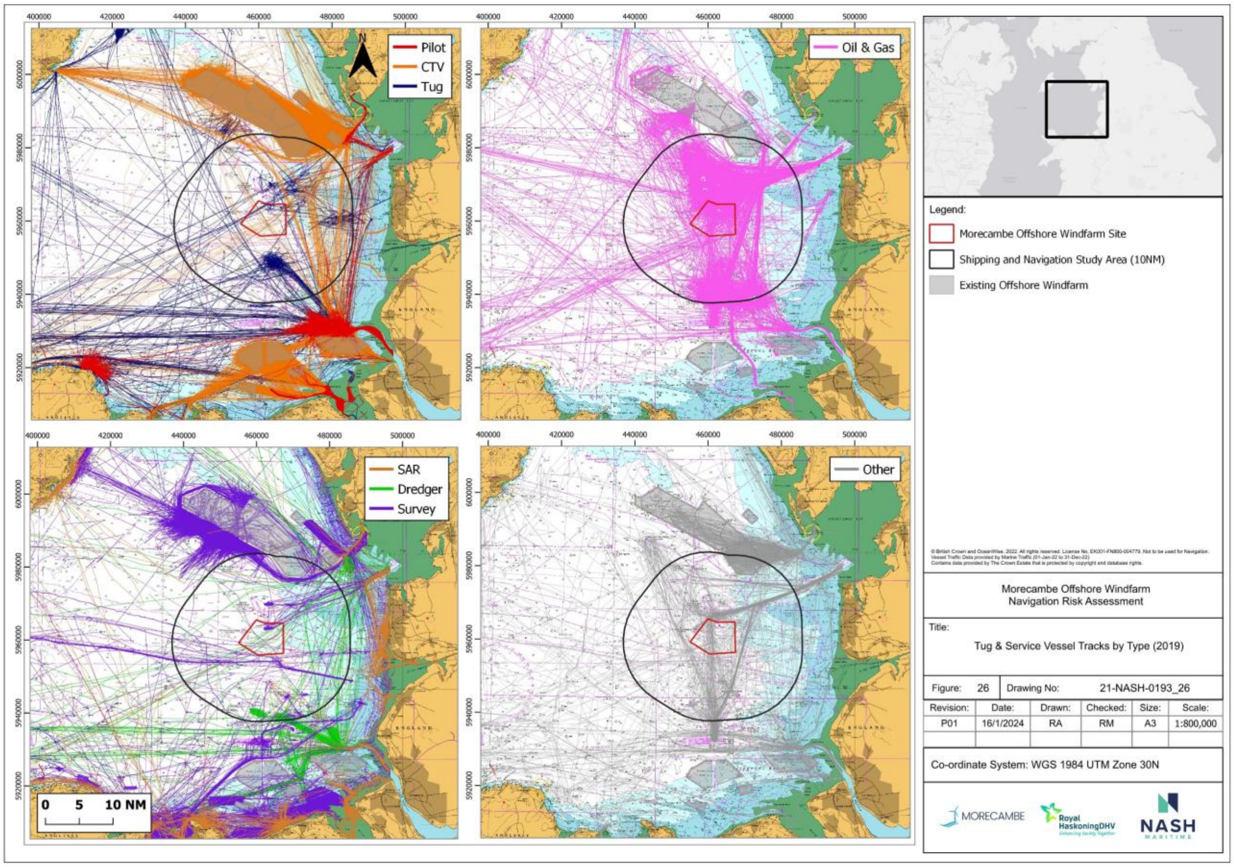


Figure 26: Tug and Service Vessel Tracks by Type (2019)

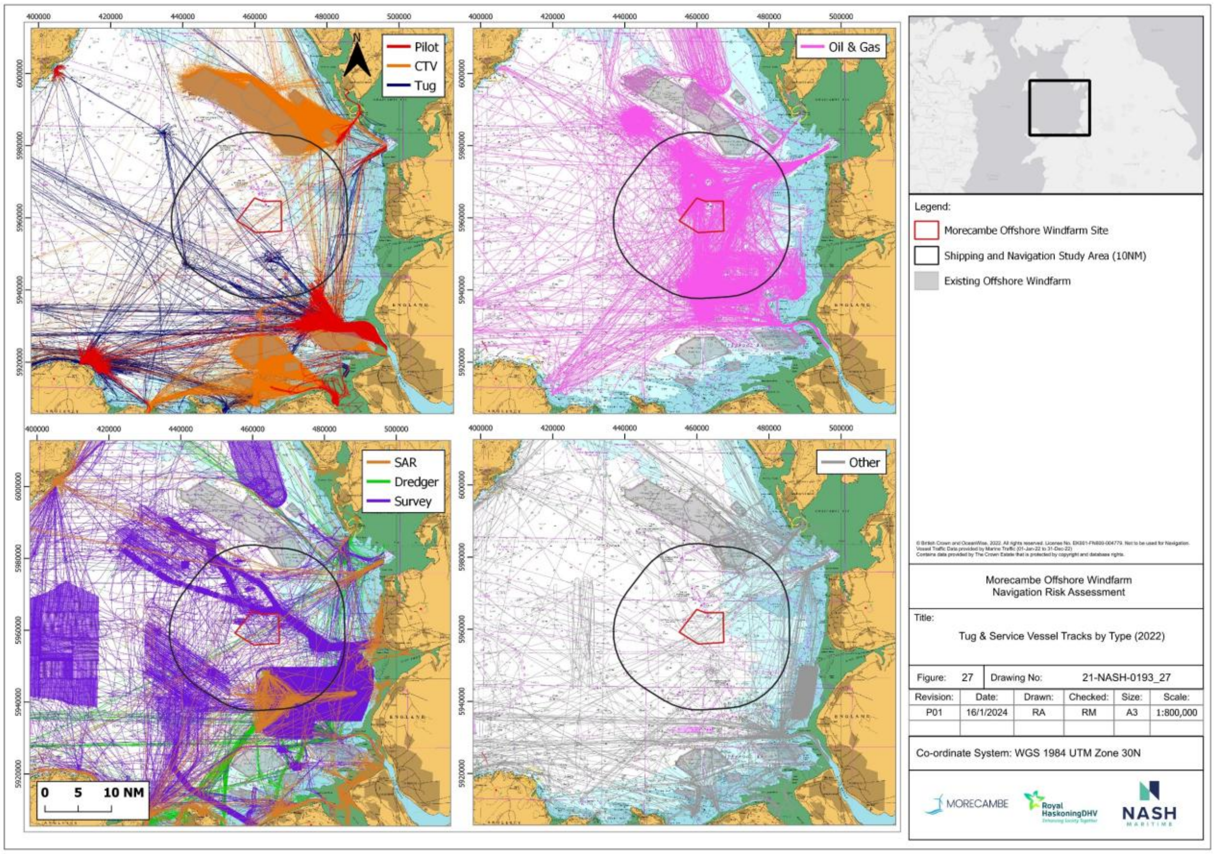


Figure 27: Tug and service vessel tracks by type (2022).

6.4.9 Transit counts and seasonality

6.4.9.1.1 **Figure 28** show the numbers of vessels transiting through the windfarm site and study area by type and by month respectively.

6.4.9.1.2 **Figure 28** illustrates that tug and service vessels are the predominant vessel type in both the windfarm site and study area with 26 vessels/day in the study area and three vessels/day in the windfarm site. This is most likely due to the offshore oil and gas infrastructure present in the area. The next most frequent vessel type was passenger vessels which is due to the ferry routes in the region.

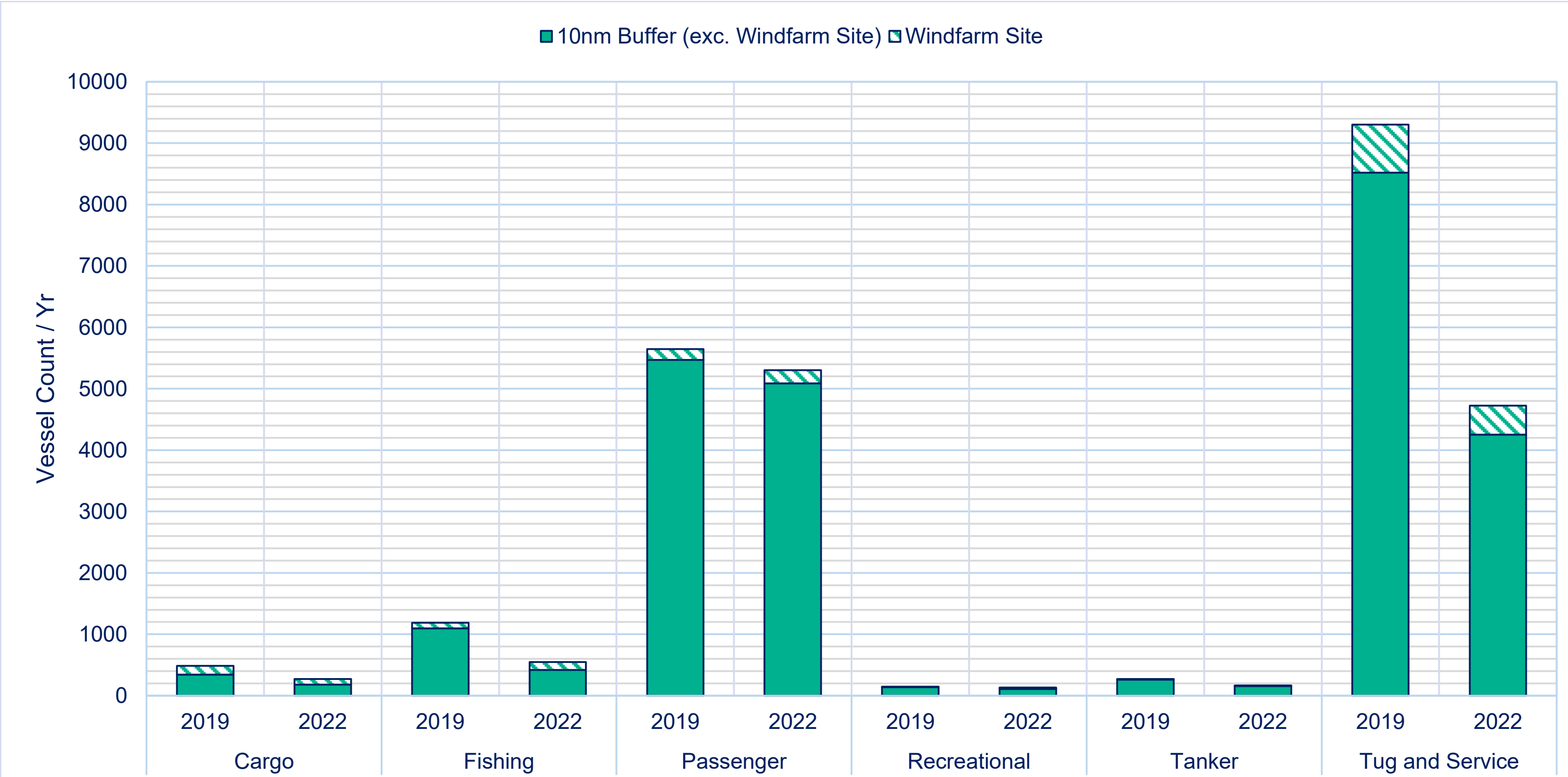


Figure 28: Vessel count per year by vessel type (2019 and 2022)

6.4.9.1.3 Analysis presented in **Figure 29** and **Figure 30** shows transit counts per month through the study area and windfarm site for 2019 and 2022, respectively. In 2019 there were between 63 (Jan) and 191 (Dec) transits/month that intersected the windfarm site, in 2022 these figures reduced to between 52 (Feb) and 129 (Jul). Additionally, in 2019 between there were between 959 (Jan) and 1,657 (Jul) transits per month through the study area, this reduced to between 508 (Feb) and 1,176 (Aug) transits/month in 2022. The vessels transiting through the study area are predominantly tug and service and passenger vessels associated with the oil and gas infrastructure and ferry routes.

6.4.9.1.4 Vessel traffic within the study area peaks during summer, due to an increase in ferry service operations, recreational and fishing activity. Vessel counts within the windfarm site fluctuate across the year, primarily driven by changes in tug and service activity. Evidence of this can be seen in December 2019, where 164 of the 191 vessels that intersected the windfarm site were tug and service. This is an increase from the 63 tug and service vessels recorded in the previous month and is primarily comprised of vessels associated with oil and gas operating around the South Morecambe Gas Field (145 out of the 164).

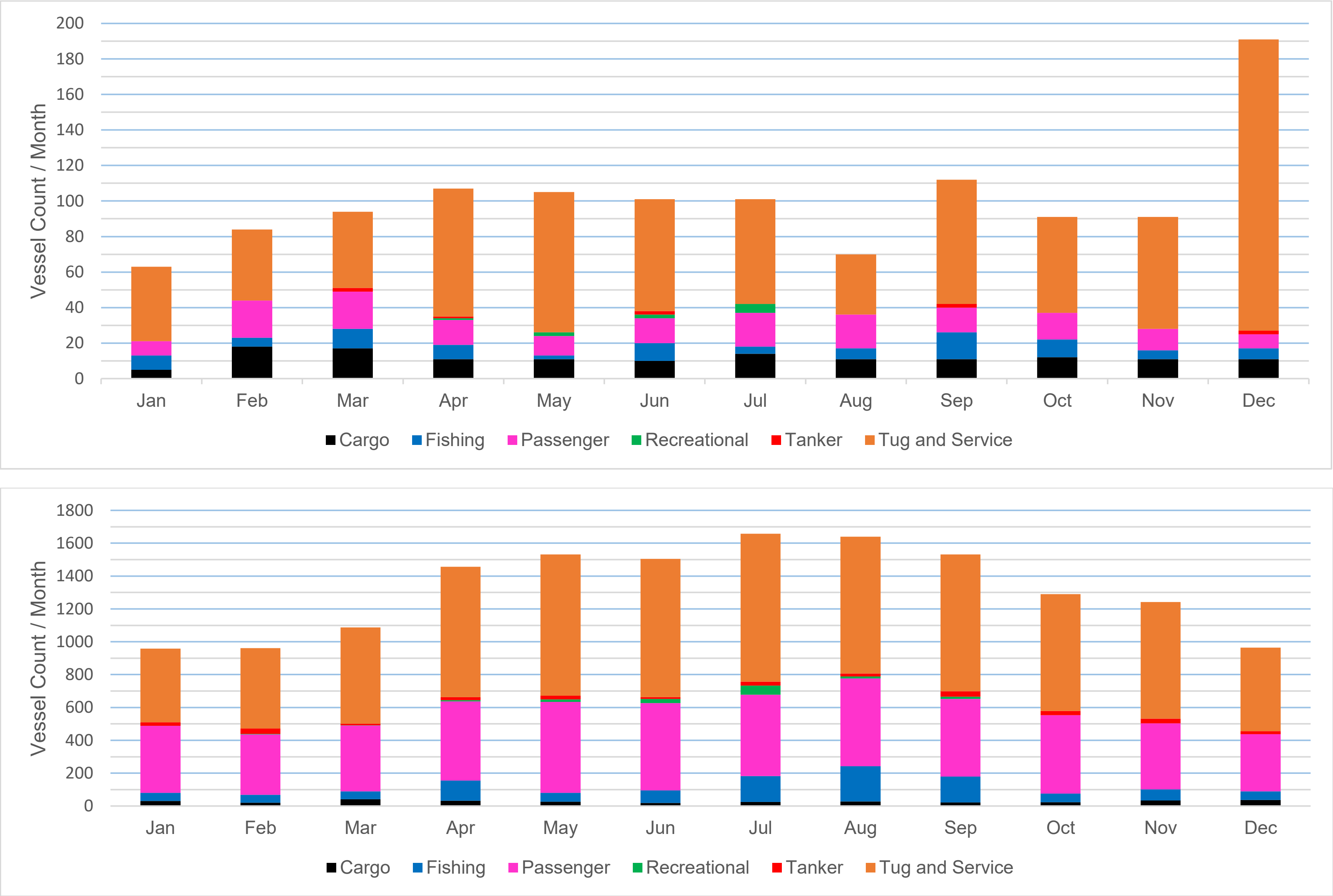


Figure 29: Vessel counts within the windfarm site (top) and study area (bottom) per month (2019).

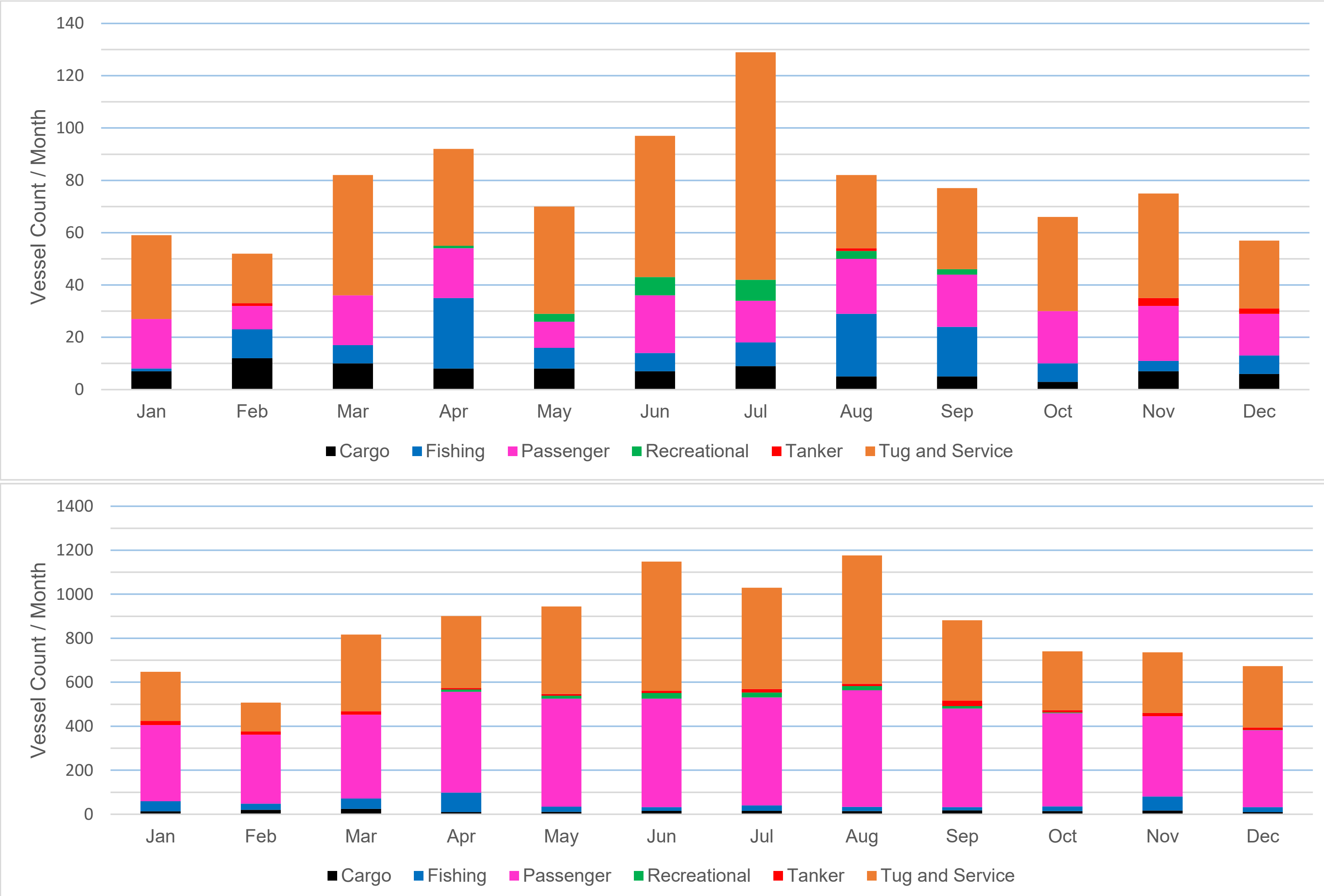
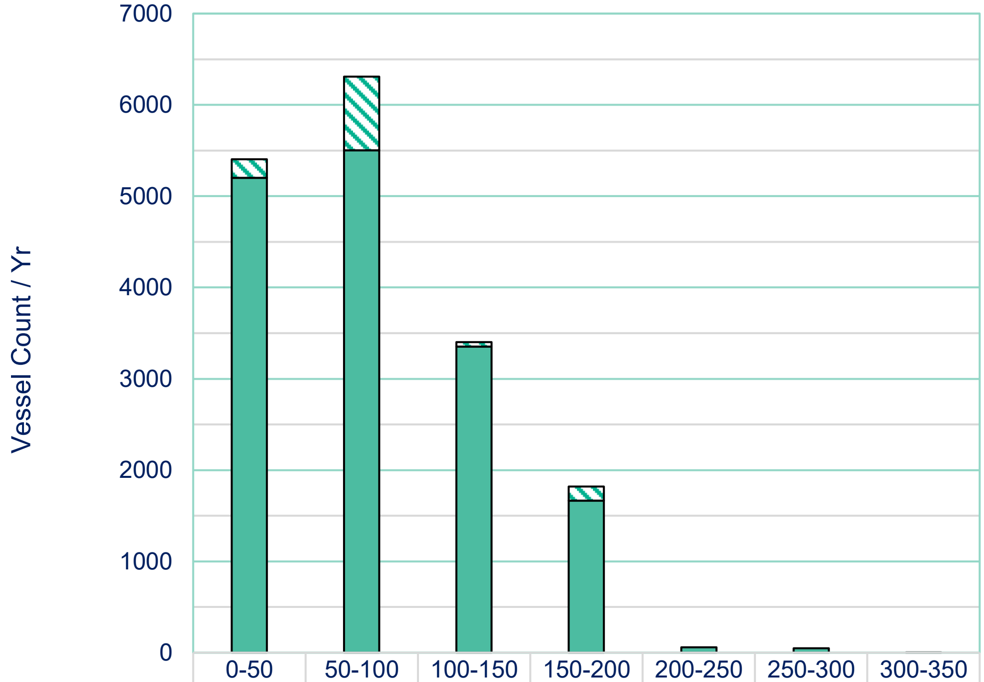


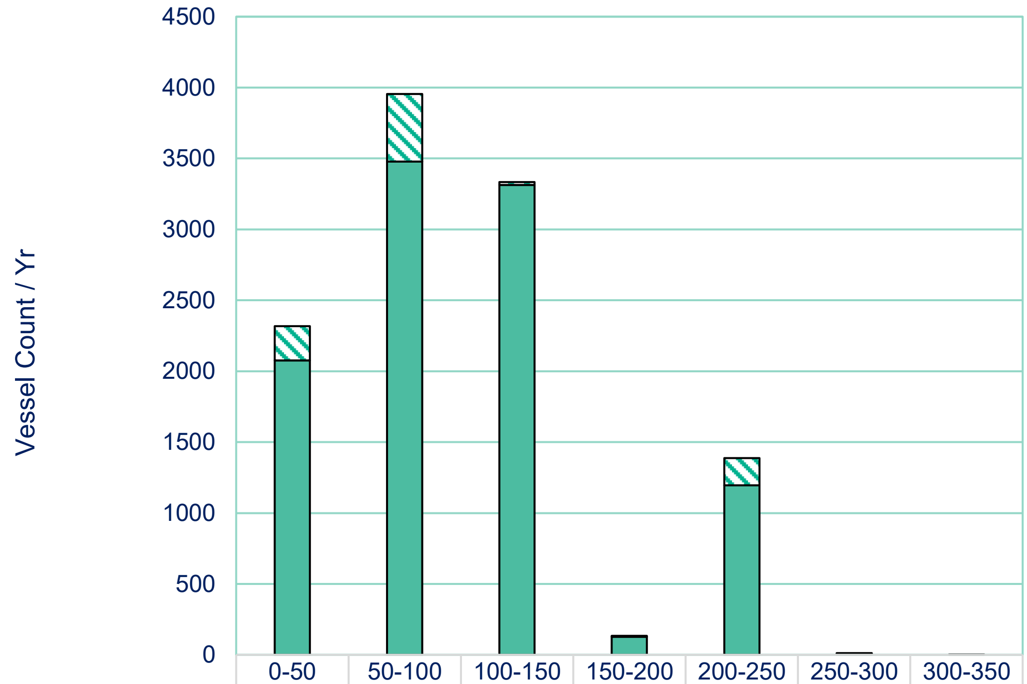
Figure 30: Vessel counts within the windfarm site (top) and study area (bottom) per month (2022).

6.4.9.1.5 **Figure 31** and **Figure 32** shows a breakdown of vessels by length. Around 23% less vessels overall passed through the windfarm site in 2022, compared to 2019, and there were 35% fewer vessels through the study area. Over three quarters (76%) of all the vessels that entered the windfarm site in 2022 were less than 100m in length. In 2022, 192 vessels over 200m in length passed through the windfarm site in comparison to none in 2019. All 190 vessel tracks are the three Stena 215m E-Flexer-class ferries that begun operating on the Irish Sea routes.



	0-50	50-100	100-150	150-200	200-250	250-300	300-350
Windfarm Site	203	807	48	154			
10nm Buffer (exc. Windfarm Site)	5201	5503	3354	1664	60	47	2

Figure 31: Vessel counts by length within the windfarm site and study area (2019)



	0-50	50-100	100-150	150-200	200-250	250-300	300-350
Windfarm Site	241	477	21	7	192		
10nm Buffer (exc. Windfarm Site)	2077	3478	3313	127	1196	13	2

Figure 32: Vessel counts by length within the windfarm site and study area (2022)

6.4.10 Identification of vessel routes

6.4.10.1.1 MGN 654 (MCA, 2021) provides guidance regarding the definition of shipping routes, in order to inform OWF assessments. To account for variation of tracks taken by vessels, the guidance note establishes the 90th percentile corridor principles, the central portion of traffic on a route containing the majority (90%) of vessel traffic. **Figure 33** shows a schematic of how the 90th percentile routes can be defined. To identify shipping routes, the MCA's 90th percentile concept has been utilised.

6.4.10.1.2 The 90th percentile concept considers that as vessels navigate between specific locations, they may take a variety of routes due to avoiding other traffic or as a result of leeway from wind or waves. However, they are generally concentrated in a particular corridor – approximately normally distributed. At any point along the route the cross track geometric distribution of vessel tracks can be determined and is typically stylised as a "normal" distribution.

6.4.10.1.3 To minimise any anomalous tracks, and therefore mark the width of a specified route, the MCA advise using the centre 90th percentile of the determined Total Route Width (see **Figure 33**) around the assumed median or centre line, for all vessels engaged on passage between the same two points.

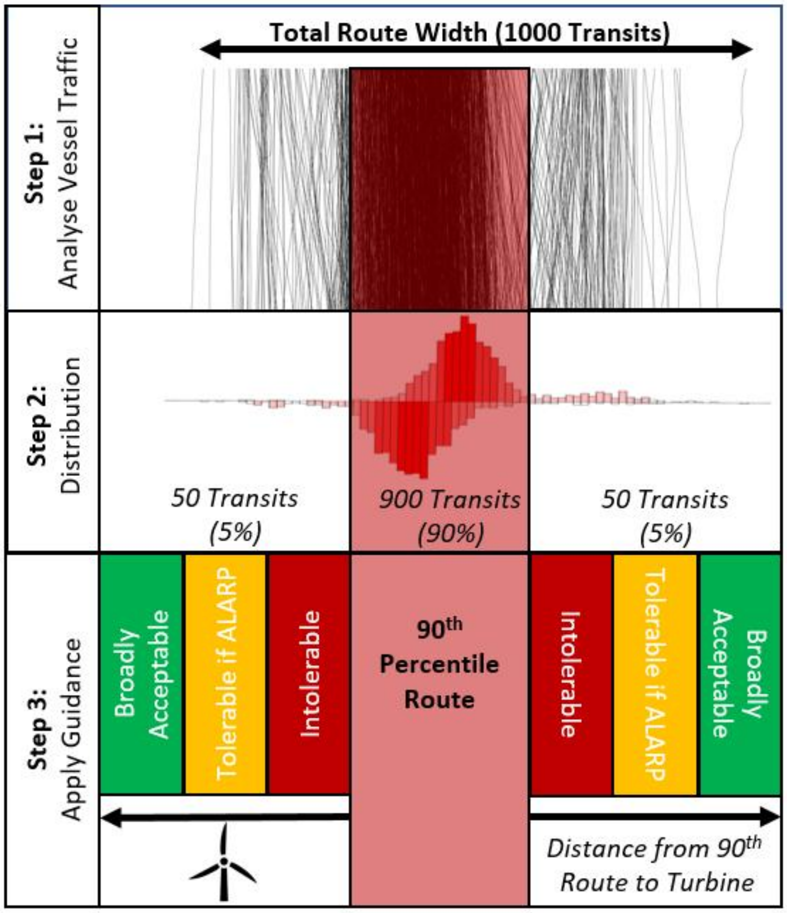


Figure 33: MGN654 90th percentile workflow

6.4.10.1.4 To identify the 90th percentile routes, the following data processing steps were undertaken:

- **Step 1:** Vessel tracks filtered to commercial only (cargo, tanker & passenger)
- **Step 2:** Tracks along a defined route selected
- **Step 3:** Gate transects constructed along the length of the route (ensuring transects at course changes are included)
- **Step 4:** Calculate number of tracks through cross track transect subsections
- **Step 5:** Calculate location of 9^{0t}h percentile through transect (**Figure 34**)
- **Step 6:** Draw polygon capturing all 9^{0t}h percentile locations on each transect

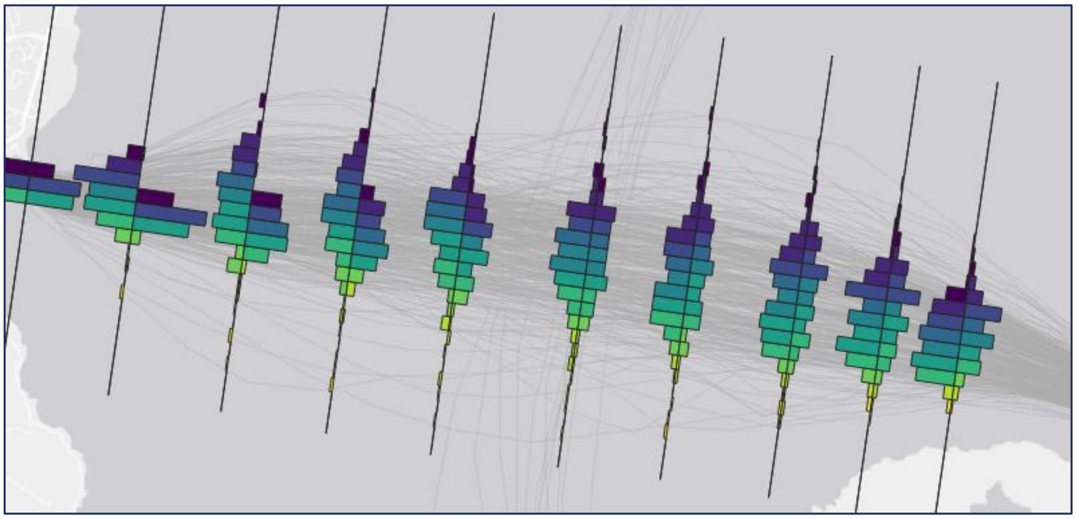


Figure 34: Determination of 90th percentile transects using cross track distributions

6.4.11 Commercial routes

6.4.11.1.1 The commercial vessel routes have been identified in **Figure 35,** which also shows the number of vessel movements per day. **Table 22** provides details of significant routes passing through the study area and windfarm site, including the number of approximate annual crossings and baseline distance.

6.4.11.1.2 All routes with more than one vessel movement/day transit between the Port of Liverpool and operate outside of the study area. The route between Liverpool Bay TSS and Off Skerries TSS south of the study area has the most vessel traffic with 4-6 vessel movements/day in either direction.

6.4.11.1.3 There are 13 commercial vessel 90th percentile routes with <1 vessel movement/day that intersect the study area, of which six intersect the windfarm site (**Table 22**).

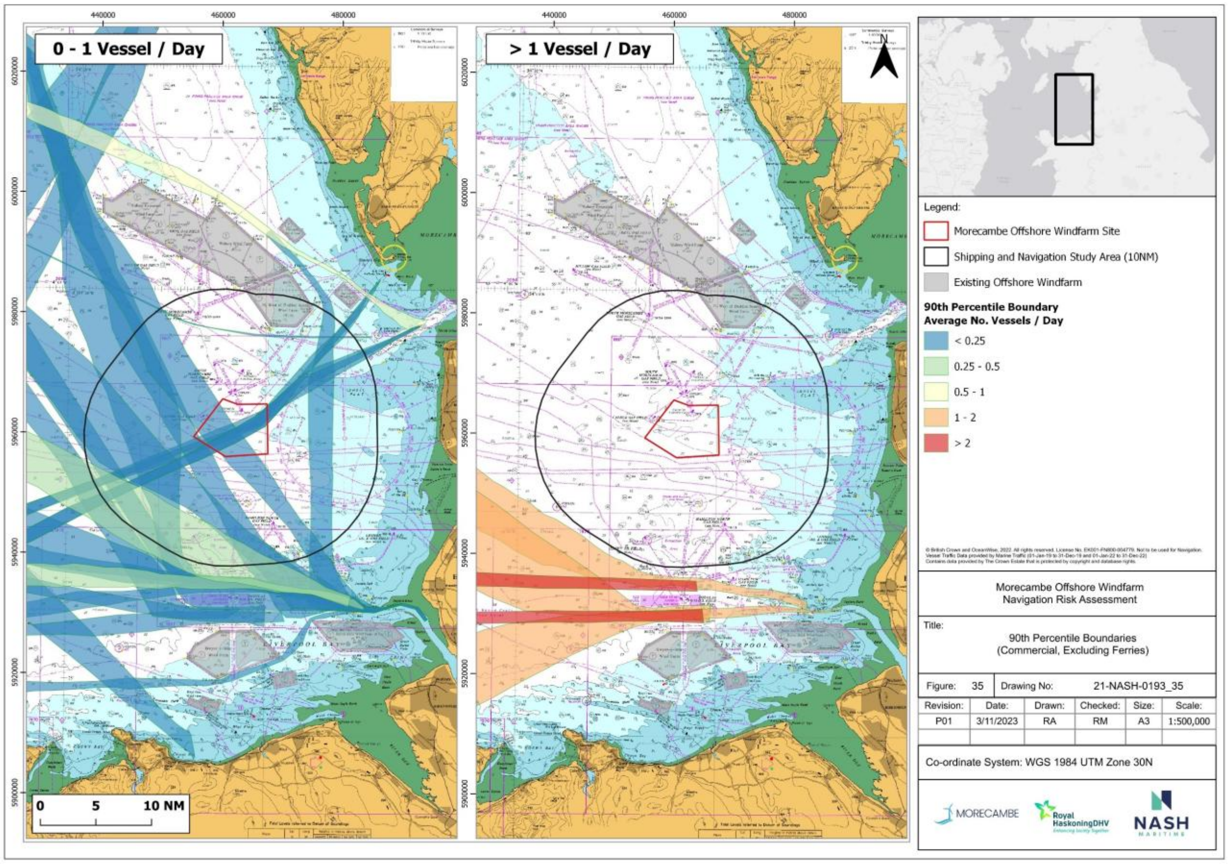


Figure 35: Commercial vessel routes

Table 22: Commercial vessel routes passing through the windfarm site

Passage Plan Route	Route Direction	Annual Vessel Count (2019)	Total Annual Vessel Count (2019)	Annual Vessel Count (2022)	Total Annual Vessel Count (2022)
LIV-East of IoM (W)	Southward / Northward	20	40	13	27
LIV-East of IoM I)	Southward / Northward	20		14	
HEY-Off Skerries TSS	Eastward	35	53	10	17
	Westward	18		7	
BAR-Off Skerries TSS	Eastward	22	39	13	17
	Westward	17		4	

6.4.12 Ferry routes

6.4.12.1.1 The ferry routes in the study area are presented in **Table 23**, along with a count of the crossings during 2019 and 2022. Eight ferry routes pass through the study area, with two 90th percentile routes passing through the windfarm site, as shown in **Figure 36**. All routes divided between the four operators are shown in **Figure 37**, which includes passage plan information provided by IoMSPC, Stena and Seatruck during consultation.

6.4.12.1.2 The IoMSPC ferries operate between Douglas on the Isle of Man, and either Heysham or Liverpool. The Heysham/Douglas route is the most frequently run route, with 1,372 and 1,451 transits/year (3-4/day) in 2019 and 2022, respectively, and passes east/west through the northern region of study area between South Morecambe gas field and WODS OWF. The Liverpool/Douglas route had 674 transits/year in 2019 and 593 in 2022, passing northwest/southeast through the study area. The route runs primarily west of the SBM, through the south of the study area (599 transits/year in 2019 and 551 transits/year in 2022). A small proportion of vessels on this route transit east of the SBM (53 transits/year during 2019, and 42 transits/year in 2022), of which 14 and 8 passed through the windfarm site in 2019 and 2022, respectively. During consultation it was confirmed vessels transit east of the SBM on northbound transits, to avoid congestion in the Liverpool Bay TSS (thereby exiting the TSS earlier) and are dependent on current and forecast weather conditions, to ensure safe and comfortable passage for passengers.

6.4.12.1.3 Stena Line operates routes between Belfast and either Liverpool or Heysham. Vessels between Heysham and Belfast transit between Barrow/Ormonde and WODS/Walney OWFs with 1,150 transits/year (3/day) in 2019 and 1,094 transits/year (3/day) in 2022. Vessels using the route between Belfast and Liverpool pass either east or west of the Isle of Man dependent on prevailing metocean conditions. Primarily, vessels use the westerly route, with a total of 1,442 transits/year (3-4/day) in 2019 and 1,490 transits/year (4/day) in 2022. However, whilst in 2019 vessels that transit to the west of the Isle of Man use one primary route, in 2022 west transiting vessels use one of three potential routes. Two of these routes are south of the study area, via the Liverpool TSS, either east (226 transits/year in 2022) or west (166 transits/year in 2022). The other route runs as in 2019, through the southwest of the study area (1,098 transits/year in 2022). Ferries passing east of the Isle of Man transit northwest/southeast on two planned routes. One route passes southwest of the windfarm site, to the west of the Calder platform, with 200 transits/year, (<1 vessel/day) in 2019, and 194 transits/year (<1/day) in 2022. Approximately, 80% of traffic that use this route is southbound traffic. On this sub-route 0.5% (one transit) and 1.5% (three transits) of vessels intersected the windfarm site in 2019 and 2022, respectively. The second route passes directly through the windfarm site, to the east of Calder, and is utilised by northbound traffic exiting Liverpool Bay TSS, with 153 transits/year (<1 vessel/day) in 2019 and 196 transits/year (<1/day) in 2022.

6.4.12.1.4 Seatruck operates two east-west routes through the northern section of the study area, passing between South Morecambe gas field and WODS OWF: Heysham to Warrenpoint and Heysham to Dublin, totalling 1,490 ferry transits/year (3-4/day) in

2019, and 1,705 (4-5/day) in 2022. Seatruck also operates a route between Liverpool to Dublin south of the study area.

6.4.12.1.5 P&O ferries operates a route between Liverpool and Dublin, which passes south of the windfarm site, outside the study area.

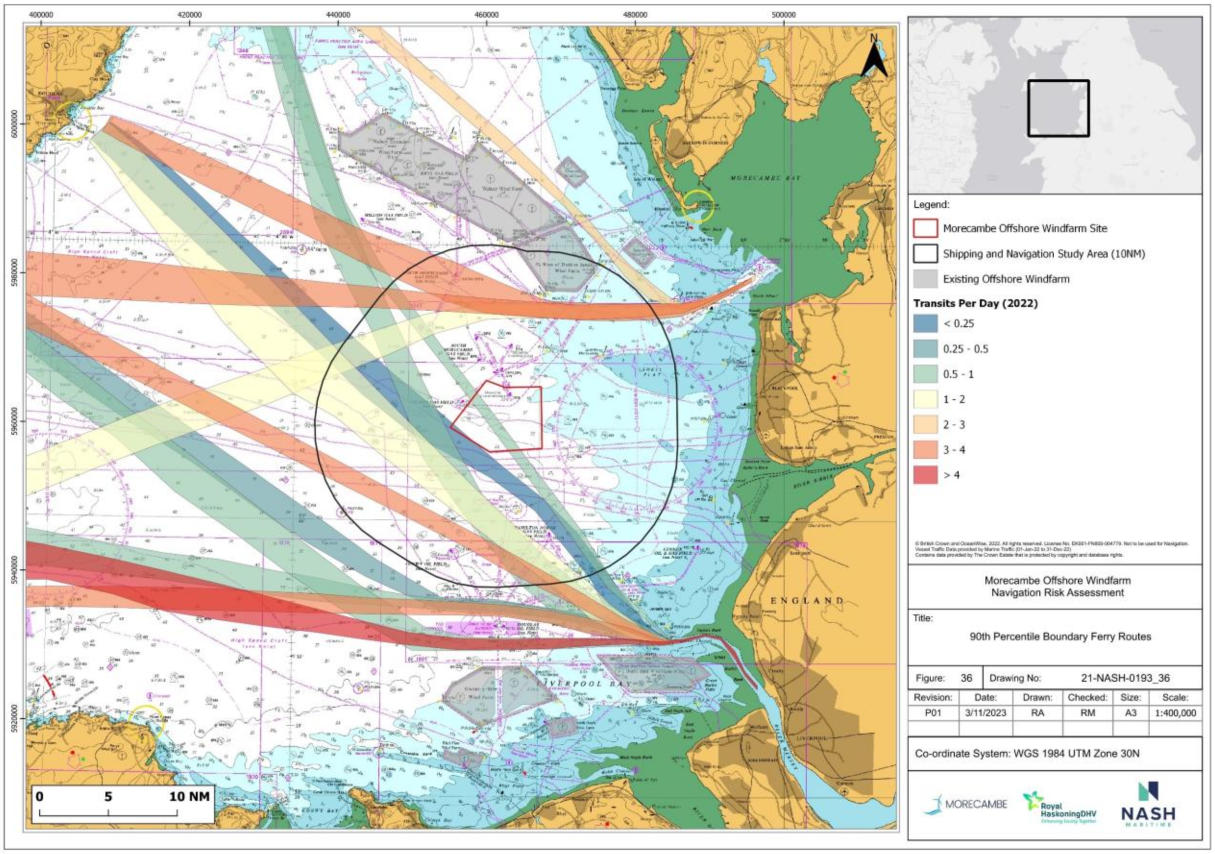


Figure 36: 90th percentile boundary ferry routes

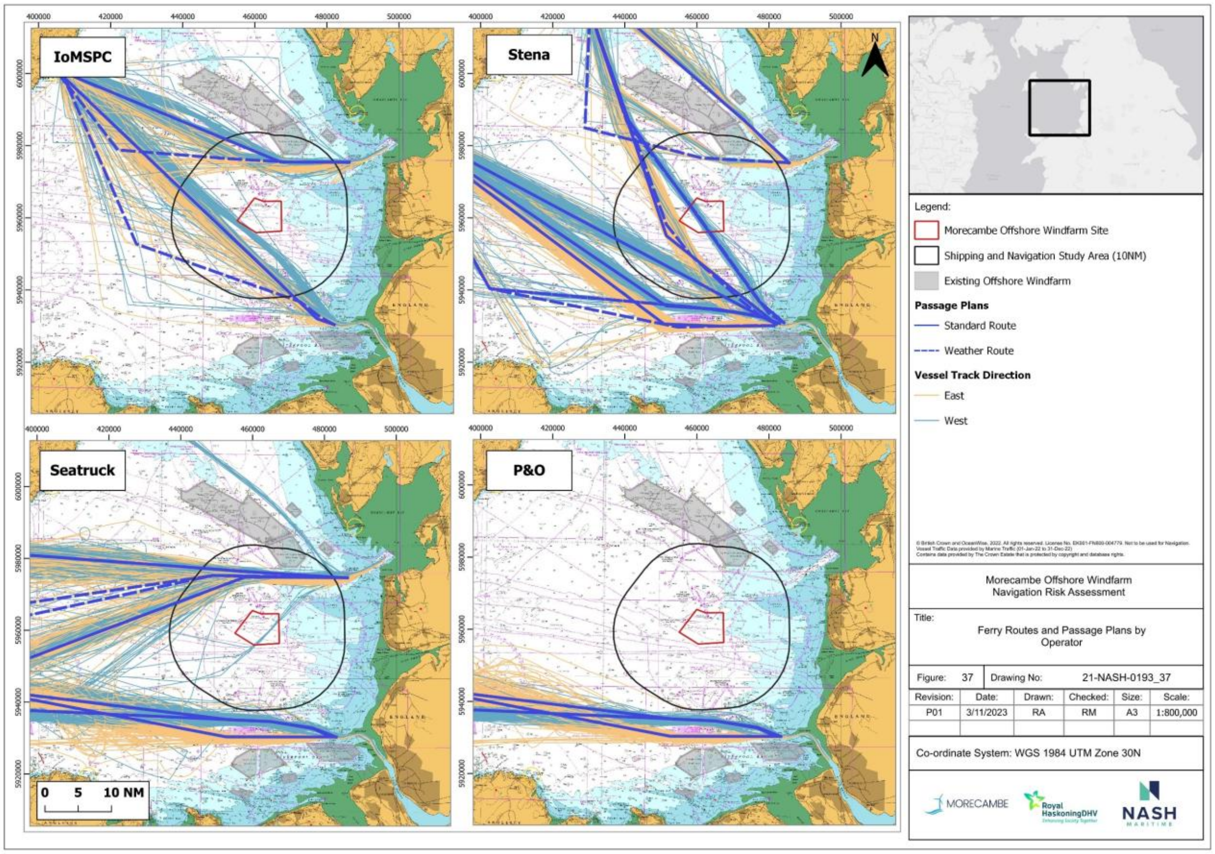


Figure 37: Ferry routes and passage plans by operator

Table 23: 90% percentile ferry routes and annual crossings by operator passing through the windfarm site (blue) and the study area (grey)

Operators	Routes	Example Vessels	Normal Conditions		Adverse Conditions	
			Approximate Annual Crossings (2019)	Approximate Annual Crossings (2022)	Approximate Annual Crossings (2019)	Approximate Annual Crossings (2022)
IoMSPC	HEY - DOUG	ARROW	86	107	0	10
		BEN MY CHREE	1286	1275	17	21
		MANANNAN	0	69	0	10
	LIV - DOUG[6]	MANANNAN	628	590	13	31
		BEN MY CHREE	46	3	0	0
Stena	LIV - BEL W of IOM & No TSS	STENA EDDA STENA EMBLA STENA ESTRID (2022 Only) STENA HORIZON (2019 Only) STENA LAGAN (2019 Only) STENA MERSEY (2019 Only) STENA FORECASTER STENA FORERUNNER (2019 Only) STENA FORETELLER (2022 Only)	1442	1098	20	15
	LIV - BEL E of IOM (E of Calder)		153	196	0	2
	LIV - BEL E of IOM (W of Calder)[7]		200	194	24	3
Seatruck	HEY - WAR	SEATRUCK PERFORMANCE SEATRUCK PRECISION	967	1099*	44	38

[6] The passage plan is outside (southwest) of the windfarm site, however 14 and 8 vessels on this route passed through the windfarm site in 2019 and 2022
[7] Route passes outside (southwest) of the windfarm site. On this sub-route one transit and three transits of vessels intersected the windfarm site in 2019 and 2022, respectively

Operators	Routes	Example Vessels	Normal Conditions		Adverse Conditions	
			Approximate Annual Crossings (2019)	Approximate Annual Crossings (2022)	Approximate Annual Crossings (2019)	Approximate Annual Crossings (2022)
	HEY - DUB	SEATRUCK PACE SEATRUCK PANORAMA (2019 Only)	523	606**	27	25

*14 transits of HEY- WAR in 2022 were undertaken by the vessels CLIPPER PENNANT (2), CLIPPER POINT (1), SEATRUCK PACE (10), and SEATRUCK PROGRESS (1).
** 48 transits of –EY - DUB in 2022 were undertaken by the vessels CLIPPER POINT (25), SEATRUCK PERFORMANCE (14), and SEATRUCK PRECISION (9).

6.4.13 Adverse commercial routeing

6.4.13.1.1 Analysis of vessel tracks during Met Office named storm events did not identify any repeatable adverse weather routeing behaviours taken by commercial shipping. This is likely due to the low number of commercial vessels operating in the area. Commercial vessels will typically route to minimise impact to cargo and crew, whilst retaining schedule requirements.

6.4.14 Adverse ferry routeing

6.4.14.1.1 **Figure 38** shows the ferry tracks alongside the calculated 90th percentile routes. Ferries deviating from these identified routes are considered as pursuing non-typical routeing. The primary reason for a ferry to take a non-typical route is to mitigate the effects of vessel movement during adverse weather conditions. Prevailing south westerly adverse weather typically results in ferries taking a more southwesterly transit, in order to both control the course relative to the conditions and take advantage of the lee from the shore. This minimises dangerous motions aboard the vessel and improves passenger comfort.

6.4.14.1.2 During adverse weather, there is evidence that IoMSPC takes routes to the south-west of their typical route. For the Liverpool to Douglas route, this takes them further southwest of the study area, as opposed to passing adjacent to the site. The Heysham to Douglas route is similarly deviated during adverse weather, but vessels pass clear to the northwest of site.

6.4.14.1.3 The Stena routes to the west of the Isle of Man between Liverpool and Belfast is similarly deviated further southwest, through the southern extent of the study area.

6.4.14.1.4 Adverse routeing of Seatruck vessels from Heysham to Dublin or Warrenpoint occurs west of the study area. There were three vessel tracks that intersected the windfarm site in the 2022 analysis.

6.4.14.1.5 Further discussion on adverse routeing of ferries is contained in **Section 8.2.3**.

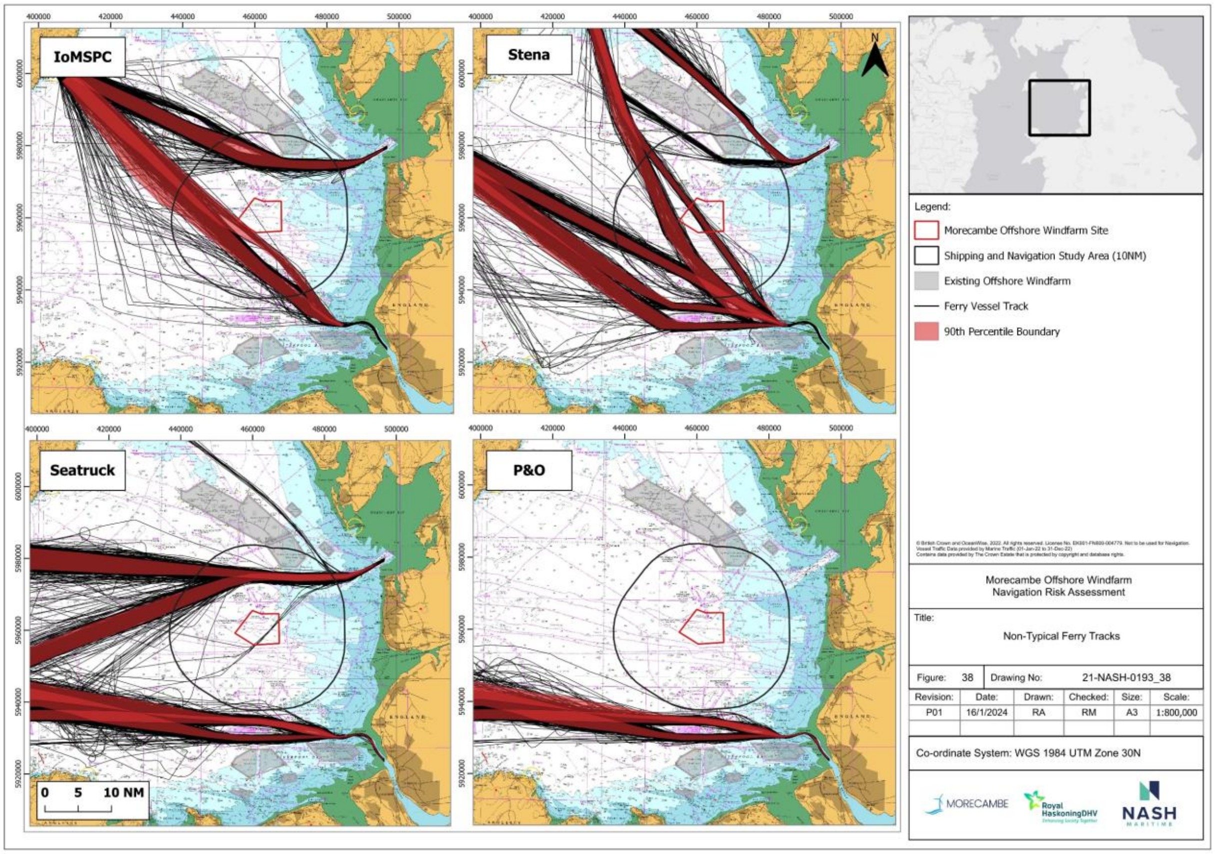


Figure 38: Non-typical ferry tracks

6.4.15 Anchoring, non-transiting and waiting vessels

6.4.15.1.1 Anchored or slow speed vessels are shown in **Figure 39**. The intensity of anchoring has been identified by extracting AIS positions with speeds of less than 0.5knots for vessels over 100m in length.

6.4.15.1.2 The most significant intensity of anchored vessel activity takes place outside of the study area, on the eastern coast of Anglesey near the Point Lynas Pilot Boarding Station. Anchoring or loitering within the study area also occurs at non-charted anchorage areas, notably around oil and gas infrastructure to the north of the windfarm site and the southern extent of the study area. No anchoring activity is evident within the windfarm site.

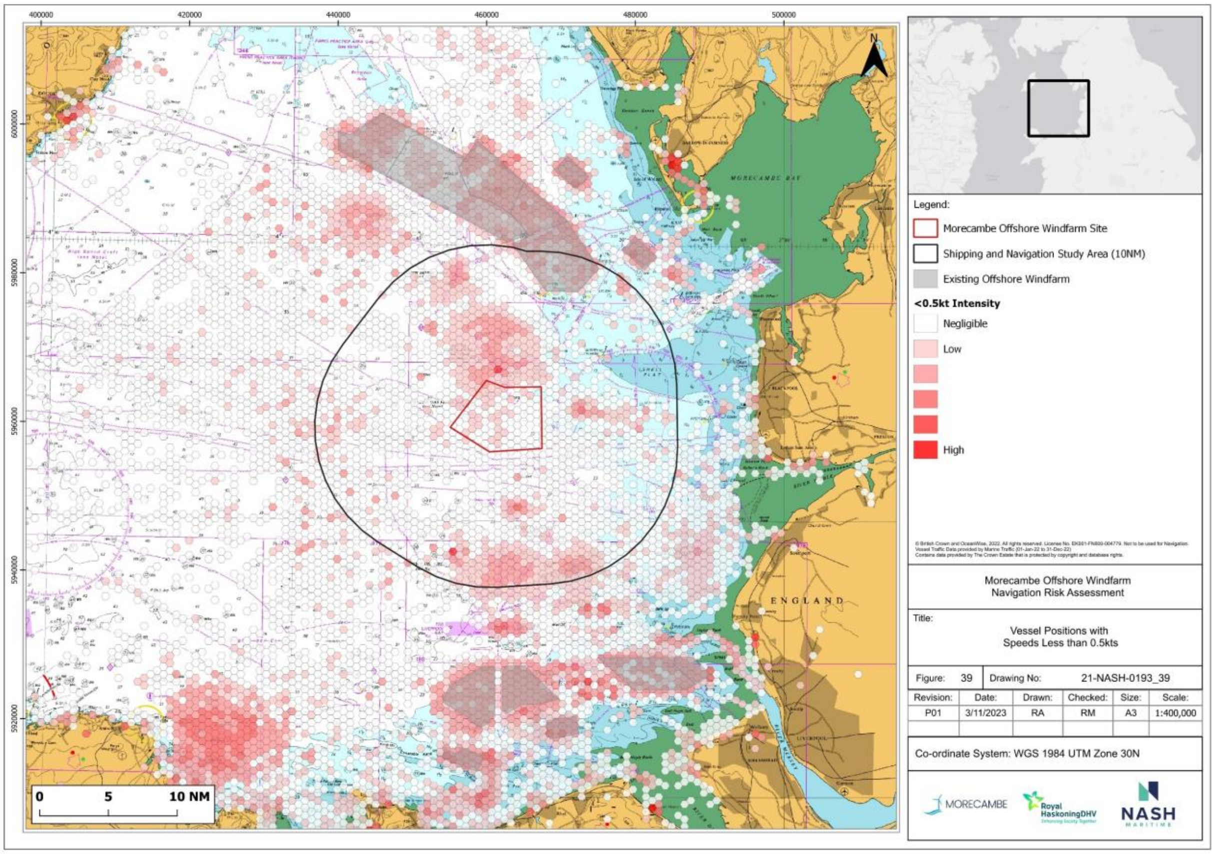


Figure 39: Non-transiting vessels and vessels at slow speed or anchored

6.5 MARITIME INCIDENTS

6.5.1 Incidents associated with other offshore windfarms

6.5.1.1.1 To better understand the types and frequency of navigational incidents that might occur with the proposed Project, analysis was conducted on historical accidents associated with UK operational OWFs. Analysis was conducted on the MAIB database (2010-2019), RNLI databases (2008-2019), MAIB incident reports and news reports.

6.5.1.1.2 In total, 69 incidents were identified between 2010 and 2019 (see **Table 24**). This includes six collisions between vessels, 29 allisions of a vessel with a fixed structure, 21 groundings and 13 near misses. 36% of incidents occurred within the array boundary, 43% occurred within ports or harbours and 20% occurred on-transit between the two. 82% of incidents involved project craft (such as Crew Transfer Vessels (CTV) or construction vessels). Few allisions are recorded by a non-project vessel, however, anecdotally there have been more allisions involving fishing and recreational vessels which are unreported.

6.5.1.1.3 From the historical incident record, and using an estimate of the number of years of operation for UK OWFs, incident rates per an "average" project are derived (see **Table**

24) (see Rawson and Brito, 2022). The accident return rates are generally low, between 10 and 45 operational years between incidents, the majority accounted for by project vessels. Therefore, over a typical 25-35 years operational duration, it would be expected that a typical project would experience three allisions, two groundings and one collision or near miss. It is notable that there are no recorded accidents involving large commercial shipping and offshore windfarms in the UK. Nor did any of the recorded navigational incidents across the UK sector result in loss of life.

Table 24: Average incident rate per project between 2010-2019 in UK

Incident Type	Total Number	Rate	Return Period
Collision	6	0.022	45.4
Grounding	21	0.077	13.0
Near Miss	13	0.048	20.9
Total Allision	29	0.107	9.4
WFSV Allisions	27	0.099	10.1
Fishing Allisions	2	0.007	136.9
Total	69	0.254	3.9

6.5.2 Incidents within study area

6.5.2.1.1 **Figure 40** and **Table 25** show navigational incidents recorded in the study area between the MAIB (1992-2022) and RNLI (2008-2022) databases. In processing the incidents, non-navigationally significant incidents have been removed, such as shore-based activities (e.g. people cut off by the tide or swimmers in distress). Furthermore, duplicate values recorded in both databases have been removed.

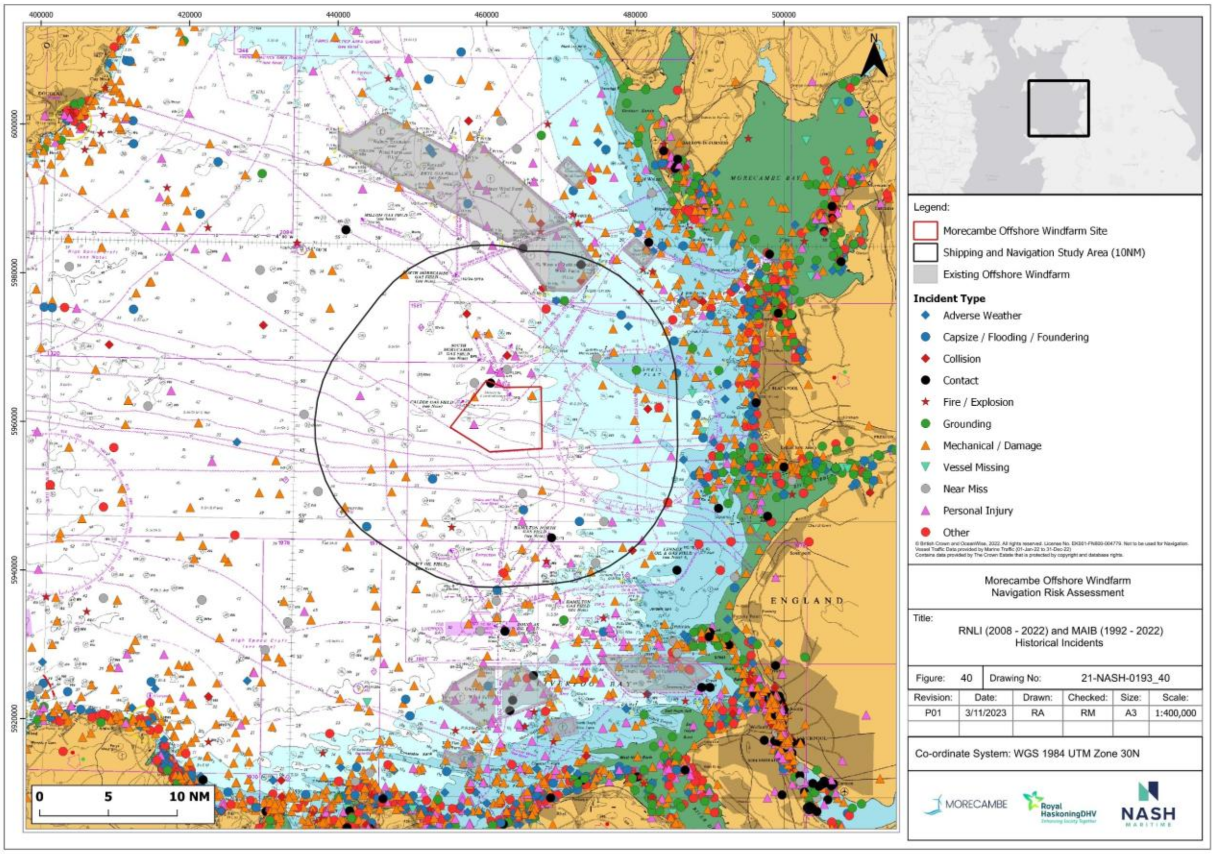


Figure 40: Historical incidents in study area

6.5.2.1.2 Four incidents were recorded within the windfarm site between 1992 and 2022. Two incidents were related to mechanical failures or damage; one involving a fishing vessel, the other involving a recreational craft. A minor personal injury incident in the windfarm site, related to the roll of a passenger ship in heavy weather, which resulted in injury to a passenger was also reported. A contact incident was recorded to the north of the windfarm site, related to the loss of control of a service ship and subsequent rig contact, at the South Morecambe gas field. The MAIB recorded this as a Less Serious incident, with minor damage reported.

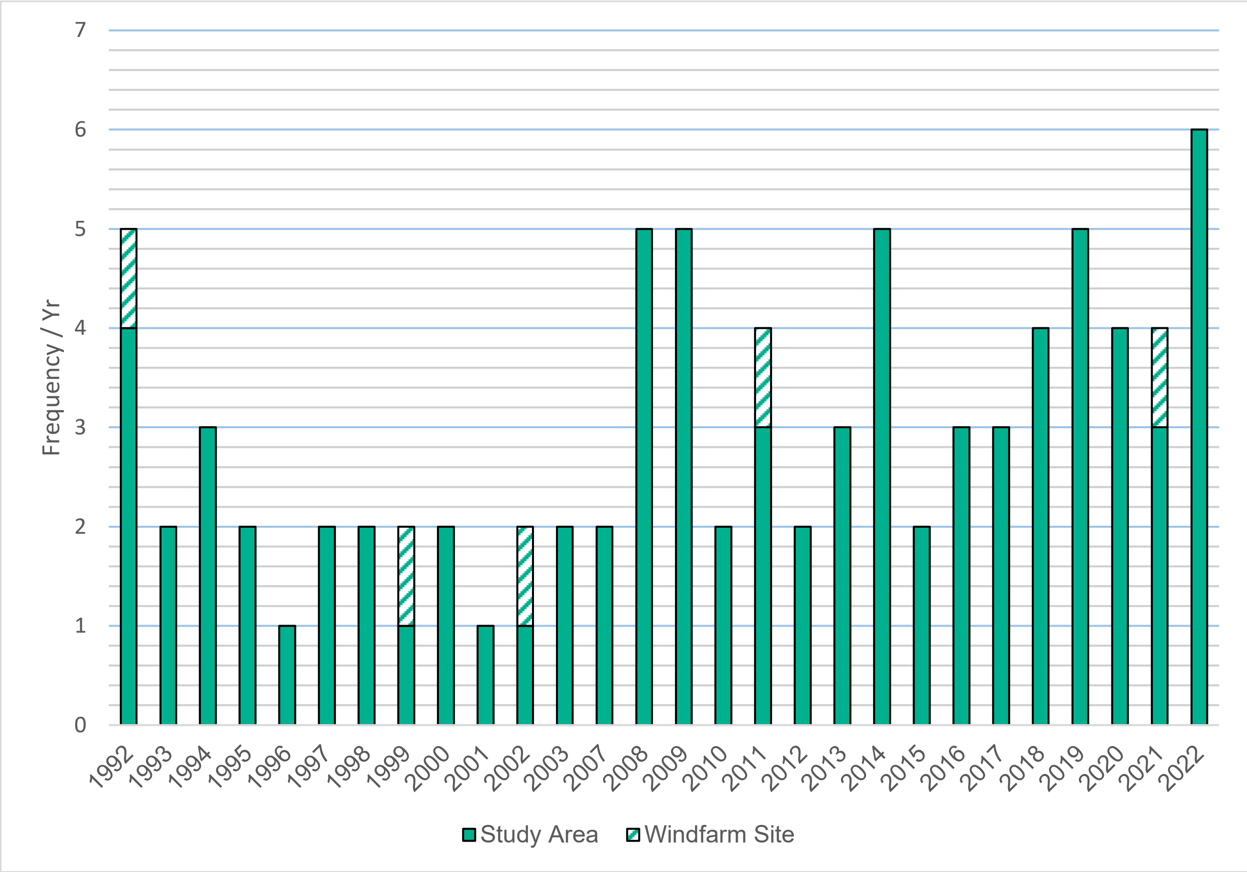


Figure 41: Incidents per year (note RNLI data applicable 2008-2022 only)

6.5.2.1.3 **Table 25** presents the base case annual accident frequency per vessel type and accident type for the study area.

6.5.2.1.4 In summary, the incident frequencies across the windfarm site and study area are low and mostly involve mechanical failure aboard recreational vessels.

Table 25: MAIB/RNLI accident frequencies in the study area per year (1992-2022)

	Cargo	Fishing	Passenger	Recreation	Tug & Service	Other	Total
Adverse Weather				2			2
Capsize/Flooding/ Foundering	1	3		1			5
Collision		1		1	3		5
Contact		1			2		3
Fire/Explosion			2				2
Grounding		1		1			2
Mechanical/Damage		9		22			31
Missing				1			1
Near Miss	1	4				1	6
Personal Injury		2	1	4	8		15
Other				2	1		3
Total	**2**	**21**	**3**	**34**	**14**	**1**	**75**

7. FUTURE CASE TRAFFIC PROFILE

7.1 COMMERCIAL TRAFFIC

7.1.1.1.1 DfT data on UK port trade is presented in **Figure 42** and **Figure 43** and shows a decline in port freight in 2020, at both the national and port level, respectively. The DfT report that UK ports were affected by measures to prevent and reduce the global spread of Covid-19 throughout 2020, as well as the UK exiting the European Union at the end of 2020. The DfT report a 9% decrease in tonnage handled by UK ports in 2020 compared to 2019. However, given the lifting of COVID-19 related restrictions, it is anticipated that port freight will continue to return to pre-pandemic levels. Evidence of this can be seen in 2021 and 2022, which both exhibited an increase in national port freight tonnage.

7.1.1.1.2 Port freight activity at the Port of Liverpool steadily increased between 2014 and 2019, before undergoing a significant reduction in 2020, likely due to pandemic related restrictions. It should be noted that an increase in tonnage does not necessarily correlate with an increase in vessels. New build vessels are often larger, capable of carrying more cargo, and ports such as Liverpool have invested in shoreside infrastructure to better handle these larger vessels.

7.1.1.1.3 **Figure 44** shows projected freight traffic into UK major ports, produced by the DfT in 2019. Overall, port traffic is forecast to remain relatively flat in the short term, but is expected to grow in the long term, with tonnage 39% higher in 2050 compared to 2016. This equates to approximately a 15% increase in national freight tonnage by 2035.

7.1.1.1.4 The long-term growth in port traffic is driven by increases in unitised freight traffic, which compensates for decreases in other freight in the short term. Liquid bulk traffic (principally crude oil) has the largest forecasted decreases, continuing a historical trend. Similarly, general cargo is forecast to decrease, in line with the historic decreasing trend, which is likely driven by increased containerisation of goods. Dry bulk traffic is forecast to have a relatively large decrease in the short term, driven primarily by demand for coal being projected to fall. In the long term, dry bulk traffic is forecast to increase, with other forms of dry bulk (principally biomass), the largest category, continuing to increase as it has done historically. Motor vehicles, Twenty-foot Equivalent Unit (TEU) forecast for Lo-Lo and the unit forecast for Ro-Ro are all forecast to grow strongly, driven by economic growth.

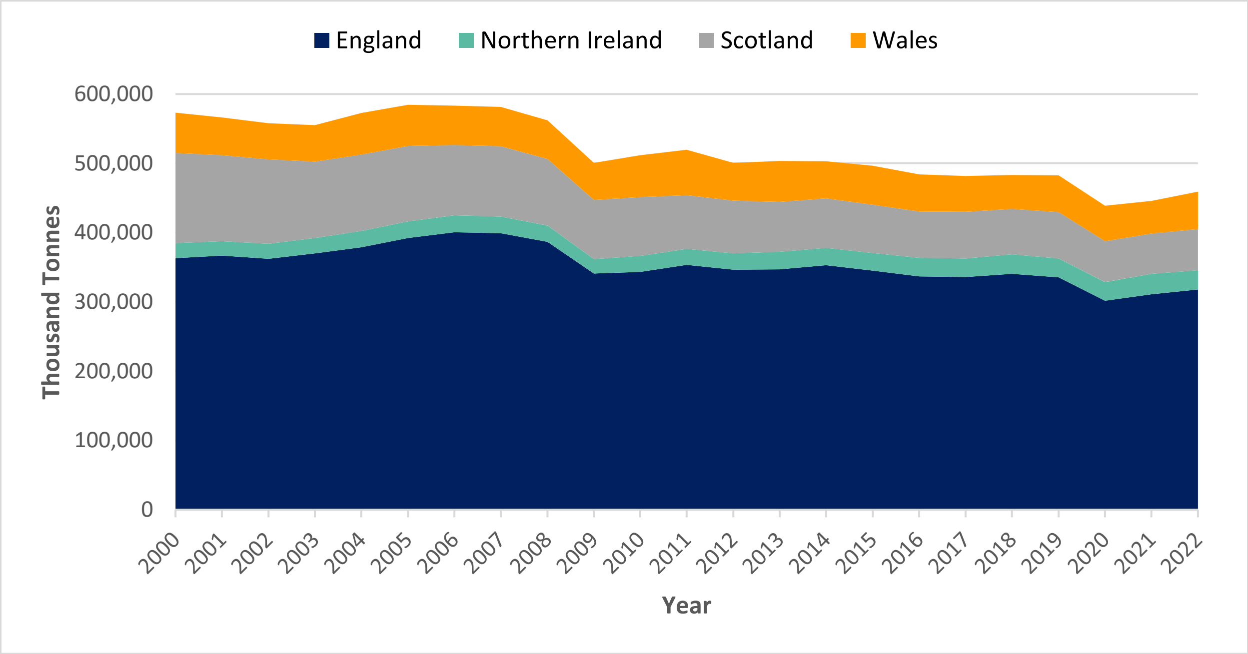


Figure 42: UK major port freight

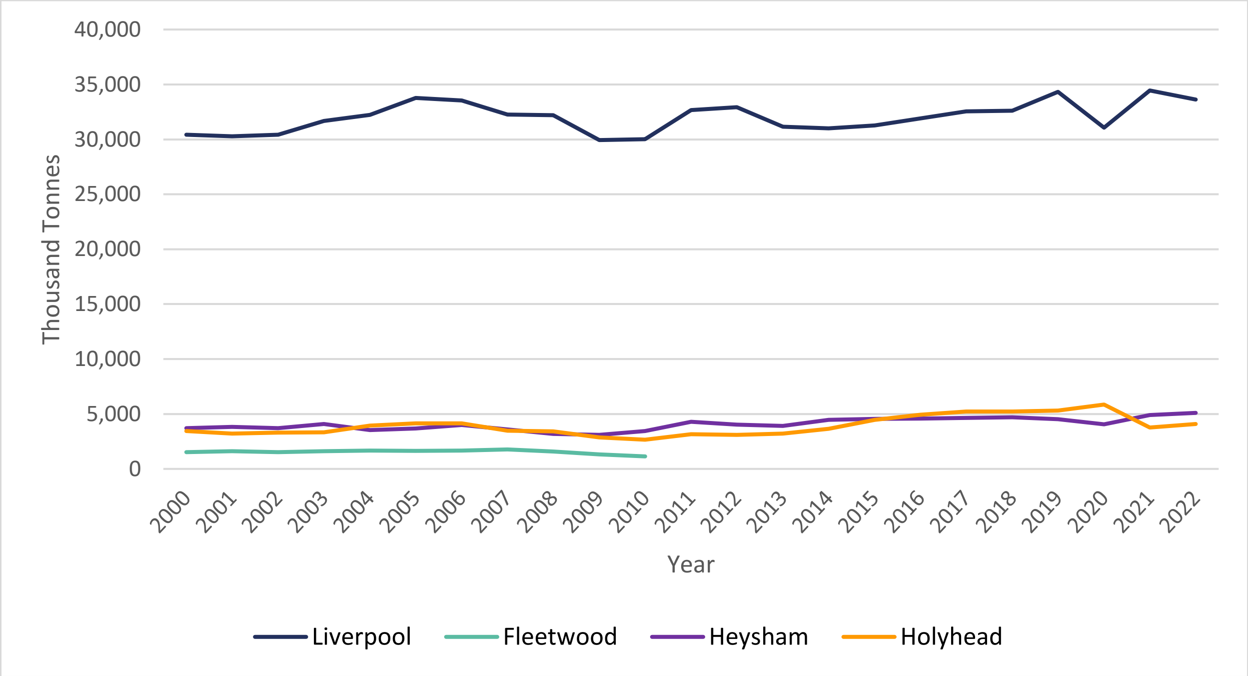


Figure 43: Port freight for UK major ports (Fleetwood ferry service closed at the end of 2010)

7.1.1.1.5 Other future changes that might occur could include the increased operation of autonomous vessels within UK waters. During the course of the NRA, autonomous or remote-controlled survey vessels were active within the windfarm site and no incidents were recorded. Regulatory bodies have insisted that any introduction of autonomous vessels into UK waters would have equivalent safety standards as conventional crewed vessels.

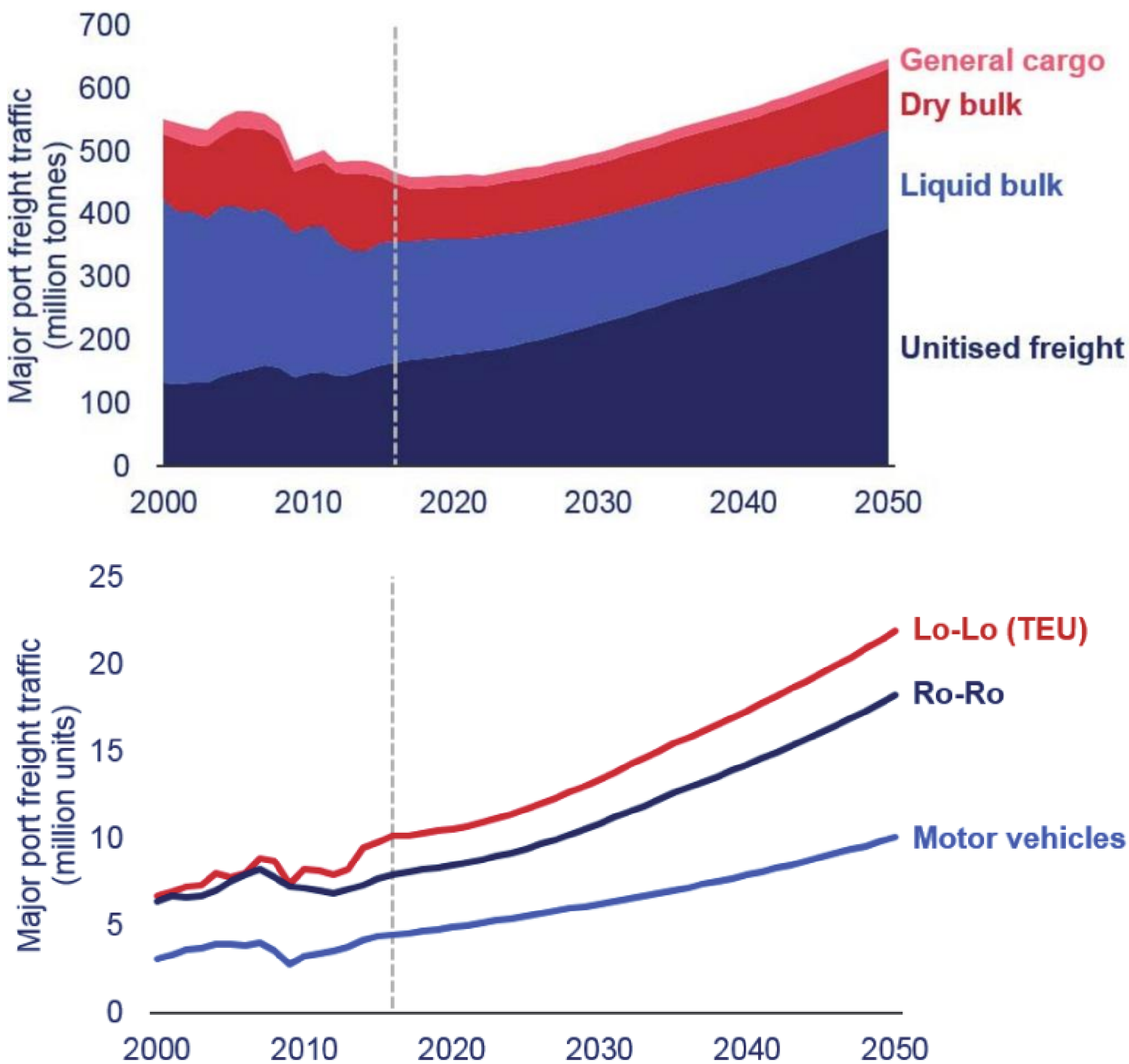


Figure 44: UK port freight projections (DfT, 2019)

7.2 FERRIES

7.2.1.1.1 Freight and passenger ferries account for a large proportion of vessel movements within the study area. These routes are subject to change both in terms of schedule, vessels and the addition of new routes, in order to meet market demand. For example, the AIS data for 2019 and the data for 2022 shows that Stena replaced several of their ferries with the new E-flex class. During consultation, each operator was asked on any potential future changes, noting that these were subject to change.

7.2.1.1.2 Seatruck has shown significant growth in demand, in 2018, and reported a 30% increase in volumes since 2015, with a 10% increase in 2017 alone[8]. The increase in unaccompanied trailer volumes between 2007 and 2018 was reportedly 250%[9]. A €100 million investment by Seatruck in 2018 was announced to increase capacity on the Warrenpoint to Heysham route by 30%.

7.2.1.1.3 Both of the IoMSPC vessels are twenty years old and will require replacement before 2035. The Ben-my-Chree will be replaced by the Manxman, which entered service in 2023. Consultation with IoMSPC determined that it is reasonable to assume that the Ben-my-Chree and Manxman will have similar handling and endurance capabilities. The Manannan is due for replacement before 31st December 2026[10]. This may be replaced by either a new fast craft or a fast conventional ferry.

7.2.1.1.4 Trends for passenger numbers are shown in **Figure 45** and show a gradual increase in passenger numbers across most routes (noting the exception of 2020 figures impacted by COVID-19). Liverpool-Dublin has had a steady decline, meanwhile Liverpool-Belfast has experienced an increase, this is especially the case in the years since the impact of COVID-19 during which time Stena Line replaced ferries with the new E-flex class. Notably, the Liverpool-Belfast passenger number were the least effected of these routes by COVID-19. Predicting how this trend may influence vessel schedules and routes is uncertain. Therefore, in the absence of definitive information, an assumption is made that vessel routes and schedules will be similar in 2035 to the existing baseline but with a likely increase in services.

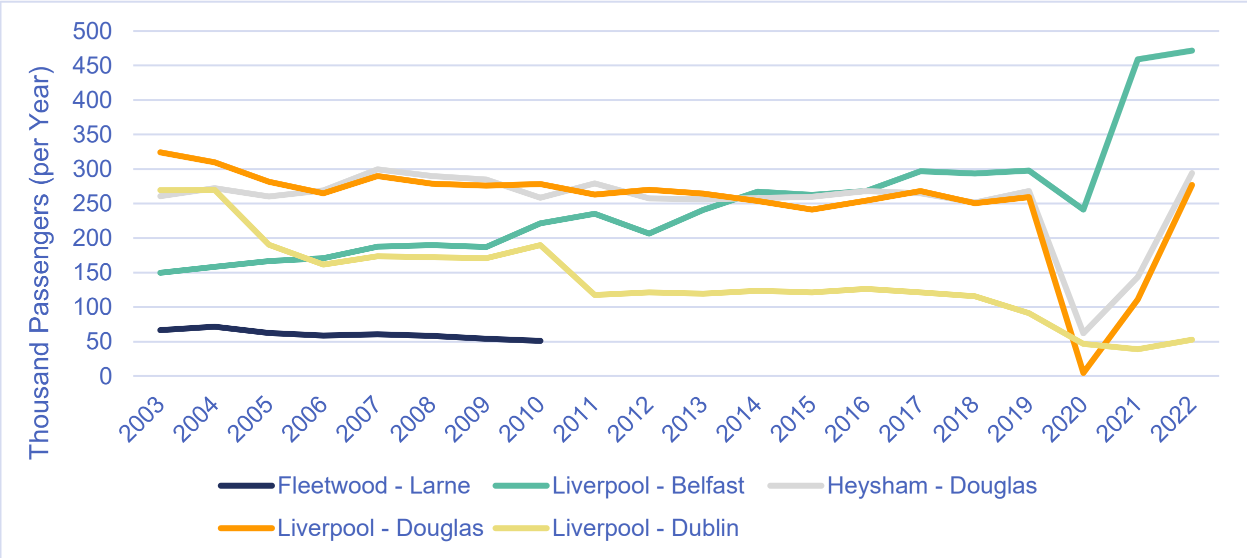


Figure 45: Passenger numbers (Fleetwood ferry service closed at the end of 2010). 2020/2021 figures heavily impacted by COVID-19

[8] https://www.seatruckferries.com/news/seatruck-surge-continues.
[9] https://www.seatruckferries.com/news/seatruck-boost-capacity-driver-shortages-fuel-unaccompanied-trailer-growth.
[10] https://www.tynwald.org.im/business/opqp/sittings/20182021/2019-GD-0009.pdf.

7.3 OIL AND GAS

7.3.1.1.1 Irish Sea oil and gas platforms are reaching end of life and it is understood that some platforms may be decommissioned. Details of which platforms and decommissioning timelines have not been fully ascertained by the NRA team.

7.3.1.1.2 The Project overlaps with the Morecambe South gas fields (owned and operated by Spirit Energy Production UK Limited) and the Calder gas field (owned by Harbour Energy PLC and operated by Spirit Energy Production UK Limited on their behalf). These fields are supported by offshore infrastructure including platforms, pipelines, cables and wells. The South Morecambe gas field includes the platforms DP6, DP8 and the Central Processing Complex (CPC) and associated cable, pipeline and umbilical infrastructure. DP3 (chartered within the windfarm site) and DP4 were decommissioned and removed in 2023 meaning there are no further obstructions to navigation present. The CPC is located 0.9nm north of the windfarm site and is a hub complex made up of three platforms on jacket substructures (CPP1, AP1 and DP1). Calder CA1 is a small production platform with a single topside located 0.5nm to the mid-west of the windfarm site boundary.

7.3.1.1.3 There is a 500m safety zone around platforms and the Project has identified an embedded mitigation of a 1.5nm separation radius around platforms with an active helideck (within which no wind turbine generators or offshore substation platforms would be located). These are considered throughout the Project design process and in consideration of the developing layout scenarios. Oil and gas operators have also noted access requirements for Platform Supply Vessels (PSV) and Emergency Rescue and Recovery Vessel (ERRV).

7.3.1.1.4 The International Guidance for Offshore Marine Operations (IGOMO) state that vessels should plan for vessel passing distance of at least 1nm (1.8km) from each platform and operations, which might be in progress in its immediate vicinity.

7.3.1.1.5 Future decommissioning operations of oil and gas platforms will require a jack-up barge, or heavy lift vessel, followed by a drilling rig, estimated to be on site six+ months per platform, and supported by service vessels. Within the South Morecambe gas field, a platform supply vessel currently operates three days a week and an ERRV operates 365 days/year. The NRA team understands that future vessel movements will continue for ERRVs during decommissioning, whilst there is a potential increase for seven days/week operations for the platform supply vessel.

7.3.1.1.6 The Project is located within areas designated for gas storage and carbon capture storage (CCS). An Agreement for Lease (AfL) with The Crown Estate was awarded for the Gateway Gas Storage Facility in 2018, which covers offshore rights in the east of the Irish Sea. No development activities have taken place to date and the storage facility is located 4km to the northeast of the windfarm site, with no direct overlap.

7.3.1.1.7 In 2020 ENI UK Limited were awarded a carbon dioxide (CO_2) appraisal and storage licence covering an area located within the Liverpool Bay area. Under the licence, Eni plans to reuse and repurpose depleted hydrocarbon reservoirs (the Hamilton, Hamilton North and Lennox fields) and associated infrastructure to permanently store

CO_2 captured in northwest England and north Wales. These fields are located 10km to the south of the windfarm site and there is no direct overlap.

7.3.1.1.8 Rights for the exploration and appraisal of potential carbon dioxide storage sites were granted by the North Sea Transition Authority in 2023 for an area overlapping with the windfarm site (East Irish Sea Area 1). This area contains the Spirit Energy proposed Morecambe Net Zero Cluster Project which would provide a carbon storage and hydrogen production cluster if a permit is sought and granted, however detailed plans for this potential project are not currently available.

7.3.1.1.9 A related question to Round 4 North Sea and Irish Sea developments is whether oil and gas vessels would navigate through or around an OWF. It is noted that the IGOMO Section 8.15 recommends that courses are planned so that, where practical, the vessel passes at the distance of at least one nautical mile from each facility. However, the familiarity and manoeuvrability of offshore supply ships or ERRVs may facilitate navigation within large OWFs. This assessment has assumed that there is sufficient space, in suitable conditions, for in-field navigation to take place.

7.4 FISHING

7.4.1.1.1 Fishing within the Irish Sea is important for both the UK and Isle of Man fisheries. There is limited information available for future fishing vessel activity on which reliable assumptions can be made.

7.4.1.1.2 Within the study area, UK fisheries primarily target non-quota shellfish species, namely queen scallop, whelk, king scallop, and lobster. Therefore, fishing fleets are unlikely to be impacted by quota transfers following the UK's withdrawal from the European Union. Market changes have the potential to impact fishing activity in the study area, however, fishing activity in the area is not anticipated to change significantly, with both local and foreign vessels continuing fishing activity in the area.

7.5 RECREATIONAL

7.5.1.1.1 The RYA Water Sports Participation Survey (see **Figure 46**), conducted in 2019, found that the proportion of adults participating in boating activities has fluctuated between 6% and 8% between 2002 and 2018. Between 2008 and 2018, the proportion participating in yacht cruising, motor boating and power boating has remained consistent at 0.8%, 1.1% and 0.7% respectively. More recent data published in the 2021 Water Sports Participation Survey is significantly influenced by COVID-19, with a significant variation between 2021 and 2022 due to national/local lockdowns.

7.5.1.1.2 Therefore, it is unlikely that there will be a significant change in the number of recreational users due to macro trends.

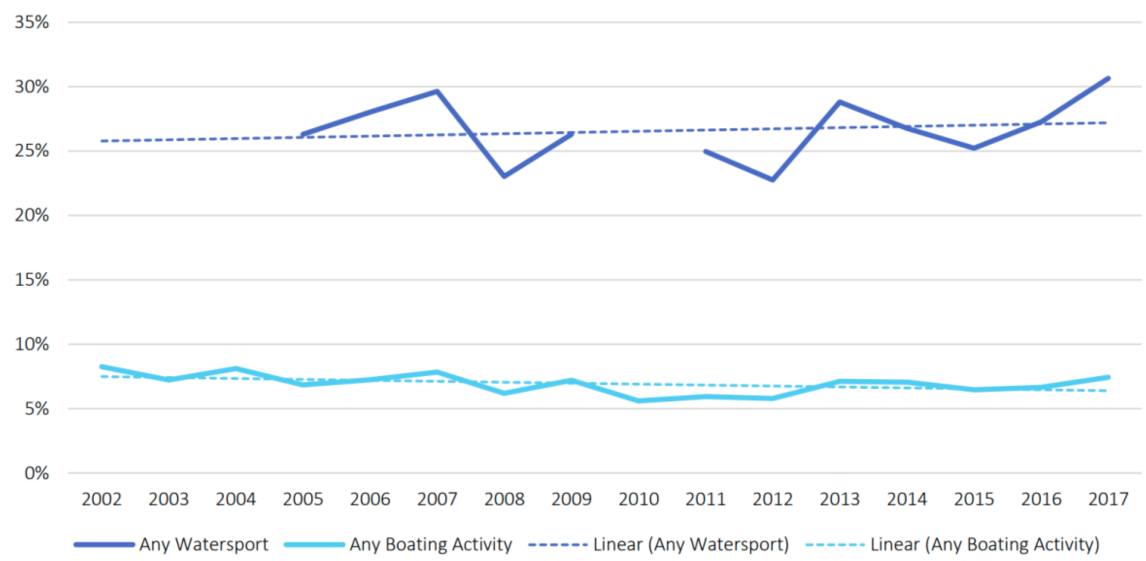


Figure 46: Recreational participation (Watersports Survey)

7.6 PROJECT OPERATIONS

7.6.1.1.1 The Project will require additional vessel movements to perform operational maintenance and inspection activities (see **Section 4.7**). The O&M base for the Project is not known at the time of assessment, therefore an assumption of 776 crew transfer vessel movements per year from north-west of England has been made. Major or significant maintenance will be managed in line with company operating procedures and the project embedded risk controls measures as documented at **Section 4.9**.

8. POTENTIAL IMPACT ASSESSMENT

8.1 IMPACT IDENTIFICATION

8.1.1.1.1 Following consultation with stakeholders, analysis of data and a review of guidance, 11 potential impacts of the Project were identified on shipping and navigation as documented in **Table 26**.

Table 26: Potential impacts

Number	Impact	Description
1	Impact of windfarm site on ferry vessel routeing	The Project could necessitate deviations to ferry routeing increasing distances resulting in additional cost and time for the passage.
2	Impact of windfarm site on commercial vessel routeing	The Project could adversely impact routeing of commercial vessels, making services unviable.
3	Impact of windfarm site on risk of allision/contact	The presence of the Project could increase the risk of allision or contact between navigating vessels and surface structures.
4	Impact of windfarm site on risk of collision	The Project could increase the risk of collision between navigating vessels, such as through the creation of choke points or increased vessel movements.
5	Impact of Project on search and rescue	The Project design could inhibit search and rescue access for vessels or aircraft during an emergency.
6	Impact of Project on visual navigation and collision avoidance	The presence of the Project could block or hinder visual navigation which could increase the risk of collision, allision or grounding.
7	Impact of Project on communications, radar and positioning systems	The Project infrastructure could interfere with shipboard or land-based equipment essential to communications or positioning.
8	Impact of windfarm site on risk of snagging	Snagging of vessels with inter-array and platform link cables.

8.1.1.1.2 No identified shipping and navigation impacts have been scoped out of the assessment.

8.2 IMPACT ON FERRY ROUTEING

8.2.1 Introduction

8.2.1.1.1 OWFs can impact vessel routeing by creating an obstruction in otherwise navigable waters that requires a deviation of an established vessel route. For regular runners, such as ferries, this has the potential to result in a significant increase in costs or make schedules unviable. Furthermore, impacts on routeing may result in increased safety related risks, which are considered **Section 8.4** and **8.5**.

8.2.1.1.2 During consultation, ferry operators raised several existing operational constraints, which should be considered in conjunction with an increased distance to clear an OWF:

- **Schedules:** Existing schedules are developed to maintain consistent arrival and departure times per 24-hour period. This may not be achievable with increased transit times on some routes.
- **Increased fuel:** Increased transit distance necessitates an increase in fuel burn, which has a direct additional cost to operators. Furthermore, this would increase the environmental impact of their operations through increased emissions.
- **Hours of Rest:** The Maritime Labour Convention requires 10 hours of rest in any 24-hour period, in a maximum of two separate periods, of which at least six hours must be uninterrupted. Existing schedules enable this requirement to be met, but increased transit duration could make compliance with the convention impossible, without compromising schedules or hiring additional crew.
- **Turn-around times:** Turn-around times within ports are constrained to enable safe loading and unloading. During busy periods, it may not be possible to reduce this duration to make up lost time, due to increased transit duration.
- **Reduced Vessel Speed:** Vessels operating in routes, performing additional turns or encountering other vessels more frequently may need to reduce speed, compounding any additional transit distance on vessel schedules.
- **Safe Manning:** Navigation in routes between offshore windfarms could be treated as constrained navigation and require additional senior officer presence on the bridge for greater proportions of crossings.

8.2.1.1.3 Berth/port constraints are also an additional consideration. Several of the ferry ports have clear operational constraints where delays might result in missing arrival windows.

- **Heysham:** Has a tight entrance requiring a significant alteration of course, which in combination with strong tides and wind conditions, makes approaching the harbour and berthing challenging. The harbour is dredged but occasionally arrival at spring low tides is not achievable with sufficient under keel clearance, requiring amendments to timetables.
- **Douglas:** Berthing in certain wind conditions is challenging and may result in cancellations.

- **Warrenpoint:** Is tidally constrained.
- **Belfast:** There is a limitation on availability of berths given the number of vessels operating on a route at the port.
- **Liverpool**: Constrained by lock timings and other vessel movements.
- **Dublin:** Dublin has recently relocated freight terminals further from the seaward entrance, increasing transit duration.

8.2.2 Ferry routeing in normal metocean conditions

8.2.2.1.1 Passenger or freight ferry services for IoMSPC and Stena Line have passage plans that pass through or in close proximity to the windfarm site (see **Section 6.4.12**). Therefore, the development of the windfarm site would necessitate re-routeing of these ferry services. It is recognised that previous projects in the Irish Sea (Barrow, Ormonde, Walney, WODS) have each impacted upon ferry routeing since 2004 (Anatec, 2016). Operators have had to adjust their passage plans to accommodate previous projects and the nature of these projects has not made any existing routes unviable.

8.2.2.1.2 **Figure 47** and **Figure 48** show the basecase passage plans (i.e. current passage plans as provided by ferry operators) and futurecase passage plans (i.e. the deviated routes around the windfarm site) for the IoMSPC and Stena Line ferry services, respectively. Futurecase passage plans were developed by the NRA team, which includes a master mariner, by reviewing the existing passage plans (e.g. to determine passing distances of 1.5nm).

8.2.2.1.3 **Table 27** summarises the annual transit count for each ferry service route, and the additional transit distance between the basecase and futurecase passage plans, as a result of deviating around the windfarm site. The key findings of this analysis are summarised within the following sections for each ferry operator.

8.2.2.1.4 IoMSPC ferry routes:

- The route between Liverpool and Douglas would be constrained by the presence of the windfarm site. The basecase passage plan is 2.3nm clear of the southwestern corner of the windfarm site and would be unaffected, however, as shown in **Figure 47**, a small proportion of westward transiting vessels (12.8% of vessels in 2022) navigate north of Hamilton North Gas Field structure (110/13). The presence of windfarm site would require all IoMSPC Liverpool/Douglas services to navigate south of the 110/13
- The Heysham/Douglas route is unaffected by the windfarm site during normal conditions

8.2.2.1.5 Stena Line ferry routes:

- The Liverpool/Belfast (East of IoM) route splits to pass to the east and west of Calder CA1 as shown in **Figure 48**. The basecase passage plan to the west of the structure is clear of the southwest corner of windfarm site by 2.5nm. In 2019, one transit on this route intersected the windfarm site and three intersected in 2022. Vessels navigating to the east of the Calder CA1 are on westbound transits. In total, 153 transits utilised the eastern passage plan in 2019 and 196 transits were recorded in 2022. The presence of the windfarm site would require all Stena Line Liverpool/Belfast (East of IoM) services to navigate south of Calder CA1, along the existing operator passage plan. This results in no additional transit distance between the basecase and futurecase passage plan for the vessels passing to the west of Calder CA1, and an additional 1.6nm for vessels passing to the east
- The Liverpool/Belfast (West of IoM) route is unaffected by windfarm site

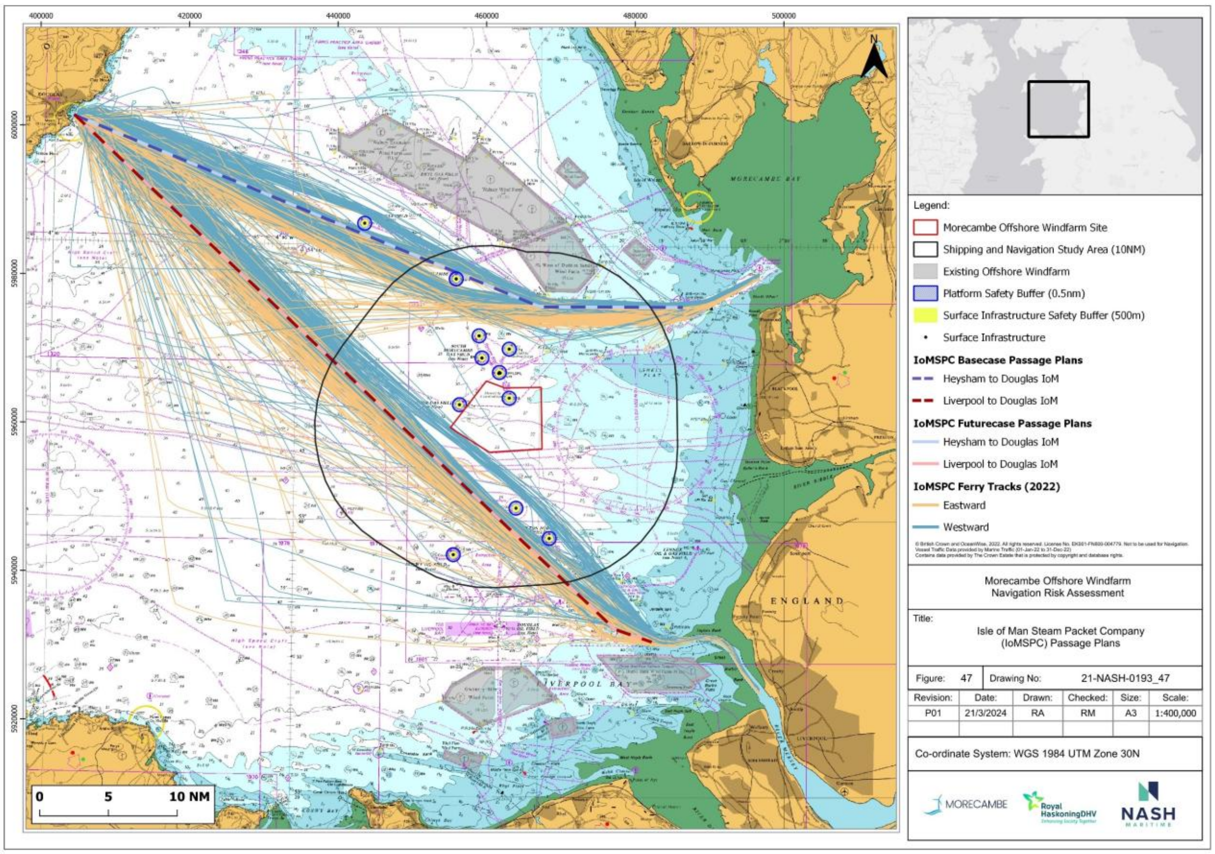


Figure 47: IoMSPC ferry basecase and futurecase passage plans

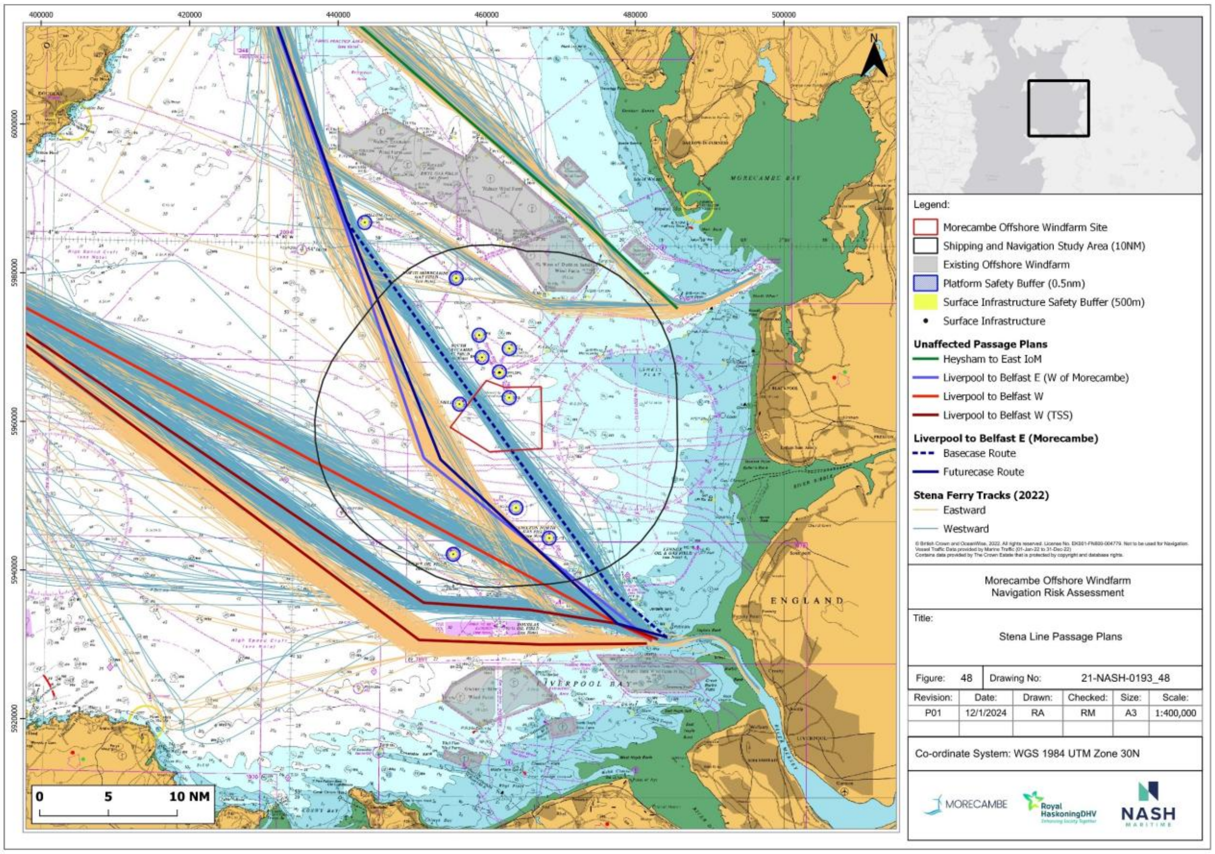


Figure 48: Stena Line ferry basecase and futurecase passage plans

Table 27: Impact on ferry passage plan routeing in normal metocean conditions

	Routes	Baseline Distance (nm)	Baseline Time (Minutes)	Service Speed (Knots)	Futurecase Distance (nm)	Additional Futurecase Distance (nm)	Additional Futurecase Time (Minutes)
IoMSPC	HEY - DOUG	46.8	225.0	13.2	46.8	0	0
				17.2			0
				28.8			0
	LIV - DOUG	56.9	165.0	28.8	56.9	0	0
				17.2			0
Stena	LIV - BEL W of IoM & No TSS	113.3	480.0	18.7	113.3	0	0
	LIV - BEL E of IoM (E of Calder)	113.9			115.5	1.6	5.1
	LIV - BEL E of IoM (W of Calder)	114.9			114.9	0	0
Seatruck	HEY - WAR	100.3	480.0	15.4	100.3	0	0
	HEY - DUB	109.3	480.0	15.0	109.3	0	0

8.2.3 Ferry routeing in adverse weather

8.2.3.1.1 **Section 8.2.2** was limited to an assessment of routeing in normal weather conditions. Where significant adverse weather is encountered, ferries may take less direct routes to take advantage of a lee from land masses, avoiding dangerous sea states or minimising the motions onboard. **Figure 49** shows futurecase adverse weather routes, including passage plans unaffected by the Project and the deviation to the Liverpool to Belfast (East of IoM) route with the windfarm site in situ. The 2019 and 2022 AIS data has been used to approximate the transit speeds and decision making in adverse weather (**Table 28**). Each revised futurecase passage plan was developed by the NASH project team, including master mariners, and account for existing decision-making principles and passage plans, where provided by operators (such as passing at least 1.5nm from a wind turbine) or that were obtained during consultation with operators. These were further developed during the navigation simulations involving Masters from each ferry company.

8.2.3.1.2 Stena Line Liverpool to Belfast (West of IoM) routes in adverse weather tend to transit to the south-west of the study area, towards the prevailing conditions, and are unaffected by the windfarm site.

8.2.3.1.3 There is infrequent use of the Liverpool to Belfast (East of IoM (East of Calder)) route during adverse weather with no vessels in 2019 and two in 2022. With the Project in place, these vessels may use the unaffected east of IoM (west of Calder) route however, they are more likely to follow the Liverpool to Belfast (West of IoM) adverse weather route which is not deviated by the Project.

8.2.3.1.4 If the vessels deviate to use the east of IoM (west of Calder) route, there will be an increased distance of 1.5nm, adding approximately 5.2 minutes to the 8 hour baseline journey time. This increases total delays from 0 – 30 minutes in the basecase to 5.2 - 35.2 minutes for the futurecase. However as noted above the route is not typically used in adverse weather conditions.

8.2.3.1.5 IoMSPC, Seatruck, and P&O adverse ferry routes are unaffected by the windfarm site.

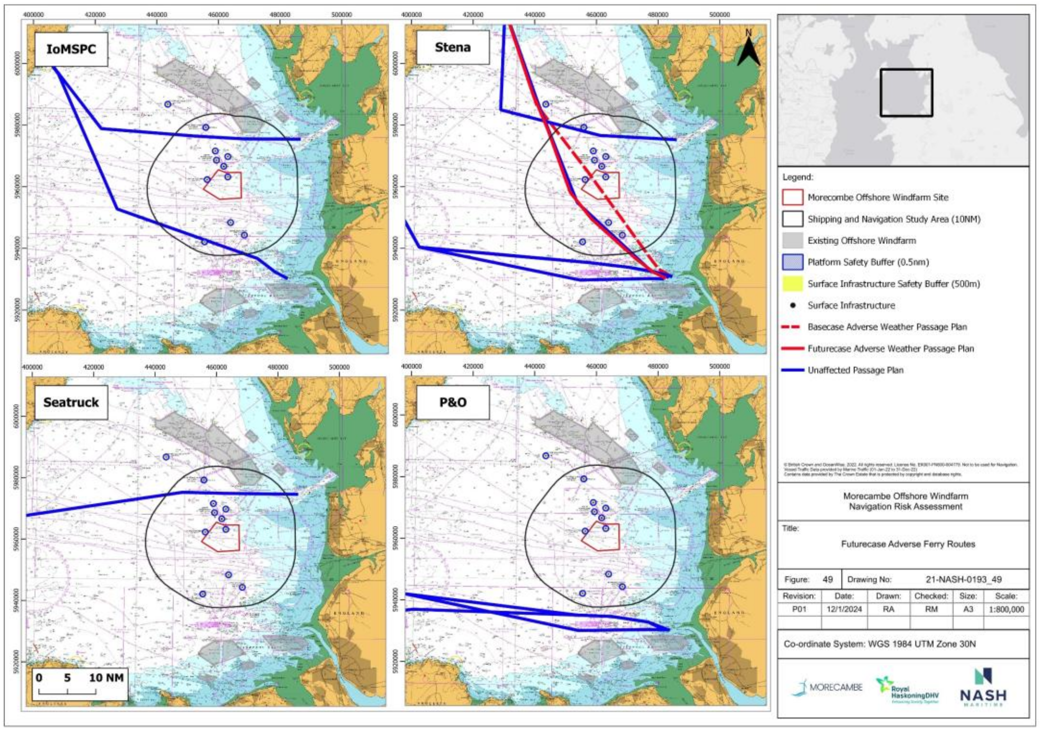


Figure 49: Impact on ferry routes in adverse weather

Table 28: Impact on ferry passage plan routeing in adverse metocean conditions

Operators	Routes	Baseline Adverse Distance (nm)	Baseline Adverse Time (Minutes)	Basecase Total Delays (Minutes)	Futurecase Distance (nm)	Additional Futurecase Distance (nm)	Additional Futurecase Time (Minutes)
IoMSPC	HEY - DOUG	50.1	225	+10 to +23	50.1	0	0
	LIV - DOUG	61.2	165	+10 to +33	61.2	0	0
							0
Stena	LIV - BEL W of IoM & No TSS	121.2	480	+20 to +60	121.2	0	0
	LIV - BEL E of IoM (E of Calder)	114.0	480	+0 to +30	115.5	1.5	+5.2
	LIV - BEL E of IoM (W of Calder)	114.5	480	+0 to +30	114.5	0	0
Seatruck	HEY - WAR	102.0	480	+27	102.0	0	0
	HEY - DUB	110.8	480	+28	110.8	0	0

8.2.4 Summary

8.2.4.1.1 **Section 8.2** has described how the windfarm site may impact upon ferry operations and routeing in both normal conditions and adverse weather. Based on the analysis Stena is the only operator with routes directly impacted.

8.2.4.1.2 The results suggest that additional transit distances of 1.6nm and 1.5nm on the Stena Liverpool/Belfast (East of IoM) route (normal and adverse routes respectively) on a 113.9nm passage is not likely to adversely impact upon ferry operations.

8.3 IMPACT ON COMMERCIAL VESSEL ROUTEING

8.3.1 Introduction

8.3.1.1.1 OWFs can impact on vessel routeing by creating an obstruction in otherwise navigable waters that requires a deviation of their route. For commercial vessels, this has the potential to result in increased transit time and cost. Furthermore, impacts on routeing may result in increased risks, which are considered in **Sections 8.4** and **Section 8.5**.

8.3.2 Commercial vessel routeing in normal conditions

8.3.2.1.1 Several low intensity commercial routes (<1 vessel per day) crossing the Irish Sea have been identified as passing through, or in close proximity to, the windfarm site (see **Section 6.4.11**). Therefore, the development of the windfarm site would necessitate re-routeing of these transits.

8.3.2.1.2 **Figure 50, Figure 51,** and **Figure 52** show the basecase passage plans (i.e. current passage plans derived by the NRA team based on 2022 AIS vessel tracks) and futurecase passage plans (i.e. the deviated routes around windfarm site) of the following three commercial routes that are impacted by the windfarm site:

- Liverpool/East of IoM
- Heysham/Off Skerries TSS
- Barrow/Off Skerries TSS

8.3.2.1.3 **Table 29** summarises the annual transit count for each commercial route, and the additional transit distance between the basecase and futurecase passage plans, as a result of deviating around the windfarm site. The key findings of this analysis are summarised within the following sections for each route.

8.3.2.1.4 The passage plan between Liverpool/East of IoM is used by vessels transiting between the UK and Ireland/Europe. The route west of Calder CA1 platform intersects the western corner of the windfarm site, whilst the route east of Calder CA1 platform passes through the centre of the windfarm site (**Figure 50**). Of the 68 vessel tracks on these routes, 40% intersected the windfarm site, while 60% transited clear to the west. The futurecase passage plan proposes a minor deviation to the west to reroute traffic 1.5nm clear of the southwestern corner of the windfarm site. This results in an additional transit distance between the basecase and futurecase passage plan of 0.1nm for the westward route and 2.4nm for the eastern route.

8.3.2.1.5 The basecase passage plan for Heysham/Off Skerries TSS is a low-use route, with 17 transits per year passing to the south of the Calder and South Morecambe gas fields through the centre of the windfarm site (seven westbound transits and ten eastbound transits in 2022). The futurecase passage plans deviate vessels north of windfarm site to pass >1.8nm south of WODS Windfarm, and >1.25nm north of DP8 (South Morecambe gas field) (see **Figure 51**). The deviation results in an additional transit distance between the basecase and futurecase passage plan of 2.4nm for the eastward route and 1.4nm for the westward route.

8.3.2.1.6 The route between Barrow/Off Skerries TSS is a low-use route, with 17 transits per year transiting through the windfarm site south of Calder CA1 and South Morecambe gas fields (four westbound transits and 13 eastbound transits in 2022). The futurecase passage plans deviate vessels north of windfarm site to pass >1.8nm south of WODS windfarm, and >1.25nm north of DP8 (**Figure 52**). The deviation results in an additional transit distance between the basecase and futurecase passage plan of 1.7nm for the eastward route and a reduction in transit distance of -0.4nm for the westward route.

8.3.2.1.7 A total of 34 commercial transits utilised routes between Heysham/Barrow and Off Skerries TSS in 2022 that intersect the windfarm site. Given the very low traffic intensity of the affected commercial routes, the impacts of the route deviations are minimal and therefore are unlikely to make operations unviable.

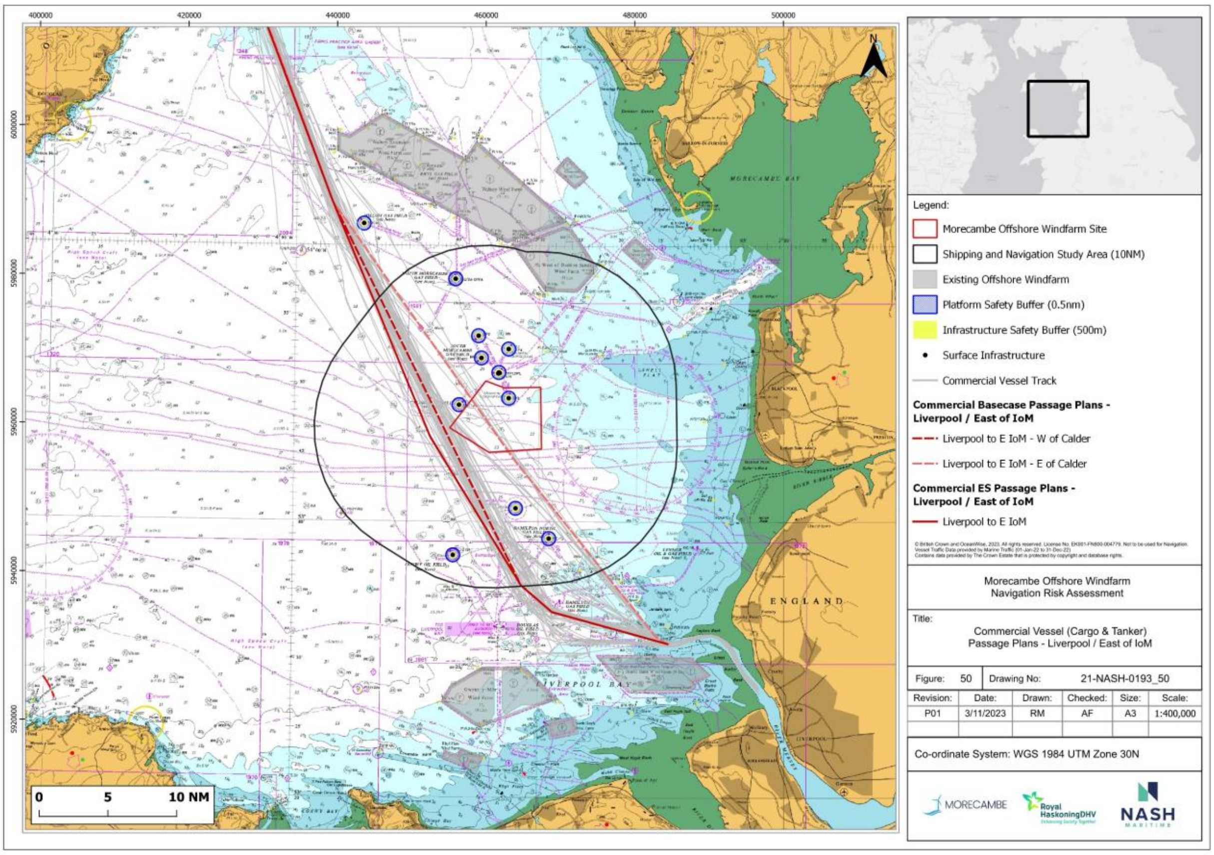


Figure 50: Liverpool/East of IoM commercial route basecase and futurecase passage plans

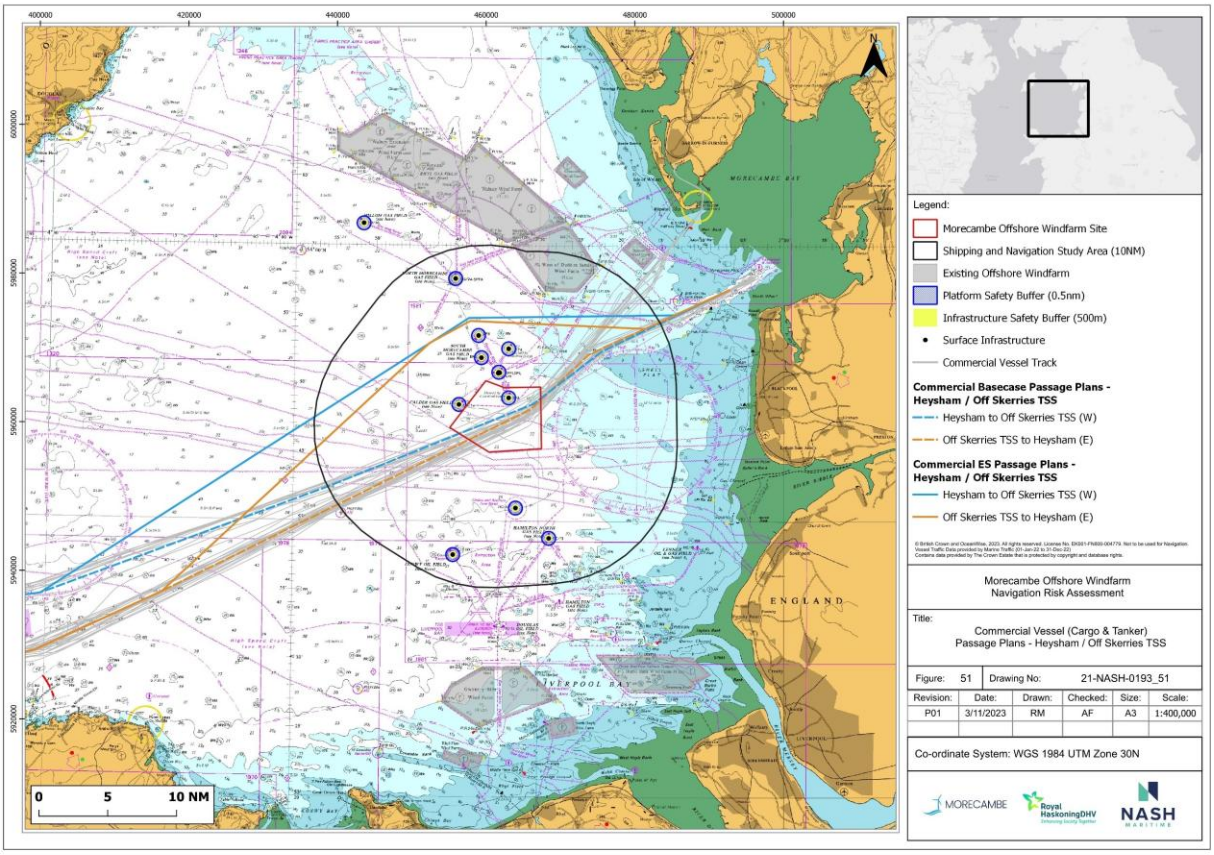


Figure 51: Heysham/Off Skerries TSS commercial route basecase and futurecase passage plans

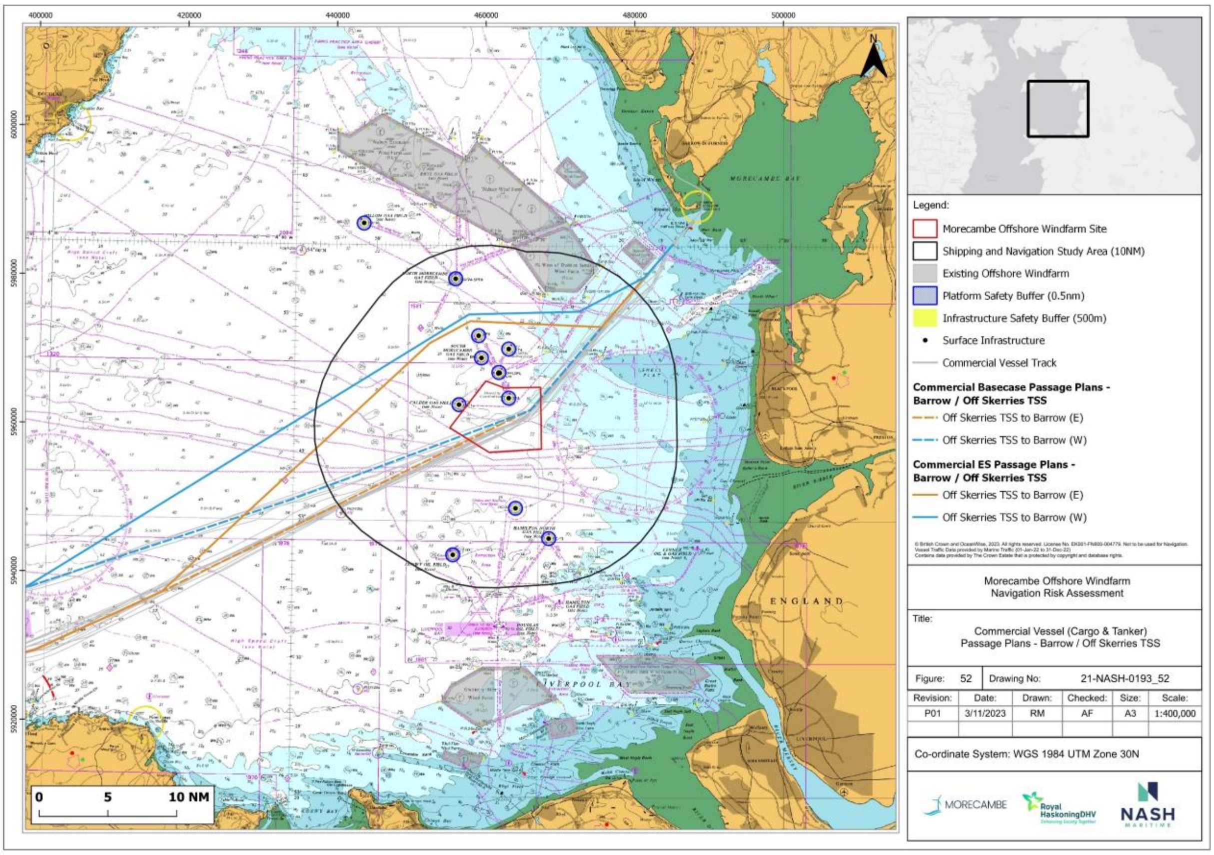


Figure 52: Barrow/Off Skerries TSS commercial route basecase and futurecase passage plans

Table 29: Impact on commercial passage plan routeing in normal metocean conditions

Passage Plan Route	Route Direction	Basecase Route Distance (nm)	Futurecase Route Distance (nm)	Additional ES Route Distance (nm)
Liverpool - East of IoM	East of Calder	70.1	72.5	+2.4
	West of Calder	72.4	72.5	+0.1
Heysham - Off Skerries TSS	Eastward	68.6	71.0	+2.4
	Westward	72.5	73.9	+1.4
Barrow - Off Skerries TSS	Eastward	67.4	69.0	+1.7
	Westward	71.8	71.4	-0.4

8.3.3 Commercial vessel routeing in adverse conditions

8.3.3.1.1 Analysis of adverse weather routeing in **Section 6.4.14**, during 2019 and 2022 named storms, did not identify any particular changes to typical routes. There was a greater demand for the anchorages along the Welsh coast, and no discernible impacts as a result of the windfarm site are identified regarding availability of anchorages for vessels to seek shelter in adverse weather. Some vessels were recorded loitering to the west of the study area, likely riding the conditions before they could berth. There is sufficient clear sea room to the west of the windfarm site to continue this practice.

8.3.4 Summary

8.3.4.1.1 Commercial shipping routes are concentrated into the Port of Liverpool and Heysham/Barrow, with minor deviations around the windfarm site required. All routes where deviation would be required are minor routes, with fewer than one vessel per day, and deviations are not considered to make such operations unviable. No significant impact on commercial ship operations in adverse weather was identified.

8.4 IMPACT ON RISK OF ALLISION

8.4.1 Introduction

8.4.1.1.1 The presence of new infrastructure in an area can increase the risk that a vessel may be involved in an allision with it. This risk is present for both vessels transiting within the windfarm site and adjacent to it.

8.4.1.1.2 To assess allision and collision risk within the study area, the IWRAP risk modelling tool has been utilised (see **Section3.3.2**). The IWRAP model was used to assess the likelihood of allision and collision for the basecase (current risk) and futurecase (risk with Project in place) scenarios. Oil and gas and other existing windfarm infrastructure is included in both basecase and futurecase scenarios (excluding DP3 and DP4 as these are now decommissioned and removed), whereas the futurecase scenario includes the presence of an indicative 30 turbine layout. Data used for the modelling includes all vessel types.

8.4.1.1.3 It should be noted that the IWRAP includes AIS from all vessel types to model the likelihood of a collision or allision. The majority of these would result in minor consequences. Furthermore, given underrepresentation of small craft using AIS, these respective return periods for all vessel types have not been presented on an individual basis. Risk (in return periods) is presented for ferries (passenger vessels) and commercial vessels (defined as cargo and tanker).

8.4.1.1.4 IWRAP modelling has a number of stages:

- Data Preparation:
- Vessel traffic legs are created that represent shipping routes and 2022 AIS data is used to determine the volume and types of traffic, and distribution across that leg
- These legs are connected into a network with waypoints where legs cross or join together
- Other hazards, such as bathymetry and fixed installations are inputted into the model
- Risk Calculation:
- Where these legs intersect with one another or physical hazards, the proportion of traffic on that leg at risk is calculated
- To account for the ability of the crew to avoid these hazards, a causation factor is used (in the order of 1 in 10,000) to represent the probability of human error or mechanical failure leading to an incident

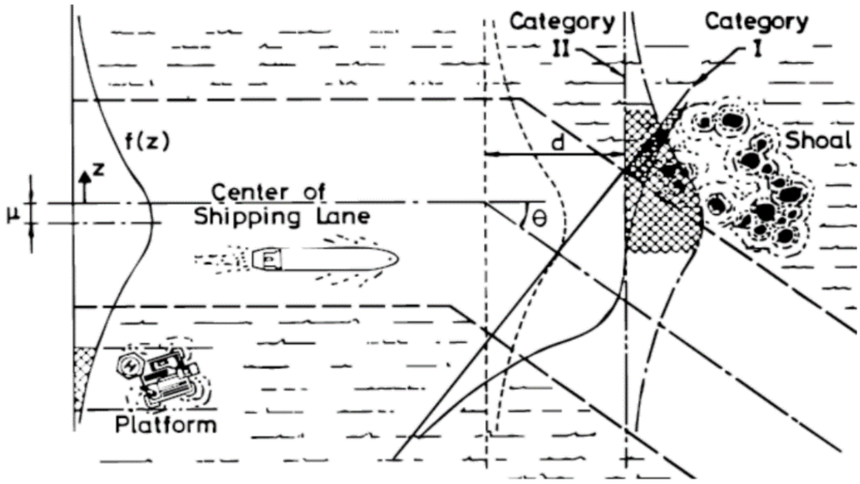


Figure 53: IWRAP traffic leg and grounding/allision calculation

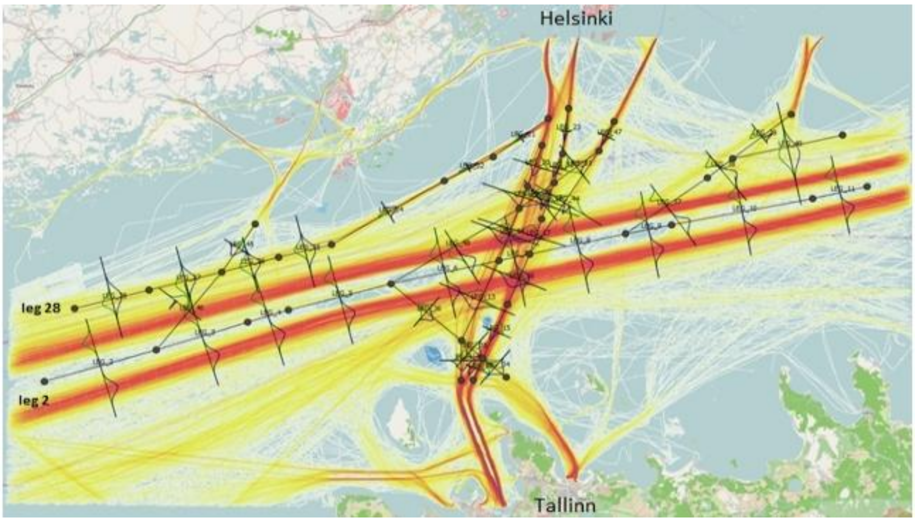


Figure 54: IWRAP MKII model example, Gulf of Finland (Source: IALA)

8.4.2 Ferries and commercial vessels

8.4.2.1.1 **Table 30** and **Figure 55** show the allision modelling results for ferries and commercial shipping. Given future traffic projections discussed in **Section 7**, the allision rate with a 15% estimated increase in traffic is given. The return period is derived from a 15% uplift of the future case probability value and converted to an updated return period.

8.4.2.1.2 The modelling shows the futurecase return periods are low, with 1 in 10,602 years for commercial vessels and 1 in 2,258 years for ferries, partly due to the greater manoeuvrability and familiarity of ferry bridge teams, which is contained within the causation probabilities for different vessels contained within the IWRAP model. The highest risk to the wind turbines within the windfarm site are the most westerly periphery WTG, primarily due to the proximity and density of passing vessels on existing and deviated commercial routes on passage between Liverpool and Belfast passing east of the IoM.

8.4.2.1.3 The basecase allision probability is greatest on the southern structures of the existing WODS OWF and the existing oil and gas platforms where there is the greatest traffic density. The rerouting of traffic in the futurecase has resulted in lower allision risk scores for Calder and South Morecambe DP8 with the Stena Line East of Calder route deviated west of the windfarm site and existing oil and gas infrastructure.

Table 30: IWRAP 30 turbine layout allision results (return periods in years)

	Hazard	Basecase (yrs)	Futurecase (yrs)	% Change	15% Traffic Uplift (yrs)
Allision	Ferries	1 in 2,936	1 in 2,596	13%	1 in 2,258
	Commercial	1 in 14,078	1 in 12,192	15%	1 in 10,602
	Total	1 in 1,912	1 in 1,699	13%	1 in 1,477

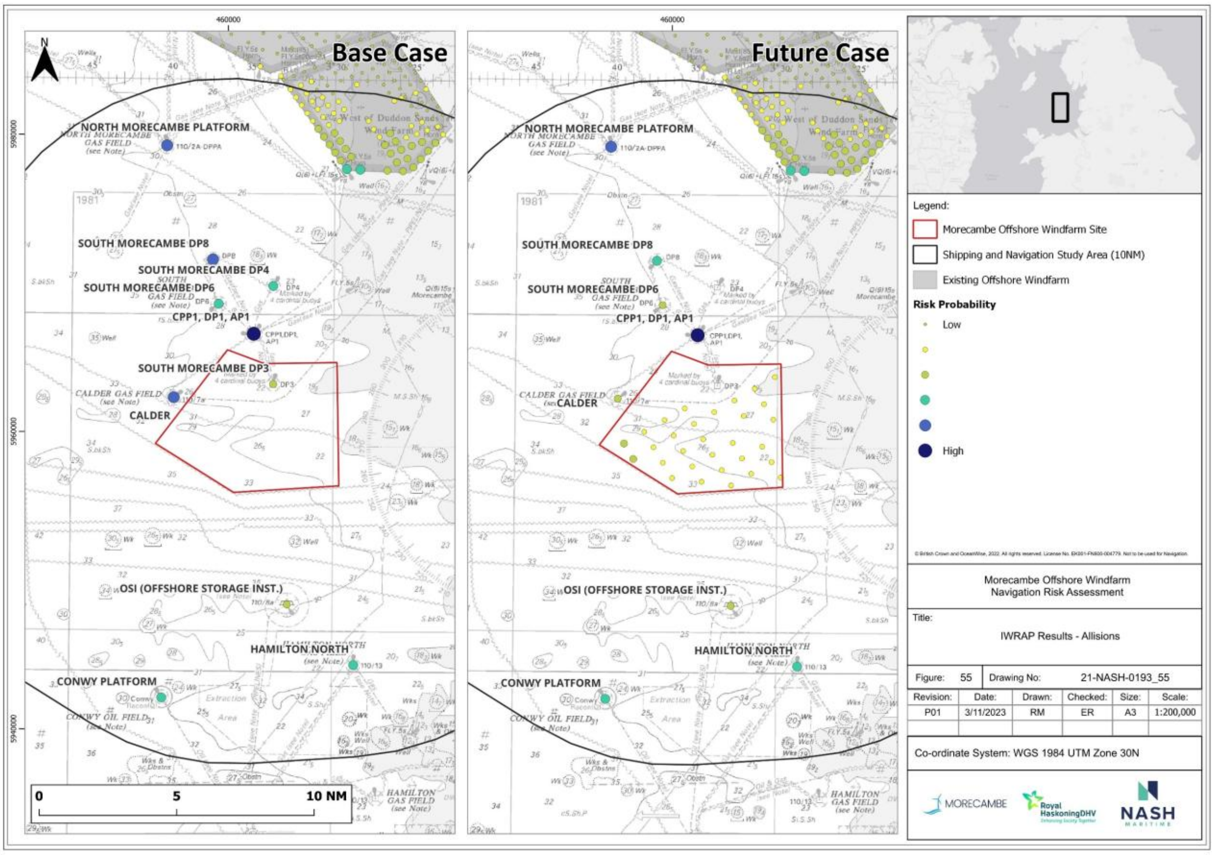


Figure 55: IWRAP allision results for the 30 turbine indicative layout

8.4.2.1.4 The results presented in **Table 30** and **Figure 55** are based on an indicative 30 turbine layout. To understand the sensitivity of layout design to allision risk, additional modelling has been undertaken to test the potential allision risk of an indicative 35 turbine layout and inclusion of two offshore substation platforms (OSPs). This would represent the MDS for maximum number of turbines as presented in **Table 11**.

8.4.2.1.5 The sensitivity modelling, presented in **Figure 56**, shows the futurecase return periods for the MDS layout, with 1 in 9,549 years for commercial vessels and 1 in 2,118 years for ferries (Table 31). This represents an increase in return period of 1,053 years for commercial vessels when compared to the 30 WTG layout (11% change), and an increase in return period of 140 years for ferries (6.6% change). These return periods are still considered to be low.

Table 31 IWRAP 35 turbine layout allision results (return periods in years)

	Hazard	Futurecase 30 WTG (yrs)	15% Traffic Uplift (yrs)	Futurecase 35 WTG + 2 OSP (yrs)	15% Traffic Uplift (yrs)	% Change
Allision	Ferries	1 in 2,596	1 in 2,258	1 in 2,436	1 in 2,118	6.6%
	Commercial	1 in 12,192	1 in 10,602	1 in 10,982	1 in 9,549	11.0%
	Total	1 in 1,699	1 in 1,477	1 in 1,587	1 in 1,380	7.0%

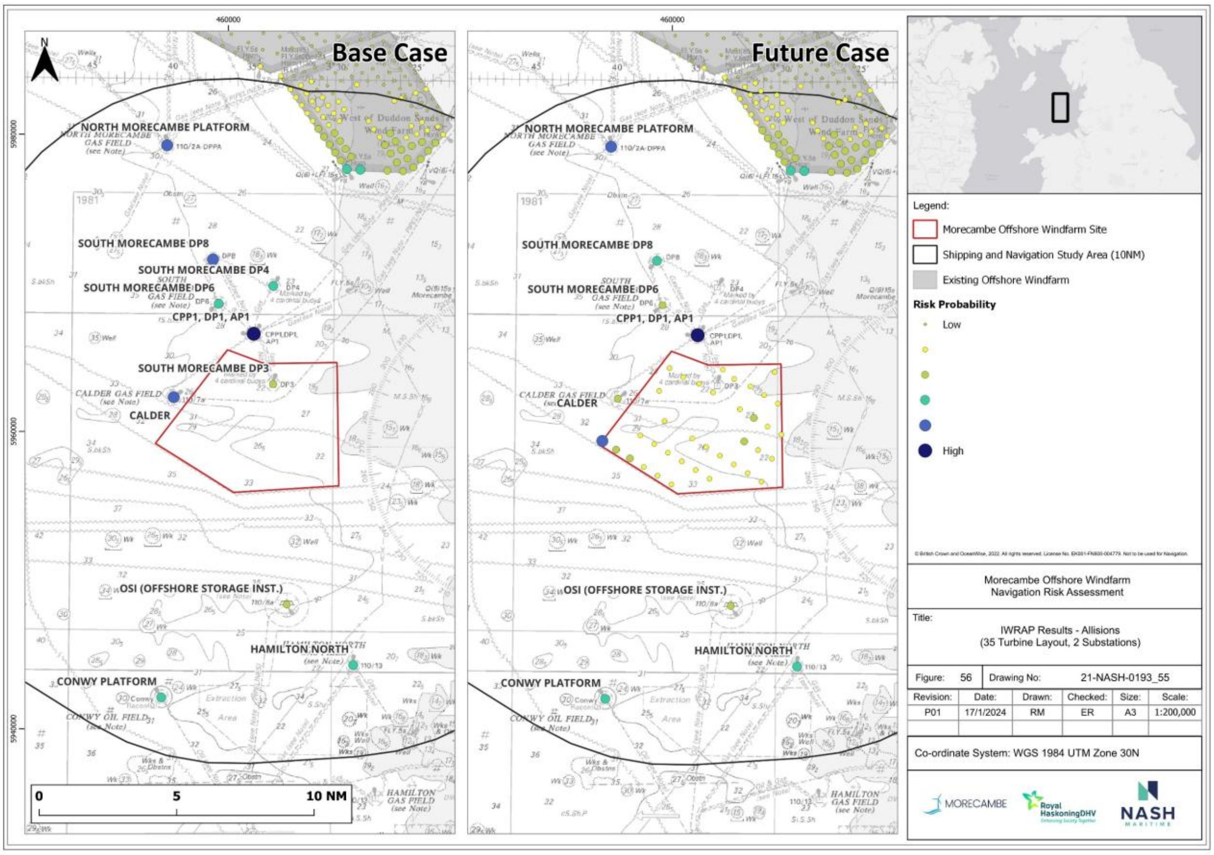


Figure 56: IWRAP allision results for the 35 turbine indicative layout

8.4.3 Project vessels

8.4.3.1.1 Historical analysis of incidents involving OWFs has identified that those vessels most likely to be involved in an allision with a WTG are Project construction and maintenance vessels with an allision between a WFSV and a WTG occurring approximately once every ten years in the UK (see **Section 6.5.1**). This is mainly due to their operational requirements meaning they are operating in close proximity to the WTGs.

8.4.4 Recreational

8.4.4.1.1 The windfarm site is located a considerable distance from the shore and, therefore, most recreational craft passing through the windfarm site would be engaged in offshore cruising. The vessel traffic survey and AIS analysis indicated that there is limited recreational activity at the windfarm site, however, there is still potential for them to pass through it. The site would be well marked and there is sufficient searoom to safely pass around the site, therefore, it is unlikely that a recreational vessel would contact a turbine. Were it to do so, a glancing blow with minor damage is the most credible outcome.

8.4.5 Fishing

8.4.5.1.1 Fishing vessel activity has been identified in the study area (see **Section 6.4.7**) and, given the minimum distance between turbines of 1,062m, there is potential for fishing to take place within the windfarm site. This means there is potential for a fishing vessel to be involved in an allision with a WTG, however, given the available searoom a glancing blow with minor damage is considered the most credible outcome, especially as trawling is unlikely in the area as most fishing is potting.

8.4.6 Consequences assessment

8.4.6.1.1 Given the historic infrequency at which vessels have allided with WTGs, there is some uncertainty to the degree of damage that would result from an allision. The degree of damage depends on the vessel characteristics, the type of allision (at speed or drifting), angle of allision (broadside or head on) and the engineering of the WTG. Several academic studies using finite element modelling have sought to explore this, including Biehl and Lehmann (2006), VINDPILOT (2008), Dai et al. (2013), Moulas et al. (2017) and Presencia and Shafiee (2018).

8.4.6.1.2 These studies suggest that:

- Ship allisions, even at low speeds, can cause significant damage to WTGs including deformation and buckling
- Some studies of in-field construction/maintenance vessels (up to 4,000 tons), with allisions at high speeds, did not result in WTG collapse
- Modelling of allisions with large commercial ships could result in holing of the vessels hull and cargo release
- Larger vessels ~~(30,00139lludinglliding~~ (30,000 DWT) alliding with the turbine might typically result in the tower collapsing away from the vessel

- However, some studies suggested that large commercial ships could result in the tower collapsing towards the vessel, with the damage likely to penetrate the deck.

8.4.6.1.3 To better understand the potential consequences of ship allision with WTGs, **Table 32** presents some case studies of past incidents and the resulting impacts to people, property and the environment. It can be concluded that where incidents have occurred, they have been at low speed, involve in-field project vessels and typically result in only minor damage or injuries. However, it is feasible that a serious allision with an OWF might result in turbine collapse, holing and eventual flooding of a vessel and potential loss of life.

Table 32: Case studies of allision

Date	Site	Vessel	Description
24-April-23	Gode Wind 1 (Germany)	Petra L – 74m 1,162 GT General Cargo	Currently under investigation by German authorities. Vessel struck turbine resulting in serious damage to the starboard bow of the vessel but was able to proceed to port. Turbine was taken out of service until the damage was assessed. There were no injuries.
31-Jan-22	Hollandse Kust Zuid	Julietta D – 190m 24,196 GT Bulk Carrier	Disabled vessel in a storm struck the foundation of a substation jacket that resulted in minor damage to both the vessel and jacket. There were no injuries or pollution.
23-Apr-20	Borkrum Riffgrund	Njord Forseti – 24m 137 GT	Vessel skipper not keeping proper lookout collided with wind turbine at speed. Vessel suffered significant structural damage.
10-Apr-18	AOWF (Baltic)	Vos Stone – 80m 4,956 GT Offshore Supply Vessel	Construction vessel casting off from a WTG lost control and was forced against the WTG due to adverse weather. Resulted in three minor injuries, dry dock to the vessel and minor damage to platform. There was no pollution.
21-Nov-12	Sheringham Shoal	Island Panther – 17m 22 GT CTV	CTV made heavy contact with unlit transition piece. Resulted in five injuries and damage to the vessels bow.
23-Apr-20	Borkum Riffgrund 1 (Germany)	Njord Forseti – 26m CTV	CTV made heavy contact with WTG. Resulted in three injuries (one seriously) and significant flooding of CTV through 0.5m crack in bow.
14-Aug-2014	Walney	OMS Pollux – Stand By Safety Vessel	Whilst conducting inspection work, the vessel collided with a turbine that resulted in no injuries, and minor leaking of marine gas.

Date	Site	Vessel	Description
06-Oct 2006	Scroby Sands	Jack up	Large jack-up barge collided with turbine resulting in damage to a turbine blade.

8.4.7 Summary

8.4.7.1.1 The construction of any windfarm will invariably increase allision likelihood, especially in areas where obstructions are not currently present. The east Irish Sea, however, already has various offshore infrastructure present, including offshore windfarms and O&G installations, and as such, vessels navigating this area are experienced in navigating around and between various types of infrastructure.

8.4.7.1.2 The allision risk profile is considered low, based on the IWRAP modelling and the consequence assessment, with return periods for allision modelled as 1 in 1,477 years for all vessel types in the future case with 15% uplifted traffic in the 30 WTG scenario, and 1 in 1,380 years for all vessel types in the future case with 15% uplifted traffic in the 35 WTG (plus 2 OSPs) scenario, which when consideration of consequence is taken into account (in which no fatalities have occurred from allision with OWFs for commercial vessels), a high consequence (e.g. single or multiple fatality event) is considered a remote possibility.

8.4.7.1.3 If oil and gas decommissioning proceeds, then allision risk will be significantly reduced due to a reduction in the presence of tug and service vessels in the area. However, the risk may be countered by potential developments in gas storage and CCS projects as described in **Section 7.3.** However, there is not sufficient information available on these projects with regards to vessel movements or potential obstructions to allow them to be assessed.

8.4.7.1.4 Allision for other vessel types, such as recreational craft and fishing vessels is also considered low due to the low density of these traffic types and the spacings between WTG which will be at least 1,060m.

8.5 IMPACT ON RISK OF COLLISION

8.5.1 Introduction

8.5.1.1.1 The presence of the windfarm site could change shipping routes, creating pinch points or increasing density of transiting vessels, which can increase encounters resulting in an increase in collision risk. The direction in which vessels are transiting also influences the risk of collision with vessels crossing other routes, or transiting head on, generally resulting in higher risk of collision. The presence of a new obstruction may also result in reduced area for a vessel to take action to avoid collision or reduce the options available to do so.

8.5.2 Ferries and commercial vessels

8.5.2.1.1 **Figure 57** and **Table 33** show the IWRAP collision modelling results for ferries (passenger) and commercial vessels (cargo, tanker). Given future traffic projections discussed in **Section 7**, the collision rate with a 15% estimated increase in traffic is given.

8.5.2.1.2 The modelling indicates an increase in the likelihood of collision across the Irish Sea from 1 in 1,176 years to 1 in 933 years for all vessel types. It is important to note that IWRAP is a probability model and does not apply consequences to collision, so return periods should be considered in relation to the range of possible outcomes of collision hazards.

8.5.2.1.3 The increase in ferry-ferry collisions, from 1 in 1,442 to 1 in 1,139 years, is driven by the concentration of Stena ferries on the Liverpool/Belfast East of IoM (East of Calder) route onto the West of Calder route which increases the likelihood of meeting situations. The 7% increase in commercial vs ferry collisions, from 1 in 19,949 to 1 in 16,226, is accounted for by the relatively low density of commercial vessel routes within the area affected by the windfarm site and therefore the minimal effect routeing changes would have on the overall risk profile. An increase in commercial vs commercial collisions, is largely accounted for the by the merging of Liverpool – East of IoM East and West of Calder routes onto a single route and the increased time that commercial vessels would spend interacting. However, the return periods are very low with <70 vessel transits in total on these routes in 2022.

8.5.2.1.4 As shown in **Figure 57**, the geographic distribution of collision probability is concentrated to the north of the study area, associated with the concentration of vessels bound to and from the ports of Heysham and Barrow passing to the south of the WODS and Walney windfarms. In the context of the diverted traffic for the model legs approaching/departing Liverpool (comprising of the Stena route passing east of the Calder Gas Field), the number of vessels transits changes as follows for the 2022 data:

8.5.2.1.5 Commercial vessels:

- **Leg 36:** 19 transits basecase, 28 transits futurecase
- **Leg 28:** 58 transits basecase, 67 transits futurecase

8.5.2.1.6 Ferry/passenger vessels:

- **Leg 36:** 600 transits basecase, 777 transits futurecase
- **Leg 28:** 187 transits basecase, 364 transits futurecase

Table 33: IWRAP collision results (return periods in years)

	Hazard	Basecase (yrs)	Futurecase (yrs)	% Change	15% Traffic Uplift (yrs)
Collisio	**Ferries vs Ferries**	1 in 1,442	1 in 1,310	10%	1 in 1,139
	Commercial vs Ferries	1 in 19,949	1 in 18,659	7%	1 in 16,226

Hazard		Basecase (yrs)	Futurecase (yrs)	% Change	15% Traffic Uplift (yrs)
	Commercial vs Commercial	1 in 3,631,510	1 in 2,518,855	44%	1 in 2,190,308
	Total	1 in 1,176	1 in 1,073	10%	1 in 933

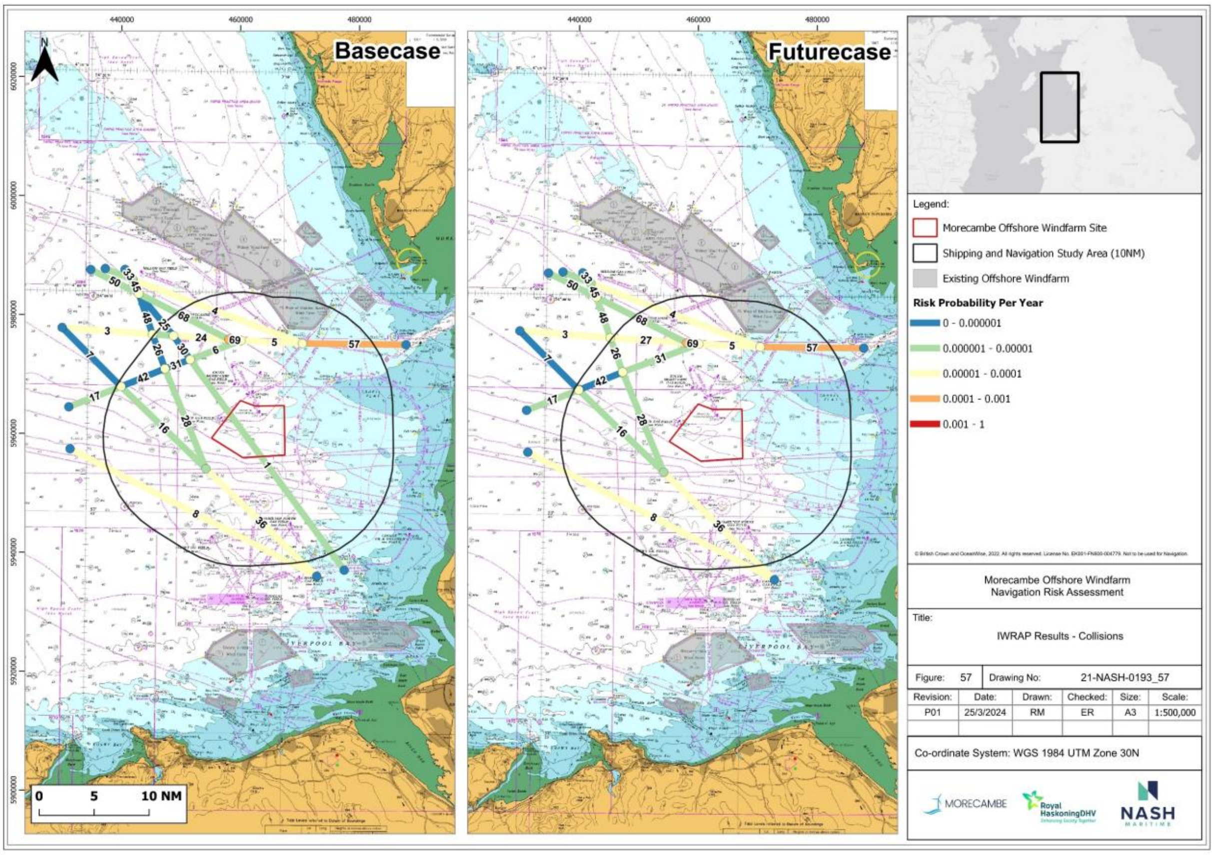


Figure 57: IWRAP collision modelling results

8.5.3 Project vessels

8.5.3.1.1 The routes that will be used by Project O&M vessels are not known and, therefore, assumptions have been made for the windfarm site. A clear additional risk of the Project is the additional vessel movements supporting its O&M activities and their interaction with other traffic. In particular, it is likely that multiple WFSVs will cross shipping routes and interact with other passing traffic, including ferries and fishing boats. The IWRAP modelling conducted identified that the risk of collision is greatest to northern extent of the study area. Were WFSVs to cross routes in these areas, they are at a heightened risk of being involved in a collision. Additional risk controls have been identified to deconflict WFSV movements with other passing traffic, such as through passage planning.

8.5.3.1.2 Navigating within the OWF is more challenging, due to the number of structures, however, most vessels of these are likely to be Project-related vessels, or fishing vessels familiar with O&M operations at other windfarms.

8.5.4 Recreational

8.5.4.1.1 The analysis of recreational vessel transits presented in **Section 6.4.6** identified relatively few cruising routes passing across the windfarm site. Most activity is concentrated near shore and/or clear of the windfarm site. The windfarm site shows a low density of AIS tracks, compared to adjacent waters, with the exception of southern section of the study area that shows low to moderate recreational activity.

8.5.4.1.2 Historically, evidence has suggested that recreational cruising vessels may choose to navigate through an OWF, and there are no restrictions on their ability to do so. However, the AIS data from 2022 reveals that 79% of cruising vessels sailing between Morecambe and Douglas avoided transiting through the existing offshore windfarms (Walney and WODS) by taking a longer southerly route. Much of this evidence has been collected from earlier Round 1 and 2 OWFs, where turbines were generally closer together. The greater turbine spacing and size of the Project will likely promote greater navigation through projects by recreational craft.

8.5.4.1.3 Vessels sailing along the routes between Liverpool to Douglas and Conwy to Morecambe would still be able to avoid transiting through the windfarm site without significantly increasing the passage time. All other identified routes are clear of the windfarm site.

8.5.4.1.4 Where yachts choose to navigate through the windfarm site, there is a risk of colliding with other craft, due in part to the reduced sea room between rows of turbines. This is partly exacerbated by the greater difficulty identifying other craft either visually or via radar, once within the windfarm site.

8.5.4.1.5 Where yachts choose to navigate adjacent to an OWF, they may be displaced into a waterway which is shared with large commercial vessels and, therefore, there is a greater risk of interactions which may lead to collision. The vessel traffic survey identified relatively few offshore cruising vessels navigating within the windfarm site, with no recreational vessels observed during winter and five observed during summer. Therefore, it would be reasonable to conclude that the increase in risk of collision would be minor.

8.5.5 Fishing

8.5.5.1.1 Large parts of the Irish Sea are regularly fished (see **Section 6.4.7**). The windfarm site could increase the risk of collision due displacement of activities into areas of higher density vessel traffic, resulting in more frequent encounters.

8.5.5.1.2 It is assumed that some commercial fishing activities could continue to take place within the windfarm site. However, during construction, fishing will be prevented where construction activities are taking place and would be required to relocate or bring to shore depending on available grounds and fishing preferences.

8.5.6 Consequences assessment

8.5.6.1.1 International studies have explored the consequences of collision between large vessels. The EMSA (2015) collision risk model developed for their FSA based on historical incidents estimated that 33% of struck RoPax vessels would result in water ingress and additionally 14% of those vessels would result in sinking (resulting in a probability of 4.6% for a struck RoPax to sink). The MSC 85-17-2 FSA gives probabilities of 16% of collisions being a serious casualty, of which 50% of struck vessels would flood, 22% would sink with a further 50% split between gradual sinking or rapid capsize (joint probability of the latter being 0.8%).

8.5.6.1.2 Analysis of MAIB data suggests that approximately 1% of collisions would result in loss of life. However, it is likely that as most collisions occur within ports and harbours, vessels are navigating at slower speeds than they may do in open sea. Furthermore, there are relatively few incidents in UK waters of significant loss of life following collisions or allisions involving large commercial shipping or ferries.

8.5.7 Summary

8.5.7.1.1 Based on the analysis provided, the collision risk changes as a result of the windfarm site for ferries and commercial vessels is very low, predominantly due to the low frequency of l vessel traffic in the area. Based on the IWRAP modelling for ferries and commercial vessels, then the likelihood post construction of the windfarm site is 1 in 933 years. When consequence is taken into account, specifically the MAIB data analysis which shows that 1% of collisions lead to a fatality, the return period for a fatality collision would be even lower.

8.5.7.1.2 The quantitative characterisation of collision risk for Project related vessels (primarily WFSV's) is limited due to O&M bases not being defined yet. However, any increase in risk could be mitigated by careful passage planning and communication with other vessels.

8.5.7.1.3 Recreational and fishing collision risk is considered low due to the low levels of these vessel types in the study area.

8.6 IMPACT TO SEARCH AND RESCUE

8.6.1 Introduction

8.6.1.1.1 In the unlikely event of an incident, SAR assets are required to access the site or surrounding area without risk to themselves. In particular, wind turbines can pose a hazard to SAR helicopters and, therefore, the design of the windfarm should be such to enable helicopter access safeguarding HM Coastguard obligations within the UK SAR Region. An ERCOP is required to facilitate information sharing regarding the OWF and SAR organisations. The principals of SAR access for OWFs are contained in MGN 654 Annex 5, and can be summarised as:

- **Lines of Orientation** – developers should maintain two lines of orientation for the windfarm layout unless a safety case is produced, and additional mitigation is proposed, that one line of orientation is tolerable. This allows multiple directions for aircraft entry and improves access, whilst a linear regular grid is both more efficient and safer for conducting SAR

- **SAR Lanes** – to be of sufficient width to enable safe transit of a SAR helicopter between the turbines. MGN 654 Annex 5 recommends turbine spacing (blade tips to blade tips) of greater than 500m
- **Helicopter Refuge Areas** – in larger developments (>10nm width, not applicable to the Project), a refuge area clear of turbines may be required to enable aircrews to reorientate themselves and change direction safely
- **Turbine Preparation** – to support winching of a casualty, the WTG needs to be configured to a specific position as requested by the SAR crew. This might include rotating the nacelle to 90 degrees from the wind, and both locking and positioning the blades to facilitate SAR access (e.g. Y configuration - see MGN654 Annex 5)

8.6.1.1.2 Several trials have been conducted by HMCG and MCA in SAR at OWFs (see MCA, 2005; 2019). They found that searching within an OWF is more complex than in open sea and there may be a delay for entry into an OWF whilst the crew familiarise themselves with the site and layouts. During poor visibility, the importance of linear SAR lanes of sufficient width was identified as of significant importance. When transiting through an OWF, all communications and navigation equipment was reported to be operating successfully with WTGs identifiable through radar. Unfamiliarity with transiting and winching in vicinity of WTGs results in slower speeds and delays, which increases fuel consumption and may make searches less effective. Concerns have also been raised regarding visual identification of casualties, as WTGs block the view, particularly during rough weather.

8.6.2 Summary

8.6.2.1.1 The Project has committed to two lines of orientation to facilitate SAR access. The spacing between the turbines would be greater than 1,000m and, therefore, helicopter access guidance is met. Furthermore, as with other similar projects, the first responders to incidents within the OWF are most likely to be project vessels, to some extent mitigating any loss in aerial asset effectiveness.

8.6.2.1.2 Specific layouts are subject to detailed engineering studies at a later date than when the NRA is conducted. Therefore, the DCO would typically stipulate that the MCA and Trinity House must agree to the design layout, in order to ensure that access of SAR assets is not compromised and confirm that principals contained in MGN 654 Annex 5 are followed.

8.7 IMPACT ON VISUAL NAVIGATION AND COLLISION AVOIDANCE

8.7.1 Introduction

8.7.1.1.1 MGN 654 notes that an OWF could block or hinder the view of other vessels or any navigational feature, such as the coastline or aids to navigation. This may result in "blind spots" between vessels, which could increase the risk of collision, by reducing the capability for early and effective collision avoidance.

8.7.1.1.2 Firstly, each individual WTG is approximately 10m in diameter above sea level and whilst vessels transit past the site, any two vessels would come into and out of visibility temporarily. Furthermore, there may be challenges identifying the vessels through radar (see **Section 8.8.2**) and targets would be visually less distinct amongst the turbines. For craft emerging from the OWF, most passing vessels would transit with sufficient safety buffer from the OWF in line with the MCA shipping route template (MGN654) (c.1.5nm), such that an emerging vessel at 15 knots would be visible for approximately six minutes. This would provide some opportunity to avoid a collision, however, would be significantly reduced beyond what would be the case pre-construction in open sea.

8.7.1.1.3 Secondly, the geometries of the OWFs could reduce the visible appreciation of other vessels, particularly where routes converge on the corners of sites. For example, vessels proceeding north to the east and west of the windfarm site may not have visual sight of one another until they meet at the north of the windfarm site. The COLREGs describe obligations for collision avoidance and the appreciation of navigational lights (port/starboard) are necessary in determining the correct response to crossing, overtaking and head-on situations. However, larger vessels would be identifiable from AIS (and tracked by radar/visual means) and, therefore, passing arrangements should be planned in accordance with COLREGs.

8.7.2 Summary

8.7.2.1.1 The spacing between turbines and density of traffic passing adjacent to the Project does not suggest that this impact would have a significant increase in risk. The risks of collision associated with Project O&M and oil and gas vessels emerging from the windfarm site could be managed through robust marine operating guidelines (see **Section 9.8**).

8.8 IMPACT ON COMMUNICATIONS, RADAR AND POSITIONING SYSTEMS

8.8.1 Introduction

8.8.1.1.1 MGN 654 notes that an OWF may have adverse impacts on the equipment used for navigation, collision avoidance or communications. Additionally, a pre-application request made by MOWL to the DIO for advice regarding the proposed development raised concerns by the MoD regarding the potential impact to military vessels operating in the area (see **Section 3.5.1**). A significant body of work has been conducted to examine the impacts on the equipment used for navigation, collision avoidance or communications in detail, and reference is made to the following studies:

- **QinetiQ (2004).** Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle Windfarm by QinetiQ and the Maritime and Coastguard Agency
- **BWEA (2007).** Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Windfarm
- Ocean Studies Board's Division on Earth and Life Studies (2022). Wind Turbine Generator Impacts to Marine Vessel Radar

8.8.1.1.2 **Table 34** provides a summary of these potential impacts, for which there are not anticipated to be any significant effects.

Table 34: Summary of impacts on equipment

Impact on	Overview
VHF	VHF is essential for the communication between vessels and shore. VHF radio waves could be blocked or interfered with by the presence of turbines. The 2004 QinetiQ study found no noticeable effect on VHF communications both ship-shore and ship-ship within or adjacent to the windfarm. A trial aboard SAR helicopters (MCA, 2005) also determined no significant impact on VHF direction finding capabilities. Therefore, no significant impact on VHF communications is anticipated.
AIS	AIS enhances the identification between vessels for collision avoidance. AIS signal could be blocked or interfered with by the presence of turbines. The 2004 QinetiQ study found no noticeable effect on AIS reception and no incidence of AIS degradation this have been reported Therefore, no significant impact on VHF communications is anticipated.
GNSS	Global Navigation Satellite System (GNSS), such as Global Positioning System (GPS), is used for satellite positioning systems and navigation. Satellite reception could be impacted by the presence of turbines. The 2004 QinetiQ study found no noticeable effect on GPS reception, even in very close proximity to the WTGs. Therefore, no significant impact on GPS is anticipated.
Marine Radar	See **Section 8.8.2**
Shore Radar	Similar to marine radars, shore radars could be impacted by the wind turbines. The windfarm site is well clear of any ports and harbours, and any VTS coverage. Therefore, no significant impact on shore radar for managing navigational safety is anticipated.
Noise	The sound generated by the WTGs could mask navigational sound signals from vessels or aids to navigation. Whilst turbines make an audible sound whilst

Impact on	Overview
	rotating, the low density of shipping and distance to other navigational marks makes this potential impact negligible. Furthermore, maritime regulations for audibility of a ship's whistle are well in excess of the typical WTG sound emissions even at very close range. Therefore, no significant impact on navigation safety from increased noise is anticipated.
Magnetic Compass	Compasses are used for vessel navigation. These are potentially impacted by electromagnetic interference from the WTGs or cables. The degree of this impact is related to the depth of water, cable design and alignment with the earth's magnetic field. However, cables for the windfarm will be buried wherever practical and cable protection applied where not possible to bury and therefore no impact is anticipated. It is possible that small vessel compasses could be impacted near to cable landfall. Although out of scope given the distance offshore of Project, it is considered likely that small craft would navigate visually near to cable landfall and therefore the impact on navigation safety would be reduced. Therefore, no significant impact on navigation safety from electromagnetic interference is anticipated.

8.8.2 Marine radar interference

8.8.2.1.1 Marine radar is used for both collision avoidance and vessel navigation. WTGs, like other structures, can result in spurious returns such as side lobes, echoes, reflections and blanketing. These effects were studied extensively in both the QinetiQ (2004) and BWEA (2007) studies. Both studies determined that the reduced capability to track small vessels within OWFs and the risk of losing acquired targets should be considered by mariners navigating adjacent to OWFs. Some of these effects can also be mitigated by careful adjustment of radar controls, such as Gain.

8.8.2.1.2 Based on this, the MCA developed a shipping route template (MGN 654) that placed the extent of these effects at 1.5nm, increasing as the vessels transit closer to the turbines. Intolerable impacts may be experienced up to 0.5nm from the OWF. Historical evidence and AIS analysis presented in **Section 6.4.2** suggests that most vessels pass more than 0.5nm from an OWF and therefore these effects are lessened. **Figure 58** shows how the Project boundaries relate to the region of potential radar effects. Routes passing within close proximity to these areas could impact on collision risk. However, existing routes pass within close proximity to other existing offshore windfarms such as WODS. Therefore, regular runners should be familiar with these effects.

8.8.2.1.3 To assess the potential impact of the Project on radar interference, a separate assessment has been commissioned by the Project (Appendix 17.2 Radar Early Warning System Technical Report Document Reference 5.2.17.2). The scope of the study is to understand the potential impact of the Project on nearby Radar Early Warning System (REWS) installations, used to monitor and protect offshore oil and gas assets from collision with errant vessels. The assessment also considers the impact on microwave communication links installed onboard offshore O&G

platforms and the effect of the rerouted traffic on alarm rates. The windfarm site is outside of all port limits, VTS and pilotage areas and therefore whilst shore-based radar may have partial coverage of the windfarm site, it would not be actively monitored. Therefore, the presence of the windfarm site would not compromise vessel traffic monitoring obligations.

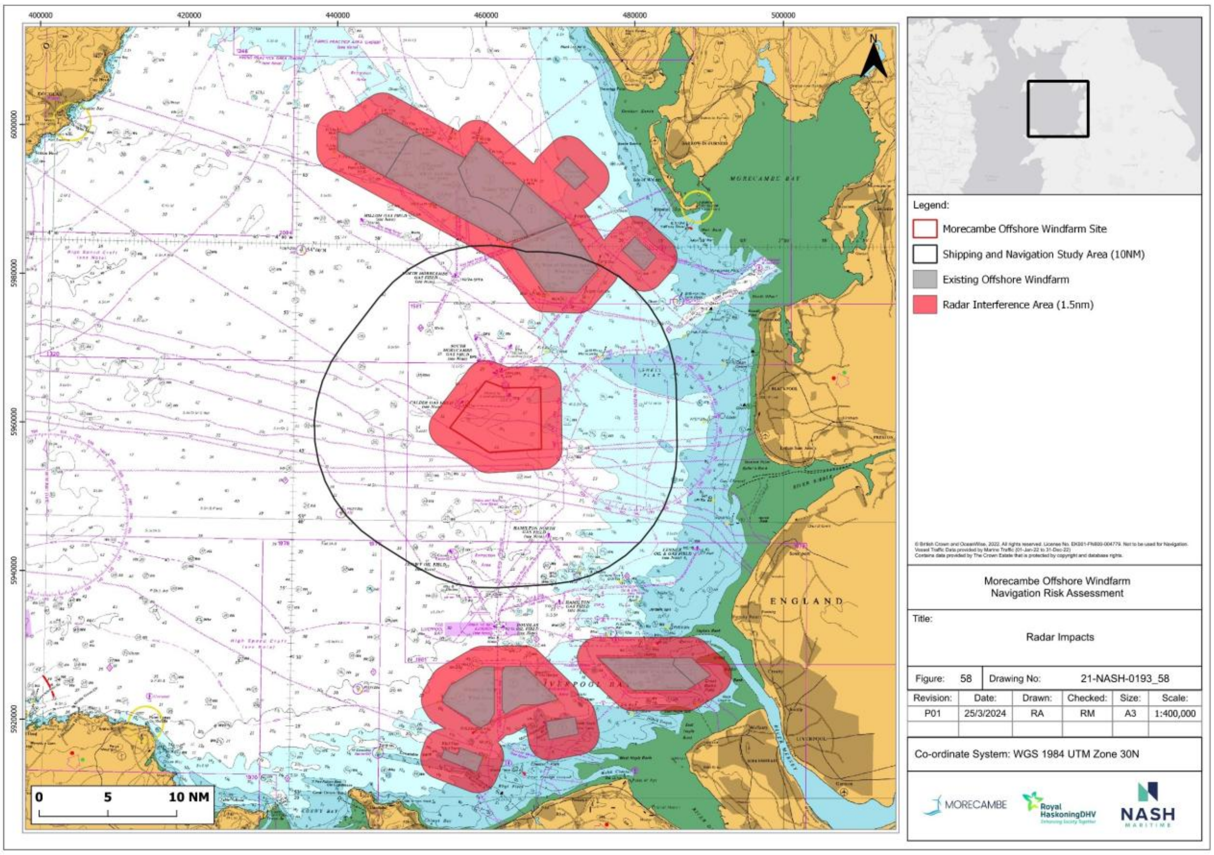


Figure 58: MGN654 radar impacts

8.8.3 Summary

8.8.3.1.1 In summary, there are no anticipated impacts on equipment as listed in **Table 34** as a result of the windfarm site. Impacts to marine radar may occur in close proximity to the turbines. However, mariners will maintain safe distance to minimise their effects.

8.8.3.1.2 The impact on radar interference is examined in more detail within the REWS study. The study concludes the impact of the Project on detection performance of nearby REWS installations is low and manageable without the need for further mitigation measures. Based on the modelled parameters for the communications links and turbines, the REWS study concluded that there will be no negative impact from the Project on microwave communication links with no mitigation measures needed.

8.8.3.1.3 The modelling results for the Project also indicate that the assessed REWS platforms will not experience a change in yearly alarm rates as a result of rerouted traffic.

8.9 IMPACT ON POTENTIAL SNAGGING

8.9.1 Introduction

8.9.1.1.1 Evidence of fishing activity was identified within the site area (**Figure 23, Figure 24,** and **Section 6.4.7**). The installation of inter-array cables, partially protected cables or platform link cables (in the event the windfarm site requires two offshore substations) during construction may increase anchor and fishing gear snagging risk. Subsea cables are both at risk of anchor or fishing gear strikes and can pose a hazard to navigating vessels where gear attached to the vessel becomes snagged.

8.9.2 Summary

8.9.2.1.1 In summary, were a fishing vessel to snag a cable, the most likely outcome is loss of gear and potentially minor damage to the cable. A worst credible outcome, however, is the loss of the fishing vessel as it capsizes, and potential fatalities. Cable burial (an embedded mitigation risk control measure) mitigates the risk of snagging post-construction, and the CBRA ensures these risks are adequately addressed for the types of gear used within the study area.

9. NAVIGATION RISK ASSESSMENT

9.1 INTRODUCTION

9.1.1.1.1 The NRA has been produced in accordance with MGN 654 and follows the IMO's FSA (see **Section 2.2.2**). The MGN 654 requires that the NRA contain a hazard log of shipping and navigation hazards caused or changed by the Project, which includes an assessment of risk with embedded controls (those controls designed and included in the Project which are commonly accepted as industry good practice – see **Section 4.9** for a list of embedded risk controls) in place, and an assessment of risk for the Project with possible additional risk controls (see **Section 9.8**) in place.

9.1.1.1.2 The development of the NRA, hazard log and associated risk scoring process is based on the following data, analysis, modelling and expertise of the NRA team:

- Project description (see Section 4)
- Overview of baseline environment (see Section 5)
- Description of existing marine activities (see Section 6)
- Future case vessel traffic profiles (see Section 7)
- Potential impact assessment (see Section 8)

9.1.1.1.3 In addition to above, a key component of the NRA is engagement with regulators and local stakeholders to confirm baseline shipping and navigation characteristics and elicit judgement on the levels of navigation risk with the Project in place.

9.1.1.1.4 The risk assessment methodology employed for the Project is the IALA SIRA process, which follows both the MCA MGN 654 guidance and is also endorsed by the IMO via SN.1/Circ.296 in December 2010. The following sections outline the:

- Overarching methodology of the risk assessment
- Details of the hazard workshops undertaken with stakeholders
- Process of hazard identification
- Results of the assessment of risk with the embedded risk controls (see **Section 4.9**) in place
- Possible additional risk control measures which may reduce risk to acceptable levels (see **Section 9.8**)
- The cumulative assessment of navigation risk posed by multiple projects proposed in the East Irish Sea (see **Section 10**)

9.1.1.1.5 The following assumptions apply to the hazard log and workshops:

- Operational scenario is 2035
- Construction scenario is 2028
- Embedded risk controls are included in the assessment of risk

- Possible additional risk controls are included in the assessment of risk
- The assessment is limited to the study area only

9.2 NRA METHODOLOGY

9.2.1.1.1 The assessment project methodology is based on the principles set out in IALA Guidelines 1018 and the IMO's FSA and is shown in **Figure 2**. Hazards are identified through, consultation and data analysis, before being assessed in terms of their likelihood and consequence. A risk matrix is utilised to identify the significance of each hazard with possible additional risk controls identified based on risk score to reduce the risks to acceptable levels. A description of the FSA process is as follows:

- **FSA Step 1: HAZID**: The NRA team identifies navigation hazards related to defined and agreed assessment parameters, such as geographic areas, marine operation, or vessel type. This is achieved using a suite of quantitative (e.g., statistical vessel traffic analysis) and qualitative (e.g. consultation with stakeholders) techniques which enables an evidentially robust identification of navigation hazards.
- **FSA Step 2: Risk Analysis:** A detailed investigation of the causes, including the initiating events, and consequences of the hazards identified in Step 1 is undertaken. This is completed using a risk matrix, and enables ranking of hazards based on navigation risk, and a determination of hazard acceptability tolerability. This process allows attention to be focused upon higher-risk hazards enabling identification and evaluation of factors which influence the level of risk.
- **FSA Step 3 & 4: Risk Controls Measures:** The identification of existing risk controls measures (which are assumed to be embedded in the assessment of navigation risk), and the identification of additional risk controls, not currently in place for the assessment parameters. Additional risk control measures are identified based on prioritising mitigation of higher-risk hazards. During this stage the risk control measures are grouped into a defined and thought-out risk mitigation strategies.
- **FSA Step 5: Findings:** The assessment findings are developed and documented into a technical report and then presented to the relevant decision makers in an auditable and traceable manner. The findings are based upon a comparison and a ranking of all hazards and their underlying causes; the comparison and ranking of risk control options as a function of associated costs

and benefits; and the identification of those risk control options which mitigate hazards to acceptable or ALARP.

9.2.1.1.2 The risk assessment process aims to ascertain risk levels and specify the requirement to apply possible additional control measures to mitigate risk to ALARP. The methodology consists of four aspects:

- Likelihood parameters (**Table 35**) – the expected frequency for which hazards occur, presented as a return rate per year. Five likelihood bands were chosen from between once in one year to once in less than 1000 years
- Severity parameters **(Table 36)** – the expected consequence of each hazard were it to occur. This has been scored separately for consequences to people (loss of life), environment (pollution), property (damage) and business (reputational/economic impacts)
- Risk matrix (**Table 37**) – based on the likelihood and each of the four severity scorings, risk scores were derived using a risk matrix
- Risk classification **(Table 38)** – based on the resulting risk score, the risk was classified from 'Negligible' and 'Acceptable' through to 'High Risk' and 'Unacceptable'

9.2.1.1.3 Having identified all relevant impacts and hazards as a result of the Project, a hazard log is constructed as described in MGN 654 Annex 1 (Annex D). Whilst there is no generally accepted standard for risk matrices, the following is proposed as suitable for the Project, meets IMO and IALA guidance, and is consistent with industry best practice.

9.2.1.1.4 Each hazard was scored for the likelihood of occurrence and expected consequence (in terms of people, property, environment, and business) for both "realistic most likely" and "realistic worst credible" occurrences. This is undertaken as the maritime industry has a range of hazard outcomes for the same hazards, with some hazards outcomes occurring frequently with low consequence (minor injuries or damage), and some outcomes of the same hazard occurring less frequently but with significantly higher consequence (loss of life/major pollution).

9.2.1.1.5 Severity of consequence with each hazard under both scenarios is considered in terms of damage to:

- People
- Property
- Environment
- Business

9.2.1.1.6 The combination of the frequency and consequence scores are then combined to produce a risk score (**Table 37**).

9.2.1.1.7 As such the assessment of risk is calculated eight times for each identified hazard; four times for the "realistic most likely" occurrence and consequence categories, and four times for the "realistic worst credible" outcome. An overall risk score is then calculated using an averaging function weighted to the highest risk score for the "realistic most likely" and the highest risk score for the "realistic worst credible". The weighted averaging calculation is an average of:

- Average of all the "realistic most likely" risk scores
- Average all the "realistic worst credible" risk scores
- Highest individual score from the "realistic most likely" scores
- Highest individual score from the "realistic worst credible" scores

9.2.1.1.8 The tolerability of overall risk scores with regards to significance and acceptability is then defined based on the parameters defined in **Table 37**. Overall hazard scores can be scored as either:

- Acceptable
- Tolerable – if As Low As Reasonably Practicable
- Unacceptable

9.2.1.1.9 This NRA, in considering and assessing navigation risk within the study area, assumes that vessels will be compliant with international legislation such as the COLREGS and Standards of Training, Certification and Watchkeeping for Seafarers (STCW)), and National regulations and Guidance (e.g. UK Merchant Shipping Act 1995, and MCA Marine Guidance Notes).

Table 35: Frequency of occurrence criteria

Rank	Definition	Description	Definition
1	Remote	Remote probability of occurrence within the study area and few examples in wider industry.	<1 occurrence per 1000 years
2	Extremely unlikely	Extremely unlikely to occur within the study area and has rarely occurred in wider industry.	1 per 100 – 1000 years
3	Unlikely	Unlikely to occur within the study area during Project lifecycle and has occurred at other OWFs.	1 per 10 – 100 years
4	Reasonably probable	May occur once or more during the Project lifecycle.	1 per 1 – 10 years
5	Frequent	Likely to occur multiple times during the Project lifecycle.	Yearly

Table 36: Severity of consequence categories and criteria

Rank		Description			
	Definition	People	Property	Environment	Commercial and Reputation
1	Negligible	Minor injury.	Less than £10,000	Minor spill no assistance required.	Minimal impact on activities.
2	Minor	Multiple minor injuries.	£10,000-£100,000	Tier 1 Local assistance required	Local negative publicity. Short term loss of revenue or interruption of services to ports/OWF/O&G/ferries and other marine users.
3	Moderate	Multiple major injuries.	£100,000-£1million	Tier 2 Limited external assistance required	Widespread negative publicity. Temporary suspension of activities to ports/OWF/O&G/ferries and other marine users.
4	Serious	Fatality.	£1million-£10million	Tier 2 Regional assistance required	National negative publicity. Prolonged closure or restrictions to ports/OWF/O&G/ferries and other marine users.
5	Major	Multiple fatalities.	>£10million	Tier 3 National assistance required	International negative publicity. Serious and long term disruption to ports/OWF/O&G/ferries and other marine users.

Table 37: Risk matrix

Risk Matrix							
Severity of Consequences	Major	5	5	10	15	20	25
	Serious	4	4	8	12	16	20
	Moderate	3	3	6	9	12	15
	Minor	2	2	4	6	8	10
	Negligible	1	1	2	3	4	5
			1	2	3	4	5
			Remote	Extremely Unlikely	Unlikely	Reasonably Probable	Frequent
			Frequency Occurrence				

Table 38: Tolerability and risk ratings

Hazard Risk Score	Hazard Risk Rating	Tolerability	Description
0 – 4	Negligible Risk	Broadly Acceptable	Generally regarded as not significant and adequately mitigated. Additional risk reduction should be implemented if reasonably practicable and proportionate
4.1 – 6	Low Risk		
6.1 – 12	Medium Risk	Tolerable (if ALARP)	Generally regarded as within a zone where the risk may be tolerable in consideration of the Project. Requirement to properly assess risks, regularly review and implement risk controls to maintain risks to within ALARP where possible.
12.1 – 20	High Risk	Unacceptable	Generally regarded as significant and unacceptable for Project to proceed without further review.
20.1 – 25	Extreme Risk		

9.3 HAZARD WORKSHOP

9.3.1.1.1 The first hazard workshop was held in Liverpool on the 10 October 2022. This workshop informed the Project NRA and PEIR that was published for statutory consultation in April 2023. It was attended by representatives from ferry operators, regulators, commercial bodies, oil and gas and the fishing community. The hazard workshop process was undertaken as follows:

- Development of a draft initial hazard log by the NASH Project team
- Identification of shipping and navigation stakeholders, made up of statutory regulators and local users and determination of workshop dates to maximise attendance

- Provision of detailed pre-read information related to the Projects, baseline vessel traffic and an assessment of likely changes brought about by the Projects as well as the draft hazard log
- A pre-hazard workshop webinar to review the collated data, NRA methodology and the draft hazard log (conducted on 3 October 2022)
- At the workshop:
- The Project team introduced the material and methodology.
- Each hazard was reviewed in turn, with each attendee invited to discuss amongst their tables and score their personalised hazard log. Stakeholders were encouraged to fill out the comments section of each hazard to provide a higher level of description regarding their scores.
- Each hazard score was then reviewed as a group with differences in scoring discussed, before a consensus was sought.
- Once each hazard discussion had come to a close, the summary spreadsheet was 'locked' to capture the concluding scores of the discussion.
- Risk controls were reviewed and appropriate additional risk controls discussed.
- Update of hazard risk scores based on the findings of the hazard workshop for inclusion in the NRA.

9.3.1.1.2 Following the Project windfarm boundary change post-PEIR, a second hazard workshop was held in Liverpool on the 29 September 2023. This workshop followed an identical structure and methodology to the first workshop and was attended by many of the same stakeholder groups and included representatives from ferry operators, regulators, commercial bodies, oil and gas, ports, fishing community and recreational users. The second workshop informed the findings presented in this NRA.

9.3.1.1.3 A full summary of both workshops is available in **Appendix C**.

9.4 HAZARD IDENTIFICATION

9.4.1.1.1 This assessment considers all identified hazards of the Project on shipping and navigation receptors. In developing the hazard log, consideration was given to Project phases, areas, hazard types and vessel types.

9.4.1.1.2 Five hazard types were identified and are detailed in **Table 39**.

Table 39: Hazard types

Hazard #	Hazard Types	Definition
1	**Collision**	Collision between two vessels underway (also includes striking of an anchored or moored vessel)
2	**Allision (Contact)**	Vessel makes contact with Fixed or Floating Object (FFO) (e.g. WTGs/substation / O&G Installation etc.)
3	**Grounding**	Vessel makes contact with the seabed/shoreline or underwater assets
4	**Snagging**	Vessel fishing gear or anchor snags a subsurface hazard (e.g. Inter-Array Cabling or other sub-surface infrastructure)
5	**Vessel Emergency**	Emergency onboard vessel that requires SAR response. This could include fire, explosion, flooding or capsize

9.4.1.1.3 For the purpose of the NRA, seven vessel types were identified as described in **Table 40**. Given the excessive number of combinations of vessel types for collision hazards, vessel types 3, 4, 5 and 6 have been grouped and defined as 'Small Craft' for some hazard types. This reflects the broadly similar consequences that could be expected following an incident, whilst maintaining a manageable number of hazards.

Table 40: Vessel type definitions

Vessel #	Vessel Types / Receptors	Includes
1	Ferry & Passenger	Passenger Ferry Freight Ferry Cruise Ship
2	Cargo & Tanker	Cargo (Container, Bulk, Reefer, General etc.) Tanker (Oil, Chemical etc.)
3	Tug & Service[11]	Tugs Offshore Supply Vessels Standby Rescue Vessels Pilot Boats Non-Morecambe OWF Crew Transfer Vessels SAR Vessels Other Service Vessels
4	Fishing[9]	Trawlers Fishing Boats
5	Recreational[9]	Yachts Pleasure Boats Motor Cruisers

[11] Vessel ID 3, 4, 5, 6 are grouped together for some hazards and defined as "Small Craft".

Vessel #	Vessel Types / Receptors	Includes
6	Small Project[9]	Morecambe OWF Crew Transfer Vessels Morecambe OWF Survey Vessels Other Morecambe OWF workboats
7	Large Project	Jack-up Barges Cable Layer Heavy Lift Vessels

9.4.1.1.4 Three areas were identified for the risk assessment and are summarised in **Table 41**.

Table 41: Risk assessment areas

Area #	Areas	Detail
1	Windfarm Site	Within the windfarm site
2	Windfarm Site + 10nm	Within the study area
3	Route from O&M Base and windfarm site	Route between O&M base and windfarm site used by Morecambe OWF Project vessels (O&M base assumed to be Heysham / Barrow)

9.4.1.1.5 Three Project phases were identified for the risk assessment:

- Construction – defined as “C” in the hazard logs
- Operation and Maintenance – defined as “O” in the hazard logs
- Decommissioning – defined as “D” in the hazard logs

9.4.1.1.6 In total, 23 hazards were identified which are summarised in **Table 42**.

Table 42: Hazard identification

Hazard Id #	Project Phase	Hazard Type	Hazard Title
1	C/O/D	Collision	Collision: Ferry & Passenger ICW. Cargo & Tanker or other Ferry & Passenger
2	C/O/D	Collision	Collision: Cargo & Tanker ICW. Other Cargo & Tanker
3	C/O/D	Collision	Collision: Ferry & Passenger or Cargo & Tanker ICW. Small Craft
4	C/O/D	Collision	Collision: Small Craft ICW. Small Craft
5	C/D	Collision	Collision: Large Project ICW. Ferry & Passenger or Cargo & Tanker
6	C/D	Collision	Collision: Large Project ICW. Small Craft
7	C/O/D	Allision	Allision: Ferry & Passenger
8	C/O/D	Allision	Allision with OWF: Cargo & Tankers

Hazard Id #	Project Phase	Hazard Type	Hazard Title
9	C/O/D	Allision	Allision: Tug & Service
10	C/O/D	Allision	Allision: Fishing
11	C/O/D	Allision	Allision: Recreational
12	C/D	Allision	Allision: Large Project
13	C/O/D	Allision	Allision: Small Project
14	C/O/D	Snagging	Snagging: Fishing
15	C/O/D	Snagging	Snagging: Recreational
16	C/O/D	Snagging	Snagging: Ferry & Passenger & Cargo & Tanker
17	C/O/D	Snagging	Snagging: Large Project, Small Project and Tug & Services.
18	C/O/D	Collision	Collision: Small Project ICW. Ferry & Passenger, Cargo & Tanker
19	C/O/D	Collision	Collision: Small Project ICW. (Other) Small Craft
20	C/O/D	Allision/ Grounding	Allision/Grounding: Small Project
21	C/O/D	Vessel Emergency	Vessel Emergency - Ferry & Passenger, Cargo & Tanker and Large Project
22	C/O/D	Vessel Emergency	Vessel Emergency - Small Craft
23	C/O/D	Allision	Allision with O&G Infrastructure: Cargo & Tankers

9.5 KEY STAKEHOLDER NAVIGATION CONCERNS

9.5.1.1.1 At the hazard workshops, stakeholders were invited to describe their key concerns regarding the Project. These are summarised in **Table 43**.

Table 43: Key stakeholder navigation concerns identified in the first (2022) hazard workshop - (*) indicates whether concern has been mitigated or reduced between the first workshop and second (2023) hazard workshop due to Project changes

Organisation	Concerns
Isle of Man (IoM) Steam Packet Company	• Increase in WFSV traffic may impact Heysham-Douglas route. • Concern about condensing traffic into the 'corridor' between the north of windfarm site and WODS Windfarm.* • Southwest corner of windfarm site impacts Liverpool-Douglas route and reduces sea room - will increase collision and allision risk.* • Windfarm site minimises the adverse weather route options for Manannan.* • Radar interference from the turbines – may obscure WFSVs exiting the windfarm site.
Seatruck Ferries	• Heysham-Liverpool route may have higher likelihood of collision with inshore vessels e.g. fishing or recreational. • Concentrating traffic into the 'corridor' between the north of windfarm site and WODS Windfarm.*
Stena Line	• Commercial impact of ferry route deviation around the windfarm site.* • Southwest corner of windfarm site impacts Liverpool-Belfast (east of IoM) route and reduces sea room – will increase collision and allision risk.* • Morecambe construction phase will overlap with the O&G decommissioning phase - will increase service vessel traffic in 'corridor' between the north of the windfarm site and WODS Windfarm. • Radar interference from the turbines (particularly at night and in poor visibility) – may obscure WFSVs exiting the windfarm site.*

Organisation	Concerns
Maritime Coastguard Agency	• Increased traffic density in the 'corridor' between the north of the windfarm site and WODS Windfarm, and at the southwest corner of the windfarm site. Will increase risk profile.*
IoM Department of Infrastructure	• Echoes what was said by the ferry operators.*
Fisheries Liaison Officer	• If the cod quota is increased (albeit this hasn't been done in the last 15 years), there will be an increased amount of beam trawler traffic and fishing activity in the Morecambe windfarm site.
UK Chamber of Shipping	• Morecambe construction phase will overlap with the O&G decommissioning phase. This may considerably increase the amount of service vessel traffic in the region. • Increased risk of tanker and cargo collision and/or allision at southwest corner of the windfarm site. This risk may be further increased by radar interference from the turbines (particularly at night and in poor visibility) – may obscure WFSVs exiting the windfarm site.*
Spirit Energy	• Traffic will be displaced to the north of the windfarm site, toward existing O&G infrastructure. • Reduced collision detection and less able to see traffic coming from the west. • O&G service vessels transiting through the windfarm need access routes. • O&G decommissioning vessels are large (up to 300m) and difficult to manoeuvre with challenging angles of approach (possibly through the windfarm).

9.6 HAZARD SCORING

9.6.1.1.1 The identified hazards were assessed by the NRA team and a draft hazard log was prepared and presented at the workshop. The draft hazard log was then refined based on the findings of the hazard workshops for which stakeholders were invited to attend and score hazards (see **Appendix C** for more details).

9.6.1.1.2 It should be noted that the embedded risk controls as described in **Section 4.9** and summarised in **Table 12,** are considered as being in place in the baseline assessment of risk.

9.7 HAZARD RESULTS

9.7.1.1.1 **Table 44** summarises the result of the risk assessment for the 23 hazards identified. In total:

- 16 hazards were assessed as Medium Risk – Tolerable (if ALARP)
- 4 hazards were assessed as Low Risk – Broadly Acceptable
- 3 hazards were assessed as Negligible Risk – Broadly Acceptable

9.7.1.1.2 Those hazards assessment as “Medium Risk”, can only be considered Tolerable if they are assessed as being as low as reasonably practicable - ALARP. The determination of ALARP can only be made once all possible additional risk control measures are identified and applied to relevant hazards and a determination of risk control effectiveness made in regard to cost.

9.7.1.1.3 The full hazard log is available in **Appendix D**.

Table 44: Hazard summary list

ID	Baseline Rank	Phase	Area	Hazard Title	Score	Rating
23	1	C/O/D	Windfarm Site + 10nm	Allision with O&G Infrastructure: Cargo & Tankers	9.8	Medium Risk - Tolerable (if ALARP)
3	1	C/O/D	Windfarm Site + 10nm	Collision: Ferry & Passenger or Cargo & Tanker ICW. Small Craft	9.8	Medium Risk - Tolerable (if ALARP)
5	3	C/D	Windfarm Site + 10nm	Collision: Large Project ICW. Ferry & Passenger or Cargo & Tanker	9.2	Medium Risk - Tolerable (if ALARP)
2	4	C/O/D	Windfarm Site + 10nm	Collision: Cargo & Tanker ICW. other Cargo & Tanker	8.9	Medium Risk - Tolerable (if ALARP)
18	5	C/O/D	O&M Route	Collision: Small Project ICW. Ferry & Passenger, Cargo & Tanker	8.8	Medium Risk - Tolerable (if ALARP)
8	6	C/O/D	Windfarm Site + 10nm	Allision: Cargo & Tankers	8.7	Medium Risk - Tolerable (if ALARP)
1	7	C/O/D	Windfarm Site + 10nm	Collision: Ferry & Passenger ICW. Cargo & Tanker or other Ferry & Passenger	8.4	Medium Risk - Tolerable (if ALARP)
7	8	C/O/D	Windfarm Site + 10nm	Allision: Ferry & Passenger	8.1	Medium Risk - Tolerable (if ALARP)
9	9	C/O/D	Windfarm Site + 10nm	Allision: Tug & Service	7.8	Medium Risk - Tolerable (if ALARP)
21	9	C/O/D	Windfarm Site + 10nm & O&M Route	Vessel Emergency - Ferry & Passenger, Cargo & Tanker and Large Project	7.8	Medium Risk - Tolerable (if ALARP)
4	11	C/O/D	Windfarm Site + 10nm	Collision: Small Craft ICW. Small Craft	7.6	Medium Risk - Tolerable (if ALARP)

ID	Baseline Rank	Phase	Area	Hazard Title	Score	Rating
22	12	C/O/D	Windfarm Site + 10nm & O&M Route	Vessel Emergency - Small Craft	7.4	Medium Risk - Tolerable (if ALARP)
6	13	C/D	Windfarm Site + 10nm	Collision: Large Project ICW. Small Craft	7.4	Medium Risk - Tolerable (if ALARP)
19	14	C/O/D	O&M Route	Collision: Small Project ICW. (Other) Small Craft	6.7	Medium Risk - Tolerable (if ALARP)
10	15	C/O/D	Windfarm Site + 10nm	Allision: Fishing	6.6	Medium Risk - Tolerable (if ALARP)
14	16	C/O/D	Windfarm Site	Snagging: Fishing	6.4	Medium Risk - Tolerable (if ALARP)
12	17	C/D	Windfarm Site + 10nm	Allision: Large Project	4.9	Low Risk - Broadly Acceptable
13	18	C/O/D	Windfarm Site + 10nm	Allision: Small Project	4.8	Low Risk - Broadly Acceptable
20	18	C/O/D	O&M Route	Allision / Grounding: Small Project	4.8	Low Risk - Broadly Acceptable
17	20	C/O/D	Windfarm Site	Snagging: Large Project, Small Project and	4.6	Low Risk - Broadly Acceptable
16	21	C/O/D	Windfarm Site	Snagging: Ferry & Passenger & Cargo & Tanker	4.1	Negligible Risk - Broadly Acceptable
11	22	C/O/D	Windfarm Site + 10nm	Allision: Recreational	3.8	Negligible Risk - Broadly Acceptable
15	23	C/O/D	Windfarm Site	Snagging: Recreational	3.5	Negligible Risk - Broadly Acceptable

9.7.1.1.4 The highest scoring hazard relates to a cargo vessel or a tanker being involved in an allision with the oil and gas infrastructure in the study area. This hazard has an overall risk score of 9.8 which means it is classed as a 'Medium' risk. Based on discussion with current O&G operators allision risk in the basecase is a concern, and detailed mitigation measures are currently in place for each installation based on safety cases. This hazard was considered to have high consequences for both the worst credible and most likely scenarios but, given the embedded risk control measures that are applicable, is judged to have a low frequency of occurrence. The basis for this hazard is that the windfarm site will constrain the navigable area in the vicinity of the oil and gas infrastructure which may increase the vessel density and the risk of allision. However, the number of vessels deviated is low and the vessels are deviated from a course (currently passing through the windfarm site) that already takes them close to O&G installations. Additionally, it is likely that fewer O&G structures would be in place as decommissioning is understood to be planned before the Project would be operational.

9.7.1.1.5 The second highest scoring hazard is a collision of a ferry, passenger, cargo or tanker – commercial vessels with small craft, during construction, operation and maintenance, or decommissioning, which has an overall risk score of 9.8/25 and scores as "Medium" risk. It should be noted that in the context of the windfarm site, it is anticipated that commercial vessels passing would do so at a safe distance of up to 1.5nm, and that with the low level of recreational and fishing vessels in the area, this hazard predominately relates to windfarm site related vessels such as WFSV, CTV's, and oil and gas associated supply ships and standby safety vessels, which will be transiting to and from northwest England ports, and therefore collision risk would be predominantly present when on transit to/from the windfarm site to the north/west of the windfarm site.

9.7.1.1.6 Large Project vessels in collision with ferry, passenger, cargo and tanker vessels during construction, operation and maintenance, or decommissioning, was ranked three and scored as "Medium" risk. At this stage of the Project, the details of the Large Project vessel movements are not well defined, though it is anticipated that these vessel types will navigate in accordance with national and international conventions and, whilst engaged with the construction, will be subject to the embedded risk controls measures for construction.

9.7.1.1.7 Collision between a cargo vessel or tanker with another cargo vessel or tanker was ranked as the fourth highest hazard with a 'Medium' risk. The level of risk associated with this hazard is due to the frequency of transits of these types of vessels through the study area and the level of consequences which may occur if two larger commercial vessels were to collide. The presence of the Project displaces some of the current cargo vessel and tanker routeing which will increase density of other routes affecting this hazard.

9.7.1.1.8 Collision of a small Project vessel with a commercial vessel (ferry, passenger, cargo, tanker) received a score of 8.8/25 'Medium' risk which makes it the fifth ranked hazard. At this stage of the Project, the operation and maintenance port has not been confirmed, however, the small Project vessels will be using similar routes to commercial vessels in some areas and crossing routes in others to approach the windfarm site. When navigating close to the windfarm site, there is potential for commercial vessels to not identify Project craft leaving the site, due to the WTG affecting radar and line of sight, leading to a close quarters situation. Therefore, this risk is predominantly present adjacent to the windfarm site.

9.8 ADDITIONAL RISK CONTROL OPTIONS

9.8.1.1.1 During the hazard workshop in 2022, a number of potential, additional risk control options were identified, which could reduce the risk scores further and their effectiveness discussed. The possible additional risk controls relevant to the Project which have been adopted and now included as embedded risk control measures, as listed in **Section 4.9,** are presented in **Table 45**.

9.8.1.1.2 The additional risk controls were reviewed with all stakeholders at the second hazard workshop in September 2023 and no further additional risk controls were identified as being required for the Project with agreement from the stakeholders attending the workshop. This means that where risks are scored as Medium, they can be considered to be ALARP and therefore Tolerable.

Table 45: Adopted additional risk control options since PEIR (embedded controls informing the NRA)

ID	Title	Description
1	Layout Design	To increase manoeuvring space and reduce impact on operators, revision of project boundaries could include: • Realignment of Morecambe western boundary to minimise impact to passage plan routes of ferries and commercial vessels, minimise course changes for vessels navigating north south.
2	Site Layout	Project commitment to two lines of orientation to support internal navigation and SAR.
3	CTV Passage Planning	Develop coordinated passage plans for CTVs that minimises impact on other traffic, could include: • Specified passage plans; • Agreed passing protocols/CPA for interactions with commercial shipping (e.g. no crossing within 5nm ahead of commercial vessel underway); • Reporting protocols to be established prior to crossing corridors; • Dissemination of passage plans and operations to regular runners and ferry services; and • Restricted visibility protocols.
4	Continued Engagement	Maintain the MNEF to facilitate information sharing and management/identification of additional risk controls: • Identify near misses and investigate incidents, disseminating learnings. • Coordinate construction activities.
5	Recreational/Fishing Liaison	Ensure nominated persons are able to coordinate and communicate project activities to recreational and fishing user groups. This includes during specific events (regattas).

9.8.1.1.3

10. CUMULATIVE ASSESSMENT

10.1 INTRODUCTION

10.1.1.1.1 During early consultation for the Project, stakeholders raised concerns regarding the cumulative impacts of the Morecambe Offshore Windfarm Generation Assets, the Morgan Offshore Wind Project Generation Assets and the Mona Offshore Wind Project (the 'Projects'). In particular, it was noted that the presence of all three Projects would result in corridors between them that had greater impacts on navigation safety and commercial operations than each Project would have in isolation.

10.1.1.1.2 In reference to this, the developers (Morecambe Offshore Windfarm Ltd, Morgan Offshore Wind Project Ltd and Mona Offshore Wind Project Limited) commissioned a joint CRNRA. The aim of the CRNRA was to assess cumulative risk and enable stakeholders to engage with and understand the potential effects of the proposed Projects. This assessment involved undertaking an NRA in compliance with guidance, undertaking vessel traffic analysis and modelling, consultation with operators and regulators, full bridge navigational simulations and a hazard workshop. Adopting a regional (collaborative) approach to assessment enabled individual Projects to quantify and manage the cumulative impacts in a coordinated, consistent and efficient manner. This was undertaken at an earlier stage in the assessment than usual, to ensure that the potential impacts of all three schemes are understood as early in the process as possible.

10.1.1.1.3 The objectives of the CRNRA were tailored to address stakeholder concerns, namely, the formation of routes between the three array (windfarm site) areas during the operation and maintenance phases of the projects. Other cumulative impacts associated with different project phases were not directly considered within the CRNRA but it was concluded that this did not undermine the assessment. The potential impacts of the construction and decommissioning phases are assessed within the Environmental Statement chapters for the respective projects and are largely consistent with operational impacts given the necessary exclusion of traffic from the construction areas.

10.1.1.1.4 The shipping and navigation study area of the CRNRA is defined as the region of the east Irish Sea bounded by the Isle of Man to the northwest and the Welsh and English coasts to the south and east respectively (**Figure 59**). The CRNRA assumed the consenting and construction/operation of the Awel-y-Mor Offshore Wind Farm and decommissioning of some oil and gas structures (DP3 and DP4 from the South Morecambe gas field).

10.1.1.1.5 The CRNRA was initially undertaken to accompany and inform the PEIR assessments for the Projects, informed by vessel traffic analysis and modelling, consultation with operators and regulators, bridge navigational simulations and a hazard workshop undertaken in October 2022.

10.1.1.1.6 The initial CRNRA that accompanied the PEIRs concluded that there was insufficient searoom between the three windfarm sites for safe navigation and therefore unacceptability high risks would result. In particular, collision risk was shown to be high for ferries in collision with other large commercial vessels and with small craft operating between the windfarm sites. Furthermore, it was concluded that the Projects would necessitate appreciably large deviations during normal and adverse weather conditions to impact on operator schedules and timetables.

10.1.1.1.7 Following review of these findings and Section 42 PEIR consultation responses received, all three Projects made commitments to address these impacts, particularly through changes to site boundaries and increasing the lines of orientation (see **Section 4.9** and **Figure 59**).

10.1.1.1.8 The CRNRA was updated to account for these changes made by the Projects through additional data collection, navigation simulations and a further hazard workshop in September 2023. The results of this updated CRNRA informs the Project Environmental Statement. The Morgan and Morecambe Offshore Wind Farms Transmission Assets, including possible offshore booster station search areas associated with the Morgan export cable corridor, unknown at the time of the initial CRNRA, were also included as a further project as part of the updated CRNRA.

10.1.1.1.9 The results of the updated CRNRA are outlined in Appendix 14.2 Cumulative Regional Navigational Risk Assessment (Document Reference 5.2.14.2) and summarised in **Section 10.2** below.

10.1.1.1.10 Immediately prior to finalisation of the CRNRA, a Scoping Report was issued in October 2023 for the Isle of Man OWF, named as Mooir Vannin OWF (Mooir Vannin OWF, 2023). At the time of assessment there was insufficient information available to include this project within the main assessment of the CRNRA (which was undertaken prior to the issuance of the Scoping Report). However, ongoing liaison between the Projects and Mooir Vannin Offshore Wind Farm Limited provided some preliminary information which has been used to prepare an Addendum to the CRNRA, which considers the additional cumulative effects were the Mooir Vannin OWF to be developed.

10.2 SUMMARY OF CUMULATIVE IMPACTS

10.2.1 Potential impacts of Projects

10.2.1.1.1 An assessment of the potential impacts of the Projects on recognised sea lanes essential to international navigation determined that access to the TSSs in the CRNRA study area would be maintained.

10.2.1.1.2 The CRNRA noted additional cumulative impacts on ferry routeing above those described in **Section 8.2**.

10.2.1.1.3 With regards to the IoMSPC routes, minor deviations of less than two minutes would be required in normal conditions to pass clear of both the Mona and Morgan windfarm sites. During adverse weather, the presence of the Mona windfarm site would impact upon the Liverpool to Douglas route, increasing transit time by a further 13 minutes, a total delay of at least 23 minutes. The Morgan windfarm site would impact upon on the Heysham to Douglas route, increasing transit time by a further 24 minutes on top of an existing delay of between 10 and 23 minutes.

Neither adverse weather route is substantially impacted by the various Projects collectively, as opposed to the impacts of the Project in isolation.

10.2.1.1.4 With regards to the Seatruck routes between Heysham and Ireland, the presence of the Mona and Morgan windfarm sites would compress traffic through the gap between these sites. The impact on the Heysham to Dublin route was negligible and on the Heysham to Warrenpoint route, a deviation of less than five minutes would be required. During adverse weather routeing, which typically occurs further west at present, the impacts would be minor.

10.2.1.1.5 With regards to the Stena routes between Liverpool and Belfast, the route to the west of the Isle of Man would be impacted by the Mona windfarm site, and the route east of the Isle of Man would be impacted by the Morgan windfarm site and Morecambe windfarm site. The passage to the east of the Isle of Man would necessitate a route around both the Morecambe windfarm site and the Morgan windfarm site. The additional distance and service speed would result in approximately 13 to 16 minutes of additional transit time under normal conditions dependent on which route through the Morecambe gas field had previously been taken. During adverse weather for routes to the east of the IoM an additional detour into the prevailing weather around the south and west of the Mona windfarm site would necessitate an additional 70 minutes of transit between projects, likely making the east of the Isle of Man route less favourable.

10.2.1.1.6 The potential presence of the Morgan Offshore Wind Project's booster station at the most westerly portion of the search areas would have a minimal impact on navigation safety but may increase the deviation of Stena Lines Liverpool to Belfast route were they to go east of the Isle of Man.

10.2.1.1.7 Impacts on the P&O route between Liverpool and Dublin were assessed as negligible, given that they pass clear of all four Projects.

10.2.1.1.8 The CRNRA concluded that the cumulative impacts of the four Projects on ferry passage planning in normal weather conditions was minor, given the total transit time, existing variation in timetables and turnaround times in port was significantly greater than the necessary deviations around the Projects. However, during infrequent adverse weather, the additional deviations around the Projects to maintain safe transit would increase schedule impacts by between 13 and 70 minutes (dependent on route). This is likely to result in increased delays and cancellations of services.

10.2.1.1.9 The impacts on cargo/tanker vessel routeing were less than those of ferries. The principal routes in the Irish Sea into Liverpool would route to the southwest of the Mona Project and impacts to less trafficked cargo/tanker routes were assessed in a similar manner between the individual assessment and cumulative assessments (**Section 8.3**). Minor cargo/tanker routes with less than one vessel a day would be deviated between the Projects, but the increase in distance would not be large given the length of voyages these vessels undertake.

10.2.1.1.10 The impacts on small craft routeing would be greater where their activities are offset from the windfarm sites were they to choose not to navigate through the windfarms. However, the spacing between wind turbines in the Projects is likely to be sufficient to enable safe internal navigation by small craft.

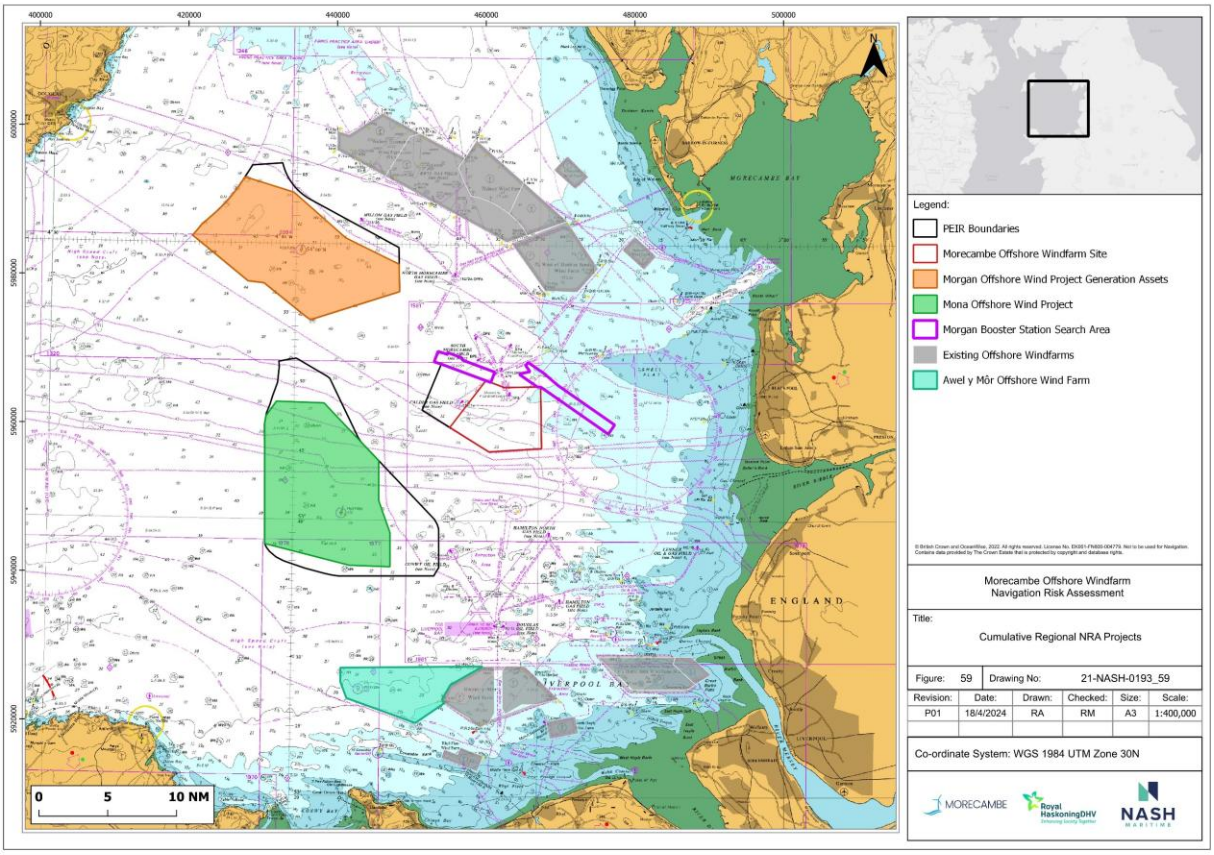


Figure 59: Cumulative projects, showing changes in boundaries of Projects since PEIR

10.2.2 Navigation safety

10.2.2.1.1 It was noted that the presence of the Projects increased the constraint on routes between them, but that each route was of sufficient width to meet both MCA and PIANC guidance, even following sensitivity analysis with greater vessel numbers:

- Mona windfarm site and Morgan windfarm site corridor at 6nm wide by 5.5nm in length
- Mona windfarm site and Morecambe windfarm site corridor at 5.7nm wide by 5.0nm in length
- Morgan windfarm site and Walney windfarm site corridor at between 4.4nm and 5.3nm wide by 11.5nm in length

10.2.2.1.2 Analysis of vessel concurrency demonstrated that, with the exception of the route south of the Mona windfarm site, the likelihood of two commercial vessels meeting between the Projects was relatively low (<25% of transits). The likelihood of two or more commercial vessels was less than 3% for the route between Mona and Morgan Array Areas and less than 1% for the routes between Morgan Array Area and Walney OWF, and Mona and Morecambe Array Areas. Whilst there was shown to be an increase in meeting situations, this was not judged to be significant.

10.2.2.1.3 Through the additional navigation simulation sessions conducted in 2023 with the Irish Sea ferry companies, the amendments to the site boundaries of the Projects was tested. It was concluded that collision risk whilst navigating between and around the Projects was manageable with existing operational procedures in complex, worst credible traffic situations. Vessels could maintain desired CPAs from other vessels and structures.

10.2.2.1.4 Other impacts such as to emergency response, visual navigation, shipboard equipment, and oil and gas activities are largely consistent with the findings contained within the Morecambe Project NRA (see **Section 9**).

10.2.3 Summary of the CRNRA Hazard Workshop

10.2.3.1.1 The second hazard workshop held in September 2023 to inform the Environmental Statement was attended by representatives from ferry operators, regulators, commercial bodies, oil and gas operators, ports and fishing community.

10.2.3.1.2 During this hazard workshop (which considered embedded risk controls, including the boundary and other changes made by the Projects since PEIR), a consensus was reached that all hazards were either Medium Risk – Tolerable if ALARP or Low Risk – Broadly Acceptable. To derive the final scores for the CRNRA, the findings of the workshop (including hazard scoring by stakeholders) were considered with the analysis and wider assessment undertaken by the NASH Project team.

10.2.4 Key findings of the CRNRA

10.2.4.1.1 The CRNRA concluded that following the changes to the Morecambe, Mona and Morgan site boundaries post-PEIR, all hazards associated with the Projects have been reduced to either Medium Risk – Tolerable if ALARP or Low Risk - Broadly Acceptable. Whilst it was recognised that the construction of the Projects in otherwise navigable waters would increase the risks of collision and allision for navigating vessels, a consensus was reached with stakeholders during the hazard workshop that these risks were not unacceptable. In particular, the increase in searoom between the OWFs provides sufficient space for vessels to safely manoeuvre in complex realistic traffic situations and adverse weather in full compliance with the COLREGs and the practice of good seamanship.

10.2.4.1.2 Whilst additional risk control measures were identified, some of these (such as ship routeing or emergency towing vessels) were not adopted as it was concluded they were disproportionate to the risk reduction they may achieve and therefore all hazards could be determined to be ALARP without the need for additional mitigation. Therefore, the CRNRA concluded that all Medium Risks can be considered ALARP and therefore Tolerable and that no further risk controls are warranted.

10.2.4.1.3 Due to the release of the Scoping Report for the Mooir Vannin OWF in October 2023, after the completion of many of the activities undertaken to inform the CRNRA, an addendum to the CRNRA was prepared to consider the additional cumulative risks that might result to vessel traffic identified within the CRNRA

(**Appendix D** of the CRNRA). It was concluded that with the addition of Mooir Vannin OWF, there were likely to be impacts on ferry routes in typical and adverse conditions and unacceptable risk to navigation safety between the Morgan Array Area, Walney OWFs and the Mooir Vannin OWF. Given the location of Mooir Vannin OWF, the Project is not considered to contribute to these further impacts.

11. CONCLUSIONS AND RECOMMENDATIONS

11.1 CONCLUSIONS

11.1.1.1.1 The NRA has been conducted in compliance with all relevant legislation, policy and guidance (**Section 2 and 3**).

11.1.1.1.2 The NRA is an update to the NRA which accompanied the Project PEIR. The update accounts for changes to the Project design made following PEIR findings and consultation responses made in relation to cumulative shipping and navigation impacts. These design changes were principally the realignment of the western boundary of the Project site and a layout commitment to two lines of orientation, which were considered along with other embedded risk controls (**Section 4.9**).

11.1.1.1.3 The Project windfarm site would account for up to 35 wind turbines and up to two offshore substation platforms within the eastern Irish Sea, plus associated inter-array and platform link cabling.

11.1.1.1.4 The study area has predominately southwesterly wind and wave conditions (**Section 5.2**). Mean spring tidal current speeds of 0.45-0.75m/s (0.87-1.46kts) occur at the windfarm site on a flood tide and 0.45-0.60m/s (0.87-1.17kts) on an ebb tide. Reduced visibility might occur up to 43 days/year dependent on location within the study area.

11.1.1.1.5 SAR facilities, including RNLI stations and helicopter stations are located immediately adjacent to the study area throughout the Welsh, English and Isle of Man coastlines (**Section 5.6**).

11.1.1.1.6 The study area includes numerous AtoNs, and there are extensive existing activities including oil and gas, offshore wind, aggregate extraction and disposal (**Section 5.7**).

11.1.1.1.7 Analysis of historical vessel traffic data (**Section 6**) identified:

- Vessels of >200m pass through the windfarm site, these are predominately ferries. There are service vessels of <200m in length which pass through the windfarm site.
- Commercial cargo and tanker shipping predominately passes southwest/northeast and northwest/southeast through the windfarm site into Heysham/Barrow and Port of Liverpool, respectively. Routes within the wider study area pass north and south of the windfarm site. Routes are low frequency with <1 vessel/day.
- Ferry routes intersecting the study area are between Liverpool-Belfast/Dublin and Liverpool-Douglas, or between Heysham-Douglas and Heysham Dublin/Warrenpoint. Cruise ship transits also occur, to a lesser extent, between Douglas and Liverpool.

- Recreational vessel traffic is concentrated along the coast, particularly along the entrance to Liverpool, and around Holyhead, Douglas and Rhyl. Cruising routes exist between Liverpool and Isle of Man and Heysham and the Welsh coast.
- Service vessels associated with existing OWFs and oil and gas infrastructure account for a large proportion of vessel movements within the study area.
- Fishing activity in the study area primarily by vessels using static gear from ports in Wales and Fleetwood, with very little trawling activity. Some fishing vessels are engaged in guard vessel duties or other survey works and account for some of the concentrations around oil and gas installations.
- Analysis of adverse weather routeing demonstrates that passenger vessels deviate from their usual routes to west of the study area (**Section 6.4.13**).
- Anchoring or loitering within the study area is at non-charted anchorage areas, notably around oil and gas infrastructure south of the windfarm site. No anchoring activity is evident within the windfarm site (**Section 6.4.15**).

11.1.1.1.8 Analysis of historical incident data identified that the majority of incidents within the study area occurred inshore, and adjacent to the approaches to the key ports (**Section 6.5**). There were four minor incidents recorded within the windfarm site involving fishing, recreational and service vessels. Analysis of incidents at other OWFs around the UK show that most accidents involve Project vessels contacting wind turbines or having incidents in transit between the arrays and O&M base.

11.1.1.1.9 An assessment of the future traffic profile within the study area (**Section 7**) determined that an increase in commercial vessel numbers of 15% by 2035 would be a reasonable assumption. There was little evidence of large changes to recreational or fishing vessel numbers. It is anticipated that oil and gas decommissioning will reduce vessel numbers, although there is uncertainty around the timing at which this would occur.

11.1.1.1.10 An assessment of the impacts of the Project on ferry vessel routeing determined that there would be necessary deviation of some IoMSPC (Liverpool to Douglas) and Stena Line (Liverpool to Belfast (East of IoM, east of Calder)) routes around the windfarm site. Basecase passage plans for both operators pass clear of the windfarm site. However, a small proportion of transits in 2019 and 2022 intersected the location of the windfarm site. Futurecase passage plans indicate that the Stena Line route between Liverpool/Belfast passing east of Isle of Man (east of Calder) is the only route affected adding an additional distance of 1.6nm.

11.1.1.1.11 During adverse weather, the assessment determined that Stena and IoMSPC routes tend to transit to the southwest of the study area, towards the prevailing conditions and are therefore unaffected by the Project.

11.1.1.1.12 An assessment of the impacts on small craft routeing determined that there is sufficient spacing between turbines to facilitate safe navigation for fishing and recreational craft. There may be some effect of offsetting these vessels into adjacent channels where vessel choose not to do so.

11.1.1.1.13 An assessment of the impacts of the Project on the likelihood of collision and allision for commercial vessels showed remote return periods, which is due to the generally low levels of vessel traffic in the study.

11.1.1.1.14 The Project has committed to two lines of orientation to facilitate SAR access. The layouts of the Project will be further assessed to ensure compliance with obligations for continued access for SAR assets.

11.1.1.1.15 Impacts to radar are inherent when navigating adjacent to OWFs and it is likely that these effects will be experienced in the vicinity of the windfarm site. The studies listed in **Section 8.8** and the distance in which vessels will be past the windfarm site mean that these impacts are considered to be tolerable. A REWS study has been undertaken to determine whether there is any impact to the system operated by the oil and gas infrastructure. The study concludes the impact of the Project on detection performance of nearby REWS installations is low and manageable without the need for further mitigation measures. The modelling results for the Project also indicate that the assessed REWS platforms will not experience a change in yearly alarm rates as a result of rerouted traffic.

11.1.1.1.16 An NRA was undertaken for the Project, supported through a hazard workshop in September 2023 attended by representatives from ferry operators, regulators, commercial bodies, oil and gas, ports, fishing community and recreational users.

11.1.1.1.17 In total 23 hazards were identified, split across different hazard types, vessel types, Project phases and areas.

11.1.1.1.18 16 of the hazards were assessed as Medium Risk – Tolerable if ALARP, including the risk of collision, allision, and snagging during construction, operation and maintenance, and decommissioning phases. The remaining seven hazards were assessed as Low Risk – Broadly Acceptable. Several hazards were scored in consideration of the human error on or mechanical failure of vessels transiting in close proximity to the windfarm site and the inherent risk of interaction between the vessel and the turbines.

11.1.1.1.19 Risk controls for the Project were reviewed with stakeholders at the hazard workshop. No further additional risk controls were identified for the Project. Therefore, the NRA concludes that where risks are scored as Medium, they can be considered to be ALARP and therefore Tolerable without the need for additional risk control measures.

11.1.1.1.20 A regional cumulative assessment (CRNRA) was undertaken in 2022 to assess the impacts of Mona Offshore Wind Project, Morgan Offshore Wind Project Generation Assets and Morecambe Offshore Windfarm Generation Assets on shipping and navigation. This CRNRA accompanied and informed the PEIRs for each project. The assessment identified that whilst there were some additional minor impacts on vessel routeing above what would be experienced on an individual Project basis, there were significant impacts on vessel safety due to the creation of narrow corridors between windfarms. The CRNRA determined that there were High Risk hazards between Mona and Morgan, and between Morgan and Walney.

11.1.1.1.21 The CRNRA was updated post-PEIR to account for designs changes made by the three projects following the PEIR findings and consultation responses made in relation to the cumulative impacts. These design changes were principally changes made to the boundaries of all three projects, a commitment to two lines of orientation and a reduction in the number of project vessel movements. The updated CRNRA also included consideration of the Morgan and Morecambe OWF Transmission Assets project.

11.1.1.1.22 The updated CRNRA, supported through a hazard workshop in September 2023 attended by representatives from ferry operators, regulators, commercial bodies, oil and gas operators, ports and fishing community, concluded that all hazards were either Medium Risk – Tolerable if ALARP or Low Risk - Broadly Acceptable. Appropriate risk controls were considered to be embedded in the design of each project and whilst additional risk control options were identified, it was agreed at the hazard workshop that these were disproportionate to the reduction in risk they might achieve. Therefore, the CRNRA has concluded that all Medium Risks can be considered ALARP and therefore Tolerable and no further risk controls are warranted.

11.1.1.1.23 Due to the release of the Scoping Report for the Mooir Vannin Offshore Wind Farm in October 2023, after the completion of many of the activities undertaken to inform the CRNRA, an addendum to the CRNRA was prepared to consider the additional cumulative risks that might result to vessel traffic identified within the CRNRA. It was concluded that with the addition of Mooir Vannin OWF, there were likely to be impacts on ferry routes in typical and adverse conditions and unacceptable risk to navigation safety between the Morgan Array Area, Walney OWFs and the Mooir Vannin OWF. Given the location of Mooir Vannin OWF, the Project is not considered to contribute to these further impacts.

REFERENCES

Admiralty (2022). Sailing Directions.

Anatec (2016). Influence of UK Offshore Windfarm Installation on Commercial Vessel Navigation.

Awel Y Mor (2021). Various submissions associated with Offshore Windfarm Application.

Biehl, F. and Lehmann, E. (2006). Collisions of Ships with Offshore Wind Turbines: Calculation and Risk Evaluation. Proceedings of OMAE 2006. 25th International Conference on Offshore Mechanics and Arctic Engineering. Hamburg, Germany.

BWEA (2007). Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Windfarm.

Department for Environment, Food and Rural Affairs (2021). North West Inshore and North West Offshore Marine Plan. Accessed December 2023.

Department for Energy Security & Net Zero (2023) National Policy Statement for Renewable Energy Infrastructure (NPS EN-3). Available: https://assets.publishing.service.gov.uk/media/655dc352d03a8d001207fe37/nps-renewable-energy-infrastructure-en3.pdf. Accessed November 2023.

DfT (2019). UK Port Freight Traffic Forecasts.

EMSA (2015). Risk Acceptance Criteria and Risk Based Damage Stability, Final Report, part 2: Formal Safety Assessment.

Friis-Hansen (2008). IWRAP MK II: Basic Modelling Principles for Prediction of Collision and Grounding Frequencies.

G+ IOER (2019). Good Practice Guidelines for Offshore Renewable Energy Developments.

HMCG (2011). UK Marine Policy Statement.

IALA (2017). G1123: The Use Of IALA Waterway Risk Assessment Programme (IWRAP).

IALA (2017). G1138: The Use of the Simplified IALA Risk Assessment Method (SIRA).

IALA (2021). G1162: The Marking of Offshore Man-Made Structures.

IALA (2022). G1018: Risk Management.

IMO (2008). FSA – RoPax Ships. MSC 85/17/2.

IMO (2018). Formal Safety Assessment. MSC-MEPC.2/Circ.12/Rev.2.

MCA and QinetiQ (2004). Results of the electromagnetic investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle windfarm by QinetiQ and the Maritime and Coastguard Agency.

MCA (2005). Offshore Windfarm Helicopter Search and Rescue Trials Undertaken at the North Hoyle Wind Farm

MCA (2008). MGN372: Guidance to Mariners Operating in the Vicinity of UK OREIs. Available at: https://www.gov.uk/guidance/offshore-renewable-energy-installations-impact-on-shipping.

MCA (2019). MCA report following aviation trials and exercises in relation to offshore windfarms

MCA (2021a). MGN654. Available at: https://www.gov.uk/guidance/offshore-renewable-energy-installations-impact-on-shipping.

MCA (2021b). MGN654 Annex 1: Methodology for Assessing the Marine Navigational Safety Risks of Offshore Renewable Energy. Available at: https://www.gov.uk/guidance/offshore-renewable-energy-installations-impact-on-shipping.

MCA (2021c). MGN654 Annex 5: Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for SAR and Emergency Response. Available at: https://www.gov.uk/guidance/offshore-renewable-energy-installations-impact-on-shipping.

Moulas, D. Shafiee, M. and Mehmanparast, A. (2017). Damage analysis of ship collisions with offshore wind turbine foundations. Ocean Engineering, 143, pp.149-162.

Nautical Institute (2013). The Shipping Industry and Marine Spatial Planning.

Ocean Studies Board's Division on Earth and Life Studies (2022). Wind Turbine Generator Impacts to Marine Vessel Radar.

PIANC (2018). WG161: Interaction between Offshore Windfarms and Maritime Navigation.

Presencia, C. and Shafiee, M. (2018). Risk analysis of maintenance ship collisions with offshore wind turbines. International Journal of Sustainable Energy, 37(6), pp.576-596.

Rawson, A. and Rogers, E. (2015). Assessing the impacts to vessel traffic from offshore windfarms in the Thames Estuary.

Rawson, A. and Brito, M. (2022). Assessing the validity of navigation risk assessments: a study of offshore windfarms in the UK. Ocean and Coastal Management, 219.

Rhiannon (2012). Scoping Report for Rhiannon Offshore Windfarm.

RYA (2019/2021). Water Sports Participation Survey.

RYA (2019). RYA Position of Offshore Renewable Developments: Wind Energy.

UN (1982). UN Convention on the Law of the Sea.

VINDPILOT (2008). Methodology for Assessing Risks to Ship Traffic from Offshore Windfarms. Vattenfall AB and Swedish Energy Agency.

Appendix A MCA MGN Check List

MGN Section	Yes/No	Comments
4. Planning Stage – Prior to Consent		
4.5 Site and Installation Co-ordinates: Developers are responsible for ensuring that formally agreed co-ordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System data, preferably in Environmental Systems Research Institute format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 (ETRS89) datum.		
4.6 Traffic Survey – includes		
All vessel types	✓	Analysis of all vessel types within the study area is contained within **Section 6**.
At least 28 days duration, within either 12 or 24 months prior to submission of the Environmental Impact Assessment Report	✓	An MGN654 compliant vessel survey (during 2021/2022) has been conducted and is described in **Section 6.3**.
Multiple data sources	✓	**Section 3.5** describes the vessel traffic, incident and secondary data sources used to inform the NRA.
Seasonal variations	✓	Seasonality has been accounted for within the 2x 14 day traffic surveys (**Section 6.3**) and is referenced throughout **Section 6**.
MCA consultation	✓	Consultation with the MCA has been conducted (see **Section 3.5.1/9.3**).
General Lighthouse Authority consultation	✓	Consultation with Trinity House has been conducted (see **Section 3.5.1/9.3**).
Chamber of Shipping and shipping company consultation	✓	Consultation with the Chamber of Shipping and ferry companies has been conducted (see **Section 3.5.1/9.3**).
Recreational and fishing vessel organisations consultation	✓	Consultation with the RYA and fishing groups has been conducted (see **Section 3.5.1/9.3**).
Port and navigation authorities consultation, as appropriate	✓	Consultation with Peel Ports has been conducted (see **Section 3.5.1/9.3**).
4.6.d Assessment of the cumulative and individual effects of (as appropriate):		
i. Proposed OREI site relative to areas used by any type of marine craft.	✓	Vessel traffic analysis within the study area is described in **Section 6**.
ii. Numbers, types and sizes of vessels presently using such areas	✓	Vessel traffic analysis within the study area is described in **Section 6**. This includes statistical analysis of vessel activity in **Section 6.3 / 6.4.9.**
iii. Non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, personal watercraft etc.	✓	Vessel traffic analysis within the study area is described in **Section 5.6 / 6.4**.
iv. Whether these areas contain transit routes used by coastal, deep-draught or international scheduled vessels on passage.	✓	Vessel traffic analysis within the study area is described in **Section 6.3**, including identification of key shipping routes in **Section 6.4.10.**

v. Alignment and proximity of the site relative to adjacent shipping routes	✓	Vessel traffic analysis within the study area is described in **Section 6.3**, including identification of key shipping routes.
vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas	✓	Navigational features are highlighted in **Section 5**.
vii. Proximity of the site to areas used for anchorage (charted or uncharted), safe haven, port approaches and pilot boarding or landing areas.	✓	Navigational features are highlighted in **Section 5**. Analysis of anchoring activity is contained within **Section 6.4.15.**
viii. Whether the site lies within the jurisdiction of a port and/or navigation authority.	✓	Navigational features are highlighted in **Section 5**.
ix. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓	Analysis of fishing vessel activity is contained within **Section 6.4.7**.
x. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓	Navigational features are highlighted in **Section 5**.
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	✓	Navigational features are highlighted in **Section 5**.
xii. Proximity of the site to existing or proposed OREI developments, in co-operation with other relevant developers, within each round of lease awards.	✓	Navigational features are highlighted in **Section 5**. Future proposed OREIs are described in **Section 7**.
xiii. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground	✓	Navigational features are highlighted in **Section 5.**
xiv. Proximity of the site to aids to navigation and/or VTS in or adjacent to the area and any impact thereon.	✓	Navigational features are highlighted in **Section 5**.
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.	✓	The impact on vessel routeing is assessed within **Section 8.2 / 8.3**.
xvi. With reference to xv. above, the number and type of incidents	✓	Analysis of historical incident data is contained within **Section 6.5**.

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.		
xvii. Proximity of the site to areas used for recreation which depend on specific features of the area	✓	Analysis of recreational traffic is contained within **Section 6.4.6.**
4.7 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.	✓	The impact on vessel routeing is assessed within **Section 8.2 / 8.3**.
b. The width of a corridor between sites or OREIs to allow safe passage of shipping.	✓	The cumulative impacts of multiple OREIs is assessed within **Section 10**.
4.8. 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.	✓	The risks of snagging on project infrastructure are assessed in **Section** 8.9. Impacts on underkeel clearance are assessed in **Section 8.9.**
b. Clearances of fixed or floating wind turbine blades above the sea surface are not less than 22 metres (above MHWS for fixed). Floating turbines allow for degrees of motion.	✓	The project has committed as an embedded risk control measures that wind turbine blades will be 25 metres above the sea surface.
c. Underwater devices i. changes to charted depth ii. maximum height above seabed iii. Under Keel Clearance	x	The impact on UKC is not considered a concern due to water depths of the windfarm site – note the transmission assets are considered as part of a separate NRA.
d. Whether structure block or hinder the view of other vessels or other navigational features.	✓	Impacts on collision avoidance are considered within **Section 8.5**.
4.9 The Effect of Tides, Tidal Streams and Weather: It should be determined whether:		
a. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide i.e. whether the installation could pose problems at high water which do not exist at	✓	Analysis of tidal conditions are given in **Section 5.2.2**.

low water (LW) conditions, and vice versa.		
b. The set and rate of the tidal stream, at any state of the tide, has a significant affect on vessels in the area of the OREI site.	✓	Analysis of metocean conditions are given in **Section 5.2**. Collision and allision (**Section 8.4** and **8.5**) assessments consider the impact of metocean conditions.
c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✓	Analysis of metocean conditions are given in **Section 5.2.** Collision and allision (**Section 8.4** and **8.5**) assessments consider the impact of metocean conditions.
d. The set is across the major axis of the layout at any time, and, if so, at what rate.	✓	Analysis of metocean conditions are given in **Section 5.2.** Collision and allision (**Section 8.4** and **8.5**) assessments consider the impact of metocean conditions.
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.	✓	Analysis of metocean conditions are given in **Section 5.2**. Collision and allision (**Section 8.4** and **8.5**) assessments consider the impact of metocean conditions.
f. The structures themselves could cause changes in the set and rate of the tidal stream.	✓	No effect anticipated.
g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the windfarm area or adjacent to the area	✓	Analysis of metocean conditions are given in **Section 5.2.**
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.	✓	Adverse weather impacts are assessed within **Section 8.2.3 / 8.3.3**.
i. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓	Analysis of metocean conditions are given in **Section 5.2**. Collision and allision (**Section 8.4** and **8.5**) assessments consider the impact of metocean conditions.
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.	✓	Analysis of metocean conditions are given in **Section 5.2**. Collision and allision (**Section 8.4** and **8.5**) assessments consider the impact of metocean conditions.
4.10 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: for all vessels, or for specified vessel types, operations and/or sizes. in all directions or areas, or in specified directions or areas. in specified tidal, weather or other conditions	✓	Impacts to vessel routeing are assessed in **Section 8.2 / 8.3**.
b. Navigation in and/or near the site should be prohibited or restricted: for specified vessels types, operations and/or sizes. in respect of specific activities, in all areas or directions, or in specified areas or directions, or in specified tidal or weather conditions.	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**.
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	✓	Impacts to vessel routeing are assessed in **Section 8.2 / 8.3**.
d. Guidance on the calculation of safe distance of OREI boundaries from shipping routes has been considered	✓	Vessel routes are identified in **Section 6.4.10**
4.11 Search and rescue, maritime assistance service, counter pollution and salvage incident response.		
The MCA, through HM Coastguard, is required to provide Search and Rescue and emergency response within the sea area occupied by all offshore renewable energy installations in UK waters. To ensure that such operations can be safely and effectively conducted, certain requirements must be met by developers and operators.		
a. An ERCOP will be developed for the construction, operation and maintenance, and decommissioning phases of the OREI.	✓	Impacts to search and rescue are considered within **Section 8.6**. Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
b. The MCA's guidance document Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response for the design, equipment and operation requirements will be followed.	✓	Impacts to search and rescue are considered within **Section 8.6**. Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**

c. A SAR checklist will be completed to record discussions regarding the requirements, recommendations and considerations outlined in the above document (to be agreed with MCA)	✓	Impacts to search and rescue are considered within **Section 8.6**. Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
4.12 Hydrography - In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:		
i. Pre-construction: The proposed generating assets area and proposed cable route	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
ii. On a pre-established periodicity during the life of the development	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
ii. Post-construction: Cable route(s)	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
iii. Post-decommissioning of all or part of the development: the installed generating assets area and cable route	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
4.13 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 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.	✓	Impact on communications, radar and positioning systems are considered within **Section 8.8**.
b. The structures could produce radar reflections, blind spots, shadow areas or other adverse effects: i. Vessel to vessel;	✓	Impact on communications, radar and positioning systems are considered within **Section 8.8**.

ii. Vessel to shore; iii. VTS radar to vessel iv. Racon to/from vessel		
c. The structures and generators might produce sonar interference affecting fishing, industrial or military systems used in the area.	✓	Impact on communications, radar and positioning systems are considered within **Section 8.8**.
d. The site might produce acoustic noise which could mask prescribed sound signals.	✓	Impact on communications, radar and positioning systems are considered within **Section 8.8**.
e. Generators and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems.	✓	Impact on communications, radar and positioning systems are considered within **Section 8.8**.
4.14 Risk mitigation measures recommended for OREI during construction, operation and maintenance, 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 Maritime and Coastguard Agency and will be listed in the developer's Environmental Statement. These will be consistent with international standards contained in, for example, the Safety of Life at Sea (SOLAS) Convention - Chapter V, IMO Resolution A.572 (14)3 and Resolution A.671(16)4 and could include any or all of the following:		
i. Promulgation of information and warnings through notices to mariners and other appropriate maritime safety information dissemination methods.	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
ii. Continuous watch by multi-channel VHF, including Digital Selective Calling.	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**.
iii. Safety zones of appropriate configuration, extent and application to specified vessel.	✓	Embedded risk controls are outlined in **Section 4.9.** Possible additional risk controls are proposed in **Section 9.8**
iv. Designation of the site as an Area to be Avoided.	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
v. Provision of AtoN as determined by the GLA	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
vi. Implementation of routeing measures within or near to the development.	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
vii. Monitoring by radar, AIS, CCTV or other agreed means	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of safety zones.	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**

ix. Creation of an Emergency Response Cooperation Plan with the MCA's Search and Rescue Branch for the construction phase onwards.	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
x. Use of guard vessels, where appropriate	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
xi. Update NRAs every two years e.g. at testing sites.		Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
xii. Device-specific or array-specific NRAs	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
xiii. Design of OREI structures to minimise risk to contacting vessels or craft	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**
xiv. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓	Embedded risk controls are outlined in **Section 4.9**. Possible additional risk controls are proposed in **Section 9.8**

Appendix B Meeting Minutes

Appendix C Stakeholder Hazard Workshop Process and Results

HAZARD WORKSHOP 1

HAZARD WORKSHOP PROCESS

The hazard workshop process was as follows:

- Invitation to workshop: Stakeholder organisations invited to attend hazard workshop;
- Pre-read material: Pre-read material issued to stakeholders containing detailed project information;
- Pre-hazard workshop seminar: Pre-hazard workshop webinar held to discuss pre-read material and familiarise stakeholders with NRA and hazard log methodology.
- Draft hazard log: Draft hazard log issued to stakeholders for score updates and comments.
- Hazard workshop; Stakeholder hazard workshop held in-person.

PRE-READ MATERIAL

Prior to the hazard workshop, all stakeholder organisations were provided with a pre-read pack that contained a detailed summary of the:

- existing marine environment and maritime activities in the Irish Sea (including detailed vessel traffic analysis);
- project description and assumptions;
- potential impacts of the project on the existing environment; and
- NRA requirements and methodology.

PRE-HAZARD WORKSHOP WEBINAR

On the 3rd October 2022, one week prior to the in-person hazard workshop, a webinar was undertaken, to discuss the pre-read material and familiarise stakeholders with the risk assessment methodology and draft hazard log spreadsheet that was to be used by stakeholder organisations in the hazard workshop.

DRAFT HAZARD LOG

On the 4th October 2022, following the webinar, each stakeholder organisation was issued a copy of the draft hazard log spreadsheet. They were invited to review and re-score each hazard as they see fit prior to the hazard workshop. Stakeholders were encouraged to add a description to the comments section of their adjusted hazard scores to clarify their reasoning and aid discussion in the hazard workshop.

HAZARD WORKSHOP

A hazard workshop was held on 12th October 2022 at the Holiday Inn Liverpool.

The agenda was as follows:

- 08:30 09:00 Coffee/Tea
- 09:00 09:15 Introductions
- 09:15 09:30 Aims and Objectives
- 09:30 09:45 Supporting Studies and Data
- 09:45 10:00 Workshop Methodology Recap
- 10:00 10:15 Key Navigation Themes / Discussion
- 10:15 11:15 Hazard Scoring Session
- 11:15 11:30 Coffee/Tea
- 11:30 12:45 Hazard Scoring Session
- 12:45 13:00 Summary
- 13:00 13:45 Lunch
- 13:45 14:30 Run Over Time
- 14:30 Finish

Table 46 details the organisations and representatives that attended the workshop.

Table 46: Hazard workshop attendees

Organisation	Role
Royal Haskoning DHV	Senior Environmental Consultant (Marine)
Flotation Energy	Communications Manager
IoM Department of Infrastructure	Isle of Man Government
IoM Steam Packet Company	Marine Manager Master Master Operations Manager
Maritime Coastguard Agency	Offshore Renewables Lead, Marine Licensing and Consenting
Seatruck Ferries	Fleet Training Superintendant
Spirit Energy	
Stena Line	Safety & Security Superintendent, Deputy CSO, DP Ports (PMSC)

Organisation	Role
Fisheries Liaison Officer	
UK Chamber of Shipping	Policy Manager (Safety & Nautical) & Analyst
NASH Maritime	Project Director Maritime Consultant Principle Maritime Consultant

At the workshop, the pre-read material was reviewed at a high level before stakeholders were invited to describe their key concerns regarding the projects. These are summarised as follows:

- Increased traffic density in the 'corridor' between the north of the windfarm site and West of Duddon Sand Wind Farm from rerouted vessels and increased number of WFSVs. Rerouted traffic will be displaced toward existing O&G infrastructure.
- Increased traffic density around southwest corner of the windfarm site - impacts multiple ferry routes, reduces sea room and increases risk of tanker and cargo collision and/or allision.
- The windfarm site minimises the adverse weather route options.
- Commercial impact of ferry route deviation around the windfarm site.
- Radar interference from the turbines (particularly at night and in poor visibility) – may obscure WFSVs exiting the windfarm site.
- Morecambe construction phase will overlap with the O&G decommission phase increase service vessel traffic in the region.
- O&G service vessels transiting through the wind farm need access routes.
- O&G decommissioning vessels are large (up to 300m) and difficult to manoeuvre with - challenging angles of approach (possibly through the wind farm).
- If the cod quota is increased), there will be an increased amount of beam trawler traffic and fishing activity in the Morecambe project area.

From these key navigational concerns, the NRA team identified five hazards to focus the hazard workshop discussions around. For each hazard, stakeholders were provided an opportunity to discuss the hazard in small groups and update their scorings in their copy of the draft risk assessment spreadsheet. These scores were then updated (live) within the summary spreadsheet (presented to the room) which contained the draft NRA teams scores alongside all attending stakeholder organisation scores. A discussion was then held across the wider room about the variation in scoring for each hazard and where differences lay. Once each hazard discussion had come to a close, the summary spreadsheet was 'locked' to capture the concluding scores of the discussion. Stakeholders were encouraged to fill out the comments section of each hazard post workshop to provide a higher level of description regarding their scores.

At the end of the day, a summary was held to discuss the key impacts identified and some potential mitigation options.

RESULTS

The baseline hazard scores and comments for the six hazards discussed in the workshop are as follows:

Hazard ID:	1
Hazard Title:	Collision: Ferry & Passenger ICW. Cargo & Tanker or other Ferry & Passenger
Area:	Array Area + 10nm

Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Reduced Searoom Between OWFs; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple major injuries; Moderate damage to vessels; Minor pollution (Tier 1); Widespread adverse publicity; Short term interruption to ferry services.	Multiple fatalities; Constructive Loss; Serious pollution incident (Tier 2); International adverse publicity. Ferry out of service.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
NASH Draft Scores	1	2	2	1	3	3	5	5	4	5	2	8.6	Medium Risk - Tolerable (if ALARP)	
Department of Infrastructure (IOM)	1	3	4	3	4	3	5	5	4	5	3	12.9	High Risk - Unacceptable	
Isle of Man Steam Packet Company Limited	1	3	4	3	4	3	5	5	4	5	3	12.9	High Risk - Unacceptable	high speed craft, full speed, aluminium hull, frequency worst case should be 2.5 as different risk in north channel compared to southwest passage
Maritime and Coastguard Agency	2	3	3	2	3	3	5	5	4	5	2	9.2	Medium Risk - Tolerable (if ALARP)	
Seatruck Ferries	1	3	3	3	4	3	5	5	4	5	3	12.8	High Risk - Unacceptable	share concerns with Stena and IoMSP. the matrix doesn't have a board enough scope to consider level between established levels (would have scored 2.5 for worst credible frequency)
Spirit Energy	4	3	3	2	3	3	5	5	4	5	3	11.6	Medium Risk - Tolerable (if ALARP)	
Stena Line	1	3	4	3	4	3	5	5	4	5	3	12.9	High Risk - Unacceptable	Scenario considered is an interaction with a North bound conventional ferry ex Liverpool (3 times daily) encountering a vessel ex IoM bound for Liverpool. This encounter takes place West of Morecambe.
Tom Watson	1	3	3	2	3	3	5	5	4	5	2	9.2	Medium Risk - Tolerable (if ALARP)	
UK Chamber of Shipping	2	3	3	2	3	3	5	5	4	5	3	11.6	Medium Risk - Tolerable (if ALARP)	Higher risk in SW corner. Frequency greater with ferry/pax involvement due to no of crossings
Final Scores	1	3	3	2	3	3	5	5	4	5	2	9.2	Medium Risk - Tolerable (if ALARP)	Increase RML people, property and environment by 1 category.

Hazard ID:	2
Hazard Title:	Collision: Cargo & Tanker ICW. other Cargo & Tanker
Area:	Array Area + 10nm

Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Reduced Searoom Between OWFs; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to vessels; Minor pollution (Tier 1); Widespread adverse publicity; Vessel requires drydock.	Single fatality; Constructive Loss; Major pollution incident (Tier 3); National adverse publicity.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
NASH Draft Scores	4	2	2	1	2	3	4	5	5	4	2	7.6	**Medium Risk - Tolerable (if ALARP)**	
Maritime and Coastguard Agency	5	2	3	2	3	3	4	5	5	4	2	8.9	**Medium Risk - Tolerable (if ALARP)**	
UK Chamber of Shipping	4	2	3	1	3	3	4	5	5	4	2	8.7	**Medium Risk - Tolerable (if ALARP)**	Higher risk in SW corner
Final Scores	1	2	3	2	3	3	4	5	5	4	2	8.9	**Medium Risk - Tolerable (if ALARP)**	Increased RML property, environment, and business by 1 category.

Hazard ID:	3
Hazard Title:	Collision: Ferry & Passenger or Cargo & Tanker ICW. Small Craft
Area:	Array Area + 10nm

Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to small craft; Minor pollution (Tier 1); Widespread adverse publicity;	Multiple fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
NASH Draft Scores	6	2	3	1	2	3	4	3	3	4	2	7.5	Medium Risk - Tolerable (if ALARP)	
Department of Infrastructure (IOM)	1	3	3	2	4	4	5	4	3	4	3	13.8	High Risk - Unacceptable	Following consideration by IOMSPC and reflecting the use of the fast craft vessel. This also takes into account the fast craft travelling along the southern sector of the array area (+10nm).
Isle of Man Steam Packet Company Limited	1	3	3	2	4	4	5	4	3	4	3	13.8	High Risk - Unacceptable	fast craft, full speed, aluminium hull, small craft construction material vary between stell and GRP
Maritime and Coastguard Agency	1	3	3	2	3	4	4	3	3	4	3	11.4	Medium Risk - Tolerable (if ALARP)	
Seatruck Ferries	2	3	3	2	3	4	5	4	3	4	3	12.5	High Risk - Unacceptable	
Spirit Energy	6	3	3	2	3	3	4	3	3	4	3	9.9	Medium Risk - Tolerable (if ALARP)	
Stena Line	1	3	3	2	4	4	5	4	3	4	3	13.8	High Risk - Unacceptable	Possibility of non-detection of service vessels, leisure craft or FV's by radar due to cumulative interference by radar or backscatter from turbine lights.

Tom Watson	1	3	3	2	3	4	4	3	3	4	3	11.4	Medium Risk - Tolerable (if ALARP)	
UK Chamber of Shipping	2	3	3	2	3	4	4	4	3	4	3	11.6	Medium Risk - Tolerable (if ALARP)	
Final Scores	1	3	3	2	3	4	5	4	3	4	2	10.3	**Medium Risk - Tolerable (if ALARP)**	Increased RML people by 1 category and frequency by 1 category. Increased RWC people and property by 1 category.

Hazard ID:	7
Hazard Title:	Allision: Ferry & Passenger
Area:	Array Area + 10nm

Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution (Tier 1); Widespread adverse publicity; Repairs to WTGs; Short term interruption to ferry services.	Multiple fatalities; Serious damage/Constructive Loss; Moderate pollution incident (Tier 2); International adverse publicity; Loss of WTGs; Ferry out of service.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
NASH Draft Scores	2	2	2	1	3	3	5	4	3	5	2	8.4	Medium Risk - Tolerable (if ALARP)	
Department of Infrastructure (IOM)	3	3	4	3	4	3	5	4	3	5	3	12.6	High Risk - Unacceptable	Following discussions and consideration by IOMSPC taking into account the impact of the scenario on the fast craft vessel.
Isle of Man Steam Packet Company Limited	3	3	4	3	4	3	5	4	3	5	3	12.6	High Risk - Unacceptable	fast craft, full speed, aluminium hull, extensive damage to vessel and turbine structure
Maritime and Coastguard Agency	4	3	3	2	3	3	5	4	3	5	2	8.9	Medium Risk - Tolerable (if ALARP)	
Seatruck Ferries	3	3	4	3	3	3	5	4	3	5	3	12.4	High Risk - Unacceptable	
Spirit Energy	1	5	5	3	5	2	5	5	4	5	3	12.1	Medium Risk - Tolerable (if ALARP)	Allision with the O&G installation
Stena Line	3	3	4	3	4	3	5	4	3	5	3	12.6	High Risk - Unacceptable	It is assumed that any contact with a turbine will result in major structural damage to the turbine and lesser damage to the vessel.
Tom Watson	4	3	3	2	3	3	5	4	3	5	2	8.9	Medium Risk - Tolerable (if ALARP)	
UK Chamber of Shipping	1	3	3	1	4	3	5	4	3	4	3	11.8	Medium Risk - Tolerable (if ALARP)	Frequency a 2.5 for worst credible
Final Scores	1	3	3	2	3	3	5	4	3	5	2	8.9	Medium Risk - Tolerable (if ALARP)	Increased RML people, property and environment by 1 category.

Hazard ID:	8
Hazard Title:	Allision with OWF: Cargo & Tankers
Area:	Array Area + 10nm

Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to vessel; No pollution; Widespread adverse publicity; Repairs to WTGs;	Single fatality; Serious damage, drydock required; Serious pollution incident (Tier 2); International adverse publicity; Loss of WTGs.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
NASH Draft Scores	2	2	2	1	2	4	4	4	4	5	2	8.4	Medium Risk - Tolerable (if ALARP)	
Maritime and Coastguard Agency	2	2	3	2	3	4	4	4	4	5	2	10.1	Medium Risk - Tolerable (if ALARP)	
UK Chamber of Shipping	5	2	3	1	3	3	4	4	4	5	2	8.6	Medium Risk - Tolerable (if ALARP)	
Final Scores	1	2	3	1	3	3	4	4	4	5	2	8.6	Medium Risk - Tolerable (if ALARP)	Increased RML property and business by 1 category. Decreased RML frequency by 1 category.

Hazard ID:	23
Hazard Title:	Allision with O&G: Cargo & Tankers
Area:	Array Area + 10nm

Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Realistic Worst Credible Scenario
Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Moderate pollution incident (Tier 2); Widespread adverse publicity; Repairs to WTGs;	Multiple fatalities; Major Damage, drydock required; Serious pollution incident (Tier 2); International adverse publicity; Loss of WTGs.

Organisation	Baseline Risk Rank	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
		People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
NASH Draft Scores	2	2	2	1	2	4	4	4	4	5	2	8.4	Medium Risk - Tolerable (if ALARP)	
Spirit Energy	1	5	5	3	5	2	5	5	4	5	3	12.1	Medium Risk - Tolerable (if ALARP)	Allision with the O&G installation
Final Scores	1	3	3	3	3	3	5	5	4	5	2	9.4	Medium Risk - Tolerable (if ALARP)	Increased RML people, property and environment by 1 category.

During the hazard workshop, consensus was not reached on a number of hazards, with a range of scores between the NRA team and stakeholders. Therefore, the findings of the workshop were considered with the analysis and wider assessment undertaken by the NRA team to derive the final risk assessment described in the NRA.

HAZARD WORKSHOP 2

HAZARD WORKSHOP TIMINGS

The hazard workshop preparation consisted of the following:

1) **09 August 2023**: Save the date email issued to the wider stakeholder group which provided the dates for the hazard workshop, format and location
2) **29 August 2023**: Issue of letter to all stakeholders introducing the Projects, the commitments made post-PEIR and provided further details of the hazard workshop venue and format
3) **18 September 2023**: Issue of Project update newsletters outlining boundary changes made to the public
4) **21 and 22 September 2023**: Issue of pre-read packs to all stakeholders which contained:
5) Slide pack containing a summary of the Projects, boundary changes, analysis, methodology and reasoning behind the hazard scoring
6) Draft hazard logs developed by the Project Team
7) **29 September 2023**: Hazard Workshop.

HAZARD WORKSHOP

A hazard workshop was held in person on 29 September 2023 at the Mercure Atlantic Tower Hotel in Liverpool.

The agenda was as follows:

- 09:00 Recap of CRNRA and Recap of Method
- 09:15 Morgan/Mona Scoring Session
- 12:00 Morgan/Mona Washup
- 12:15 Lunch
- 13:30 Morecambe Scoring Session
- 16:30 Morecambe Washup

ATTENDEES

Table 47 details the organisations and representatives that attended the workshop.

Table 47: Hazard workshop attendees.

Organisation	Category	Role
NASH Maritime	Project Team	Shipping and Navigation Consultants (Mona/Morgan/Morecambe)
HR Wallingford		Consultant Master Mariner Supporting NASH Maritime
Brookes Bell		Consultant Master Mariner Supporting NASH Maritime
bp/EnBW		Developer of Mona and Morgan
Flotation Energy		Developer of Morecambe
Royal Haskoning		EIA Lead for Morecambe
Anglo-North Irish Fish Producers Organization (ANIFPO)	Stakeholder	Impact on Fishing
ENI		Impact on Oil and Gas Operations
Harbour Energy		Impact on Oil and Gas Operations
IoM Government		Impact on Ferry Services and IoM Developments
MCA		Impact on Navigation Safety
Orsted		Impact on Existing and Planned offshore windfarms
Peel Ports		Impact on Navigation Safety and Port Operations
Scottish Whitefish Producers Association (SWFPA)		Impact on Fishing
Seatruck Group		Impact on Navigation Safety and Ferry Services
Spirit Energy		Impact on Oil and Gas Operations
Steam Packet		Impact on Navigation Safety and Ferry Services
Stenaline		Impact on Navigation Safety and Ferry Services
Fisheries Liaison Officer		Impact on Fishing
UK Chamber of Shipping		Impact on Navigation Safety and Commercial Operators

HAZARD WORKSHOP PROCESS

At the workshop:

- The Project team introduced the material and methodology
- Each hazard was reviewed in turn, with each attendee invited to discuss amongst their tables and score their personalised hazard log. Stakeholders were encouraged to fill out the comments section of each hazard post workshop to provide a higher level of description regarding their scores
- Each hazard score was then reviewed as a group with differences in scoring discussed, before a consensus was sought
- Once each hazard discussion had come to a close, the summary spreadsheet was ‘locked’ to capture the concluding scores of the discussion

- Risk controls were reviewed and appropriate additional risk controls discussed
- Update of hazard risk scores based on the findings of the hazard workshop for inclusion in the NRA.

RESULTS

During the hazard workshop it was agreed that the hazards discussed for the cumulative scenario were similar but lesser for the Project individually. It was agreed that the two highest scoring hazards (Hazard ID 3 and 23) should be discussed, and the other hazards should be amended based on the feedback from the CRNRA workshop on 28 September 2023 (see Appendix 14.2 Cumulative Regional Navigational Risk Assessment (Document Reference 5.2.14.2). The baseline hazard scores and comments for the hazards discussed in the Project NRA hazard workshop are provided in the following tables.

During the hazard workshop, consensus was not reached on the discussed hazards, with a range of scores between the NRA team and stakeholders. However, consensus was reached with the stakeholders that no further additional risk controls were required for the Project. This means that, where risks are scored as Medium, they are considered to be ALARP and therefore Tolerable. The findings of the workshop were considered with the analysis and wider assessment undertaken by the NRA team to derive the final risk assessment described in this NRA (see **Section 9** and Appendix **D**).

Hazard ID:	3
Hazard Title:	Collision: Ferry & Passenger or Cargo & Tanker ICW. Small Craft
Area:	Windfarm Site + 10nm

Organisation	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
	People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
Draft Scores	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	
ANIFPO	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	
CoS	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	
ENI	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	
Harbour Energy	3	4	2	3	2	5	5	3	4	2	**8.1**	Medium Risk - Tolerable (if ALARP)	
IoM Gov	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	
IoMSPC	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	
MCA	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	
Seatruck	3	4	2	3	3	5	4	3	4	2	**9.8**	Medium Risk - Tolerable (if ALARP)	
Spirit Energy	3	4	2	3	2	5	5	3	4	2	**8.1**	Medium Risk - Tolerable (if ALARP)	
Stenaline	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	
SWPAL	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	
Fisheries Liaison Officer	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	
WCSP	3	3	2	3	3	5	4	3	4	2	**8.8**	Medium Risk - Tolerable (if ALARP)	

Hazard ID:	23
Hazard Title:	Allision with O&G Infrastructure: Cargo & Tankers
Area:	Windfarm Site + 10nm

Organisation	Realistic Most Likely Scores					Realistic Worst Credible Scores					Baseline Risk Score	Baseline Risk Rating	Notes
	People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency			
Draft Scores	3	3	3	3	3	5	5	4	5	2	**9.4**	Medium Risk - Tolerable (if ALARP)	
ANIFPO	3	3	3	3	3	5	5	4	5	2	**9.4**	Medium Risk - Tolerable (if ALARP)	
CoS	3	3	3	3	3	5	5	4	5	2	**9.4**	Medium Risk - Tolerable (if ALARP)	
ENI	3	3	3	3	3	5	5	4	5	2	**9.4**	Medium Risk - Tolerable (if ALARP)	
Harbour Energy	5	5	3	5	2	5	5	4	5	2	**9.6**	Medium Risk - Tolerable (if ALARP)	
IoM Gov	3	3	3	3	3	5	5	4	5	2	**9.4**	Medium Risk - Tolerable (if ALARP)	
IoMSPC	3	3	3	3	3	5	5	4	5	2	**9.4**	Medium Risk - Tolerable (if ALARP)	
MCA	3	3	3	3	3	5	5	4	5	2	**9.4**	Medium Risk - Tolerable (if ALARP)	
Seatruck	3	3	3	3	3	5	5	4	5	2	**9.4**	Medium Risk - Tolerable (if ALARP)	
Spirit Energy	5	5	3	5	2	5	5	4	5	2	**9.6**	Medium Risk - Tolerable (if ALARP)	
Stenaline	3	3	3	3	3	5	5	4	5	2	**9.4**	Medium Risk - Tolerable (if ALARP)	
SWPAL	3	3	3	3	3	5	5	4	5	2	**9.4**	**Medium Risk - Tolerable (if ALARP)**	
Fisheries Liaison Officer	3	3	3	3	3	5	5	4	5	2	**9.4**	**Medium Risk - Tolerable (if ALARP)**	
WCSP	3	3	3	3	3	5	5	4	5	2	**9.4**	**Medium Risk - Tolerable (if ALARP)**	

Appendix D Hazard Log Tables

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores – People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores – People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
1	7	C/O/D	Windfarm Site + 10nm	Collision: Ferry & Passenger ICW. Cargo & Tanker or other Ferry & Passenger	Reduced Searoom Between OWFs; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple major injuries; Moderate damage to vessels; Minor pollution (Tier 1); Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	4	2	Multiple fatalities; Constructive Loss; Serious pollution incident (Tier 2); International adverse publicity. Ferry out of service.	5	5	4	5	2	8.4	Medium Risk - Tolerable (if ALARP)
2	4	C/O/D	Windfarm Site + 10nm	Collision: Cargo & Tanker ICW. other Cargo & Tanker	Reduced Searoom Between OWFs; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple minor injuries; Moderate damage to vessels; Minor pollution (Tier 1); Widespread adverse publicity; Vessel	2	3	2	3	3	Single fatality; Constructive Loss; Major pollution incident (Tier 3); National adverse publicity.	4	5	5	4	2	8.9	Medium Risk - Tolerable (if ALARP)

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
					from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;		requires drydock.													
3	1	C/O/D	Windfarm Site + 10nm	Collision: Ferry & Passenger or Cargo & Tanker ICW. Small Craft	Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to small craft; Minor pollution (Tier 1); Widespread adverse publicity;	3	3	2	4	3	Multiple fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	5	4	3	4	2	9.8	**Medium Risk - Tolerable (if ALARP)**

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores – People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores – People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
4	11	C/O/D	Windfarm Site + 10nm	Collision: Small Craft ICW. Small Craft	Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to small craft; No pollution; Minor adverse publicity.	2	3	1	2	3	Multiple serious injuries/single fatality; Moderate damage; Moderate pollution incident (Tier 2); National adverse publicity.	4	4	3	4	2	7.6	Medium Risk - Tolerable (if ALARP)
5	3	C/D	Windfarm Site + 10nm	Collision: Large Project ICW. Ferry & Passenger or Cargo & Tanker	Reduced Searoom Between OWFs; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference	Notice to Mariners; Site Marking and Charting; ERCOP; Layout Plan and Lines of Orientation.	Multiple major injuries; Moderate damage to vessels; Minor pollution (Tier 1); Widespread adverse publicity; Vessel	3	3	2	3	3	Multiple fatalities; Constructive Loss; Serious pollution incident (Tier 2); International adverse publicity.	5	5	4	5	2	9.2	Medium Risk - Tolerable (if ALARP)

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores – People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores – People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
					from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;		requires drydock.													
6	13	C/D	Windfarm Site + 10nm	Collision: Large Project ICW. Small Craft	Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; ERCOP; Incident Investigation and Reporting; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring; Guard Boat.	Multiple major injuries; Moderate damage to small craft; Minor pollution (Tier 1); Widespread adverse publicity;	3	3	2	3	2	Multiple fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity.	5	4	3	4	2	7.4	Medium Risk - Tolerable (if ALARP)

								Baseline											Baseline Risk Score	
								Realistic Most Likely Scores						Realistic Worst Credible Scores						
ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
7	8	C/O/D	Windfarm Site + 10nm	Allision: Ferry & Passenger	Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to vessel; Minor pollution (Tier 1); Widespread adverse publicity; Repairs to WTGs; Short term interruption to ferry services.	3	3	2	4	2	Multiple fatalities; Serious damage/Constructive Loss; Moderate pollution incident (Tier 2); International adverse publicity; Loss of WTGs; Ferry out of service.	5	4	3	5	2	8.1	Medium Risk - Tolerable (if ALARP)

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
8	6	C/O/D	Windfarm Site + 10nm	Allision: Cargo & Tankers	Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to vessel; No pollution; Widespread adverse publicity; Repairs to WTGs;	2	3	1	3	3	Single fatality; Serious damage, drydock required; Serious pollution incident (Tier 2); International adverse publicity; Loss of WTGs.	4	5	4	5	2	8.7	Medium Risk - Tolerable (if ALARP)

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores – People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores – People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
9	9	C/O/D	Windfarm Site + 10nm	Allision: Tug & Service	Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels.	Multiple minor injuries; Moderate damage to small craft; No pollution; Widespread adverse publicity; Repairs to WTGs.	2	3	1	3	3	Single fatality; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to WTGs.	4	4	3	4	2	7.8	**Medium Risk - Tolerable (if ALARP)**

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores					Realistic Worst Credible Scenario	Realistic Worst Credible Scores					Baseline Risk Score	
								People	Property	Environment	Business	Frequency		People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
10	15	C/O/D	Windfarm Site + 10nm	Allision: Fishing	Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; Fishing Liaison Plan; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Minor damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	3	Single fatality; Loss of small craft; Minor pollution incident (Tier 2); National adverse publicity; Repairs to WTGs.	4	4	2	4	2	6.6	Medium Risk - Tolerable (if ALARP)

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores – People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Baseline: Realistic Worst Credible Scores – People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
11	22	C/O/D	Windfarm Site + 10nm	Allision: Recreational	Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation.	Multiple minor injuries; Minor damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	2	Multiple serious injuries/single fatality; Loss of small craft; Minor pollution incident (Tier 2); National adverse publicity; Repairs to WTGs.	4	4	2	4	1	3.8	Negligible Risk - Broadly Acceptable

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
12	17	C/D	Windfarm Site + 10nm	Allision: Large Project	Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Vessel Traffic Monitoring.	Multiple minor injuries; Moderate damage to vessel; No pollution; Widespread adverse publicity; Repairs to WTGs;	2	3	1	3	2	Single fatality; Serious damage, drydock required; Moderate pollution incident (Tier 2); International adverse publicity; Loss of WTGs.	4	4	3	5	1	4.9	Low Risk - Broadly Acceptable

								Baseline											Baseline Risk Score	
								Realistic Most Likely Scores						Realistic Worst Credible Scores						
ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
13	18	C/O/D	Windfarm Site + 10nm	Allision: Small Project	Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels.	Multiple minor injuries; Minor damage to small craft; No pollution; Minor adverse publicity; Repairs to WTGs.	2	2	1	2	3	Single fatality; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to WTGs.	4	4	3	4	1	4.8	Low Risk - Broadly Acceptable
14	16	C/O/D	Windfarm Site	Snagging: Fishing	Insufficient Lookout; Inadequate Passage Planning; Human Error/Fatigue; Poor Visibility in Area;	Notice to Mariners; Site Marking and Charting; Safety Zones; Incident Investigation and Reporting;	Multiple minor injuries; Minor damage; No pollution; Minor adverse publicity.	2	2	1	2	3	Multiple serious injuries/single fatality; Serious damage/Loss of small craft; Minor pollution; Repairs to cable/armour.	4	4	2	3	2	6.4	Medium Risk - Tolerable (if ALARP)

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores – People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores – People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
					Charts not up to date.															
15	23	C/O/D	Windfarm Site	Snagging: Recreational	Insufficient Lookout; Inadequate Passage Planning; Human Error/Fatigue; Poor Visibility in Area; Charts not up to date.	Notice to Mariners; Site Marking and Charting; Safety Zones; Incident Investigation and Reporting;	Minor injuries; Minor damage; No pollution; Minor adverse publicity.	1	2	1	2	2	Multiple serious injuries/single fatality; Moderate damage; Minor pollution (Tier 1); Repairs to cable/armour.	4	3	2	3	1	3.5	Negligible Risk - Broadly Acceptable
16	21	C/O/D	Windfarm Site	Snagging: Ferry & Passenger & Cargo & Tanker	Insufficient Lookout; Inadequate Passage Planning; Human Error/Fatigue; Poor Visibility in Area; Charts not up to date.	Notice to Mariners; Site Marking and Charting; Safety Zones; Incident Investigation and Reporting;	Minor injuries; No property damage; No pollution; Widespread adverse publicity; Survey of cable.	1	1	1	3	2	Multiple serious injuries/single fatality; Serious damage; Minor pollution; Cable out of service until repaired.	4	4	2	3	1	4.1	Negligible Risk - Broadly Acceptable

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Baseline: Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores: People	Property	Environment	Business	Frequency	Baseline: Realistic Worst Credible Scenario	Baseline: Realistic Worst Credible Scores: People	Property	Environment	Business	Frequency	Baseline Risk Score: Baseline Risk Score	Baseline Risk Score: Baseline Risk Rating
17	20	C/O/D	Windfarm Site	Snagging: Large Project, Small Project and Tug & Services.	Insufficient Lookout; Inadequate Passage Planning; Human Error/Fatigue; Poor Visibility in Area; Charts not up to date.	Notice to Mariners; Site Marking and Charting; Safety Zones; Incident Investigation and Reporting;	Multiple minor injuries; Minor damage; No pollution; Minor adverse publicity; Survey of cable.	2	2	1	2	3	Multiple serious injuries/single fatality; Serious damage; Minor pollution (Tier 1); Cable out of service until repaired.	4	4	2	3	1	4.6	Low Risk - Broadly Acceptable
18	5	C/O/D	O&M Route	Collision: Small Project ICW. Ferry & Passenger, Cargo & Tanker	Increased Project Vessel Movements; Human Error/Poor Seamanship; Failure to Comply with COLREGs; Fatigue; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; ERCOP; Incident Investigation and Reporting; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple major injuries; Moderate damage to small craft; Minor pollution (Tier 1); Widespread adverse publicity; Short term interruption to ferry services.	3	3	2	3	3	Multiple fatalities; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity. Long term interruption to ferry services.	5	4	3	4	2	8.8	Medium Risk - Tolerable (if ALARP)

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores – People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores – People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
19	14	C/O/D	O&M Route	Collision: Small Project ICW. (Other) Small Craft	Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels; Vessel Traffic Monitoring.	Multiple minor injuries; Minor damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	3	Single fatality; Moderate damage; Moderate pollution incident (Tier 2); National adverse publicity.	4	4	3	4	2	6.7	Medium Risk - Tolerable (if ALARP)
20	18	C/O/D	O&M Route	Allision / Grounding: Small Project	Increased Project Vessel Movements; Human Error/Poor Seamanship; Fatigue; Mechanical Failure; Adverse Weather; Avoidance of Small Craft; Reduced Visibility;	Notice to Mariners; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Marine Operating Guidelines; Vessel Standards; Training; Compliance of Project Vessels.	Multiple minor injuries; Minor damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	3	Single fatality; Loss of small craft; Moderate pollution incident (Tier 2); National adverse publicity; Repairs to WTGs.	4	4	3	4	1	4.8	Low Risk - Broadly Acceptable

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores – People	Property	Environment	Business	Frequency	Realistic Worst Credible Scenario	Realistic Worst Credible Scores – People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
21	9	C/O/D	Windfarm Site + 10nm & O&M Route	Vessel Emergency - Ferry & Passenger, Cargo & Tanker and Large Project	Human Error/Poor Seamanship; Fatigue; Mechanical Failure; Adverse Weather;	ERCOP; Periodic Exercises; Incident Investigation and Reporting;	Multiple minor injuries; Minor damage to vessel; No pollution; Minor adverse publicity.	2	2	1	2	3	Multiple fatalities; Major damage; Major pollution incident (Tier 3); International adverse publicity.	5	5	5	5	2	7.8	Medium Risk - Tolerable (if ALARP)
22	12	C/O/D	Windfarm Site + 10nm & O&M Route	Vessel Emergency - Small Craft	Human Error/Poor Seamanship; Fatigue; Mechanical Failure; Adverse Weather;	ERCOP; Periodic Exercises; Incident Investigation and Reporting;	Multiple minor injuries; Minor damage to small craft; No pollution; Minor adverse publicity.	2	2	1	2	3	Multiple fatalities; Serious damage; Serious pollution incident (Tier 2); National adverse publicity.	5	4	4	4	2	7.4	Medium Risk - Tolerable (if ALARP)
23	1	C/O/D	Windfarm Site + 10nm	Allision with O&G Infrastructure: Cargo & Tankers	Presence of WTGs; Reduced Searoom Between OWFs; Increased Project Vessel Movements; Human Error/Poor Seamanship; AtoNs Failure; Fatigue; Radar Interference from WTGs; Mechanical Failure; Adverse	Notice to Mariners; Site Marking and Charting; Safety Zones; ERCOP; Periodic Exercises; Incident Investigation and Reporting; Aids to Navigation; Air Draught Clearance; Layout Plan and Lines of Orientation;	Multiple major injuries; Moderate damage to vessel; Moderate pollution incident (Tier 2); Widespread adverse publicity; Repairs to WTGs;	5	5	3	5	2	Multiple fatalities; Major Damage, drydock required; Serious pollution incident (Tier 2); International adverse publicity; Loss of WTGs.	5	5	5	5	2	9.8	Medium Risk - Tolerable (if ALARP)

ID	Baseline Haz. Rank	Project Phase	Area	Hazard Title	Possible causes	Embedded Mitigation	Realistic Most Likely Scenario	Baseline: Realistic Most Likely Scores					Realistic Worst Credible Scenario	Realistic Worst Credible Scores					Baseline Risk Score	
								People	Property	Environment	Business	Frequency		People	Property	Environment	Business	Frequency	Baseline Risk Score	Baseline Risk Rating
					Weather; Avoidance of Small Craft; Reduced Visibility;	Vessel Traffic Monitoring.														

Appendix E Vessel Traffic Surveys

NASH
MARITIME
+44 (0) 2380 381 681
info@nashmaritime.com
www.nashmaritime.com