Arklow Bank Wind Park 2

Environmental Impact Assessment Report

Volume III, Appendix 15.1: Navigational Risk Assessment

sse Renewables

Arklow Bank Wind Park 2

Navigational Risk Assessment

Prepared by	Anatec Limited
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Glossary of Terms

Term	Definition
Array Area	The Array Area is the area within which the Wind Turbine Generators (WTGs), the Offshore Substation Platforms (OSPs), and associated cables (export, inter- array and interconnector cabling) and foundations will be installed.
Allision	The act of striking or collision of a moving vessel against a stationary object.
Automatic Identification System (AIS)	A system by which vessels automatically broadcast their identity, key statistics including location, destination, length, speed and current status, e.g. under power. Most commercial vessels and European Union (EU) fishing vessels over 15 metres (m) in length are required to carry AIS.
Base Case	The current amount of traffic, including seasonal variation, in the vicinity of the Array Area as identified on AIS and Radar.
Cable Corridor and Working Area	The Cable Corridor and Working Area is the area within which export, inter-array and interconnector cabling will be installed This area will also facilitate vessel jacking operations associated with installation of WTG structures and associated foundations within the Array Area.
Collision	The act or process of colliding (crashing) between two moving objects.
Factored In Mitigation	Measures which have been identified by this assessment to reduce the potential risks posed at all stages of the wind farms development which form part of the design of the Proposed Development.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity.
Future Case	The assessment of risk based on the predicted growth in shipping densities and traffic types as well as foreseeable changes in the marine environment.
International Maritime Organization (IMO) Routeing Measure	Predetermined shipping routes established by the IMO.
Main Route	Defined transit route (mean position) of commercial vessels identified within the specified Study Area.

Term	Definition
Marine Guidance Note (MGN)	A system of guidance notes issued by the UK Maritime and Coastguard Agency (MCA) which provide significant advice relating to the improvement of the safety of shipping at sea, and to prevent or minimise pollution from shipping.
Navigational Risk Assessment (NRA)	A document which assesses the overall impact to shipping and navigation of a proposed Offshore Renewable Energy Installation (OREI) based upon Formal Risk Assessment (FSA).
Offshore Renewable Energy Installation (OREI)	As defined by *Marine Guidance Note 654 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response* (MCA, 2021). For the purposes of this report and in keeping with the consistency of the EIA, OREI can mean offshore Wind Turbine Generators (WTG) and the associated electrical infrastructure such as offshore substation platforms.
Radio Detection and Ranging (Radar)	An object-detection system which uses radio waves to determine the range, altitude, direction or speed of objects.
Traffic Separation Scheme (TSS)	A traffic management route system ruled by the International Maritime Organization (IMO). The traffic lanes (or clearways) indicate the general direction of the vessels in that zone; vessels navigating within a TSS all sail in the same direction or they cross the lane at an angle as close to 90 degrees (°) as possible.
Unique Vessel	An individual vessel identified on any particular calendar day, irrespective of how many tracks were recorded for that vessel on that day. This prevents vessels being over counted. Individual vessels are identified using their Maritime Mobile Service Identity (MMSI).
Vessel Traffic Service (VTS)	A service implemented by a Competent Authority designed to improve the safety and efficiency of vessel traffic and to protect the environment. The service should have the capability to interact with the traffic and to respond to traffic situations developing in the VTS area.

Abbreviations Table

Abbreviation	Definition
µPa	Micro Pascals
ABWP1	Arklow Bank Wind Park 1
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ALB	All-weather lifeboat
ARPA	Automatic Radar Plotting Aid
BBC	British Broadcasting Corporation
BEIS	Business, Energy and Industrial Strategy (UK)
BWEA	British Wind Energy Association
CA	Cruising Association
CBA	Cost Benefit Analysis
CBRA	Cable Burial Risk Assessment
CIA	Cumulative Impact Assessment
CHIRP	Confidential Human Factors Incident Reporting Programme
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea
CSO	Central Statistics Office
CTV	Crew Transfer Vessel
dB	Decibels
DF	Direction Finding
DfT	Department for Transport (UK)
DPC	Dublin Port Company
DSC	Digital Selective Calling
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
EBA	European Boating Association

Abbreviation	Definition
ERCoP	Emergency Response Cooperation Plan
FLO	Fisheries Liaison Officer
FRB	Fast Rescue Boat
FSA	Formal Safety Assessment
GE	General Electric
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
HAT	Highest Astronomical Tide
HDD	Horizontal Directional Drilling
HSE	Health, Safety and Environment
IAA	Irish Aviation Authority
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ILB	Inshore Lifeboats
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
IPS	Intermediate Periphery Structure
IRCG	Irish Coast Guard
ITAP	Institut für technische und angewandte Physik
ITOPF	International Tanker Owners Pollution Federation
kHz	Kilohertz
km	Kilometre
LMP	Lighting and Marking Plan
LOA	Length Overall
m	Metre
MAIB	Marine Accident Investigation Branch (UK)
MCA	Maritime and Coastguard Agency (UK)
MCIB	Marine Casualty Investigation Branch
MEHRA	Marine Environmental High Risk Area
MEPC	Marine Environment Protection Committee

Abbreviation	Definition
MGN	Marine Guidance Note
MHWS	Mean High Water Spring
MIDA	Marine Irish Digital Atlas
MMSI	Mobile Maritime Service Identity
MOD	Ministry of Defence
MSC	Maritime Safety Council
MSI	Maritime Safety Information
MSO	Marine Survey Office
MW	Megawatt
N	North
NAVTEX	Navigational Telex
nm	Nautical Mile
nm^2	Square Nautical Miles
NMOC	National Maritime Operations Centre
NOREL	Nautical and Offshore Renewable Energy Liaison
NtM	Notice to Mariners
NRA	Navigational Risk Assessment
OMF	Operation and Maintenance Facility
OREI	Offshore Renewable Energy Installation
OSP	Offshore Substation Platforms
OSPAR	Oslo and Paris
PLA	Port of London Authority
PLL	Potential Loss of Life
POB	People on Board
POCC	Port of Cork Company
QHSE	Quality, Health, Safety and Environment
Racon	Radar Beacon
REZ	Renewable Energy Zones
RIB	Rigid-hulled Inflatable Boat
RNLI	Royal National Lifeboat Institution

Abbreviation	Definition
RoPax	Roll-on/Roll-off Passenger
RoRo	Roll on Roll off
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SAR	Search and Rescue
SCADA	Supervisory Control and Data Acquisition
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea
SOV	Service Operation Vessel
SPS	Significant Periphery Structure
TCE	The Crown Estate
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
VHF	Very High Frequency
VMP	Vessel Management Plan
VTS	Vessel Traffic Service
SONAR	Sound Navigation Ranging
W	West
WGS84	World Geodetic System 1984
WTG	Wind Turbine Generator

1 Introduction

Anatec was commissioned by Sure Partners Limited (SPL) (hereafter 'the Developer') to undertake a Navigational Risk Assessment (NRA) for the proposed Arklow Bank Wind Park 2 Offshore Infrastructure (hereafter 'the Proposed Development'). The purpose of the NRA is to inform Volume II, Chapter 15: Shipping and Navigation of the Environmental Impact Assessment Report (EIAR) and forms an appendix to this chapter.

1.1 Navigational Risk Assessment

The EIAR provides an environmental assessment of a development and is utilised for informing the management of the construction, operational and maintenance, and decommissioning phases of a project. An important requirement of the EIAR for offshore developments is the NRA which is the technical report for shipping and navigation. This has been prepared in-line with relevant guidance as determined via consultation with key stakeholders, primarily the Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 654 (MCA, 2021) and its annexes which is widely recognised as current best practice including by Irish stakeholders. It is noted that equivalent Irish guidance is expected in the near future, and it is understood that this guidance will closely resemble MGN 654. Further details on guidance are provided in Section 2.

In line with MGN 654, this NRA includes:

- Overview of existing environment;
- Vessel traffic survey;
- Implications of offshore wind farms including position of Wind Turbine Generators (WTGs);
- Assessment of navigational risk pre- and post-development of the Proposed Development;
- Formal Safety Assessment (FSA);
- Implications on marine navigation and communication equipment;
- Identification of mitigation measures;
- Emergency response; and
- Future monitoring.

The NRA has been reviewed for all phases of the Proposed Development, namely:

- Construction;
- Operational and Maintenance; and
- Decommissioning.

There are two layout design scenarios under consideration, both of which have been assessed in full in the NRA. Further details on project design are provided in Volume II, Chapter 4: Description of Development and further details on Environmental Impact Assessment (EIA) methodology are provided in Volume II, Chapter 5: EIA Methodology.

2 Guidance and Legislation

2.1 Primary Guidance

The primary guidance documents used to inform this NRA are as follows:

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

It is noted that the Irish Coast Guard (IRCG), Irish Lights and the Marine Survey Office (MSO) have been consulted with respect to the guidance that should be followed for shipping and navigation risk assessment. It was confirmed that, at present, they look towards the UK guidance in the absence of equivalent detailed guidance in Ireland. Equivalent Irish guidance is expected in the near future, which is expected to closely resemble MGN 654 (MCA, 2021) based on current general understanding.

The MGN 654 approach is centred on risk management and requires that sufficient controls are, or will be, in place for the assessed risk (base case and future case) to be judged as broadly acceptable, tolerable, or unacceptable.

2.2 Other Guidance

Other guidance documents used during the assessment are as follows:

- *MGN 372 Amendment 1 (Merchant and Fishing) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs* (MCA, 2022);
- *International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Guidance G1162 on The Marking of Offshore Man-Made Structures* (IALA, 2021);
- *The Royal Yachting Association's (RYA) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy (RYA, 2019); and*
- *The European Boating Association's (EBA's) Position Statement Marine Renewable Energy Developments (EBA, 2023).*

3 Navigational Risk Assessment Methodology

3.1 Formal Safety Assessment Methodology

A shipping and navigation receptor can only be affected by a hazard if there is a pathway through which an impact can be transmitted between the source activity and the user. In cases where a user is exposed to a hazard, the overall severity of consequence to the user is determined. This process incorporates a degree of subjectivity. Assessments for shipping and navigation users apply various criteria including the following:

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

3.2 Formal Safety Assessment Process

The IMO FSA process (IMO, 2018) approved by the IMO in 2018 under Maritime Safety Council (MSC)-Marine Environment Protection Committee (MEPC).2/Circ. 12/Rev.2 was applied within the two Hazard Workshops (see Section 6) by using the five steps outlined below and subsequently within the matrices used to assess impacts. The FSA is a structured and systematic methodology based upon risk analysis and Cost Benefit Analysis (CBA) (if applicable) to reduce impacts to As Low as Reasonably Practicable (ALARP). There are five basic steps within this process as illustrated in Figure 15.1.1 and detailed in the following list:

- Step 1 – identification of hazards (a list is produced of hazards prioritised by risk level specific to the problem under review);
- Step 2 – risk analysis (investigation of the causes and initiating events and consequences of the more important hazards identified in step 1);
- Step 3 – risk control options (identification of measures to control and reduce the identified hazards);
- Step 4 – CBA (identification and comparison of the benefits and costs associated with the risk control options identified in step 3); and
- Step 5 – recommendations for decision-making (defining of recommendations based upon the outputs of steps 1 to 4).

Figure 15.1.1 Flow chart of the FSA methodology

3.3 Hazard Workshop Methodology

A key tool used in the NRA process is the Hazard Workshop which ensures that all risks are identified and qualified in agreement with interested parties prior to assessment using the EIAR methodology. Table 15.1.1 and Table 15.1.2 identify how the severity of consequence and the frequency of occurrence are defined within the Hazard Log, respectively.

Table 15.1.1 Severity of consequence ranking definitions used in Hazard Log

Rank	Description	Definition			
		People	Property	Environmental	Business
1	Negligible	No perceptible impact	No perceptible impact	No perceptible impact	No perceptible impact
2	Minor	Slight injury(s)	Minor damage to property i.e., superficial damage	Tier 1 local assistance required	Minor reputational risks – limited to users
3	Moderate	Multiple minor or single serious injury	Damage not critical to operations	Tier 2 limited external assistance required	Local reputational risks

Rank	Description	Definition			
		People	Property	Environmental	Business
4	Serious	Multiple serious injuries or single fatality	Damage resulting in critical impact on operations	Tier 2 regional assistance required	National reputational risks
5	Major	More than one fatality	Total loss of property	Tier 3 national assistance required	International reputational risks

Table 15.1.2 Frequency of occurrence ranking definitions used in Hazard Log

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

The severity of consequence and frequency of occurrence are then used to define the significance of risk via a tolerability matrix approach as shown in Table 15.1.3. The tolerability of a hazard is defined as Broadly Acceptable (low risk), Tolerable (intermediate risk) or Unacceptable (high risk).

Table 15.1.3 Tolerability matrix and risk rankings

Severity of Consequence						
	5	Tolerable	Tolerable	Unacceptable	Unacceptable	Unacceptable
	4	Broadly Acceptable	Tolerable	Tolerable	Unacceptable	Unacceptable
	3	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable	Unacceptable
	2	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable	Tolerable
	1	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Broadly Acceptable	Tolerable
		1	2	3	4	5
		Frequency of occurrence				

(red)	Unacceptable (high risk)
(orange)	Tolerable (intermediate risk)
(green)	Broadly Acceptable (low risk)

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

3.4 Methodology for Cumulative Impact Assessment

The impacts identified in the FSA are also assessed for cumulative impacts with the inclusion of other projects and plans – known as the Cumulative Impact Assessment (CIA). For the purposes of the NRA, given the international nature of shipping, other developments within 50 nautical miles (nm) are considered and screened for potential effect on a cumulative basis. This distance is considered adequate taking into account the geographical position of the Proposed Development located over a sand bank and the navigational features of the surrounding area of the Irish Sea which mean that any effects will be localised. It is also a standard value used for similar assessments in the UK.

Where any hazard pathway is found, a cumulative assessment is undertaken, applying the same FSA methodology as set out in Section 3.1.

Given the varying type, status and location of developments, a tiered approach to cumulative risk assessment has been undertaken within the NRA, which splits developments into tiers depending upon project status, proximity to the Proposed Development and the level to which they are anticipated to cumulatively impact relevant users. It also considers data confidence, most notably in terms of the level of certainty over the location and timescales for a development. The tiering process is described as follows:

- Tier 1: Phase One projects within 50 nm that may interact with routeing also impacted by the Array Area; and
- Tier 2: Other projects within 50 nm.

Tier 1 projects are assessed for the potential of cumulative deviations within the NRA. Tier 2 projects have been screened out of the cumulative routeing assessment on the basis that data confidence is insufficient to meaningfully assess cumulative deviations.

It is noted that this tiering system is bespoke for the NRA. This is due to the cumulative influence from other developments on vessel routeing being a key screening criteria for the NRA. Full details of the wider tiering approach are provided in Volume II, Chapter 5: EIA Methodology.

3.5 Transboundary Impact Assessment Methodology

Transboundary impacts of offshore wind developments with regards to vessel routeing and international ports have also been assessed. Any fishing, recreation and marine aggregate dredging impacts, although they have the potential to be internationally owned or located, have been considered as part of the baseline assessment.

3.6 Assumptions

The shipping and navigation baseline and impact assessments have been undertaken based upon the information available and responses received at the time of preparation. Potential hazards have been assessed based upon the relevant design parameters selected for shipping and navigation hazards.

4 Description of Development

This section provides details of the Proposed Development relevant to shipping and navigation. The Proposed Development consists of the Array Area, and the Cable Corridor and Working Area. The Array Area is located between approximately 3.2 nm and 8.3nm (6 and 15 kilometres (km)) off the east coast of Ireland, covers an area of approximately 19 square nautical miles (nm^2) and is situated on and around the Arklow Bank itself. The Proposed Development will accommodate up to 800 megawatts (MWs) export capacity and will be constructed over a period of up to five years.

4.1 Array Area Key Coordinates

The coordinates defining the Array Area are illustrated in Figure 15.1.2 and provided in Table 15.1.4 (using World Geodetic System 1984 (WGS84)). The existing Arklow Bank Wind Park 1 (ABWP1) WTGs are shown for reference.

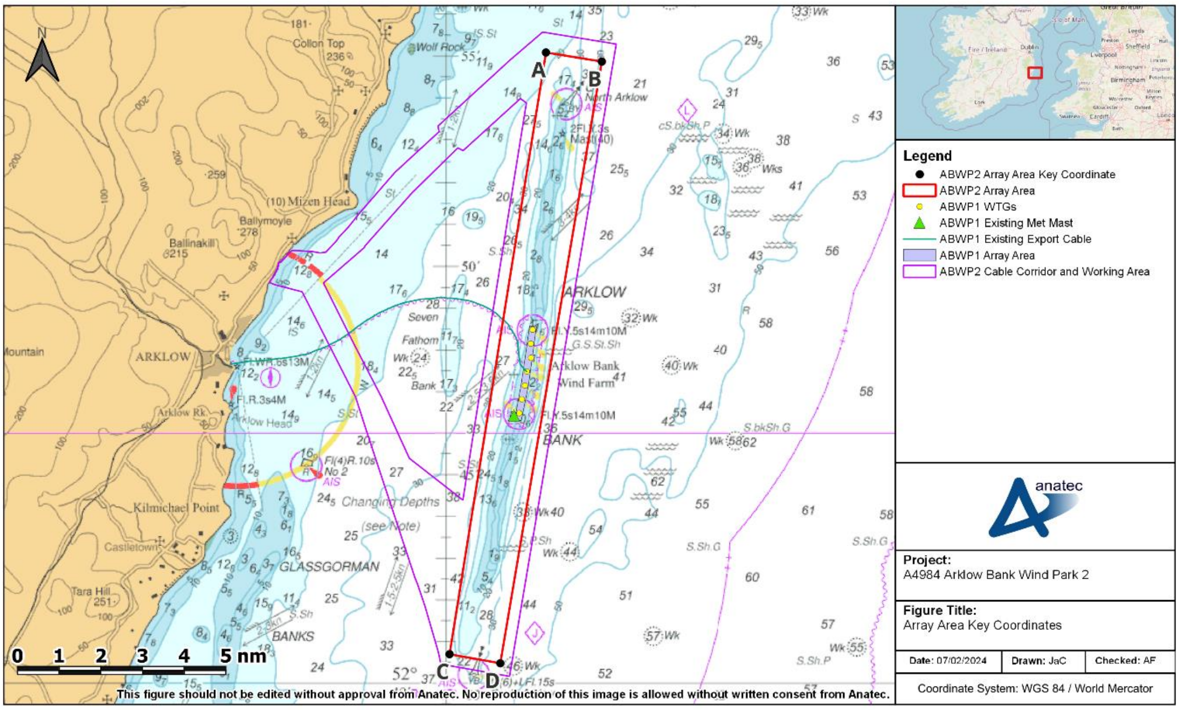

Figure 15.1.2 Key Coordinates of Array Area (Geographic)

Table 15.1.4 Key Coordinates of Array Area (Numeric)

Point	Latitude	Longitude
A	052° 55’ 05’’ North (N)	05° 56’ 03’’ West (W)
B	052° 54’ 52’’ N	05° 53’ 51’’ W
C	052° 40’ 42’’ N	05° 59’ 51’’ W
D	052° 40’ 29’’ N	05° 57’ 51’’ W

4.2 Surface Infrastructure

The Developer is seeking consent for a 56 WTG layout (Project Design Option 1) or a 47 WTG layout (Project Design Option 2). The Developer is also seeking consent for two Offshore Substation Platforms (OSPs), with their positions consistent between the two WTG layouts. Both layouts have been assessed in the NRA including via collision and allision modelling (see Section 17).

There are also eight existing structures (seven WTGs and one monopile with a met mast installed) associated with ABWP1 within the centre of the Array Area. These structures are considered to be part of the baseline environment (see Section 9.2).

Figure 15.1.3 and Figure 15.1.4 present the 56-WTG layout (Project Design Option 1) and the 47-WTG layout (Project Design Option 2), respectively.

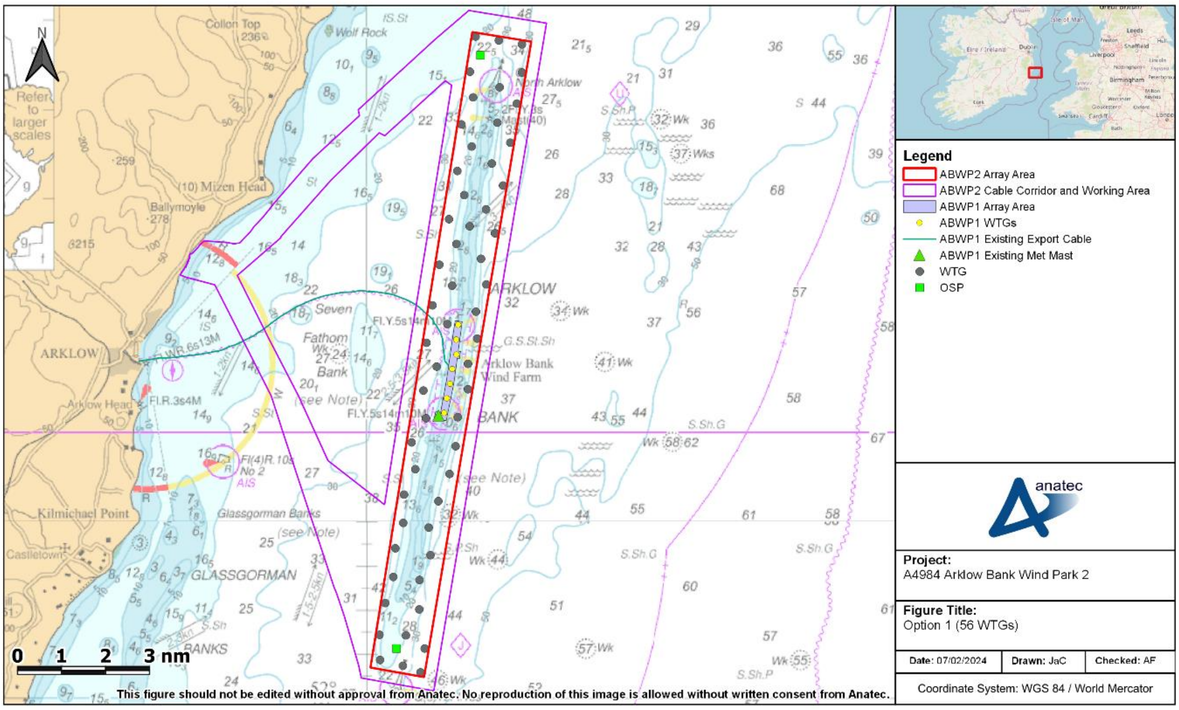

Figure 15.1.3 Overview of Project Design Option 1 (56 WTGs)

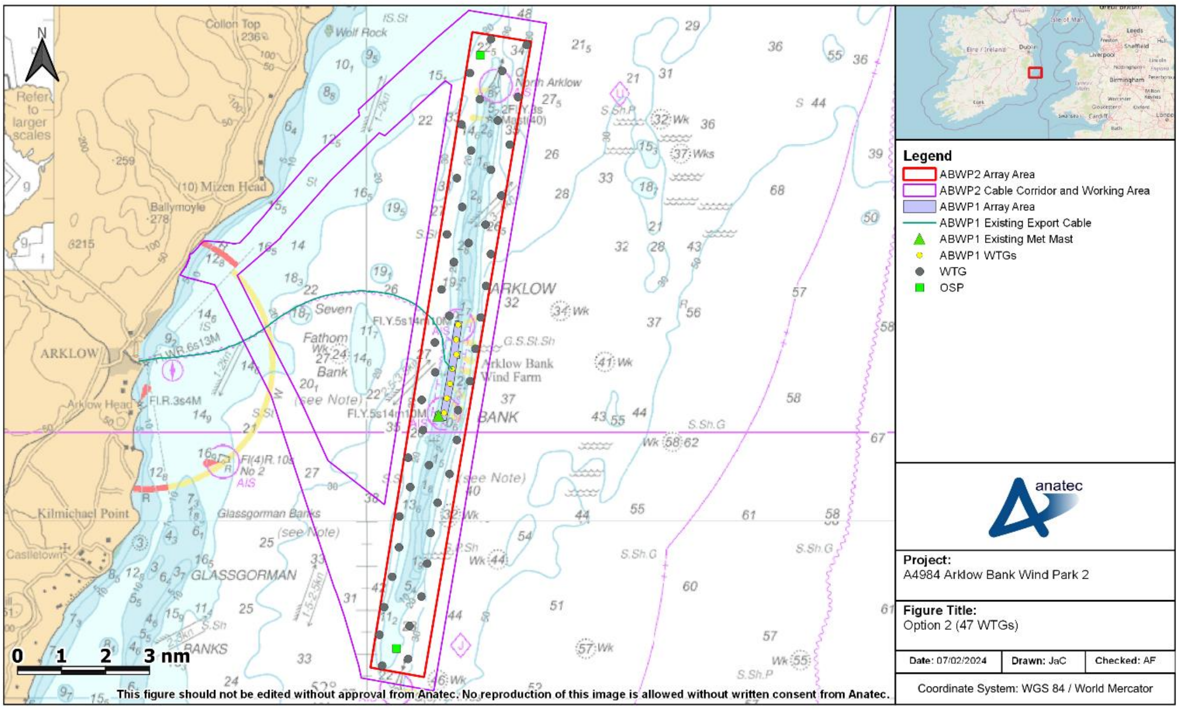

Figure 15.1.4 Overview of Project Design Option 2 (47 WTGs)

4.2.1 Wind Turbine Generators

Key WTG parameters used in the NRA modelling are provided in Table 15.1.5.

Table 15.1.5 WTG parameters used in the NRA modelling

Parameter	Project Design Option 1	Project Design Option 2
Number of WTGs	56	47
Foundation type	Monopile	Monopile
Maximum Foundation dimensions at sea surface	11 metres (m)[1]	11 m

4.2.2 Offshore Substation Platforms

The OSPs are designed to collect the electricity generated by the WTGs for delivery to shore. The structures will be installed on monopile foundations, however, to ensure the greatest risk is modelled, topside dimensions have been assessed rather than surface level dimensions, as presented in Table 15.1.6.

[1] Diameters under consideration range from 7-11m. The greatest value (11m) has been used in the NRA modelling as this will create the greatest allision risk.

Table 15.1.6 OSP parameters used in the NRA modelling

Parameter	Specification
Number of OSPs	2
Topside Dimensions (rectangle)	46 m × 33.5 m

4.3 Subsea Infrastructure

4.3.1 Inter Array Cables

Inter array cables will connect individual WTGs and the OSPs using Alternating Current (AC). Between 110 and 122 km of inter array cables will be required. Cable burial will involve creating trenches to a maximum of 15 m wide and it is anticipated that burial depth will be between 0 and 1.5 m.

4.3.2 Offshore Export Cables

Offshore export cables will connect the OSP(s) to shore with two offshore export cables installed using AC, with total length of between 35 and 40km. Cable burial will involve creating trenches to a maximum of 15 m wide and it is anticipated that burial depth will be between 0 and 2.5 m, with external cable protection above the seabed used where necessary.

4.3.3 OSP Interconnectors

There will be an interconnector cable joining the OSPs, with length between 25 and 28 km.

Cable burial will involve creating trenches to a maximum of 15 m wide and it is anticipated that burial depth will be between 0 – 2.5 m, with a cable protection height to a maximum of 1.8 m.

4.4 Construction Phase

The offshore construction phase is anticipated to occur over a period of up to five years. Table 15.1.7 provides an indicative construction programme for the Proposed Development which indicates the approximate duration of each element in the construction process. It should be considered that this is dependent on various factors, and therefore is subject to change.

Table 15.1.7 Indicative construction programme

Activity	Year 1				Year 2				Year 3				Year 4				Year 5			
Seabed preparation activities																				
Landfall Horizontal Directional Drilling (HDD) / direct pipe works																				
Foundations installation																				
OSP installation and commissioning																				
Offshore export cable installation																				
Inter-array cable installation																				
WTG installation																				
WTG commissioning																				
Completions and snagging																				

4.5 Operational and Maintenance Phase

Activities are assumed throughout the operational and maintenance phase, with Arklow Harbour chosen as the base port for the Operations and Maintenance Facility (OMF).

During both the construction and operational and maintenance phases, logistics will be managed by a marine coordination team and an integrated Health, Safety and Environment (HSE) management system will be in place to ensure control of all vessels and their respective works. Further details are provided in Volume III, Appendix 25.1: Environmental Management Plan.

5 Factored In Measures

5.1 Overview

The following factored in measures form part of the design of the Proposed Development and have therefore been assumed as being in place within the impact assessment undertaken in Volume II, Chapter 15: Shipping and Navigation. Due to the lack of offshore wind development in Ireland to date, much of this section draws upon standard industry practice in the UK:

- Use of 'rolling'/temporary 500 m advisory safe passing distances surrounding the location of all proposed/fixed structures where work is being undertaken by a construction or maintenance vessel;
- Use of 'rolling'/temporary 500 m advisory clearance distances around installation/maintenance vessels;
- Use of 50 m advisory safe passing distances around all surface structures up until the point of commissioning;
- Appropriate vessel health and safety including IMO conventions and HSE requirements;
- Cable Burial Risk Assessment (CBRA) undertaken pre-construction including consideration of under keel clearance and appropriate cable protection applied based upon the outcomes;
- Charting of all structures associated with the Proposed Development on relevant nautical and electronic charts;
- Compliance from all project vessels with Irish Law, international maritime regulations as adopted by the relevant flag state including the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) (IMO, 1972/77) and International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974);
- Consideration of MGN 654 (MCA, 2021) guidance with respect to WTG design and construction;
- Creation and implementation of an Emergency Response Cooperation Plan (ERCoP) (Volume III, Appendix 25.5: Emergency Response Cooperation Plan);
- Implementation of a buoyed construction/decommissioning area around the Array Area during the respective phases;
- Lighting and marking in accordance with IALA Guidance G1162 (IALA, 2021) and Irish Lights requirements during both the construction and operational and maintenance phases (Volume III, Appendix 25.6: Lighting and Marking Plan);
- Marine pollution contingency planning;
- Marine coordination;
- Creation and implementation of a Vessel Management Plan (VMP), including operational procedures such as the use of entry/exit points to manage the movement of project vessels (Volume III, Appendix 25.7: Vessel Management Plan);
- Minimum WTG blade clearance above Mean High Water Spring (MHWS) of at least 22 m in line with UK MCA and RYA Guidance;

- Circulation of information via Notice to Mariners (NtM) and other appropriate means including a Fisheries Liaison Officer (FLO);
- Provision of self-help capability;
- Use of a temporary guard vessel where justified by risk assessment, e.g. to protect unlit structures and/or unprotected cable prior to burial;
- Vessel traffic monitoring by Automatic Identification System (AIS) during the construction phase; and
- Any water depths reductions from subsea project infrastructure that of more than 5% referenced to chart datum will be consulted on with the MSO.

The following subsections provide greater detail of key factored in mitigation measures, including in relation to marine aids to navigation and other lighting and marking considerations.

5.2 Marine Aids to Navigation

Throughout the construction, operational and maintenance, and decommissioning phases of the Proposed Development, marine aids to navigation will be provided in accordance with the requirements of Irish Lights and will comply with IALA G1162 (IALA, 2021), unless alternative requirements are agreed with Irish Lights. Further details are provided in the LMP (Volume III, Appendix 25.6: Lighting and Marking Plan).

All navigational aids will be suitably monitored and maintained to ensure the relevant IALA availability targets are met.

5.3 Wind Farm Layout Numbering

The numbering of the structures within the Proposed Development shall consider the guidance in MGN 654 Annex 5. The numbering shall follow a navigationally logical and sequential manner, using a combined alphabetical and numerical order as far as is practicable, with the wind farm designator code used as a prefix.

The numbering will be such that from a SAR perspective the numbering and orientation is aligned with any agreed 'SAR Access Lanes' such that the progression through the Proposed Development is indicated by increment/decrement of WTGs in a logical fashion. Note letters 'O' and 'I' should not be used to avoid confusion or misunderstanding with numbers 0 and 1.

5.4 Future Monitoring

5.4.1 Safety Management System and Emergency Response Planning

Quality, Health, Safety and Environment (QHSE) documentation, including a policy statement, Safety Management System (SMS) and ERCoP (see Section 5), will be in place for the Proposed Development prior to construction. This will be continually updated throughout the development process. The following subsections provide an overview of this documentation and how it will be maintained and reviewed with reference, where required, to specific marine documentation.

Monitoring, reviewing and auditing will be undertaken on all procedures and activities and feedback actively sought. Any designated person, managers and supervisors are to maintain continuous monitoring of all marine operations and determine if all required procedures and processes are being correctly implemented.

5.4.2 Future Monitoring of Vessel Traffic

The monitoring of third party vessel traffic by AIS is expected to occur during construction and early operation to ensure that measures in place are effective.

The vessel traffic data collected will be compared against the results of the vessel traffic analysis (see Section 13) and predicted post wind farm routeing (see Section 17.3) to ensure the findings of the NRA remain valid.

5.4.3 Subsea Cables

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

If exposed cables or ineffective protection measures were to be identified during post-construction monitoring, these would be promulgated to relevant sea users including via NtM. Where immediate risk was observed, additional temporary measures would also be deployed in consultation with Irish Lights and the MSO (such as a temporary guard vessel or buoyage) until such time as the risk was permanently mitigated.

Details will be included in full within the CBRA document which will be produced prior to construction.

5.4.4 Rehabilitation Schedule

A Rehabilitation Schedule has been developed (Volume III, Appendix 4.1: Rehabilitation Schedule). With regards to hazards on shipping and navigation, where upon decommissioning and completion of removal operations, an obstruction is left on site (attributable to the Proposed Development) which is considered to be a danger to navigation and which it has not proven possible to remove, such an obstruction may require marking until such time as it is either removed or no longer considered a danger to navigation, the continuing cost of which would need to be met by the Developer.

6 Consultation

Consultation with key shipping and navigation stakeholders has been undertaken throughout the NRA process. This section presents the consultation to date, with Section 6.1 presenting recent consultation and Section 6.2 presenting the initial consultation and early engagement undertaken at the time of the first scoping report submission in 2020. Project design has changed since this earlier consultation, however the points raised are still considered relevant and important to consider.

Section 6.2 covers:

- A Hazard Workshop held in June 2019;
- The 2020 scoping report; and
- Stakeholder meetings held prior to 2023.

Section 6.1 (recent consultation) covers:

- The 2023 Scoping Report;
- Stakeholder meetings held in 2023 onwards;
- Summary of an outreach to local vessel operators; and
- A Hazard Workshop held in August 2023.

6.1 Recent Consultation

6.1.1 Scoping 2023

Table 15.1.8 summarises the key shipping and navigation responses received to the 2023 scoping report.

Table 15.1.8 Scoping Report 2023 Summary

Stakeholder	Response	Where Addressed
Port of Cork Company (POCC) 18 August 2023	POCC consider that the ABWP2 EIAR should take account of the potential impacts on shipping & operations at the construction staging port during the construction phase and potentially the operational and decommissioning phases of any development	This has been assessed in Volume II, Chapter 15: Shipping and Navigation.

Stakeholder	Response	Where Addressed
	POCC recommend that projects have regard to the Port of Cork Masterplan 2023.	See Section 15.1.
	Projects should also have regard to all other known proposed renewable energy and carbon capture projects in the harbour and potential interactions with these projects. This cumulative assessment should consider interactions with extra shipping movements generated by its own and all other known projects during construction and operational phases.	Cumulative impacts have been assessed in Volume II, Chapter 15: Shipping and Navigation, noting that potential for traffic increases associated with port expansion is provided in Section 15.1.
	Consultation should be undertaken with: ▪ MSO; ▪ Irish Lights; ▪ SAR providers (IRCG, RNLI); ▪ Ports and harbours; ▪ Ferry and commercial vessel companies; ▪ Irish Chamber Shipping; ▪ Recreational User Groups; and ▪ Fishing Representatives.	Extensive consultation with appropriate parties including those listed have been consulted with as per this section.
	The following impacts should be considered: ▪ Displacement and third-party collision risk; ▪ Third-party to Project vessel collision risk; ▪ Allision risk; ▪ Loss of station; ▪ Port access; ▪ Impacts on existing Aids to Navigation; ▪ Subsea structure interaction; ▪ Impacts on emergency response provision; ▪ Use of navigation, communication and position fixing equipment; and ▪ Cumulative and transboundary impacts.	These impacts have been assessed in Volume II, Chapter 15: Shipping and Navigation and / or the NRA.

6.1.2 Key Stakeholder Meetings

Organisations consulted after the scoping stage, via dedicated meetings and the second Hazard Workshop, included the following:

- Dublin Port;
- IRCG;
- Irish Chamber of Shipping;
- Irish Ferries;
- Irish Lights;
- MSO;
- IAA;
- Port of Cork Company;
- Arklow Sea Scouts; and
- Royal National Lifeboat Institution (RNLI).

Table 15.1.9 summarises the key consultation undertaken after the scoping stage. Details of the Hazard Workshops (the output of which is vital to the impact assessment) are included in Sections 6.1.4 and 6.2.1.

Table 15.1.9 Summary of Key Recent Consultation

Stakeholder(s)	Date and form of correspondence	Summary Points	Response and/or where addressed in this NRA
IRCG	10 August 2023 Dedicated meeting	Noted that accommodation and rescue facilities for the OSPs would assist if any rescue operations were required or if workers were unable to return to shore.	Impacts on SAR have been assessed in Volume II, Chapter 15: Shipping and Navigation.
		Noted that non-AIS data should be considered in the assessment.	Vessel traffic surveys utilising Radar and visual observations to capture non AIS traffic have been undertaken and are assessed in Section 13.
		Indicated that lighting provisions and additional SAR mitigations are likely to resemble that within the UK MGN 654 guidance.	MGN 654 has been considered as primary guidance as detailed in Section 2.
MSO	21 August 2023 Dedicated meeting	Noted that Irish guidance is likely to closely resemble MGN 654.	This NRA has been undertaken in alignment with MGN 654 as detailed in Section 2.
		Noted content with the data collected given that it aligns with MGN 654.	The data collected aligns with MGN 654; in particular, more than 28 days of seasonal vessel traffic has been captured via AIS, Radar and visual observations (see Section 7).

Stakeholder(s)	Date and form of correspondence	Summary Points	Response and/or where addressed in this NRA
		Noted content for project to use advisory safe passing distances in lieu of safety zones, but noted that this should be clear in the promulgation of information.	Full details of approach are provided in the VMP (Volume III, Appendix 25.7: Vessel Management Plan).
		Noted that SSE should keep the United Kingdom Hydrographic Office (UKHO) informed throughout the consenting process.	
		Noted that the VMP should be circulated to shipping and navigation stakeholders.	
RNLI	22 August 2023 Hazard Workshop	Queried if due consideration was being given to recreational traffic and their harbour access.	Associated impacts have been assessed in Volume II, Chapter 15: Shipping and Navigation.
Irish Ferries	22 August 2023 Hazard Workshop	Stated that it was reassuring to see low levels of traffic at the Arklow Bank presently and therefore the low potential for a large increase in vessel displacement, including to Irish Ferry vessels.	This was reflected in the base case routeing (see Section 14) and future case routeing (see Section 15.2) used in the collision and allision modelling (see Section 17).
Dublin Port	22 August 2023 Hazard Workshop	Queried about the level of coordination in the discussions between the Arklow project and other nearby cumulative projects.	Developer is engaging with other Phase 1 projects to exchange data for the purposes of cumulative assessment.
		Noted that if water depths become particularly shallow close to shore due to cable protection then an inshore buoy may be needed but that the cable and depths should also be charted.	Underkeel clearance has been assessed in Volume II, Chapter 15: Shipping and Navigation.

Stakeholder(s)	Date and form of correspondence	Summary Points	Response and/or where addressed in this NRA
		Queried if there would be a guard vessel during construction phase.	Use of guard vessels where appropriate as determined via risk assessment has been considered as a factored in mitigation in Volume II, Chapter 15: Shipping and Navigation.
Irish Lights	6 September 2023 Dedicated meeting	Noted that they are content with the data collection process following that set out in MGN 654.	Details on data collected are presented in Section 7, noting that this includes MGN 654 compliant survey data.
		Noted there may be a need for a cardinal mark for the gap between the Proposed Development and Codling.	Buoyage requirements will be discussed and agreed with Irish Lights via the LMP process (Volume III, Appendix 25.6 Lighting and Marking Plan).
		Noted they would be looking for two to three AIS aids to navigation but that this would depend on the layout.	
		Stated that sound signals are not commonly used but could be discussed as part of the LMP process.	The LMP can be found in Volume III, Appendix 25.6: Lighting and Marking Plan.
		Stated content with the use of construction buoyage and temporary lighting for construction phase mitigations, noting that the plans would need to be agreed via the LMP.	The LMP can be found in Volume III, Appendix 25.6: Lighting and Marking Plan.

Stakeholder(s)	Date and form of correspondence	Summary Points	Response and/or where addressed in this NRA
		Indicated a buoy could be used to mark the reduction in underkeel clearance resulting from cable protection but that this would depend on the reduction.	The LMP can be found in Volume III, Appendix 25.6: Lighting and Marking Plan.

6.1.3 Regular Operator Outreach

Twelve months of vessel traffic data (see Annex A) was analysed to identify regular commercial vessel operators in the area. These operators were subsequently contacted to request comment on the Proposed Development. Responses received are provided in Table 15.1.10. The letter sent to the operators is provided in Annex C for reference.

Table 15.1.10 Regular Operators Comments Log

Operator	Response	Where Addressed
Stena Line	"our vessels on [sic] the North Sea will not be affected"	Noted.

6.1.4 Hazard Workshop (2023)

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

The Hazard Workshop was held virtually via Microsoft Teams on 22 August 2023. During the Hazard Workshop, key maritime hazards associated with the construction, operation and maintenance and decommissioning of the Proposed Development were identified and discussed. Where appropriate, hazards were considered by vessel type to ensure risk control options could be identified on a type-specific basis.

Following the Hazard Workshop, the risks associated with the identified hazards were ranked in the Hazard Log based upon the discussions held during the workshop, with appropriate factored in mitigation measures identified, including any additional measures required to reduce the risks to ALARP. The Hazard Log was then provided to the Hazard Workshop attendees for comment and their feedback incorporated into the NRA. The Hazard Log has been used to inform Volume II, Chapter 15: Shipping and Navigation and is provided in full in Annex A

Input received during the Hazard Workshop is included in Table 15.1.9. In attendance were the Arklow Sea Scots, RNLI, Irish Ferries, Dublin Port and the Irish Chamber of Shipping.

Details of the initial Hazard Workshop held in 2019 is presented in Section 6.2.1.

6.2 Initial Consultation

Organisations consulted at the original scoping report stage included the following:

- MSO;
- IRCG;
- Irish Lights;
- General Electric (GE) Energy;

- Arklow Fishing Sector;
- Arklow Marina Ltd;
- Arklow Sailing Club;
- Wicklow Harbour;
- RNLI; and
- Irish Chamber of Shipping.

Table 15.1.11 summarises the key consultation undertaken at the scoping stage.

Table 15.1.11 Summary of key initial consultation

Organisation/Date	Summary Points	Response and/or where addressed in this NRA
MSO 20 February 2019	Of the approximately 2,000 fishing vessels registered in Ireland only around 10% are required to carry AIS mandatorily. Fishing vessels switching off AIS has been known to occur. Therefore consultation with the local fishing industry is considered important.	The Arklow Fishing Sector has been included in consultation (see Table 15.1.11) and a member of the sector attended the 2019 Hazard Workshop. It is noted that the project has appointed an FLO based out of Arklow.
	There could be an issue for wind farm related vessels exiting the Array Area and encountering north-south traffic passing inshore of the Array Area.	Compliance from all project vessels with international maritime regulations including the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974) is included as a factored in mitigation measure (see Section 5). Operational procedures will be in place such as the use of entry/exit points to be used where and when possible, to manage the movement of project vessels. This is covered within the VMP (Volume III, Appendix 25.7: Vessel Management Plan).
IRCG	The IRCG is responsible for response to, and coordination of, maritime incidents which require SAR and counter pollution operations. Emergency plans will need to be developed on a case-by-case basis and a control centre/coordinator monitoring from shore will be necessary.	An overview of emergency response Is provided in Section 11. The creation and implementation of an ERCoP (Volume III, Appendix 25.5: Emergency Response Cooperation Plan) and marine coordination are included as factored in mitigation measures (see Section 5).

Organisation/Date	Summary Points	Response and/or where addressed in this NRA
	There is a lack of experience within the IRCG at present with respect to offshore wind farms and therefore there is no existing precedent in relation to the coastguard's role.	UK guidance has been used in a number of sections in this NRA pending availability of equivalent Irish guidance, including with respect to lessons learnt (see Section 8). In consultation, the IRCG indicated the UK guidance was appropriate to refer to at this time.
Irish Lights 20 February 2019	Any lighting and marking associated with the project would require statutory sanction from Irish Lights who will determine the requirements based on IALA guidance.	Lighting and marking of the Proposed Development will be agreed with Irish Lights and will broadly be in accordance with IALA G1162 (IALA, 2021). The LMP can be found in Volume III, Appendix 25.6: Lighting and Marking Plan.
	The north and south cardinal marks at the extents of the Array Area could be relocated following construction. Alternatively, aids to navigation on the WTGs may suffice with this dependent upon the final layout.	Impacts on existing aids to navigation have been considered in Section 18.10.
	Irish Lights tend to refer to UK renewables guidance and discussions at Nautical and Offshore Renewable Energy Liaison (NOREL).	UK and international guidance (i.e. IALA) have been used in a number of sections in this NRA pending availability of equivalent Irish guidance, including with respect to lessons learnt (see Section 8).
GE Wind Energy	ABWP1 was installed as a demonstrator site and plans for decommissioning cannot be confirmed at this stage.	Noted in Section 9.2. At the time of writing there are no plans for the decommissioning of the ABWP1 in the public domain.

Organisation/Date	Summary Points	Response and/or where addressed in this NRA
Arklow Fishing Sector	There is no significant seasonal variation in fishing activity levels during the year and therefore the March and July survey periods used for the vessel traffic survey data should be representative.	This is validated by the long-term data analysis; see Figure D.4.
	An estimated 10 to 11 fishing vessels operate out of Arklow Harbour with four to five on AIS. The tracks of those fishing vessels on AIS should be representative of the non-AIS traffic.	Noted in Section 13.3.
	Fishing offshore of the Array Area is considered an unlikely occurrence with fishing south of the Array Area more likely.	
	Two angling charter vessels operate out of Wicklow Harbour but do not venture as far out as the Array Area.	
	Based upon the minimum spacing of the layout potting activity should be possible within the array, with strings typically around 200 m long.	Quantitative assessment of the fishing vessel to structure allision risk is undertaken in Section 17.3.
Arklow Sailing Club	July is a peak period for recreational activity and includes the SSE Renewables Round Ireland Yacht Race which takes place biannually and results in an influx of yachts from further afield.	The SSE Renewables Round Ireland Yacht Race has been considered and assessed in the baseline assessment of recreational vessel traffic (see Section 13.3).

Organisation/Date	Summary Points	Response and/or where addressed in this NRA
	Only a proportion of recreational vessels carry AIS and these tend to be the better-equipped and longer distance vessels. Therefore, the recreational vessel tracks in the vessel traffic survey data visiting Arklow were likely visiting overnight before continuing their journey along the Irish east coast.	This has been considered as a data limitation (see Section 7.3). However, information on non-AIS traffic has been obtained from Arklow Marina (see below) and from the traffic survey conducted during geophysical work (see Annex E of this report). MGN 654 compliant vessel traffic surveys have been undertaken which account for non-AIS traffic (see Section 7).
Arklow Fishing Sector / Arklow Sailing Club / RNLI	Vessels would not deliberately cross the Arklow Bank even in a shallow vessel in perfect conditions. For example, if a local fishing vessel wanted to fish on the eastern side, they would pass around the bank rather than pass across the bank.	Noted in Section 13.3.
Wicklow Harbour	There are no known plans for expansion of the local ports at Arklow or Wicklow although Dun Laoghaire is planning to expand its commercial traffic.	Future case vessel traffic levels are considered in Section 15.1 and include consideration of port traffic.
RNLI	The number of maritime incidents at the Arklow Bank in recent years has been low. Only three grounding incidents associated with the Arklow Bank have occurred over the past 25 years.	Maritime incidents in proximity to the Proposed Development are considered in Section 12 and include a review of previous grounding incidents on the Arklow Bank.
	The RNLI station closest to an incident will most likely respond with the IRCG coordinating any operation. Lifeboats from all nearby stations may be utilised for a significant emergency. The response time from Arklow to an incident at the southern extent of the Array Area is estimated to be 25 minutes.	An overview of emergency response is provided in Section 11.

Organisation/Date	Summary Points	Response and/or where addressed in this NRA
	Partially completed structures pose a concern with regard to allision risk given that lighting would not yet be operational.	The presence of a buoyed construction area and the promulgation of information via NtM and other appropriate means are included as factored in mitigation measures (see Section 5). The LMP can be found in Volume III, Appendix 25.6: Lighting and Marking Plan. The use of temporary lighting on partial structures will also be applied.
	A large vessel suffering a mechanical failure offshore of the Array Area would likely drift east (i.e. away from the Array Area). In strong easterlies drifting towards the Array Area may occur but these are infrequent. The RNLI have successfully towed large vessels which are drifting but if unfeasible then holding the stricken vessel whilst awaiting further assistance is possible.	Quantitative assessment of the vessel to structure allision risk posed to a drifting vessel is undertaken in Section 17.3.
Irish Chamber of Shipping (Irish Ferries)	Irish Ferries do not allow Masters to pass close to the Arklow Bank and therefore the current clearance would be sufficient post wind farm. Therefore, there are no concerns in relation to vessel displacement.	Noted in Section 15.2.2.

Organisation/Date	Summary Points	Response and/or where addressed in this NRA
Arklow Marina	Season is from May to August. Average approx. 3 to 4 yachts per day during May increasing to 6 to 8 per day for June, July and August. Normal size of visiting yacht is 10 to 12 m with average draft of 2 m. Various nationalities but most commonly Irish, British and French. Visitors heading South tend to have sailed from Dublin Area, and visitors from South have usually come from Kilmore Quay Marina.	Considered in the baseline assessment of recreational vessel traffic (see Section 13.3).

6.2.1 Hazard Workshop (2019)

A Hazard Workshop was held in Arklow on Thursday 20 June 2019. The stakeholders who attended were as follows:

- Arklow Fishing Sector;
- Arklow Sailing Club;
- Irish Ferries;
- Irish Lights;
- RNLI; and
- Wicklow Harbour.

Additionally, the IRCG, MSO and Wicklow Sailing Club were unable to attend in person on the day. The IRCG and MSO were however consulted during the scoping exercise for the Proposed Development.

The Hazard Log was drafted following the Hazard Workshop and provided to the attending organisations for comment, prior to finalisation. It is noted that the updated hazard log arising from the second hazard workshop (Section 6.1.4) did not result in changes to rankings from the first hazard log, and the updated hazard log maintained all key comments raised from the first.

6.2.2 Scoping/pre-application consultation

A Scoping Report was submitted for the Proposed Development in September 2020. Relevant feedback received is summarised in Table 15.1.12 together with the section of this NRA where it is addressed. Additional pre-application consultation on the lighting and marking arrangements are also summarised.

Table 15.1.12 Scoping/pre-application consultation

Organisation	Comment	Response and/or Where Addressed in this NRA
Irish Lights – Scoping Response	Possible constraint on the navigable water in the following areas: North of the Array Area for deeper drafted vessels on the inner passage, between the Array Area and the Horseshoe buoy (southeast of Wicklow Head). Therefore, traffic may be displaced closer to shore and also prove constricting for any traffic needing to avoid the Wicklow Reef Special Area of Conservation (SAC); and Routes that transit west of the India Bank especially as the traffic already has limited searoom for passing west of the India South buoy and east of the North Arklow buoy.	Post Wind Farm Routeing (Section 17.3) considers navigable depths and other relevant navigational features.
	Dublin port is not listed as a scoping consultee but much of the traffic routeing to/from the south in the area is to/from Dublin Port and will be affected by the Proposed Development. Individual local leisure clubs/fishing interests along the east from Dublin to Wexford do not appear on the consultee list.	Dublin Port has been issued with the Scoping Report, although no response has been received to date. Local leisure and fishing clubs have also been consulted (see below). Deviations to routes are considered in Section 17.3, including vessels to/from Dublin Port.
	No mention of the Traffic Separation Scheme (TSS) in Dublin Bay.	Noted in Section 9.1.
	Changes in sediment transport may occur due to the presence of the WTGs that could alter the depths in the navigable channel to the west of the Arklow Bank.	Changes in sediment transport are addressed in Volume II, Chapter 6: Coastal Processes. Post Wind Farm Routeing (Section 17.3) has considered re-routeing a minimum of 1 nm from the Array Area. This is considered to account for changes in navigable depths which may affect routes.

Organisation	Comment	Response and/or Where Addressed in this NRA
	Observation of non-AIS traffic was from visual observations and limited to only 21 days. It is acknowledged that this is relatively limited given the potential number of non-AIS users in the area.	Consultation has been undertaken to assess non-AIS traffic behaviour which was considered to be similar to AIS traffic. MGN 654 compliant vessel traffic surveys have also been undertaken which account for non AIS traffic (see Section 7).
	The North Arklow buoy would need to be relocated or the northern limits of the Proposed Development similarly marked.	Impacts on existing aids to navigation have been considered in Section 18.10.
Sea-Fisheries Protection Authority – Scoping Response	Site investigation works for the Arklow Bank Wind Park 2 has proposed three possible locations in the application for routes to landfall. The area has already been licensed for the generation of wind power and its location on top of the banks has been in place for some time now with no effects on the local fishing fleet. The Sea-Fisheries Protection Authority have to receive contact details of the FLO appointed by the applicant and a list of the stakeholders contacted during the public consultation phase.	The Proposed Development has since been refined to include only two offshore export cable routes to landfall. See Volume II, Chapter 14: Commercial Fisheries for details of fisheries consultation and factored in mitigation measures including appointment of a FLO.
Belfast Harbour – Scoping Response	No Comment	N/A

Organisation	Comment	Response and/or Where Addressed in this NRA
Department of Defence (DoD) – Scoping Response	NtM should be promulgated prior to construction. These NtM's should indicate any restrictions around the area during construction, such as minimum restricted proximity to the site. This will assist if DoD are required to enforce these restrictions. Ideally a restricted access area should be signalled by the Coast Guard (similar to filming on Skelligs) if this is to be enforceable.	Promulgation of information via NtM and other appropriate means are included as factored in mitigation measures (see Section 5). Advisory safe passing distances shall be in place (see Section 5).
	Is there going to be any speed restrictions around the area and how close is this restriction to construction.	Advisory safe passing distances shall be in place (see Section 5). There are no plans for specific speed restrictions noting that COLREGS Rule 6 requires vessels to proceed at a safe speed in the prevailing circumstances and conditions.
	The cable runs ashore will need to be indicated in the respective charts.	All infrastructure (including cables) will be charted (see Section 5).
	What lighting is going to be marking the construction site and afterwards when the wind farm is complete.	Lighting and marking of the Proposed Development will be agreed with Irish Lights and will broadly be in accordance with IALA G1162 (IALA, 2021) (see Section 5).

Organisation	Comment	Response and/or Where Addressed in this NRA
Arklow Sailing Club	Provided a chart showing race marks, including one ('Turbine') in the vicinity of the existing ABWP1 WTGs, which is used regularly. Arklow Sailing Club race as far north as the horseshoe buoy off Wicklow and as far south as Chore harbour on a regular basis. Once a year, Arklow Sailing Club race around the WTGs. The number of sailing boats in each sailing event varies but a heavily attended event would usually attract more than 20 boats. Organised sailing occurs on Wednesday evenings and Saturday afternoons from April to end of October. Some longer Saturday races may take place between 10 am and 6 pm.	Recreational traffic is considered in Section 13. Recreational stakeholders have also been consulted during the Stakeholder Outreach.
	Queried whether there will be access through the wind farm for marine traffic or an exclusion zone. Concern in relation to potential for increase in traffic inshore of the Arklow Bank.	Vessels will be free to transit through the site, noting that advisory safe passing distances will be in place during construction/ major maintenance (see Section 5). Post Wind Farm Routeing is considered in Section 17.3.
Wicklow Bay Sea Angling Club	The following offshore and shoreline fishing marks are used by fishing vessels, both clubs and individuals: Arklow Bank (inside and outside, north and south), Seven Fathom Bank, India Bank, Horseshoe Bank, Wicklow Bay, South Beach Arklow, Ennerielly, Mizen head, Brittas Bay, Jack's Hole, Magharamore, Silver Strands, Long Rock, Wicklow Head, North Beach Wicklow (Kiloughter), Kilcoole, and Greystones.	Section 13 considers the fishing vessels in the area.

Organisation	Comment	Response and/or Where Addressed in this NRA
	Two charted fishing boats are run by Wicklow Boat Charters; Private boats are also present in the area, and largely launch out of Wicklow; Many club, provincial, and national championships are fished out of Wicklow; and A number of clubs fish out of Greystones and Bray.	Fishing and recreational vessels are considered in Section 13 based on survey data collection (AIS, radar and visual).
	Raised concerns in relation to the following: Recreational fishing being affected mostly during surveys, sampling, and construction; Reduced access due to the works and project vessels present in the area; Damage that any works will cause to the seabed; Water borne particles affecting fish populations; Noise and vibration affecting fish populations.	Fishing and recreational vessels are considered in Section 13 and assessed in Volume II, Chapter 15: Shipping and Navigation. Advisory safe passing distances shall be in place during construction/major maintenance (see Section 5), so access will not be restricted. Local liaison and NtMs will be issued prior to any works. Issues relating to damage to the seabed, water borne particles, and noise and vibration are considered in Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology.
Wicklow Sailing Club	Club races involving approximately seven to 15 vessels come in close proximity to the Proposed Development two or three times a year, with the majority of club racing held well to the north of the Proposed Development. Noted the biannual SSE Renewables Round Ireland Yacht race.	Recreational vessels and the SSE Renewables Round Ireland Yacht race are considered in Section 13.

Organisation	Comment	Response and/or Where Addressed in this NRA
	The Proposed Development should act an aid to navigation, improving safety when sailing in proximity to the bank.	Lighting and marking of the Proposed Development will be agreed with Irish Lights and will broadly be in accordance with IALA G1162 (IALA, 2021) (see Section 5).
Wicklow Boat Charters	Provided a list of angling groups and individuals, with an estimated number of trips per year of 622.	Section 13 includes all fishing vessels recorded in the vessel traffic surveys.
	Noted a number of offshore and shoreline fishing marks are used in the area, and that Wicklow Boat Charters used these fishing marks a minimum of 220 times in 2019.	
	Noted two chartered fishing boats are in the local area, both run by Wicklow Boat Charters.	Noted.
	Raised the following concerns: Negative impacts on recreational fishing during the survey and construction phase, in particular; Reduced access; Damage to the seabed affecting fishing; Water borne particles affecting fish/fishing; and Noise and vibrations affecting fish/fishing.	Fishing vessels are considered in Section 13 and assessed in . Advisory safe passing distances shall be in place during construction/major maintenance (see Section 5), so access will not be restricted. Issues relating to damage to the seabed, water borne particles, and noise and vibration are considered in Volume II, Chapter 10: Fish, Shellfish and Sea Turtle Ecology.
Irish Lights – Meeting	Initial discussion of lighting and marking.	See Section 5.2.
IRCG – Meeting	Initial discussion of lighting and marking, including in relation to SAR.	See Section 5.2.

7 Data Sources

7.1 Summary of Data Sources

The main data sources used in assessing the shipping and navigation baseline for the Proposed Development are outlined in Table 15.1.13.

Table 15.1.13 Data sources used to inform shipping and navigation baseline

Data	Source
Vessel traffic	Vessel traffic survey data collected during: ▪ 14 days between 8 and 26 September 2022; and ▪ 29 days between 7 July and 14 August 2023 To capture AIS traffic and non-AIS traffic (via Radar and visual observations). The AIS was supplemented with additional satellite-based and onshore-based AIS to ensure comprehensive coverage.
	Vessel traffic survey data (AIS) collected during: ▪ 14 days between 15 and 28 July 2019. This further 14 days of AIS recording was from the initial period of the vessel traffic survey undertaken by a vessel during a geophysical survey. The full vessel traffic survey report, undertaken during the geophysical survey, is provided in Annex E of this report.
	Anatec in-house AIS data collected covering the entirety of 2022. The analysis of this data is provided in Annex A of this report.
Maritime incidents	Marine Casualty Investigation Branch (MCIB) incident reports (1992 to 2022)
	RNLI incident data (2013 to 2022)
	Marine Accident Investigation Branch (MAIB) incident data (2002 to 2021)
Offshore renewables	Oslo and Paris (OSPAR) Offshore Renewables data layer (2017)
Other navigational features	*Admiralty Sailing Directions Irish Coast Pilot NP40* (UKHO, 2019)
	Marine Irish Digital Atlas (MIDA) (MIDA, revised 2018)
	East & North Coasts of Ireland Sailing Directions (Irish Cruising Club, 2014)
	UK Admiralty Charts 1410, 1411 and 1121 (UKHO, 2023)

7.2 Study Area

A 10 nm buffer has been applied around the Array Area, as shown in Figure 15.1.5. This Study Area has been defined in order to provide local context to the analysis of risks by capturing the relevant routes and vessel traffic movements within and in proximity to the Proposed Development. This 10 nm buffer has been used within the majority of past NRAs undertaken by Anatec and was also used within the scoping report.

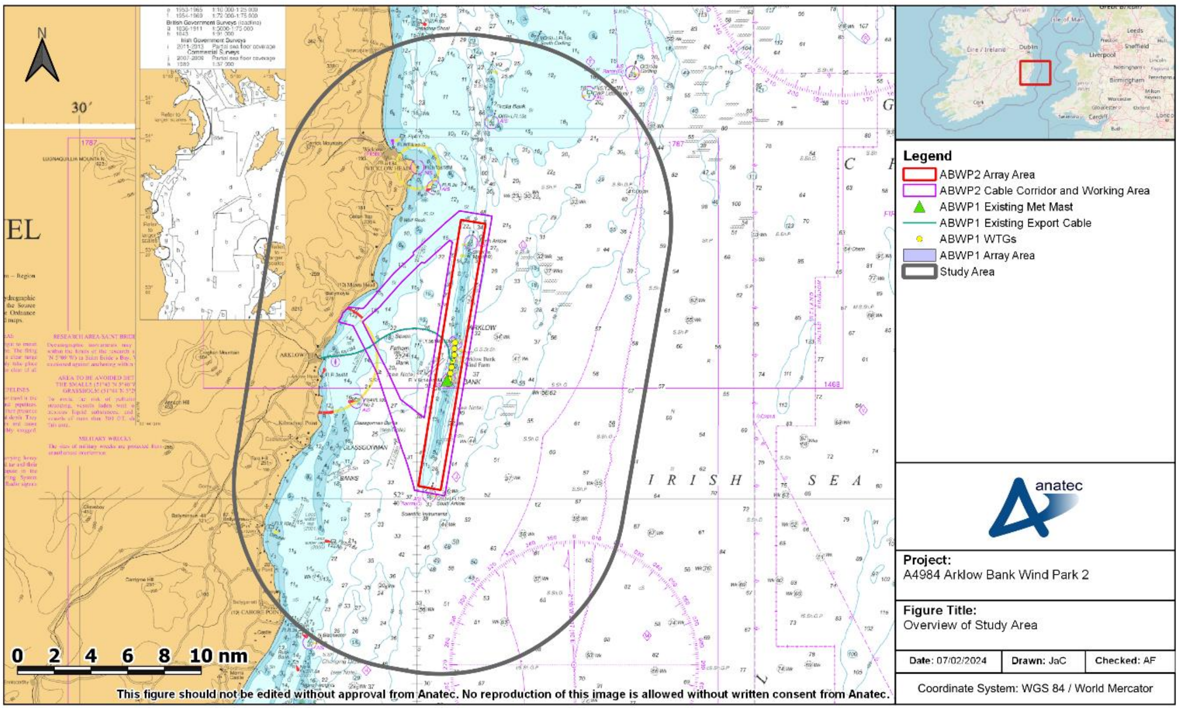

Figure 15.1.5 Overview of Study Area

7.3 Data Limitations

The 12 months AIS analysis (Annex D) is desk-based only and therefore vessels which are not required to carry AIS mandatorily including recreational vessels and smaller fishing vessels may not be recorded in the data. Additionally, it is noted that naval vessels do not typically broadcast on AIS.

There may be limited downtime in AIS coverage on occasion, although this is not expected to be significant or affect the completeness of the vessel traffic baseline. The vessel traffic survey undertaken during the geophysical surveys in summer 2019 does include visual observations, thus supporting the desk-based vessel traffic data, although it is noted that the non-AIS data was of limited range and duration (approximately 21 days) and therefore some activity will not have been identified. However, from consultation there is no significant seasonal variation in fishing activity during the year and it is known that summer captures the peak period for recreational vessels. Further, additional non AIS data has been collected via radar in the 2022 and 2023 surveys.

Navigational features are based upon the most recently available UKHO Admiralty Charts and Sailing Directions at the time of writing the first revision of the NRA, i.e. 2019.

7.4 AIS Data

A number of vessel tracks recorded during the survey periods were classified as temporary (non-routine). These have therefore been excluded from the analysis.

8 Lessons Learnt

There is considerable benefit to developers in the sharing of lessons learnt within the offshore industry. The NRA, and in particular the impact assessment, includes general consideration for lessons learnt and expert opinion from previous offshore wind farm developments, with particular focus on UK developments given the operational experience available.

Data sources for lessons learnt include the following:

- *G+ Global Offshore Wind Health & Safety Organisation 2019 Incident Data Report* (G+, 2020);
- *Interference to Radar Imagery from Offshore Wind Farms* (Port of London Authority (PLA), 2005);
- *Offshore Wind and Marine Energy Health and Safety Guidelines* (RenewablesUK, 2014);
- *Offshore Wind Farm Helicopter Search and Rescue Trials Undertaken at the North Hoyle Wind Farm* (MCA, 2005);
- *Results of the Electromagnetic Investigations* (MCA & QinetiQ, 2004);
- *Sharing the Wind – Recreational Boating in the Offshore Wind Strategic Areas* (RYA & Cruising Association (CA), 2004); and
- *Strategic Assessment of Impacts on Navigation of Shipping and Related Effects on Other Marine Activities Arising from the Development of Offshore Wind Farms in the UK Renewable Energy Zones (REZ)* (Anatec & The Crown Estate (TCE), 2012).

9 Navigational Features

A plot of navigational features in proximity to the Proposed Development is presented in Figure 15.1.6. Each of the features shown is discussed in the following subsections and has been identified using the most detailed UKHO Admiralty Chart available. Given the wide extent, IMO routeing measures have not been included in Figure 15.1.6 but are presented separately in Section 9.1.

It is noted that although relevant to shipping and navigation, none of the following navigational features were identified in proximity to the Proposed Development:

- Surface platforms, production wells or suspended wells relating to the oil and gas sector;
- Marine aggregate dredging areas; and
- Foul and spoil grounds.

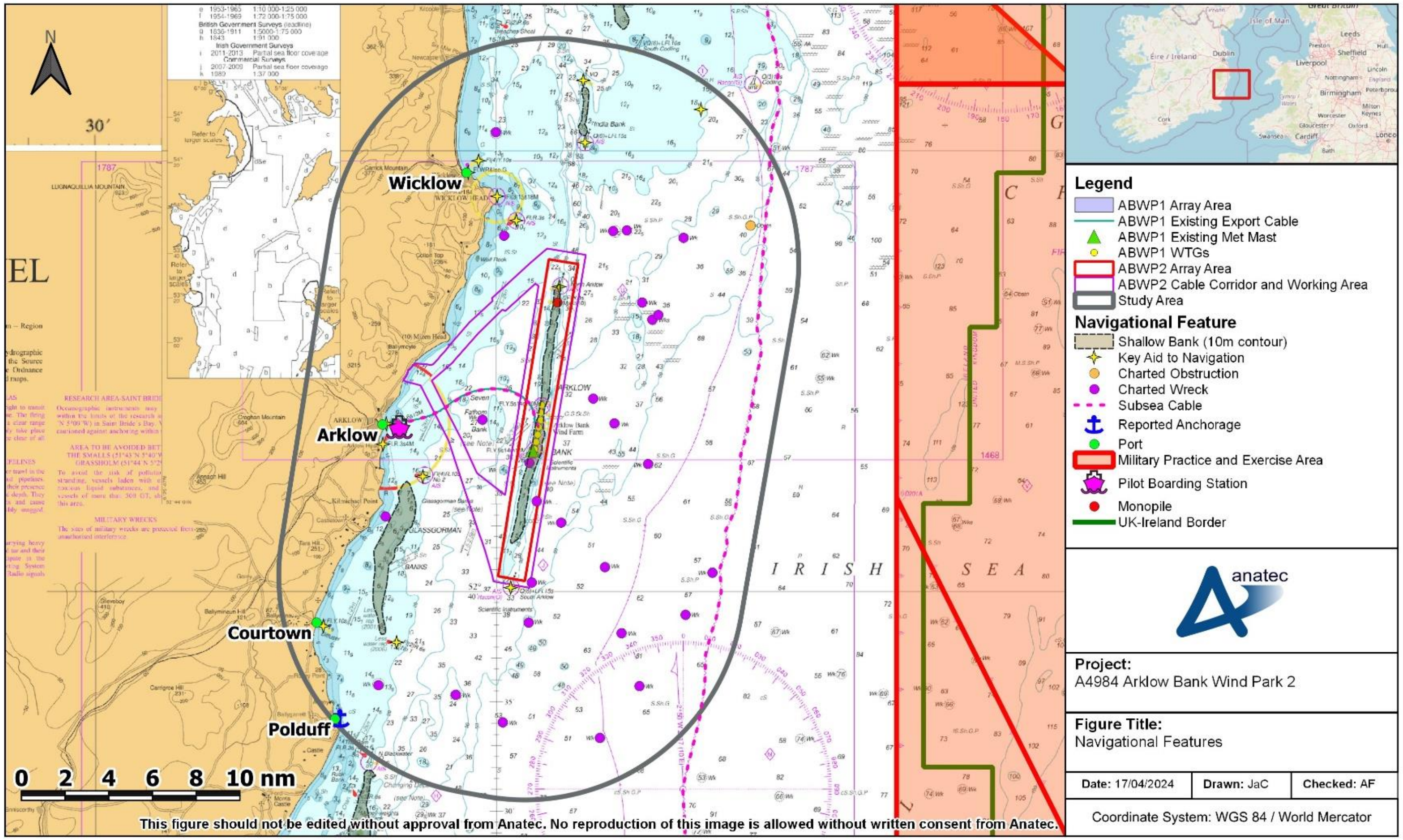

Figure 15.1.6 Navigational features in proximity to the Proposed Development

9.1 IMO Routeing Measures

A plot of IMO adopted routeing measures in proximity to the Proposed Development is presented in Figure 15.1.7. It is noted that the routeing measures in the approaches to Dublin port have been excluded from Figure 15.1.7 as they cover a much smaller area than the routeing measures shown and are not directly linked to the Proposed Development.

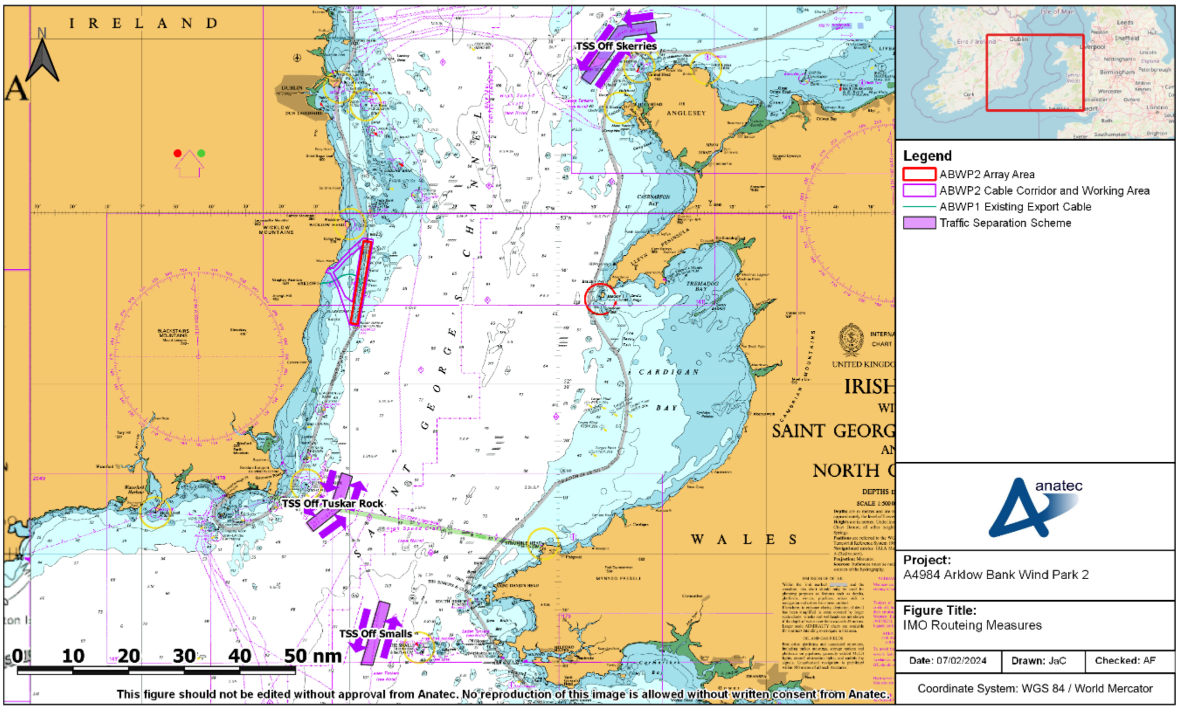

Figure 15.1.7 IMO Routeing Measures

The closest routeing measure to the Proposed Development is the Off Tuskar Rock TSS located approximately 26 nm south which regulates traffic passing around the south eastern tip of Ireland. The Off Smalls TSS further south regulates traffic passing north to south near the English Channel and the Off Skerries TSS located approximately 46 nm northeast of the Proposed Development regulates traffic passing around the northwestern tip of Wales.

9.2 Other Offshore Wind Farms

ABWP1 is located within the Array Area and has been operational since 2004. At the time of writing, there is no information in the public domain relating to the potential decommissioning of the ABWP1. The ABWP1 project is likely to be decommissioned during the lifetime of the Proposed Development. The decommissioning strategy is anticipated to be similar to that proposed for the Proposed Development, i.e. removal of above surface infrastructure, removal of foundations to seabed level, with cables and any scour/cable protection to be left *in situ*. See Volume III, Appendix 25.10: Rehabilitation Schedule for further details.

Other proposed offshore wind farm projects are discussed in Section 14, and considered on a cumulative basis.

9.3 Aids to Navigation

Given the location of the Proposed Development near the coast, there are a large number of aids to navigation in proximity to the Proposed Development. This includes the North Arklow Light north cardinal buoy, which broadcasts on AIS. This buoy advises shipping that safe water is found to the north and that vessels should be aware of a navigational hazard to the south, in this case the reduced water depth at the Arklow Bank. The South Arklow Light south cardinal buoy, located approximately 750 m south of the Array Area, serves a similar function and transmits using a Radar Beacon (Racon) in addition to AIS.

A Lidar beacon is also present in the Array Area located on top of a monopile.

9.4 Submarine Cables and Pipelines

There is a submarine cable which runs between Arklow Harbour and ABWP1 and therefore passes through the Array Area. Another submarine cable passes approximately 8.3 nm east of the Array Area between Dublin Bay and the North Atlantic.

There are no submarine pipelines in proximity to the Proposed Development.

9.5 Ports

The two main ports in proximity to the Proposed Development are Arklow and Wicklow, located approximately 6.3 nm west and 5.4 nm northwest of the Array Area, respectively. Arklow Harbour is a small port noted for its fishing fleet and marina, and has non-compulsory pilotage services. Wicklow Harbour is a small harbour mainly used by fishing vessels and coasters.

Dublin Port is located further north and is the largest freight and passenger port in Ireland. Port arrival statistics published by the Central Statistics Office (CSO) between 2013 and 2017 (CSO, 2018) and between 2020 and 2022 (CSO, 2023) for key ports in the area are presented in Figure 15.1.8. It can be seen that the overwhelming majority of port arrivals are to Dublin. However, it should be noted that only the activity of trading vessels, car ferries and other passenger vessels above 100GT is covered within the data in its provided format. Various vessel types are excluded such as fishing, tug, dredger, research, survey, naval and other non-commercial types.

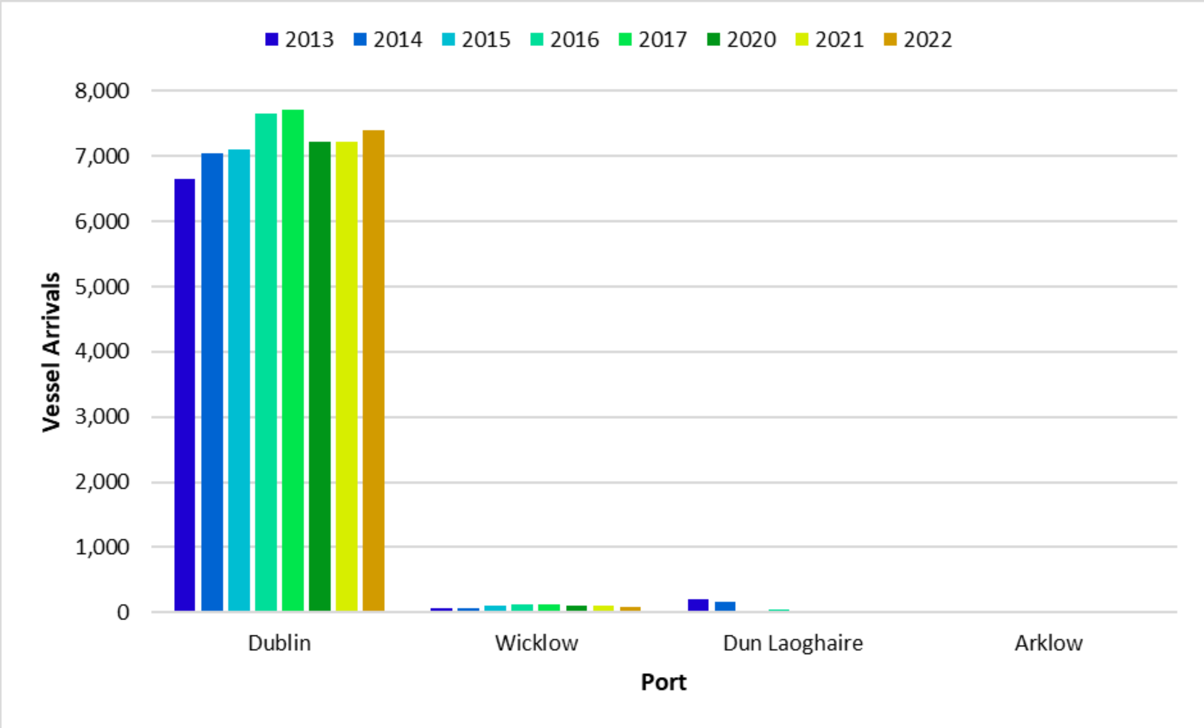

Figure 15.1.8 Vessel arrivals to ports in proximity to the Proposed Development (CSO, 2018) (CSO, 2023)

9.6 Charted Wrecks

Charted wrecks are the subset of all wrecks detailed on UKHO Admiralty Charts which pose a potential risk to surface navigation or subsea operations. There are a number of charted wrecks in proximity to the Proposed Development including two located within the Array Area; one of these has 33 m depth and the other has unknown depth. The closest charted wreck outside of the Array Area is located approximately 580 m from the southeastern corner and has 46 m depth.

It is noted that there are other wrecks not charted but these are not considered by UKHO to be of significance to navigation. Site surveys have identified additional wrecks, further details are provided in Volume II, Chapter 18: Marine Archaeology and Cultural Heritage.

9.7 Anchorage Areas

The closest charted anchorage area is located approximately 9.7 nm southwest of the Array Area at Polduff Harbour. This anchoring location is considered useful for southbound traffic in south westerly winds and awaiting a fair tide. Another anchorage is located near Wexford Harbour.

9.8 Military Practice and Exercise Areas

A firing practice area (Ministry of Defence (MOD) Aberporth) is located approximately 14 nm east of the Array Area. There are no restrictions in place with regard to the right for vessels to transit within such areas with firing only taking place when the area is considered to be clear of all shipping.

10 Meteorological Ocean Data

This section presents meteorological and oceanographic statistics local to the Proposed Development based on data provided by SSE in June 2023 in addition to Admiralty Sailing Directions and Admiralty charts. The data presented in this section has been used as input to the risk assessment, and in particular used in the collision and allision risk modelling (see Section 17).

10.1 Wind

The breakdown of wind direction data provided by SSE in June 2023 is presented in Figure 15.1.9 in the form of a wind rose.

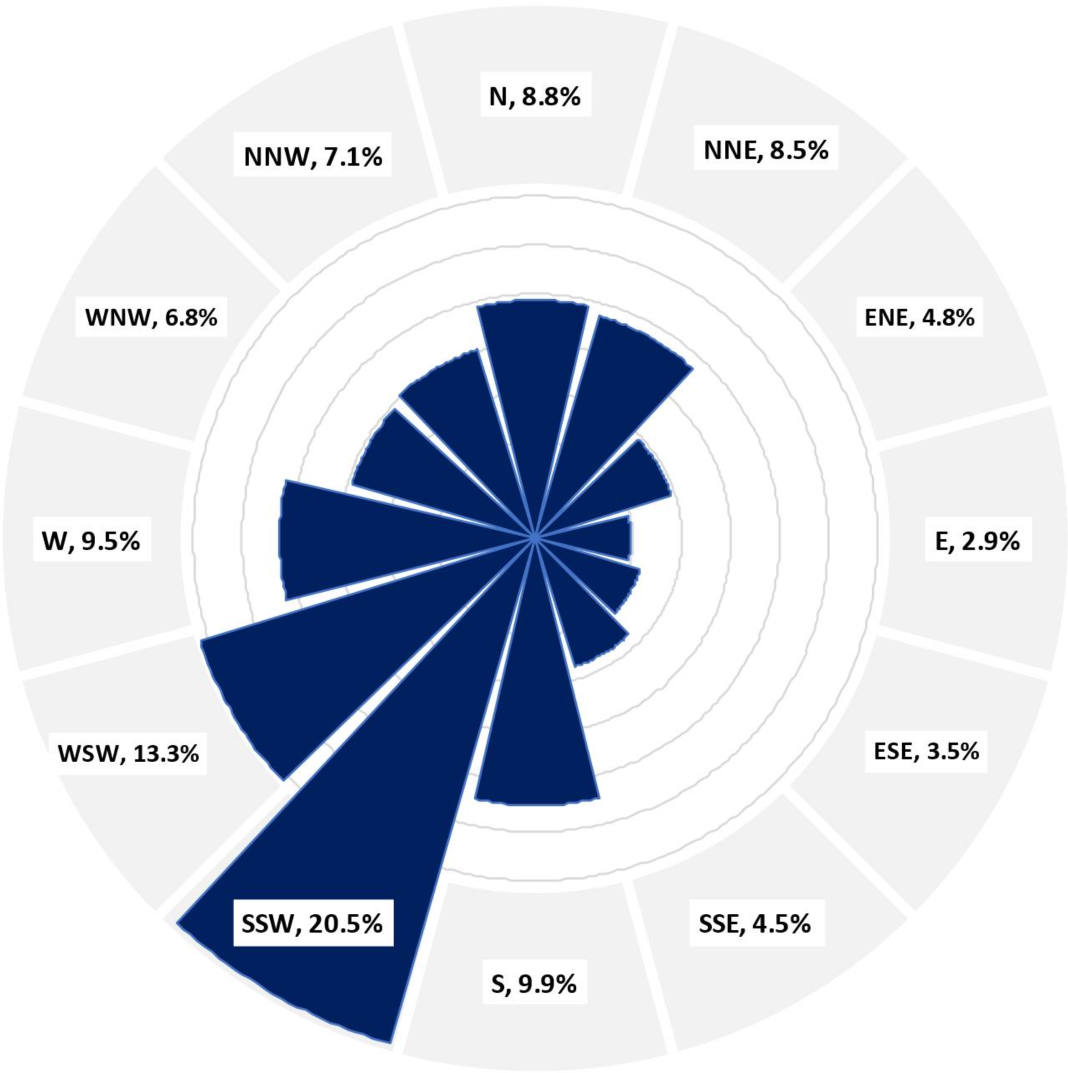

Figure 15.1.9 Wind direction distribution

Figure 15.1.9 demonstrates that winds are predominantly from the south-southwest.

10.2 Wave

Wave data provided by SSE in June 2023 is presented in Table 15.1.14 and Table 15.1.15, presented as the proportion of the sea state within each of three defined ranges, where the sea state is defined using significant wave height.

Table 15.1.14 Sea state data (South Arklow Bank)

Sea State	Proportion (%)
Calm (< 1 m)	59.09
Moderate (1–5 m)	40.90
Severe (> 5 m)	0.01

Table 15.1.15 Sea state data (North Arklow Bank)

Sea State	Proportion (%)
Calm (< 1 m)	70.43
Moderate (1–5 m)	29.57
Severe (> 5 m)	0.00

10.3 Visibility

It is assumed that the proportion of poor visibility (defined as the proportion of a year where the visibility can be expected to be less than 1 km) is 3%. This is based upon details provided in the UKHO Admiralty Sailing Directions for the area (UKHO, 2019).

10.4 Tide

Tidal data to be used as an input to the allision modelling is based upon the information available from Admiralty Chart 1410. Table 15.1.16 presents the peak flood and ebb direction and speed values for each charted tidal diamond in the vicinity of the Array Area.

Table 15.1.16 Charted Tidal Diamonds

Tidal Diamond	Flood		Ebb	
	Direction (°)	Speed (knots)	Direction (°)	Speed (knots)
H	194	3.2	14	3.1
J	205	3.3	25	3.2
L	205	3.8	25	3.8
M	198	3.1	19	3.1

11 Emergency Response Resources

This section summarises the emergency response resources (including SAR) relevant to the Proposed Development and surrounding waters.

11.1 Search and Rescue Helicopters

The IRCG is responsible for the response to, and coordination of, maritime accidents which require SAR, counter-pollution operations, and ship casualty operations. In 2023, Bristow Ireland Limited, a subsidiary of Bristow Group, signed a 10-year contract for the provision of SAR helicopter services for the IRCG (Bristow, 2023).

The IRCG has four SAR helicopter bases around the country located at Waterford, Sligo, Shannon, and Dublin airports. Each site has one Sikorsky S-92 helicopter with an additional helicopter being rotated between bases. The Sikorsky S-92 has an air speed of 145 knots and endurance time of over four hours. The locations of these bases are presented in Figure 15.1.10.

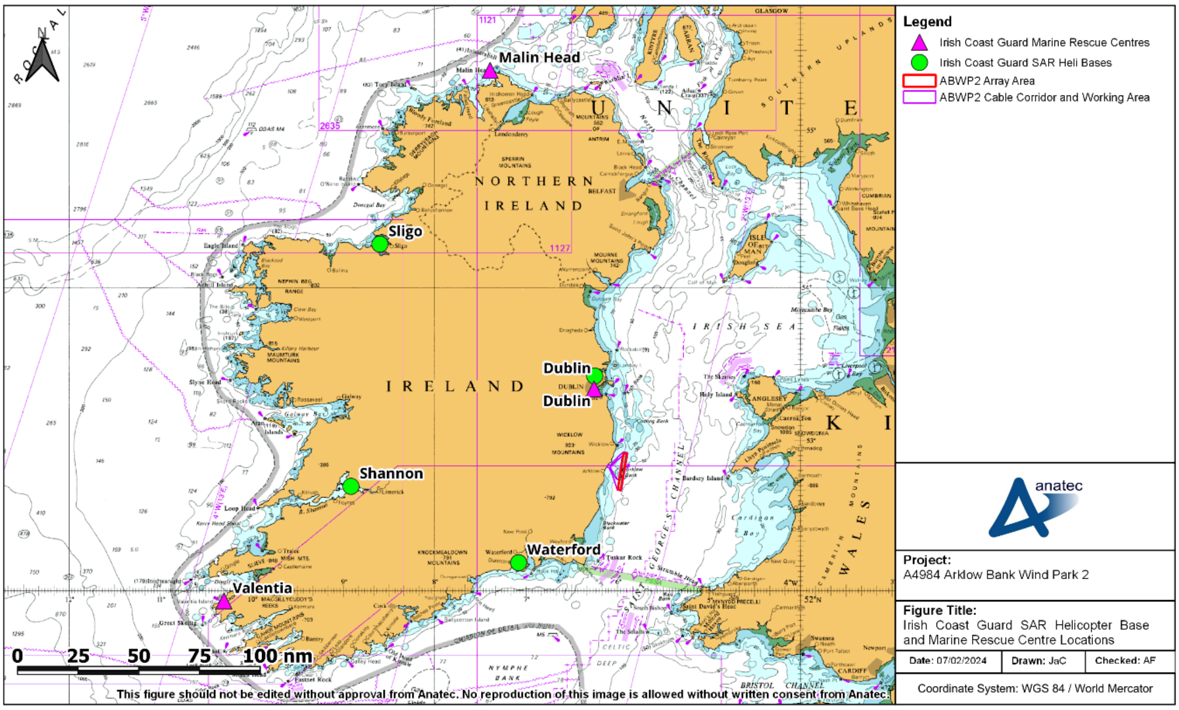

Figure 15.1.10 IRCG SAR helicopter base and marine rescue centre locations

The closest base to the Proposed Development, and most likely to respond to an incident requiring helicopter assistance at the Proposed Development, is the Dublin Airport base, approximately 33 nm northwest of the Array Area. The Dublin Airport base was redeveloped in 2018.

11.2 Marine Rescue Centres

The IRCG operates three marine rescue centres around Irish waters, based in Dublin, Malin Head and Valentia Island. The locations of these bases are presented in Figure 15.1.10. The closest of these centres is in Dublin (a National Maritime Operations Centre (NMOC)), approximately 28 nm from the Proposed Development, which provides marine SAR response services and co-ordinates the response to marine casualty incidents within the Irish Exclusive Economic Zone (EEZ).

There are also a total of 44 Coast Guard Units There are 44 Coast Guard Units around the coast made up solely from the local communities. There are approximately 940 volunteers in all.

11.3 Royal National Lifeboat Institution

The RNLI is organised into six divisions, with the relevant region for the Proposed Development being “Scotland and Ireland”. Based out of more than 230 stations around the UK and Ireland, there are over 440 lifeboats across the RNLI fleet, including All-Weather Lifeboats (ALBs) which can be operated in all weather conditions and Inshore Lifeboats (ILBs) suitable for coastal operations.

Figure 15.1.11 presents the locations of RNLI stations in proximity to the Proposed Development. Following this, Table 15.1.17 summarises the types of lifeboat operated by the RNLI out of these stations and the minimum distance from each station to the Proposed Development.

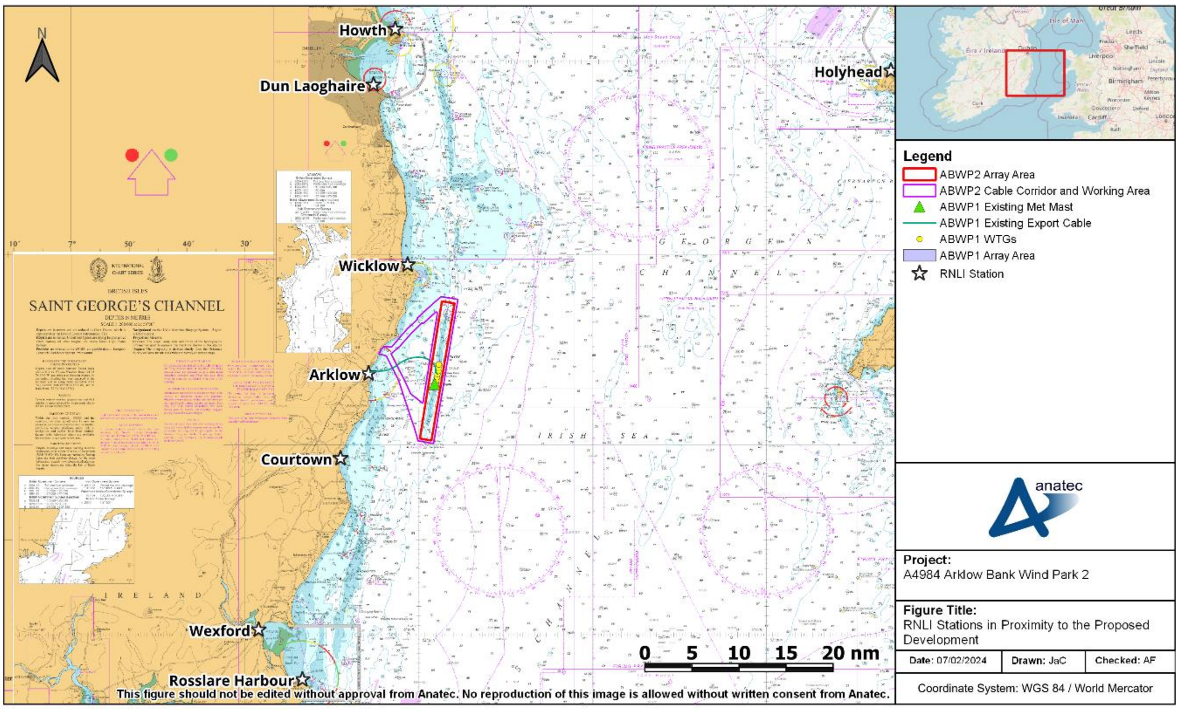

Figure 15.1.11 RNLI station locations in proximity to the Proposed Development

Table 15.1.17 Types of lifeboat held at RNLI stations in proximity to the Proposed Development

Station	Lifeboat(s)	ALB Class	ILB Class	Minimum Distance to Array Area (nm)
Wicklow	ILB	–	D Class	5.0
Arklow	ALB	Trent	–	6.2
Courtown	ILB	–	D Class	8.4
Dun Laoghaire	ALB and ILB	Trent	D Class	24
Wexford	ILB (×2)	–	D Class (×2)	26
Howth	ALB and ILB	Trent	D Class	29
Rosslare Harbour	ALB	Severn	–	29

11.4 Third Party Assistance

Companies operating offshore typically have resources of vessels, helicopters and other equipment available for normal operations that can assist with emergencies offshore. Moreover, all vessels under IMO obligations set out in the SOLAS (IMO, 1974) as amended, are required to render assistance to any person or vessel in distress if safely able to do so.

12 Maritime Incidents

This section reviews historic maritime incidents which have occurred in proximity to the Proposed Development and includes consideration of incidents which have occurred at existing offshore wind farm developments in the UK.

The analysis is intended to provide a general indication of whether the area of the Proposed Development is currently low or high risk in terms of maritime incidents and whether offshore wind farms in general pose a high risk to vessels. If the area was found to be of particularly high risk for incidents then this may indicate that the Proposed Development could exacerbate the existing maritime safety risks in the area.

12.1 Marine Casualty Investigation Board Data

The MCIB is tasked with examining and, if necessary, carrying out investigations into all types of marine casualties to, or on board, Irish registered vessels worldwide and other vessels in Irish territorial waters and inland waterways.

Although the MCIB do not publish comprehensive incident data in the public domain, they do publish investigation reports. It is noted that not all incidents will be documented and not all documented incidents have accurate coordinates available. Details on each incident within the study area that is documented and that has available coordinates are provided in this section.

12.1.1 Collision between *Clara* and *Coral Antillarum* in August 2000

On the 24 August 2000, the fishing vessel *Clara* and the tanker *Coral Antillarum* collided. There was poor visibility, with light winds. The fishing vessel was engaged in active fishing at the time. The incident occurred 7.7 nm northwest of the Array Area.

12.1.2 Accident to Person on *Kerri Heather* in November 2016

On 16 November 2016, the fishing vessel *Kerri Heather* had departed from Arklow and was lifting and baiting lines of pots. Whilst operations were being undertaken one of the crew fell overboard. Despite immediate recovery attempts and searches by lifeboats, other fishing vessels and a SAR helicopter, the person was not recovered. The incident occurred 1.8 nm west of the Array Area.

12.2 Royal National Lifeboat Institution Data

Data on RNLI responses within the Study Area for the 10-year period between 2013 and 2022 has been analysed, with incidents involving hoaxes or false alarms excluded.

The locations of incidents are presented in Figure 15.1.12, colour-coded by incident type. The same data is presented in Figure 15.1.13, colour-coded by casualty type.

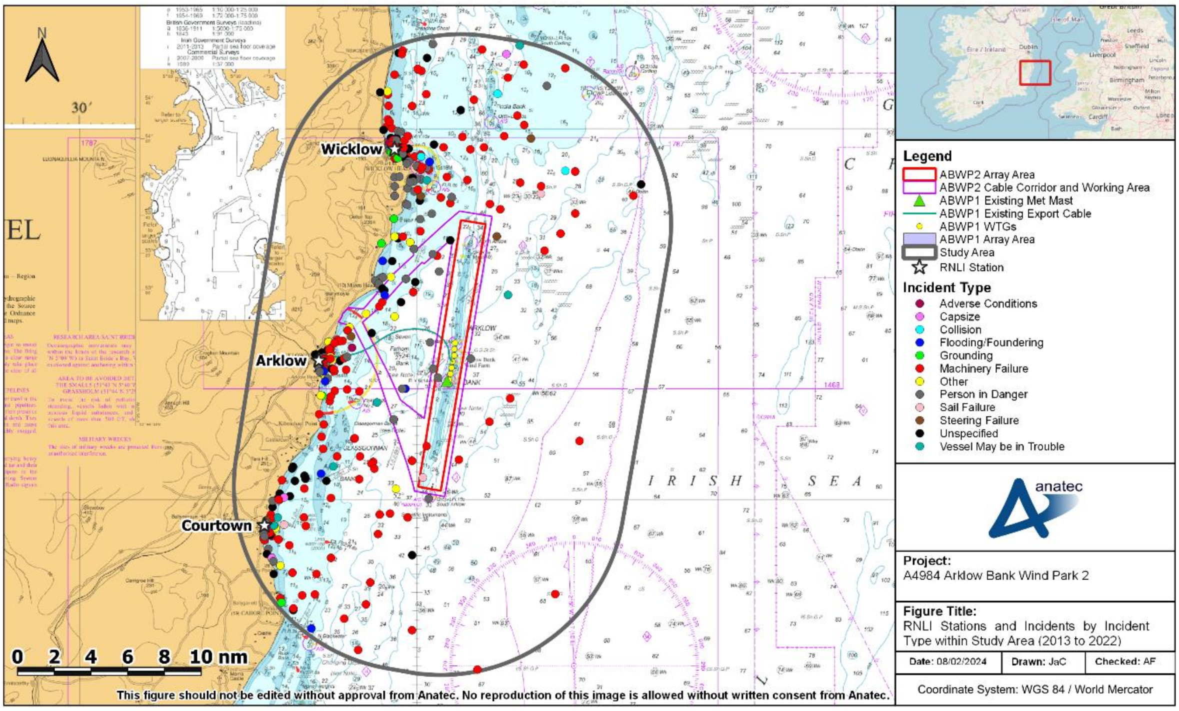

Figure 15.1.12 RNLI incident locations by incident type (2013 to 2022)

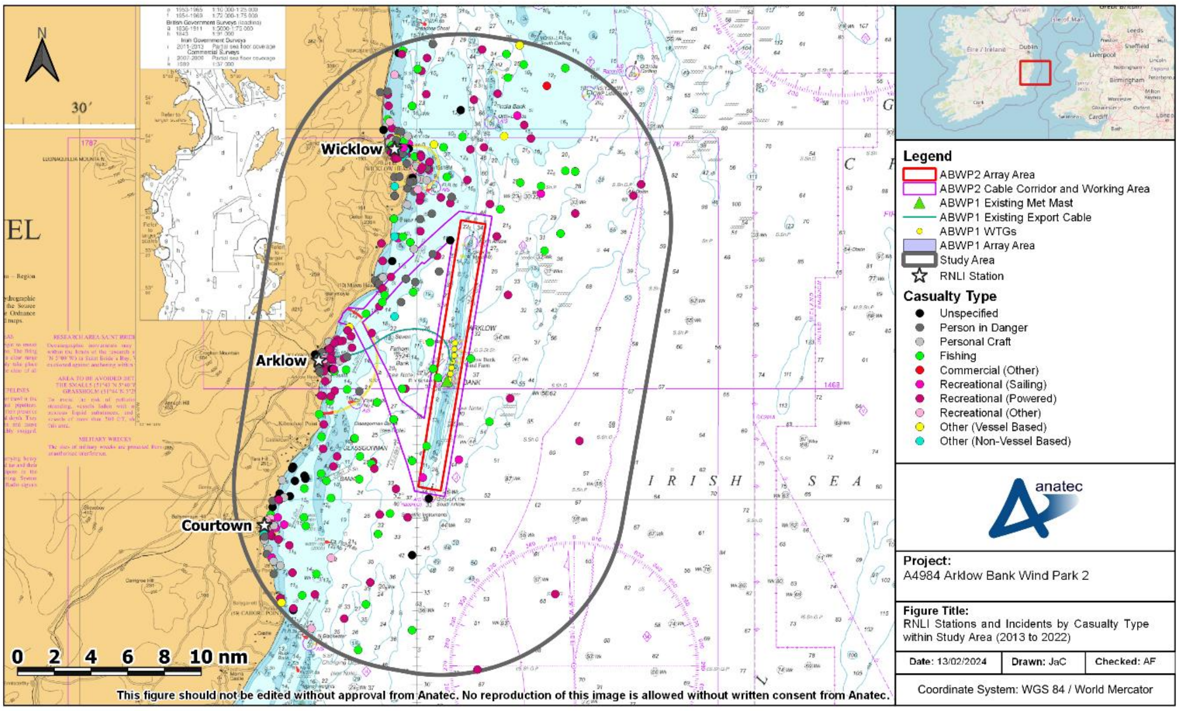

Figure 15.1.13 RNLI incident locations by casualty type (2013 to 2022)

A total of 426 lifeboat responses to 404 incidents were recorded within the study area during the ten-year period, corresponding to an average of 40 to 41 incidents per year. Incidents were concentrated inshore of the Array Area, around Wicklow, Arklow and Courtown in particular, with relatively few incidents in open waters.

It is noted that three incidents are documented as occurring within the Array Area; a fishing vessel experiencing machinery failure, a recreational vessel experiencing machinery failure and a man overboard from a fishing vessel. Two were responded to by Arklow station while the third was responded to by Wicklow station.

The most common incident type in the RNLI data was “machinery failure”, accounting for 38% of the data. This was followed by “person in danger”, which accounted for 25%. Excluding “person in danger” and non-vessel incidents, the most frequent casualty type was powered recreational vessels (37%), followed by fishing vessels (25%) and personal craft (15%).

The majority (51%) of lifeboat responses were from Wicklow station. This was followed by Arklow (32%), and Courtown (15%) and the remainder (2%) from Rosslare Harbour.

12.3 Historical Offshore Wind Farm Incidents

Given the early stage of offshore wind farm development in Ireland, there is no historical incident data available in terms of incidents arising from or caused by the presence of offshore wind farm structures. There are no reported incidents to vessels associated with the ABWP1 WTGs (see Section 9.2), noting a high profile incident did occur in October 2022 involving a lightning strike on one of the WTGs (Offshore WIND, 2022). No injuries or vessel damage has been reported.

Therefore, UK experience has been considered in this section given that it provides a wide range of incidents relating to offshore wind farm development in a similar regulatory framework.

12.3.1 Incidents Involving UK Offshore Wind Farm Developments

At the time of writing[2] there are 42 fully commissioned and operational offshore wind farms in the UK, ranging from the North Hoyle Offshore Wind Farm (fully commissioned in November 2003) to Hornsea Project Two (commissioned in November 2022). These developments consist of a total of over 22,000 fully operational WTG years.

MAIB incident data has been used to collate a list of historical collision and allision incidents involving UK offshore wind farm developments. All UK flagged vessels and non-UK flagged vessels in UK territorial waters (12 nm), a UK port or carrying passengers to a UK port are required to report accidents to the MAIB. Other sources have also been used to produce this list including the UK Confidential Human Factors Incident Reporting Programme (CHIRP) for Aviation and Maritime, International Marine Contractors Association (IMCA) and basic web

[2] Correct as of 16 January 2024.

searches. The list of historical collision and allision incidents involving UK offshore wind farm developments is presented in Table 15.1.18.

Table 15.1.18 Summary of Historical Collision and Allision Incidents Involving UK Offshore Wind Farm Developments

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Harm to Persons	Source
Project	Allision	7 August 2005	WTG installation vessel allision with WTG base whilst manoeuvring alongside it. Minor damage sustained to a gangway on the vessel, the WTG tower and a WTG blade.	Minor damage to gangway on the vessel	None	MAIB
Project	Allision	29 September 2006	Offshore services vessel allision with rotating WTG blade.	None	None	MAIB
Project	Allision	8 February 2010	Work boat allision with disused pile following human error with throttle controls whilst in proximity. Passenger later diagnosed with injuries and no serious damage sustained by vessel.	Minor	Injury	MAIB
Project / third-party	Collision	23 April 2011	Third-party catamaran collision with project guard vessel within harbour.	Moderate	None	MAIB
Project	Allision	18 November 2011	Cable-laying vessel allision with WTG foundation following watchkeeping failure. Two hull breaches to vessel.	Major	None	MAIB
Project / project	Collision	2 June 2012	Crew Transfer Vessel (CTV) allision with flotel. Nine persons safely evacuated and transferred to nearby vessel before being brought back in to port.	Moderate	None	UK CHIRP
Project	Allision	20 October 2012	Project vessel allision with WTG monopile following human error (misjudgement of distance). Minor damage sustained by vessel.	Minor	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Harm to Persons	Source
Project	Allision	21 November 2012	Passenger transfer catamaran allision with buoy following navigational error. Vessel abandoned by crew of 12 having been holed, causing extensive flooding but no injuries sustained.	Major	None	MAIB
Project	Allision	21 November 2012	Work boat allision with unlit WTG TP at moderate speed following navigational error. Vessel able to proceed to port unassisted with no water ingress but some structural damage sustained.	Moderate	None	MAIB
Project	Allision	1 July 2013	Service vessel allision with WTG foundation following machinery failure. Minor damage sustained by vessel.	Minor	None	IMCA Safety Flash
Project	Allision	14 August 2014	Standby safety vessel allision with WTG pile. Oil leaked by vessel which moved away from environmentally sensitive areas until leak was stopped.	Minor with pollution	None	UK CHIRP
Third-party	Allision	26 May 2016	Third-party fishing vessel allision with WTG following human error (autopilot). Lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)
Project	Allision	14 February 2019	Survey vessel contacted with WTG jacket whilst autopilot was engaged.	Minor	None	MAIB

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Harm to Persons	Source
Project	Allision	17 January 2020	Project vessel allision with WTG. Injury sustained by crew member but vessel able to proceed to port unassisted.	None	Injury	Web search (Vessel Tracker, 2020)
Project	Allision	27 January 2020	Project vessel allision with WTG. Minor damage to vessel and WTG sustained, with no personal injuries.	Minor	None	Marine Safety Forum
Third-party	Allision	9 June 2022	Fishing vessel allision with WTG resulting in damage to vessel and two minor injuries for crew members. RNLI lifeboat escorted vessel under its own power to port.	Minor	Injury	Web search (RNLI, 2022)

(*) As per incident reports.

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

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

As of January 2024, there have been 13 reported cases of an allision between a vessel and a WTG (under construction, operational or disused) in the UK, with all but one involving a support vessel for the development. Therefore, there has been an average of 1,730 WTG years per WTG allision incident in the UK, noting that this is a conservative calculation given that only operational WTG hours have been included (whereas allision incidents counted include non-operational WTGs).

12.3.2 Incidents Involving Non-UK Offshore Wind Farms

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

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

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

From news reports, basic web searches and experience at working with existing offshore wind farm developments, a list has been collated of historical incidents responded to by vessels associated with UK offshore wind farm developments, which is summarised in Table 15.1.19.

Table 15.1.19 comprises known incidents that were responded to by a wind farm vessel. Additional incidents associated with the construction or operation of offshore wind farms are also known to have occurred. These incidents typically involve an accident to person which requires medical attention (including emergency response) but does not affect the operation of the vessel involved.

Table 15.1.19 Historical Incidents Responded to by Vessels Associated with UK Offshore Wind Farm Developments

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

Incident Type	Date	Related Development	Description of Incident	Source
Machinery failure	28 September 2019	Race Bank Offshore Wind Farm	Fishing vessel suffered mechanical failure and launched flares. Guard vessel and Service Operation Vessel (SOV) for Race Bank both immediately offered assistance until the MC’'s arrival on-scene.	Internal daily progress report received by Anatec
Vessel in distress	13 December 2019	Race Bank Offshore Wind Farm	Passing vessel got into difficulty and guard vessel for Race Bank was requested to assist. The Coastguard later requested that the guard vessel tow the casualty vessel into port.	Internal daily progress report received by Anatec
Search	21 May 2020	Walney Offshore Wind Farm	Coastguard contacted guard vessel for Walney reporting red flare sighting at the wind farm. Guard vessel proceeded to undertake search but did not find anything to report.	Internal daily progress report received by Anatec
Aircraft crash	15 June 2020	Hornsea Project One	United States (US) jet crashed into sea during routine flight. CTV and SOV for Hornsea Project One joined the search for the missing pilot.	Web search (4C Offshore, 2020)
Fire/ explosion	15 December 2020	Dudgeon Offshore Wind Farm	Fishing vessel experienced explosions on board with crew injured. SOV for Dudgeon deployed its Fast Rescue Boat (FRB) and evacuated the casualty vessel.	Web search (Offshore WIND, 2020)

Incident Type	Date	Related Development	Description of Incident	Source
Vessel in distress	3 July 2021	Robin Rigg	Wind farm CTV fire alarm sounded, with the engine then shut down. A support vessel for Robin Rigg was able to assist in escorting the vessel to port.	Web search (Vessel Tracker, 2021)
Drifting	17 July 2021	Neart na Gaoithe	Small dinghy with two children aboard drifted offshore due to strong winds. A guard vessel associated with Neart na Gaoithe was able to retrieve the children.	Web search (Edinburgh Evening News, 2021)
Allision	9 June 2022	Westermost Rough	Fishing vessel allided with a WTG at Westermost Rough. A supply vessel was among the responders as an RNLI lifeboat escorted the vessel under its own power to port.	Web search (Vessel Tracker, 2022)

13 Vessel Traffic Analysis

13.1 July / August 2023

This section presents analysis of the 2023 vessel-based survey which was undertaken from the vessel *Connector* between the 7 July 2023 and the 14 August 2023. The vessel was on-site for a total of 29 full calendar days, which were selected as the survey period for this report, as follows:

- 7 – 13 July 2023 (inclusive);
- 16 – 18 July 2023 (inclusive);
- 21 July – 1 August 2023 (inclusive); and
- 8 – 14 August 2023 (inclusive).

It is noted that the AIS data recorded from the vessel was supplemented with AIS data recorded from onshore receivers to ensure maximal coverage.

13.1.1 Overview

An overview of the vessels recorded within the Study Area during the survey period is presented in Figure 15.1.14. The types of all vessels recorded on AIS were identified, with one vessel recorded on Radar being of unknown type.

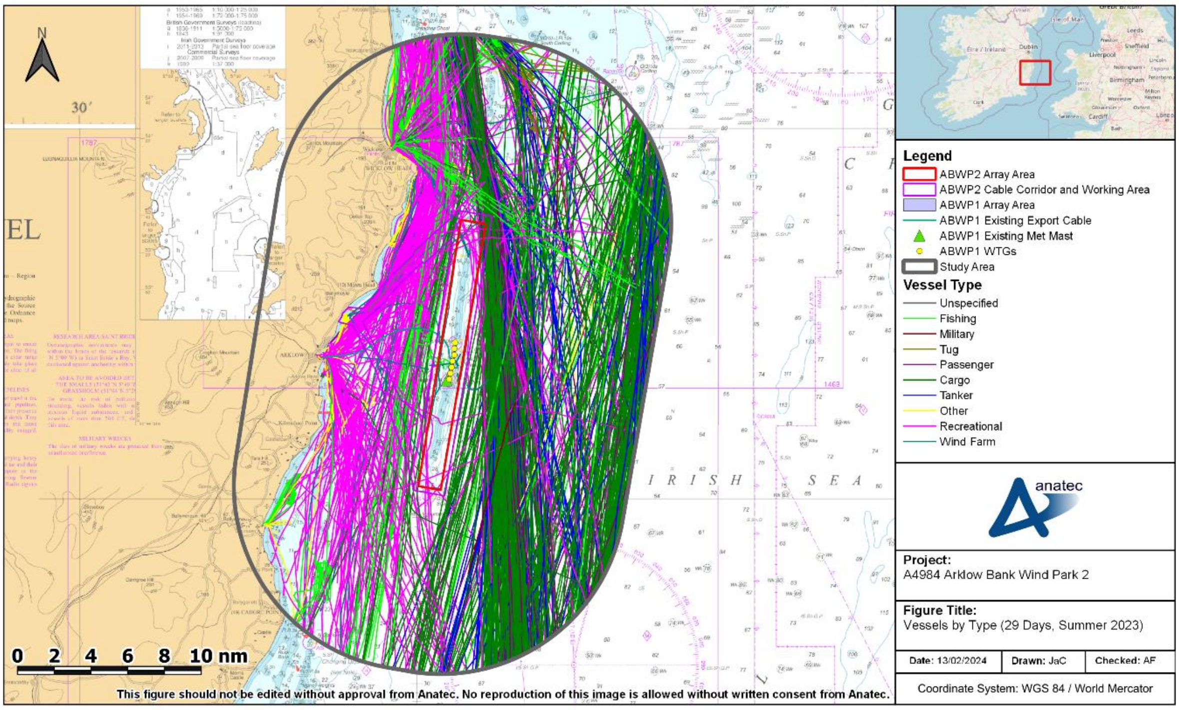

Figure 15.1.14 Vessel by Type (29 Days, Summer 2023)

The majority of commercial traffic was recorded offshore of the Array Area, while the majority of fishing and recreational traffic was recorded inshore of the Array Area. All vessel types were generally recorded avoiding Arklow Bank, with minimal intersections through the Array Area noting the shallow water depths. Further information about Array Area intersections can be found in Section 13.1.8 and further information about each main vessel type can be found in Section 13.1.9.

The distribution of the main vessel types is presented in Figure 15.1.15.

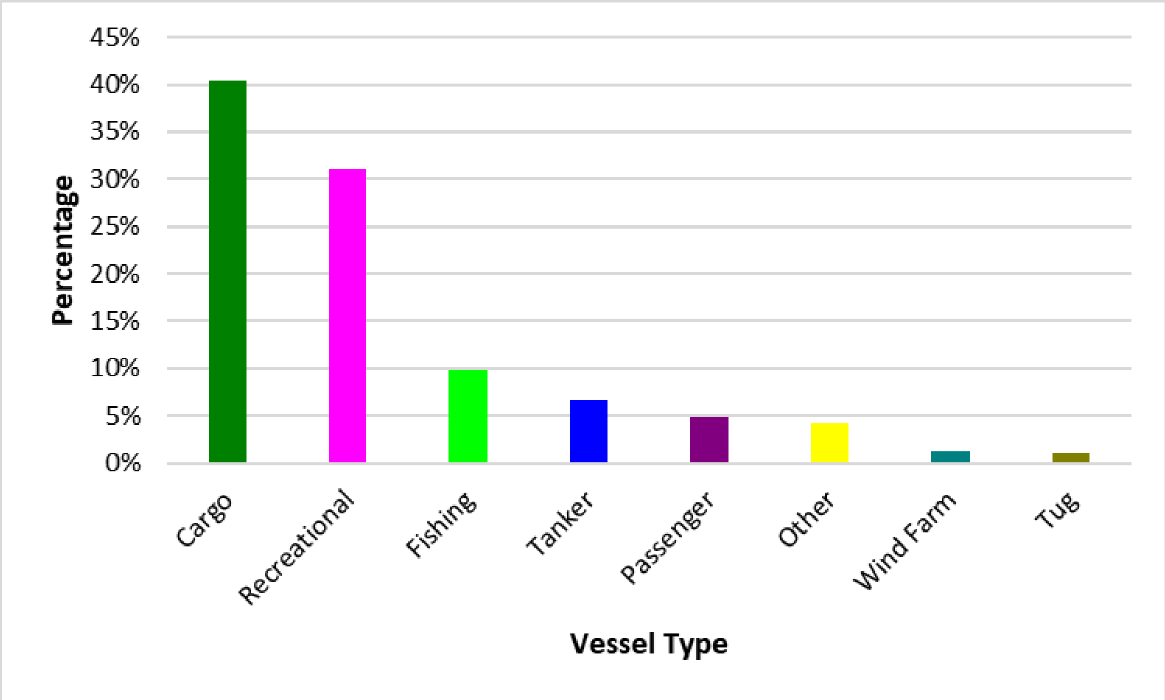

Figure 15.1.15 Distribution of Main Vessel Types (29 Days, Summer 2023)

The most common vessel types recorded within the Study Area during the survey period were cargo vessels and recreational vessels, accounting for 40% and 31% respectively. This was followed by fishing (10%), tanker (7%), passenger (5%) and the 'other' category (4%) which was observed to primarily consist of lifeboats and a workboat. Also recorded in small numbers were wind farm vessels (1%), tugs (1%), and military vessels (less than 1%).

13.1.2 Vessel Count

The number of unique vessels per day recorded within the Study Area during the survey period are presented in Figure 15.1.16.

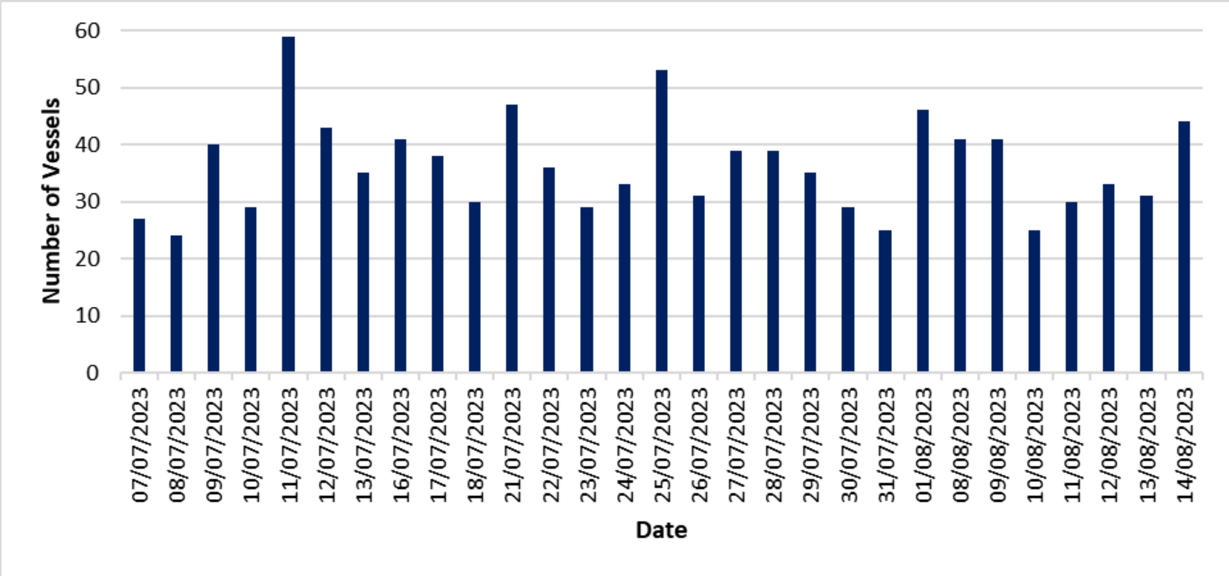

Figure 15.1.16 Number of Unique Vessels per Day (29 Days, Summer 2023)

An average of 36 to 37 unique vessels were recorded per day during the 29-day period. The busiest day during the period was the 11 July 2023, on which 59 unique vessels were recorded. The quietest day during the period was the 8 July 2023, on which 24 unique vessels were recorded.

13.1.3 Vessel Length

An overview of the vessels recorded within the study area during the survey period, colour-coded by vessel length, is presented in Figure 15.1.17. Approximately 6% of vessels could not be associated with a valid length and have therefore been excluded from the analysis that follows (but are included in Figure 15.1.17 for reference).

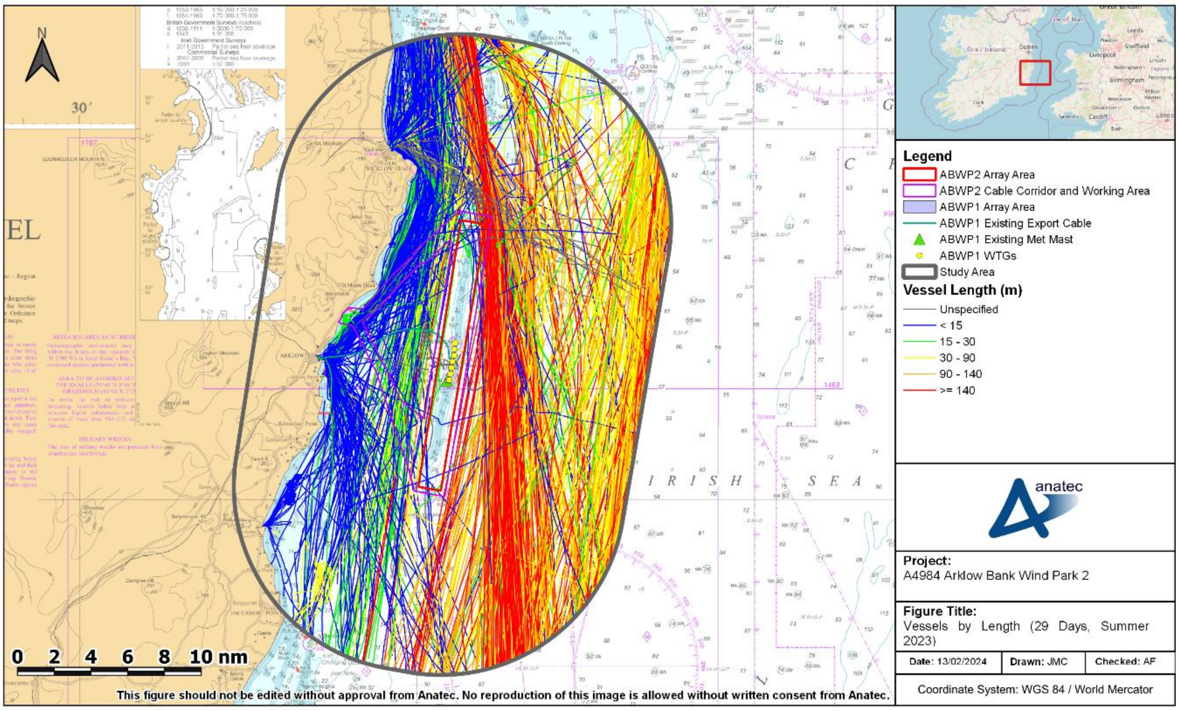

Figure 15.1.17 Vessel by Length (29 Days, Summer 2023)

Smaller vessels (with length less than 30 m) were generally recorded inshore of the Array Area while larger vessels were generally recorded offshore of the Array Area. The large majority of vessels undertaking the southeast/northwest route offshore of the Array Area were at least 90 m in length.

The distribution of vessel lengths recorded is presented in Figure 15.1.18 (excluding approximately 6% of vessels with unspecified length).

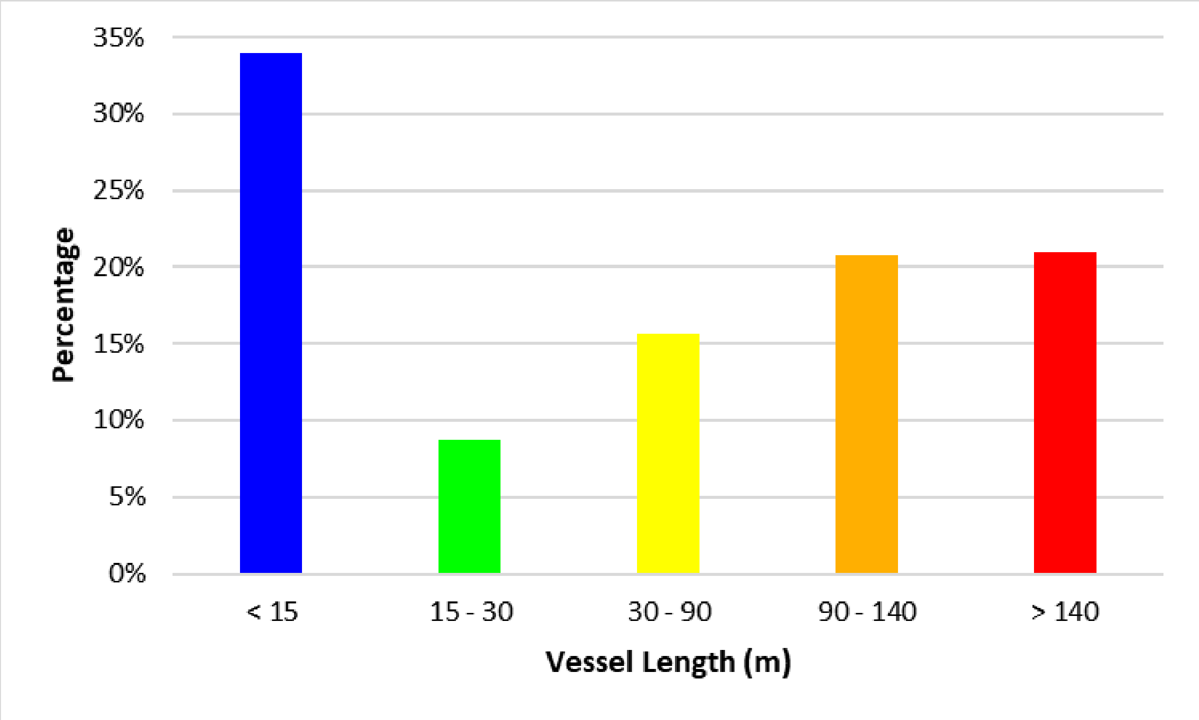

Figure 15.1.18 Distribution of Vessel Lengths (29 Days, Summer 2023)

The average length of vessel recorded within the Study Area during the survey period was 78 m. The smallest vessels (less than 15 m) mainly consisted of recreational vessels, fishing vessels and lifeboats. The longest vessel was a 330 m cruise ship, recorded in northward transit at the eastern extent of the Study Area.

13.1.4 Vessel Draught

Figure 15.1.19 presents the vessels recorded within the Study Area during the survey period colour-coded by vessel draught. This is only available for vessels broadcasting a valid draught on AIS (which accounted for 54% of all vessel tracks); these are included in Figure 15.1.19 but are excluded from the analysis that follows to avoid skewing the analysis. Vessels with unspecified draught were primarily recreational vessels and fishing vessels and therefore likely were of shallow draught.

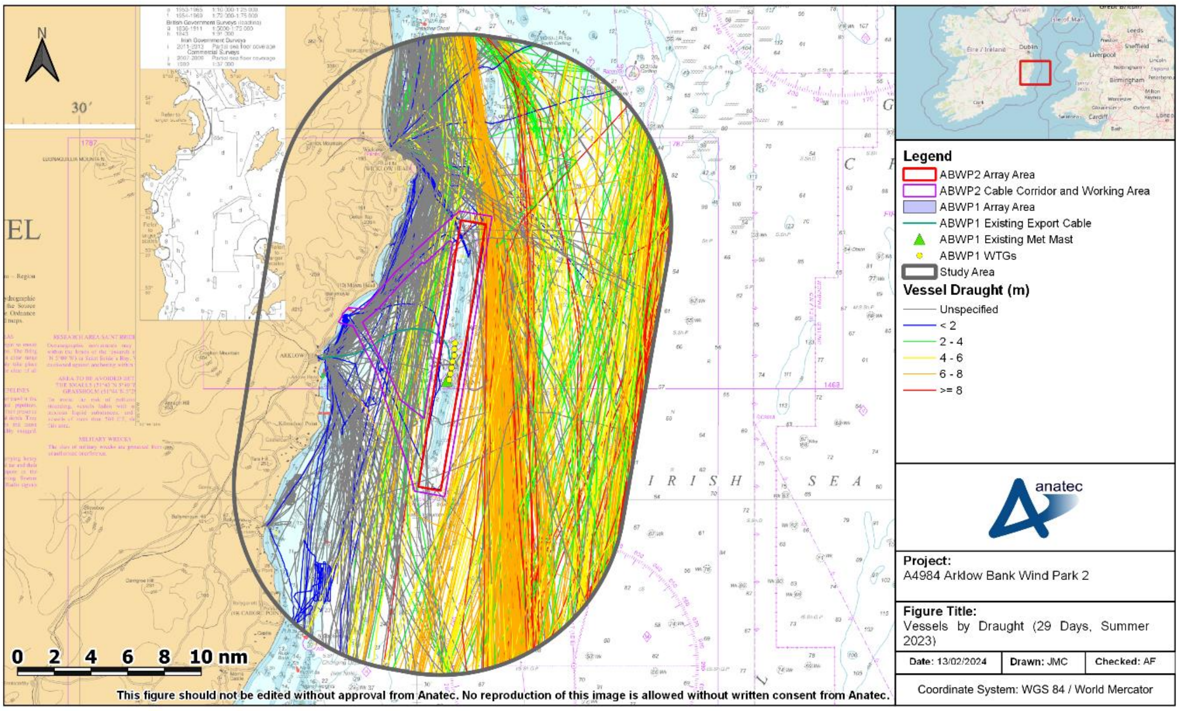

Figure 15.1.19 Vessel by Draught (29 Days, Summer 2023)

It can be seen that, similar to the vessel length distribution, the smallest draughts (less than 2 m) were generally recorded inshore of the Array Area while most of the larger draughts were generally recorded offshore of the Array Area. The majority of vessels undertaking the southeast/northwest route offshore of the Array Area had a draught of between 6 m and 8 m.

The distribution of vessel draughts recorded is presented in Figure 15.1.20 (excluding unspecified draughts).

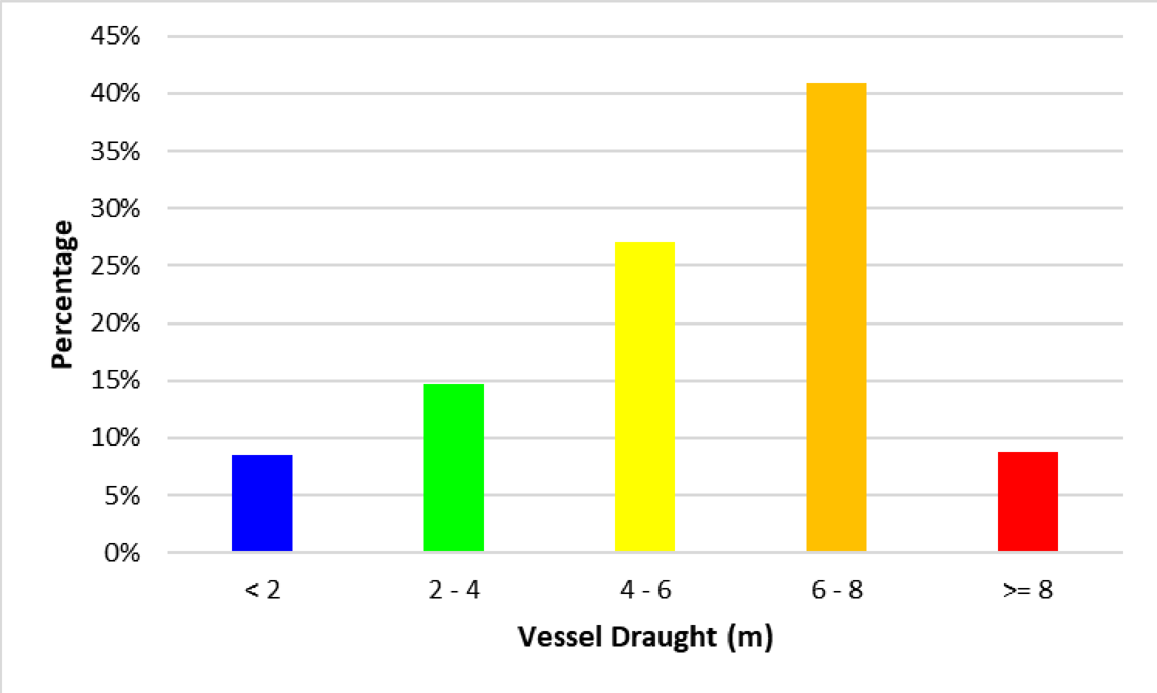

Figure 15.1.20 Distribution of Vessel Draughts (29 Days, Summer 2023)

The most common draught range was 6 to 8 m, accounting for 41%, followed by 4 m to 6 m, which accounted for 27%. The average draught was 5 m. The deepest draught recorded was 11 m, broadcast by a Roll-on/Roll-off (RoRo) container ship in southwest transit at the southeast extent of the Study Area.

13.1.5 Vessel Speed

Figure 15.1.21 presents the vessels recorded within the Study Area during the survey period colour-coded by vessel speed. All vessel tracks were associated with a valid average speed.

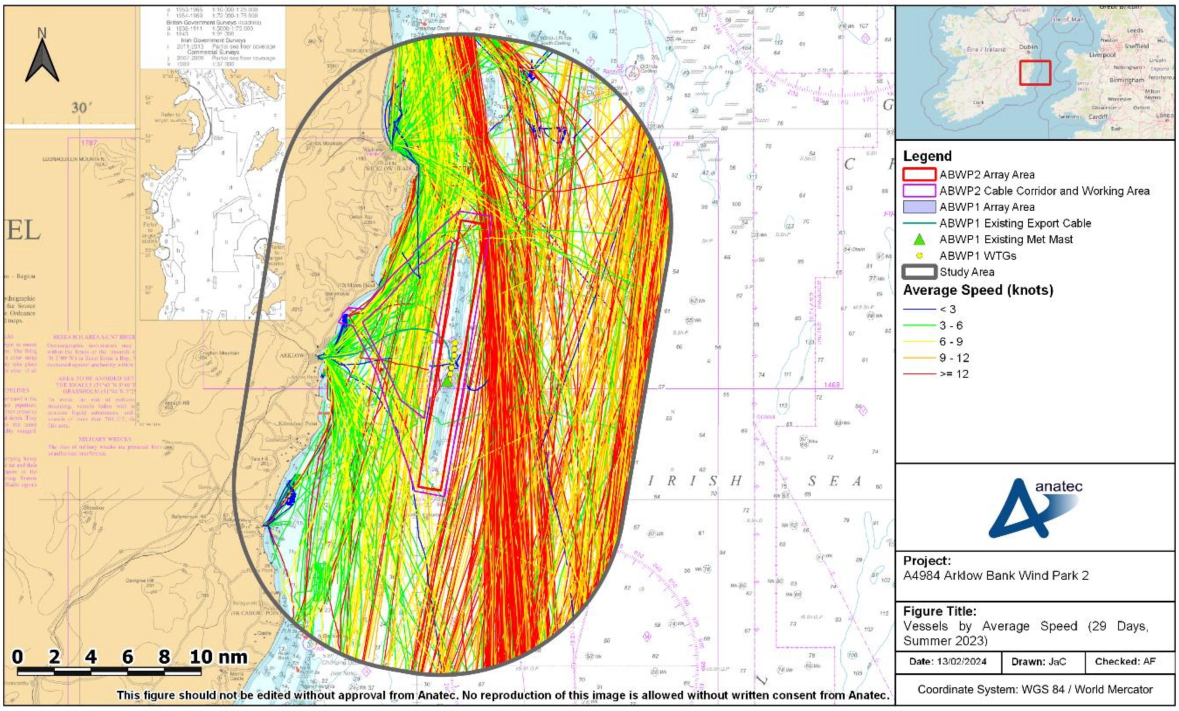

Figure 15.1.21 Vessels by Average Speed (29 Days, Summer 2023)

The slowest vessels (less than 6 knots) were generally recorded inshore of the Array Area and were mainly fishing and recreational, while most of the fastest vessels (at least 9 knots) were recorded offshore of the Array Area and were commercial.

Figure 15.1.22 presents the distribution of vessel speeds recorded within the Study Area during the survey period.

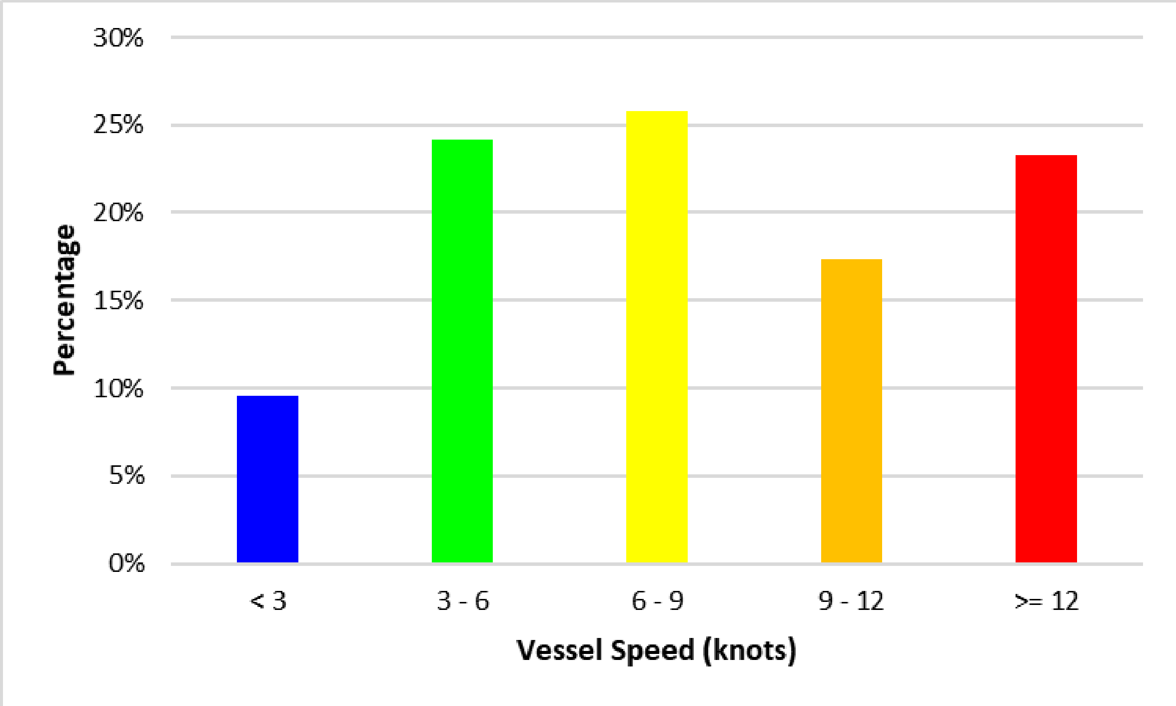

Figure 15.1.22 Distribution of Vessel Speeds (29 Days, Summer 2023)

The average speed recorded within the Study Area during the survey period was 9 knots. The fastest vessel was a Roll-on/Roll-off Passenger (RoPax) vessel, recorded travelling at an average speed of 24 knots in a northwest direction offshore of the Array Area.

13.1.6 Vessel Destinations

The distribution of the main vessel destinations recorded within the Study Area during the survey period is presented in Figure 15.1.23.

Destination information was available for 61% of the overall data due to a proportion of AIS traffic not broadcasting a valid destination, in addition to destination information not being available for Radar targets (which accounted for 1-2% of the data); the analysis that follows excludes these unspecified/invalid destinations.

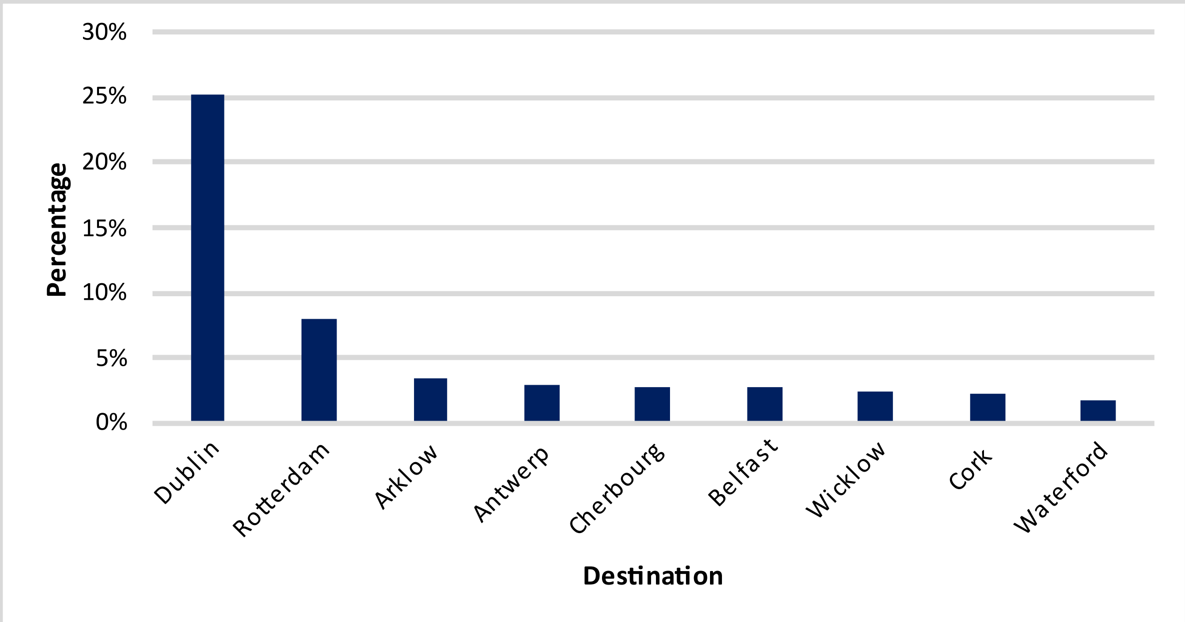

Figure 15.1.23 Distribution of Main Vessel Destinations (29 Days, Summer 2023)

The most common destination broadcast on AIS within the Study Area during the survey period was Dublin, which accounted for 25%. This was followed by Rotterdam (8%), Arklow (3%), Antwerp (3%) Cherbourg (3%), Belfast (3%), Wicklow (2%), Cork (2%) and Waterford (2%).

13.1.7 Anchored Vessels

Vessel navigation status information, including whether the vessel is at anchor, is transmitted via AIS. Any such cases within the data were identified and reviewed within the dataset to confirm the behaviour indicated anchoring activity. On this basis, four cargo vessels were identified as at anchor.

However, navigation status is not always up to date since it relies on the officer of the watch; therefore, any anchored vessel with a different navigation status would not be captured using the above method. Therefore, as an additional step, AIS tracks from vessels which transmitted a navigation status other than 'At Anchor' were used as input to Anatec's Speed Analysis model. The program detects any tracks of vessels that were travelling with speeds less than one knot for a minimum of 30 minutes. The output of this model was reviewed and none of the vessels displayed clear signs of anchoring activity.

The identified anchored vessels are presented in Figure 15.1.24.

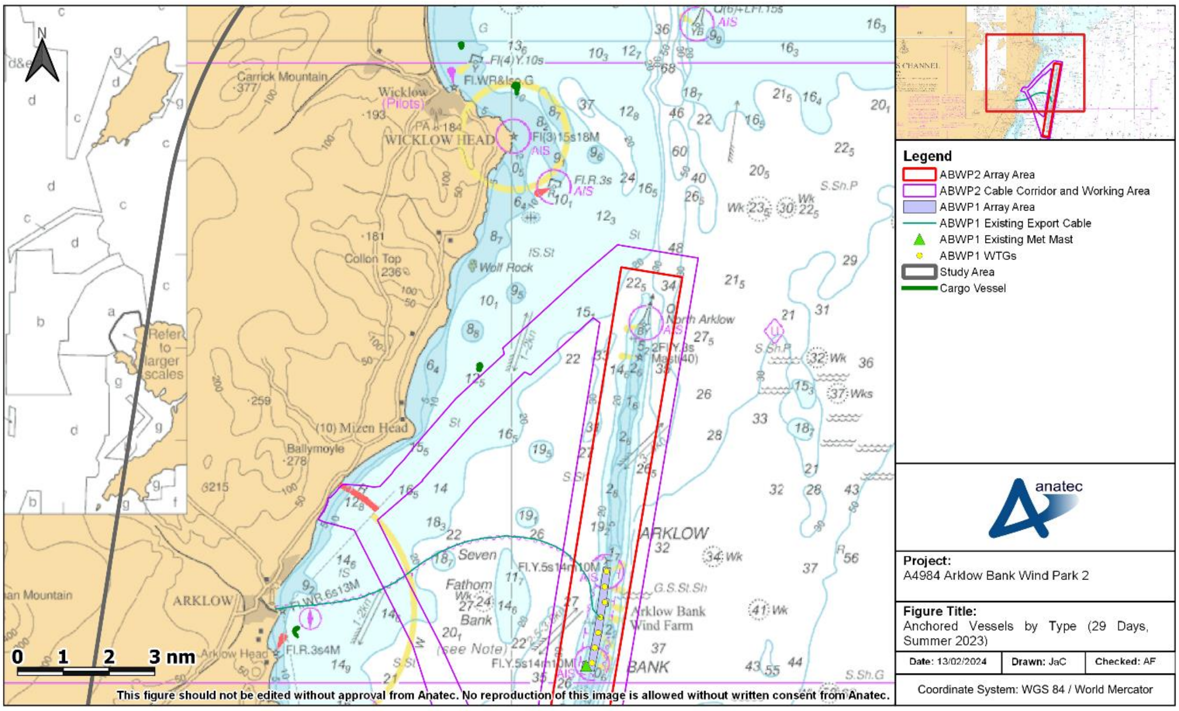

Figure 15.1.24 Anchored Vessels (Summer 2023)

Each of the four anchored cargo vessels were engaged in a single instance of anchoring. Two of these instances were located at the approach to Wicklow, another was located at the approach to Arklow and another was located near Brittas Bay, approximately 1.2 nm off the coast.

13.1.8 Vessels Intersecting the Array Area

This section presents detailed analysis of the vessels that intersect the Array Area.

An overview of the vessels recorded intersecting the Array Area during the survey period, colour-coded by vessel type, is presented in Figure 15.1.25.

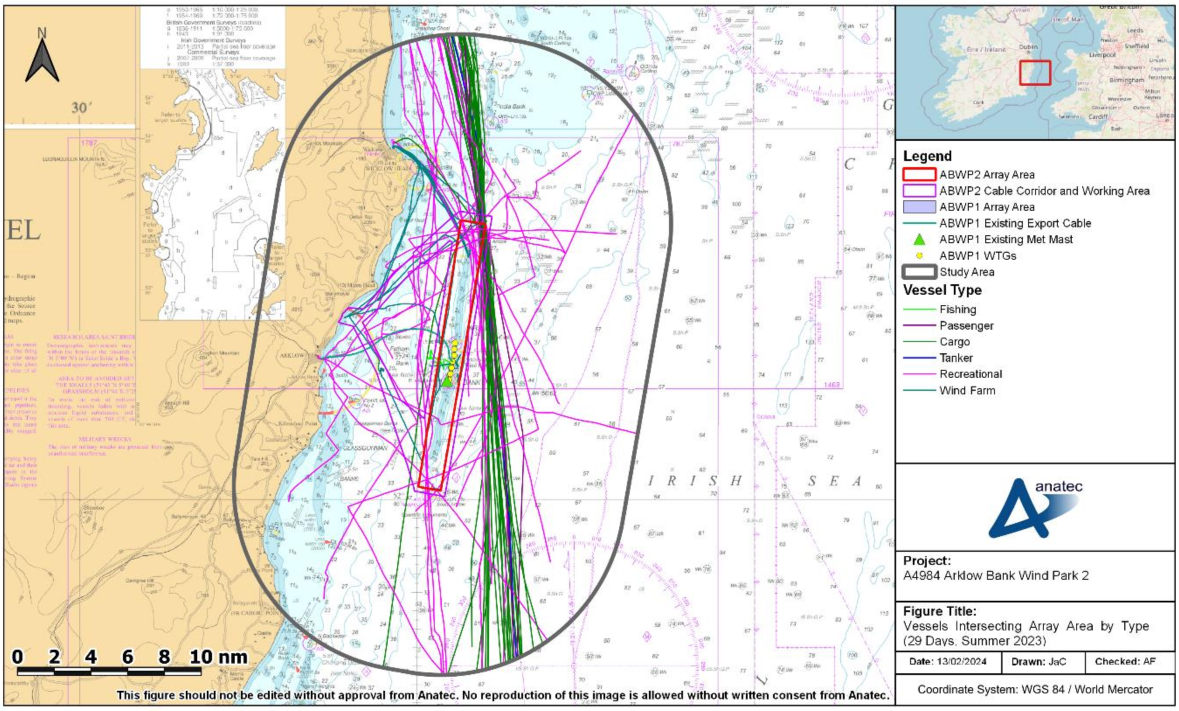

Figure 15.1.25 Vessels Intersecting Array Area by Type (29 Days, Summer 2023)

Array Area intersections were minimal due to vessels avoiding Arklow Bank (noting the shallow water depths). Most of the Array Area intersections occurred from vessels undertaking the southeast/northwest commercial route, whose outer limit intersects the northeastern extent of the Array Area, and from recreational vessels, which mainly intersected the northern and southern portions of the Array Area.

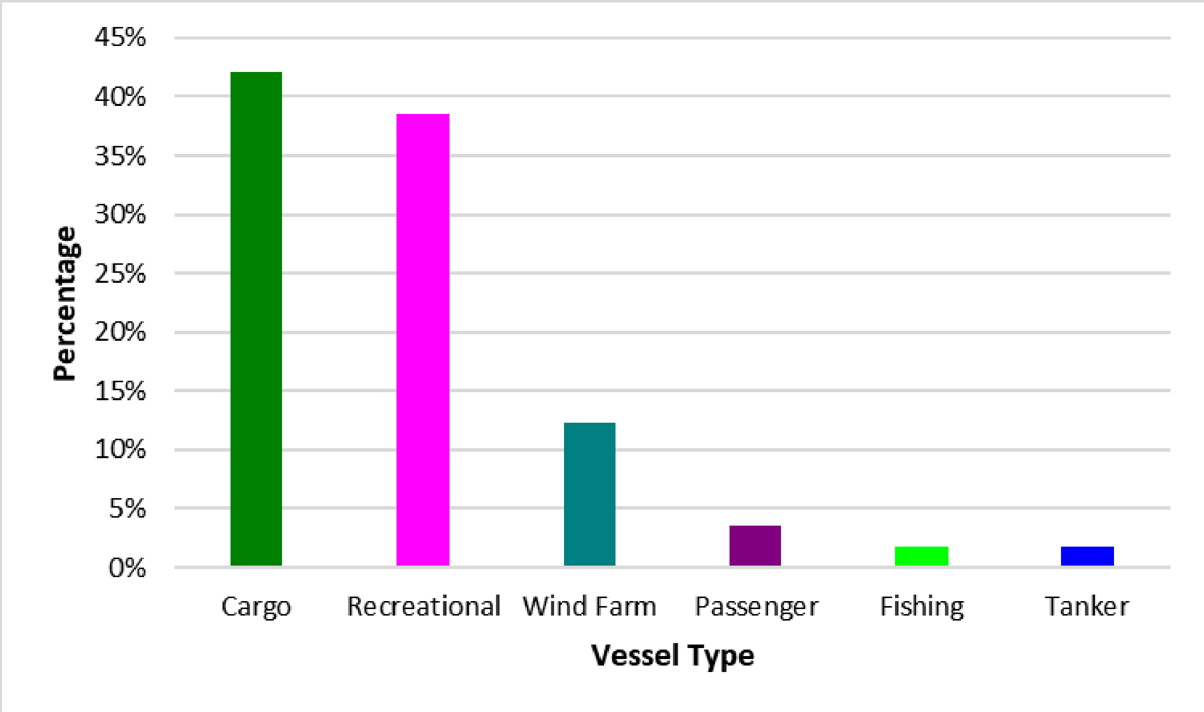

Figure 15.1.26 Distribution of Vessel Types Intersecting Array Area (29 Days, Summer 2023)

A total of 57 Array Area intersections were recorded during the survey period, corresponding to an average of two unique vessels per day. Six of these vessels were recorded on Radar.

The most common vessel types intersecting the Array Area were cargo vessels and recreational vessels, accounting for 42% and 39% respectively. This was followed by wind farm (12%), passenger (4%), fishing (2%) and tanker (2%).

13.1.9 Vessel Types

This section provides detailed analysis of vessels recorded within the Study Area during the survey period for each vessel type.

13.1.9.1 Cargo Vessels

Figure 15.1.27 presents the cargo vessels recorded within the Study Area during the survey period. All were recorded on AIS.

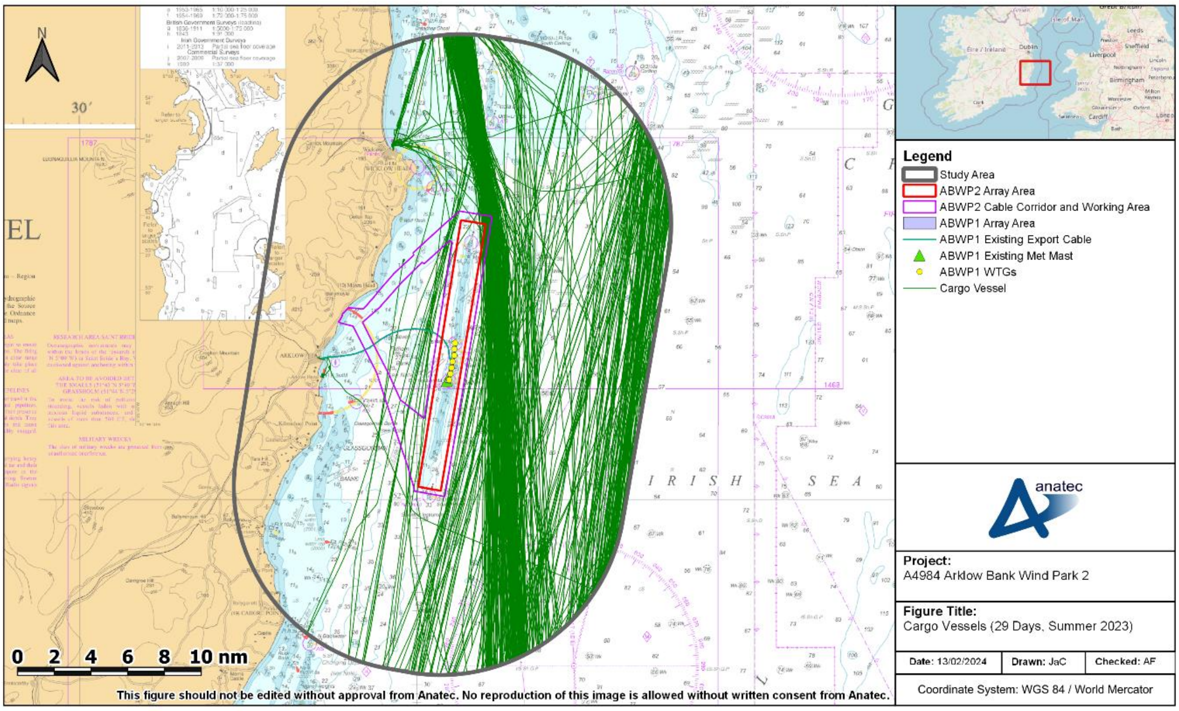

Figure 15.1.27 Cargo Vessels (29 Days, Summer 2023)

Cargo vessels were mainly recorded undertaking either a northwest/southeast route (whose edge intersects the northeastern extent of the Array Area, as seen in Section 13.1.8) or a north/south route at the eastern extent of the Study Area. The northwest/southeast route was undertaken by various container ships as well as RoRo vessels operated by CLdN.

Vessels undertaking the northwest/southeast route were mainly recorded travelling between Dublin and Rotterdam. Vessels undertaking the north/south route were recorded most commonly travelling between British or Irish ports and Rotterdam or Antwerp.

An average of between 14 and 15 unique cargo vessels per day was recorded within the Study Area during the survey period. A total of 24 intersections through the Array Area by cargo vessels was recorded, corresponding to an average of one per day.

13.1.9.2 Recreational Vessels

Figure 15.1.28 presents the recreational vessels recorded within the Study Area during the survey period. Approximately 1% were recorded on Radar.

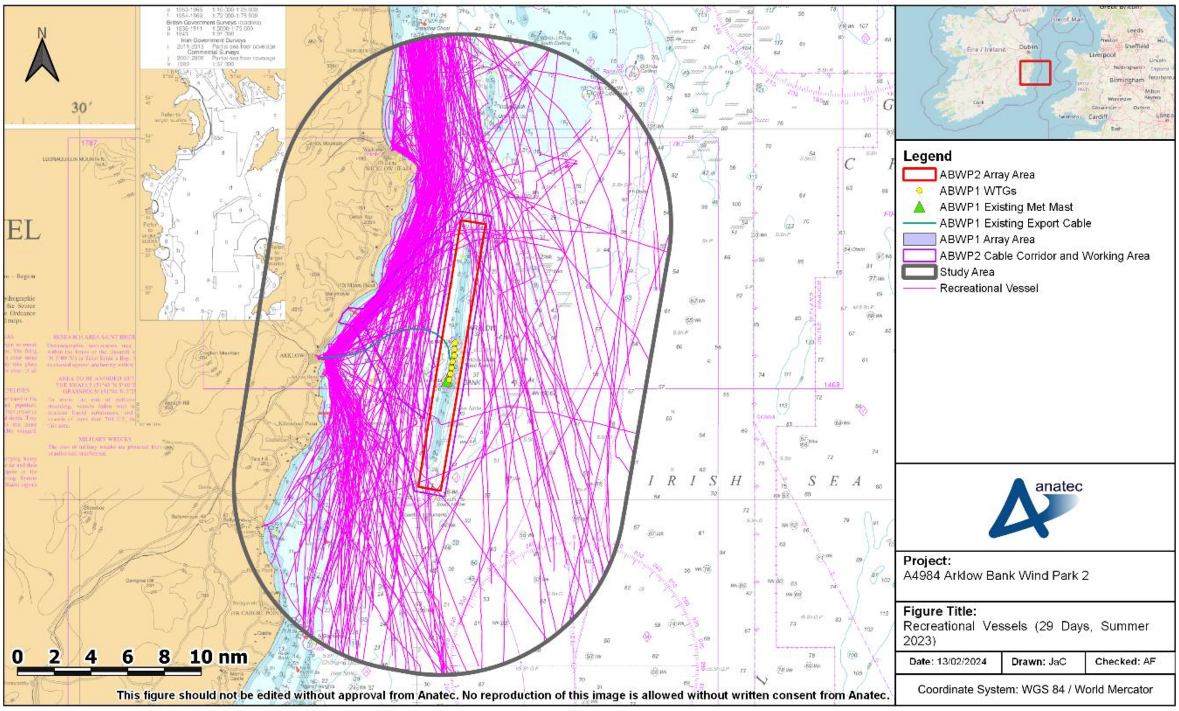

Figure 15.1.28 Recreational Vessels (29 Days, Summer 2023)

Approximately half of the recreational vessels were recorded travelling to/from Arklow, with the remainder transiting either north/south inshore of the Array Area or northwest/southeast offshore of the Array Area.

An average of between 11 and 12 unique recreational vessels per day was recorded within the Study Area, with a total of 22 intersections through the Array Area during the survey period.

13.1.9.3 Fishing Vessels

Figure 15.1.29 presents the fishing vessels recorded within the Study Area during the survey period. Approximately 5% were recorded on Radar.

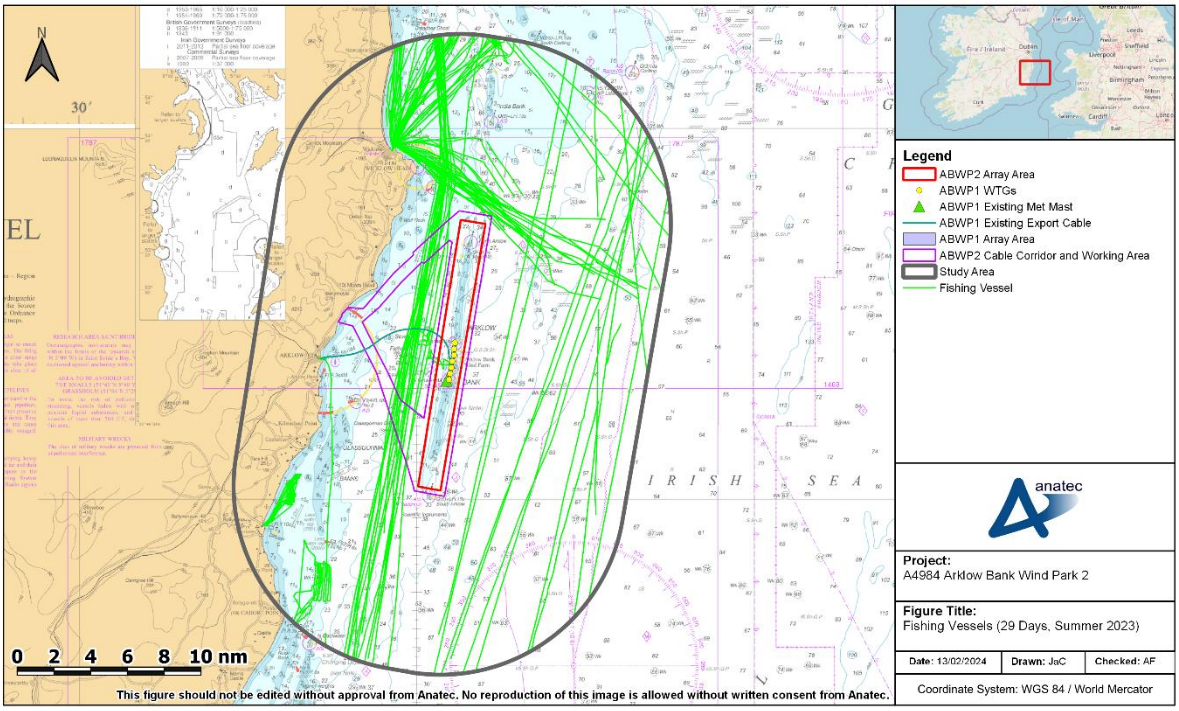

Figure 15.1.29 Fishing Vessels (29 Days, Summer 2023)

Fishing vessels were mainly recorded transiting either to/from Wicklow or north/south inshore of the Array Area. Potential active fishing activity was observed to the southwest of the Array Area as well at the northern extent of the Study Area.

An average of three to four unique fishing vessels per day was recorded within the Study Area during the survey period. A single intersection through the Array Area was recorded, on Radar.

13.1.9.4 Tankers

Figure 15.1.30 presents the tankers recorded within the Study Area during the survey period. All were recorded on AIS.

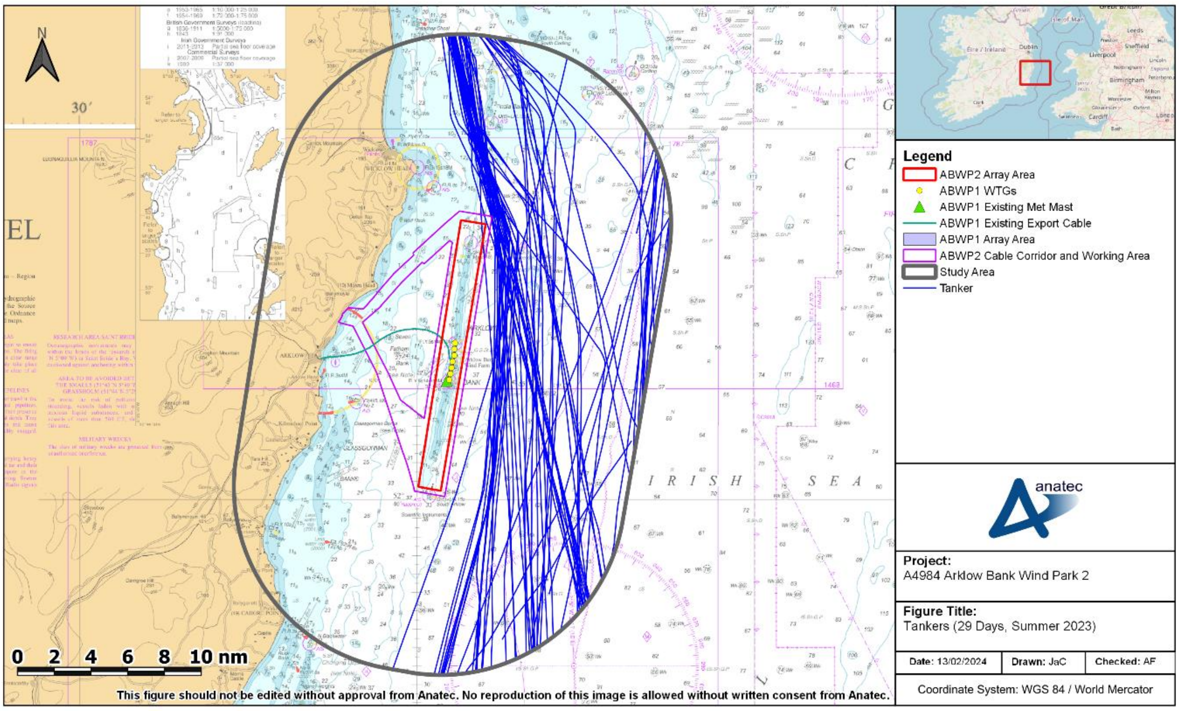

Figure 15.1.30 Tankers (29 Days, Summer 2023)

All tankers were recorded passing offshore of the Array Area during the survey period, with approximately half undertaking the southeast/northwest route (with the most common destinations being Dublin and Pembroke). Tankers were also seen undertaking a similar route, passing offshore of India Bank to the north of the Array Area, and also transiting north/south at the eastern extent of the Study Area.

An average of two to three unique tankers per day was recorded within the Study Area during the survey period. A single tanker was recorded intersecting the Array Area, in southeast transit at the Array Area's northeastern extent.

13.1.9.5 Passenger Vessels

Figure 15.1.31 presents the passenger vessels recorded within the Study Area during the survey period. All were recorded on AIS.

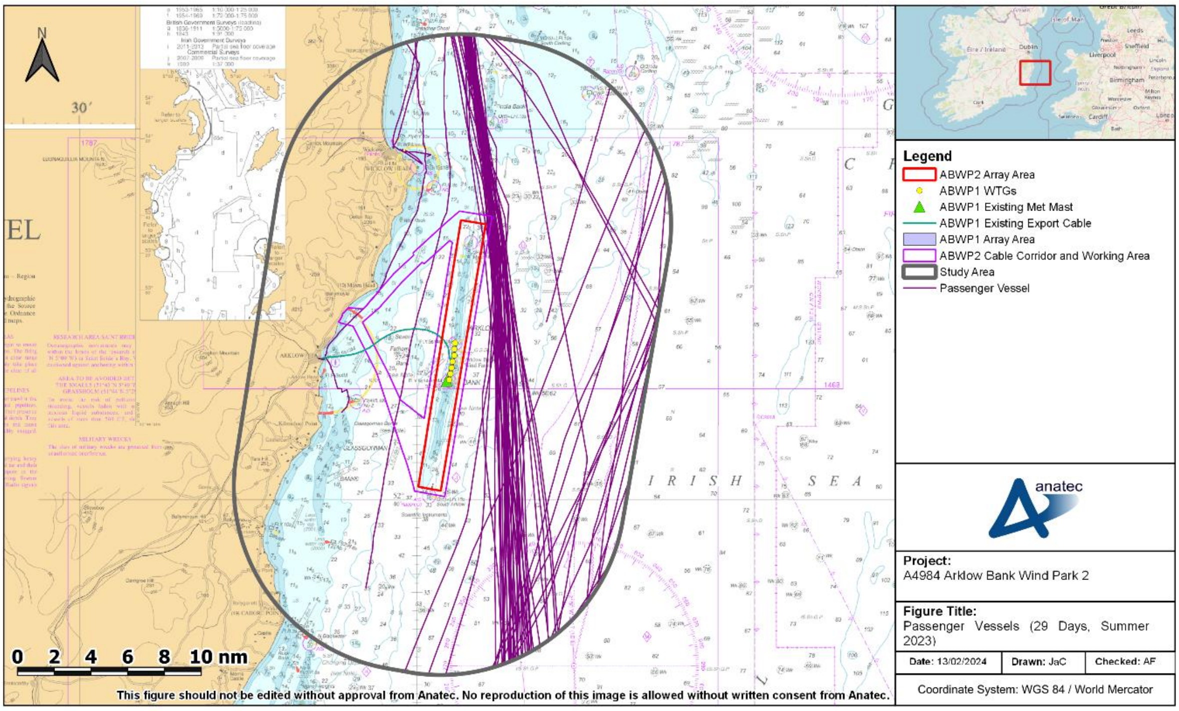

Figure 15.1.31 Passenger Vessels (29 Days, Summer 2023)

Passenger vessels were mainly recorded undertaking the southeast/northwest route offshore of the Array Area; this route was mainly undertaken by two RoRo passenger vessels (both operated by Irish Ferries) each travelling between Cherbourg and Dublin. Passenger vessels were also recorded in northeast/southwest transit at the eastern extent of the Study Area.

An average of two unique passenger vessels per day was recorded within the Study Area during the survey period. There were two intersections through the Array Area by the same RoPax vessel in southeast transit to Cherbourg, on two separate days.

13.2 September 2022

This section presents analysis of the 2022 vessel-based survey which was undertaken from the survey vessel *Roman Rebel* between the 8 and 26 September 2022.

The survey period was chosen to account for periods when the survey vessel was offsite to ensure a total of 14 x 24-hour periods were captured, and on this basis are as follows:

- 11:00 8 September – 23:59 19 September; and
- 00:00 23 September – 11:00 26 September.

The overall effective survey period is therefore 14 days (accounting for a 24 hour period from 01:30 16 September to 01:30 17 September, when the survey vessel was offsite).

It is noted that the AIS has been supplemented with additional satellite-based AIS to ensure maximal coverage.

13.2.1 Overview

An overview of the vessels recorded within the Study Area during the survey period is presented in Figure 15.1.32. The types of all vessels recorded on AIS were identified, however some vessels recorded on Radar had unknown type (these unknown types accounted for less than 1% of overall data).

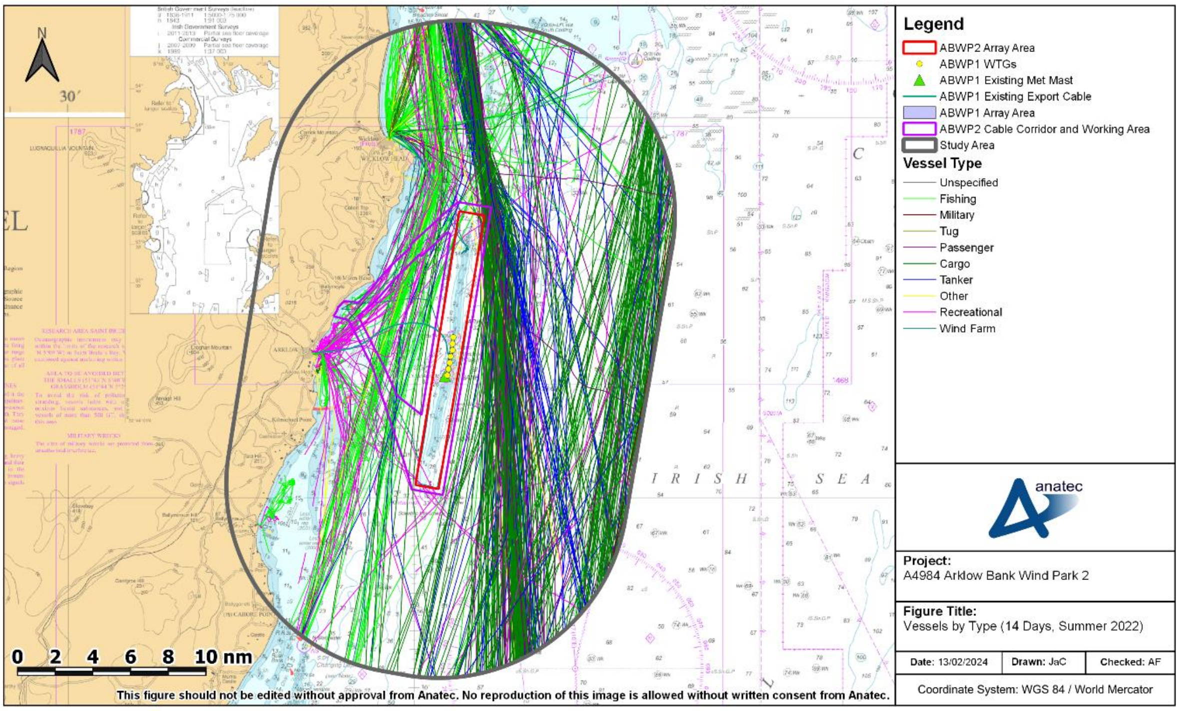

Figure 15.1.32 Vessels by Type (14 Days, Summer 2022)

Commercial vessels were frequently recorded within the Study Area offshore of the Array Area, and a smaller proportion of fishing vessels and recreational vessels were recorded inshore of the Array Area. All vessel types were generally recorded avoiding Arklow Bank, with minimal Array Area intersections noting the shallow water depths. Further information about site intersections can be found in Section 13.2.8 and further information about each vessel type can be found in Section 13.2.9.

The distribution of the main vessel types is presented in Figure 15.1.33.

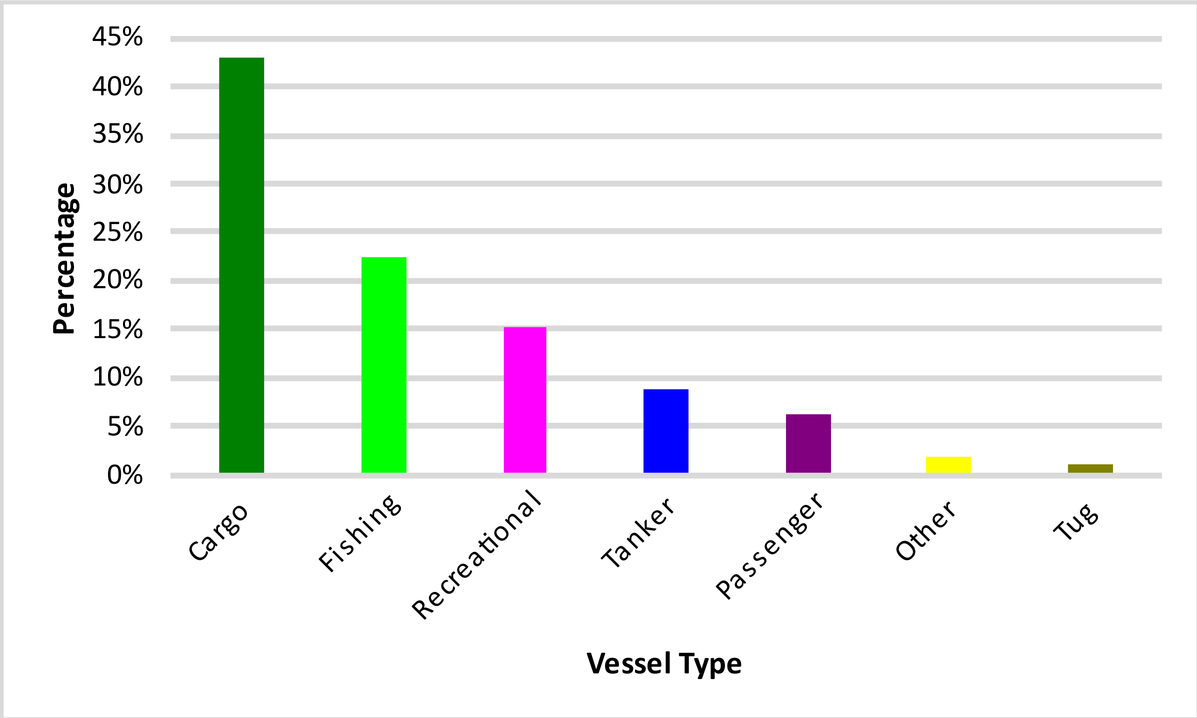

Figure 15.1.33 Distribution of Vessel Types (14 Days, Summer 2022)

The most common vessel type recorded within the study area during the survey period was cargo, accounting for 43%. This was followed by fishing (22%) and recreational (15%). The remainder of the main types consisted of tanker (9%), passenger (6%), the 'other' category (2%) and tug vessels (1%). The 'other' category was observed to primarily consist of lifeboats. Vessel types recorded in very limited numbers (which accounted for less than 1% and are not shown in Figure 15.1.33) included wind farm vessels and military.

13.2.2 Vessel Count

The number of unique vessels per day recorded within the study area during the survey period are presented in Figure 15.1.34. The partial[3] survey days are colour-coded.

[3] Counts on these days do not include 24-hour Radar coverage given that the vessel left the study area.

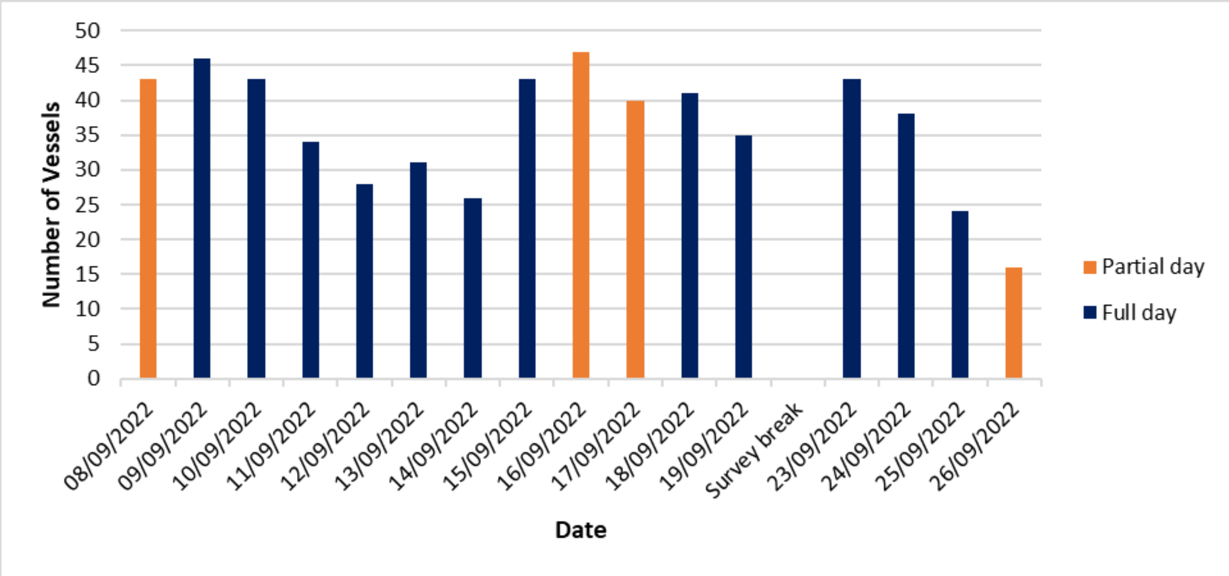

Figure 15.1.34 Number of Unique Vessels per Day (14 Days, Summer 2022)

An average of 36 unique vessels were recorded per day during the 16-day period on which data was recorded. The busiest full day during the period was the 9 September 2022, on which 46 unique vessels were recorded. The quietest full day during the period was the 25 September 2022, on which 24 unique vessels were recorded.

13.2.3 Vessel Length

An overview of the vessels recorded within the study area during the survey period, colour-coded by vessel length, is presented in Figure 15.1.35. Approximately 3% of vessels could not be associated with a valid length and have therefore been excluded from the analysis that follows (but are included in Figure 15.1.35).

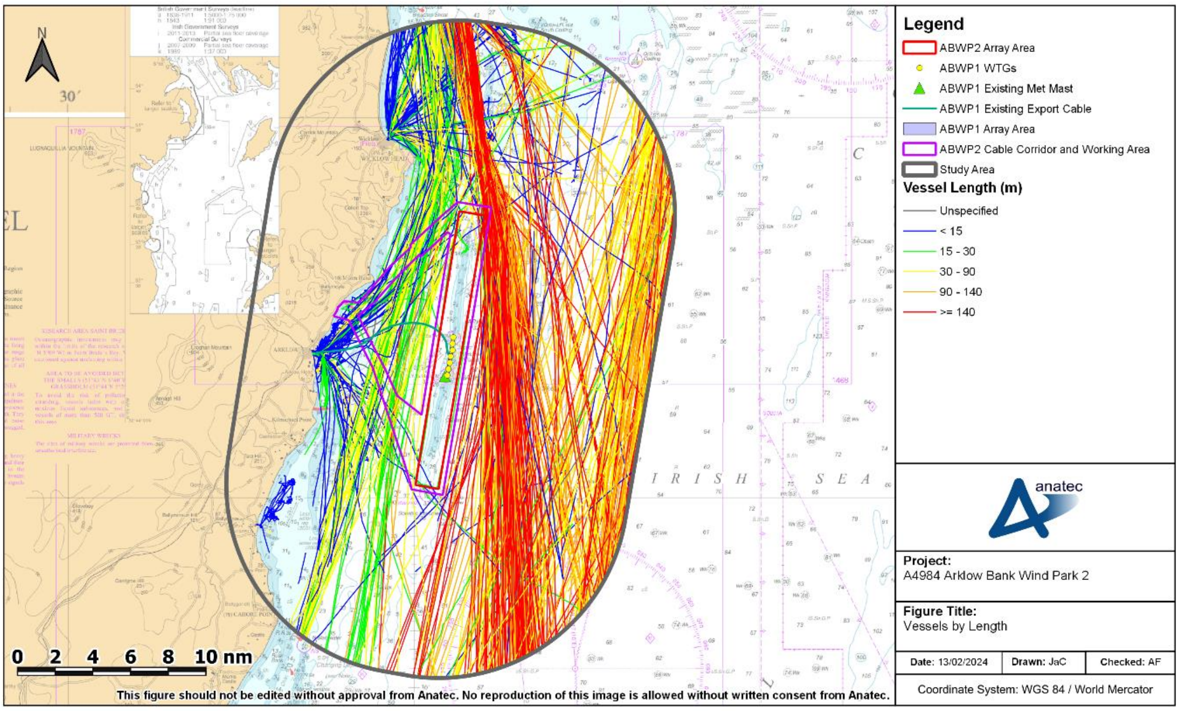

Figure 15.1.35 Vessels by Length (14 Days, Summer 2022)

Longer vessels (with length of at least 90 m) were mostly recorded offshore of the Array Area while most of the shorter vessels (with length of less than 30 m) were recorded inshore of the Array Area. Vessels with length between 30 m and 90 m were generally recorded both inshore and offshore of the Array Area.

The distribution of vessel lengths recorded is presented in Figure 15.1.36 (excluding a small percentage of vessels with unspecified length).

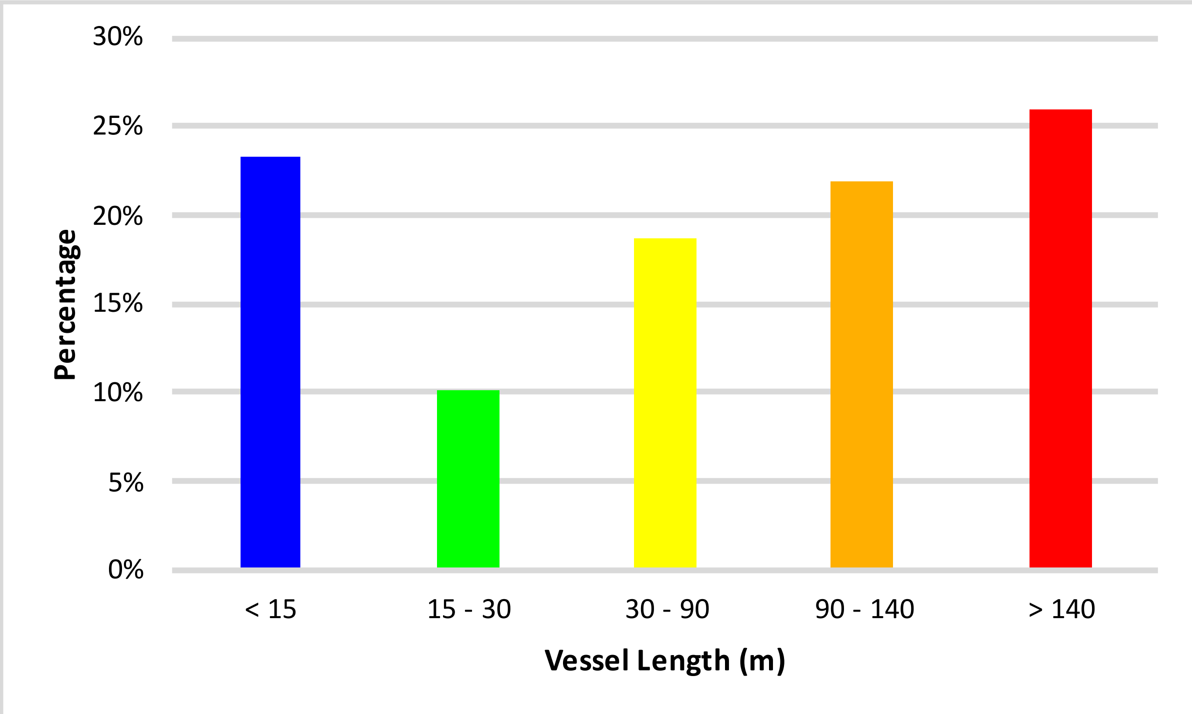

Figure 15.1.36 Distribution of Vessel Lengths (14 Days, Summer 2022)

The average length of vessel recorded within the Study Area during the survey period was 86 m. The smallest vessels (less than 15 m) mainly consisted of fishing vessels, recreational vessels, and lifeboats. The longest vessel was a 319 m passenger vessel, recorded in southward transit at the eastern extent of the Study Area.

13.2.4 Vessel Draught

Figure 15.1.37 presents the vessels recorded within the Study Area during the survey period colour-coded by vessel draught. This is only available for vessels broadcasting a valid draught on AIS (which accounted for 67% of all vessel tracks); these are included in Figure 15.1.37 but are excluded from the analysis that follows.

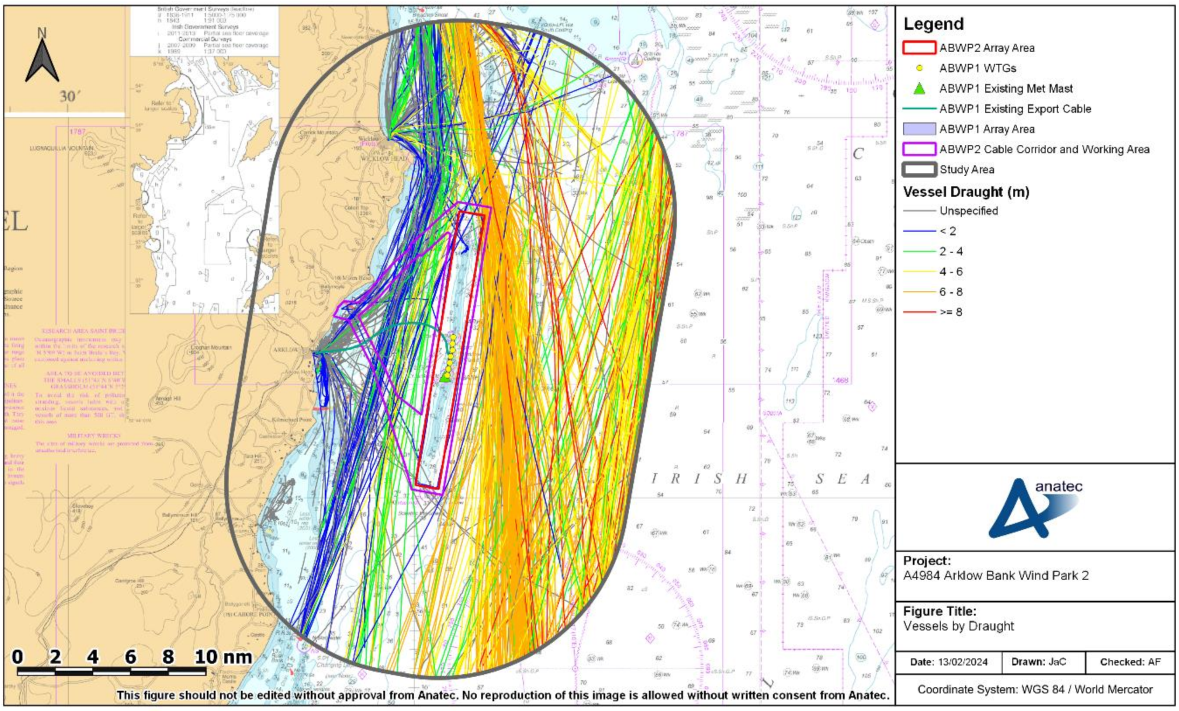

Figure 15.1.37 Vessels by Draught (14 Days, Summer 2022)

It can be seen that, similar to the vessel length distribution, the smallest draughts (less than 2 m) were generally recorded inshore of the Array Area while most of the larger draughts (at least 4 m) were recorded offshore of the Array Area. Draughts of between 2 m and 4 m were generally recorded on both sides of the Array Area.

Vessels with unspecified draught were mainly fishing vessels and recreational vessels, and it is therefore likely that these vessels have relatively small draughts.

The distribution of vessel draughts recorded is presented in Figure 15.1.38 (excluding unspecified draughts).

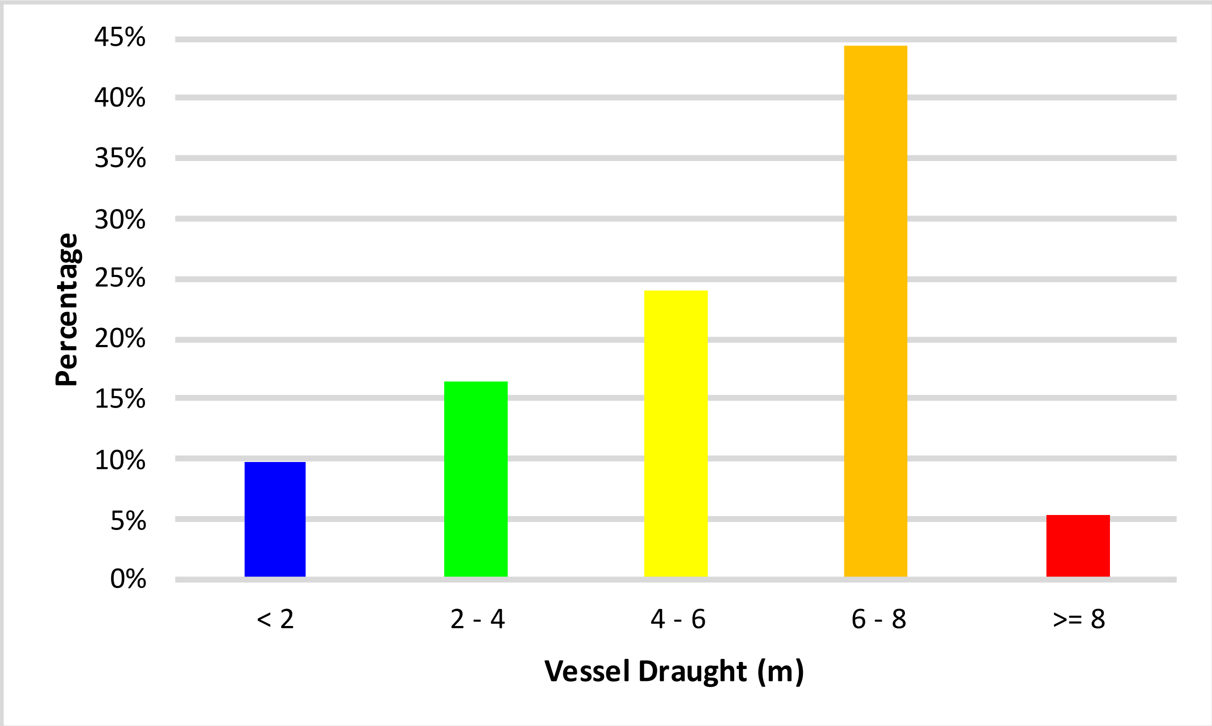

Figure 15.1.38 Distribution of Vessel Draughts (14 Days, Summer 2022)

The most common draught range was 6 m to 8 m, accounting for 44%, followed by 4 m to 6 m, which accounted for 24%. The average draught was 5 m. The deepest draught recorded was 14 m, broadcast by a cargo vessel in southwest transit offshore of the Array Area.

13.2.5 Vessel Speed

Figure 15.1.39 presents the vessels recorded within the Study Area during the survey period colour-coded by vessel speed. All vessel tracks were associated with a valid average speed.

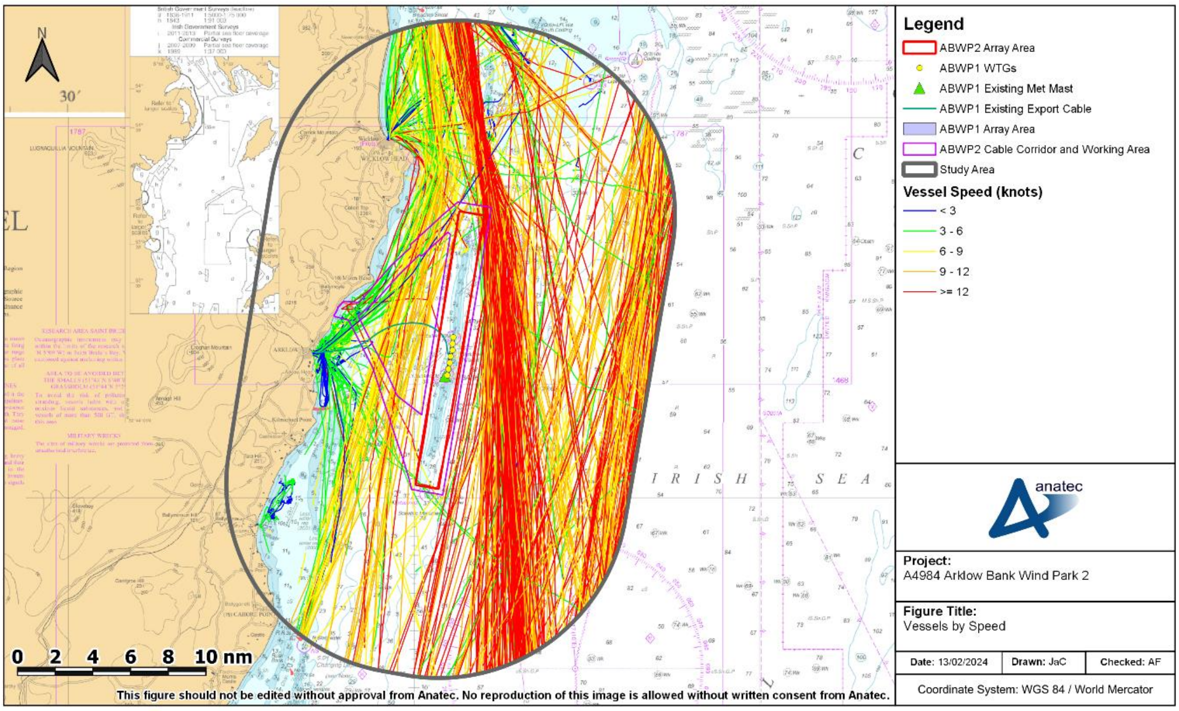

Figure 15.1.39 Vessels by Speed (14 Days, Summer 2022)

The slowest vessels (less than 6 knots) were generally recorded inshore of the Array Area and were mainly fishing and recreational, while most of the fastest vessels (at least 12 knots) were recorded offshore of the Array Area and were commercial. Vessels between 6 knots and 12 knots were generally recorded on both sides of the Array Area.

Figure 15.1.40 presents the distribution of vessel speeds recorded within the Study Area during the survey period.

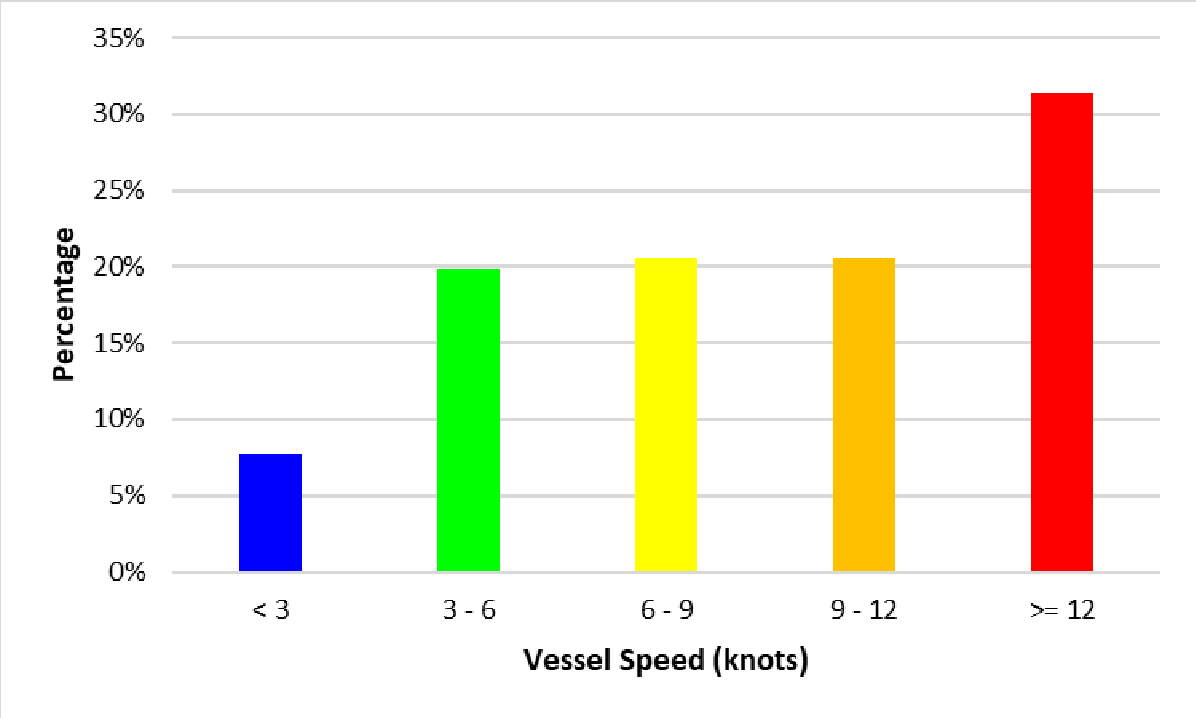

Figure 15.1.40 Distribution of Vessel Speeds (14 Days, Summer 2022)

The average speed recorded within the Study Area during the survey period was 10 knots. The fastest vessel was a lifeboat, recorded travelling at a speed of 26 knots in a southward direction inshore of the Array Area.

13.2.6 Vessel Destinations

The distribution of the main vessel destinations recorded within the Study Area during the survey period is presented in Figure 15.1.41. This excludes AIS traffic that did not specify a valid destination (which accounted for 29%). Radar targets (which accounted for 5% of the overall data) were also excluded given destination information cannot be derived via Radar.

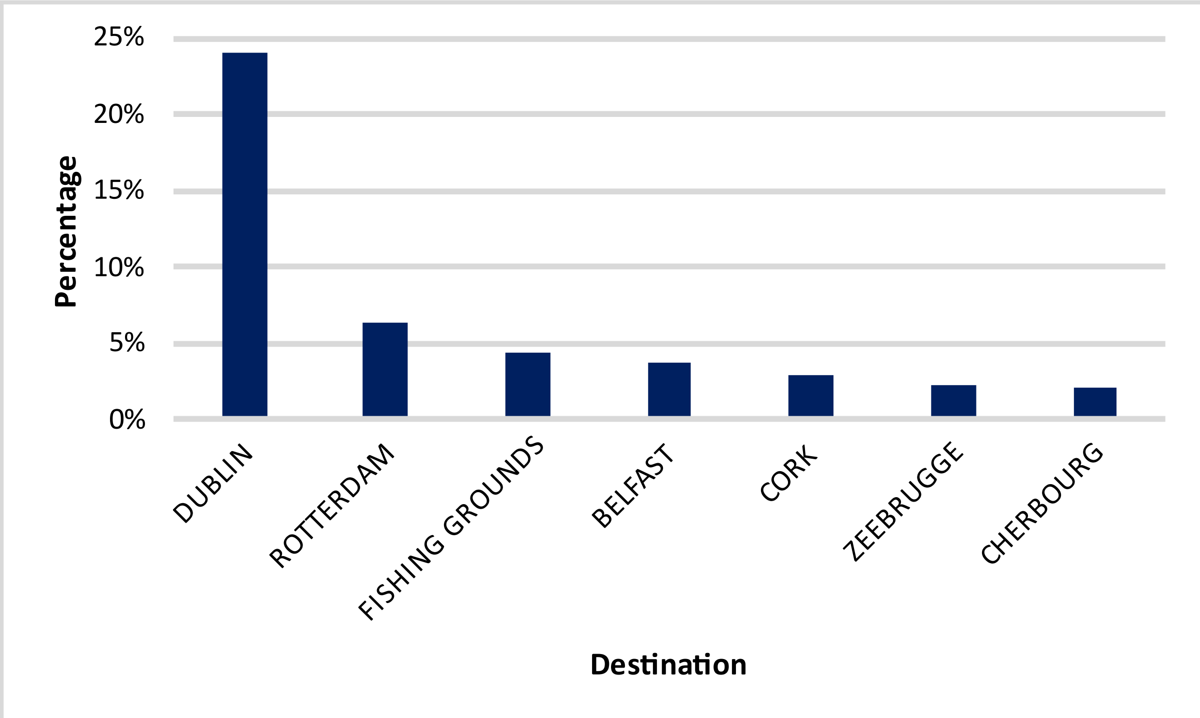

Figure 15.1.41 Distribution of Main Vessel Destinations (14 Days, Summer 2022)

The most common destination broadcast on AIS within the Study Area during the survey period was Dublin, which accounted for 24%. This was followed by Rotterdam (6%), fishing grounds (4%), Belfast (4%), Cork (3%), Zeebrugge (2%) and Cherbourg (2%).

13.2.7 Anchored Vessels

Based on the approach outlined in Section 13.1.7, one vessel was deemed to be at anchor during the survey period. The associated tracks are presented in Figure 15.1.42. The vessel was a cargo vessel recorded approximately 1.4 nm north of Wicklow.

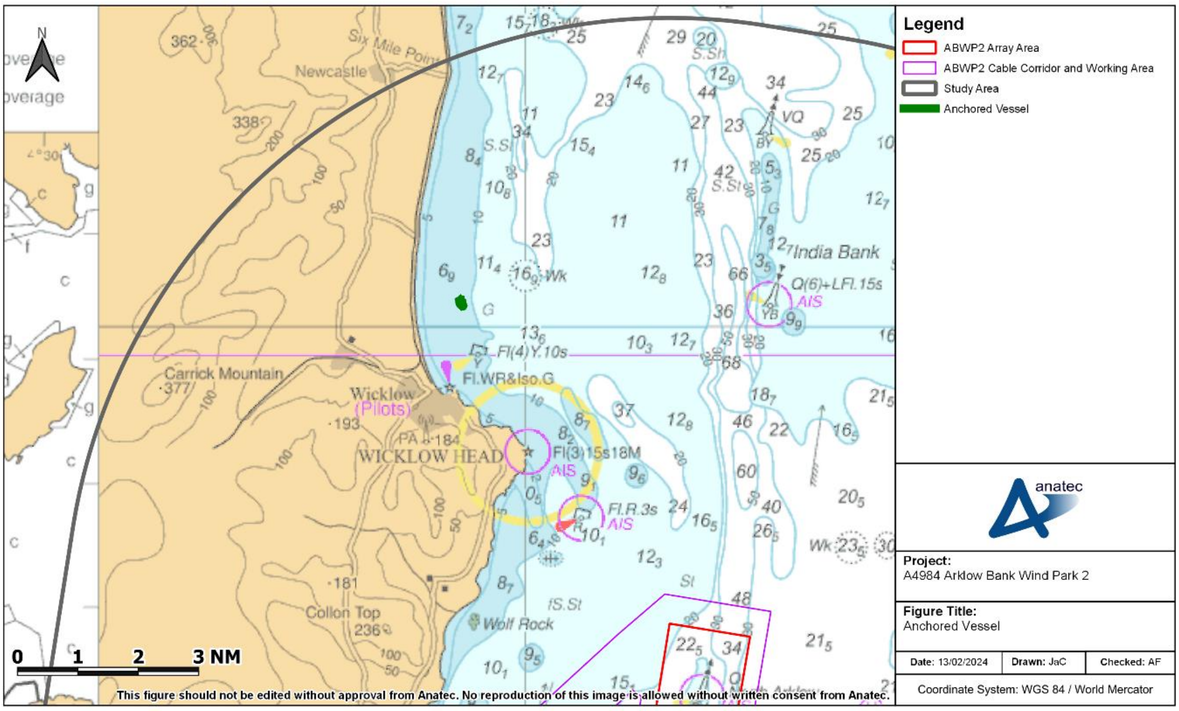

Figure 15.1.42 Anchored Vessel (Summer 2022)

13.2.8 Vessels Intersecting the Array Area

This section presents detailed analysis of the vessels that intersect the Array Area.

An overview of the vessels recorded intersecting the Array Area during the survey period, colour-coded by vessel type, is presented in Figure 15.1.43.

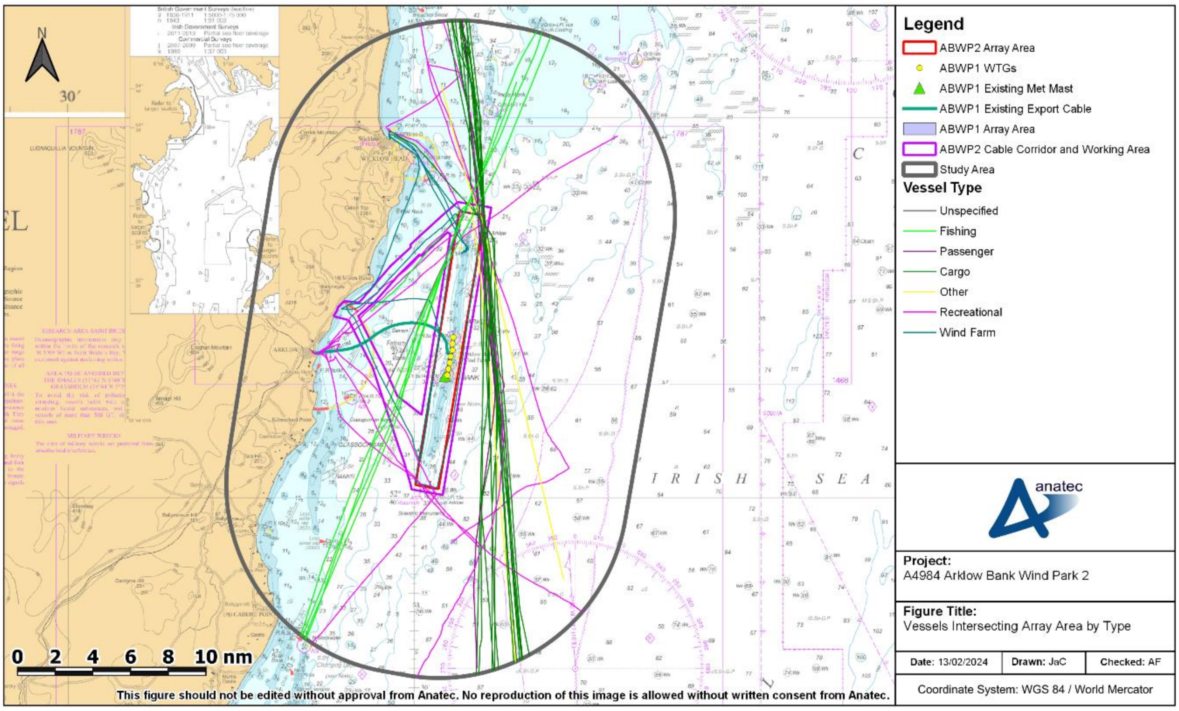

Figure 15.1.43 Vessels Intersecting Array Area by Type (14 Days, Summer 2022)

Intersections through the Array Area were minimal due to vessels avoiding Arklow Bank (noting the shallow water depths); most of the Array Area intersections occurred from vessels undertaking the southeast/northwest commercial route, whose outer limit intersects the northeastern extent of the Array Area.

The distribution of vessel types intersecting the Array Area during the survey period is presented in Figure 15.1.44.

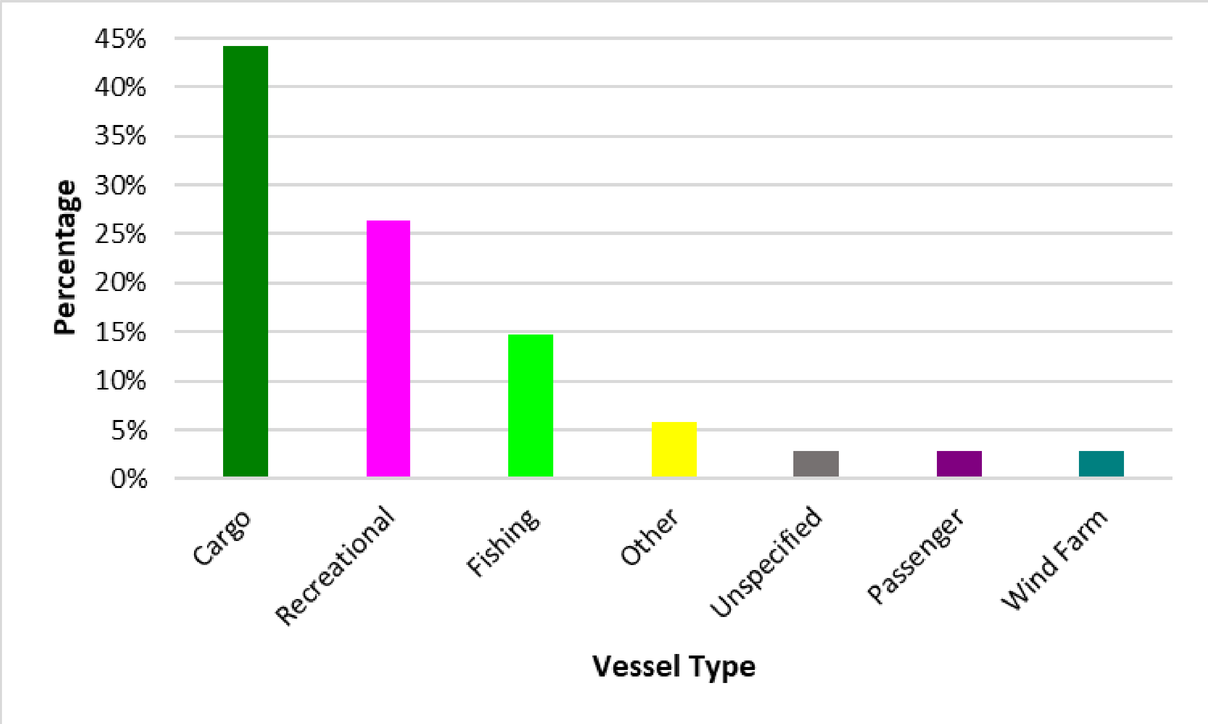

Figure 15.1.44 Distribution of Vessel Types Intersecting Array Area (14 Days, Summer 2022)

A total of 34 Array Area intersections were recorded during the survey period, corresponding to an average of two unique vessels per day. Two of these vessels were recorded on Radar.

The most common vessel type intersecting the Array Area was cargo, accounting for 44%. This was followed by recreational (26%) and fishing (15%). The remainder consisted of vessels in the 'other' category (6%), vessels of unknown type (3%), passenger vessels (3%) and wind farm vessels (3%). It is noted that one wind farm vessel may have been involved in activities associated with the existing ABWP1 based on its behaviour.

13.2.9 Vessel Types

This section provides detailed analysis of vessels recorded within the Study Area during the survey period for each vessel type.

13.2.9.1 Cargo Vessels

Figure 15.1.45 presents the cargo vessels recorded within the Study Area during the survey period. All were recorded on AIS.

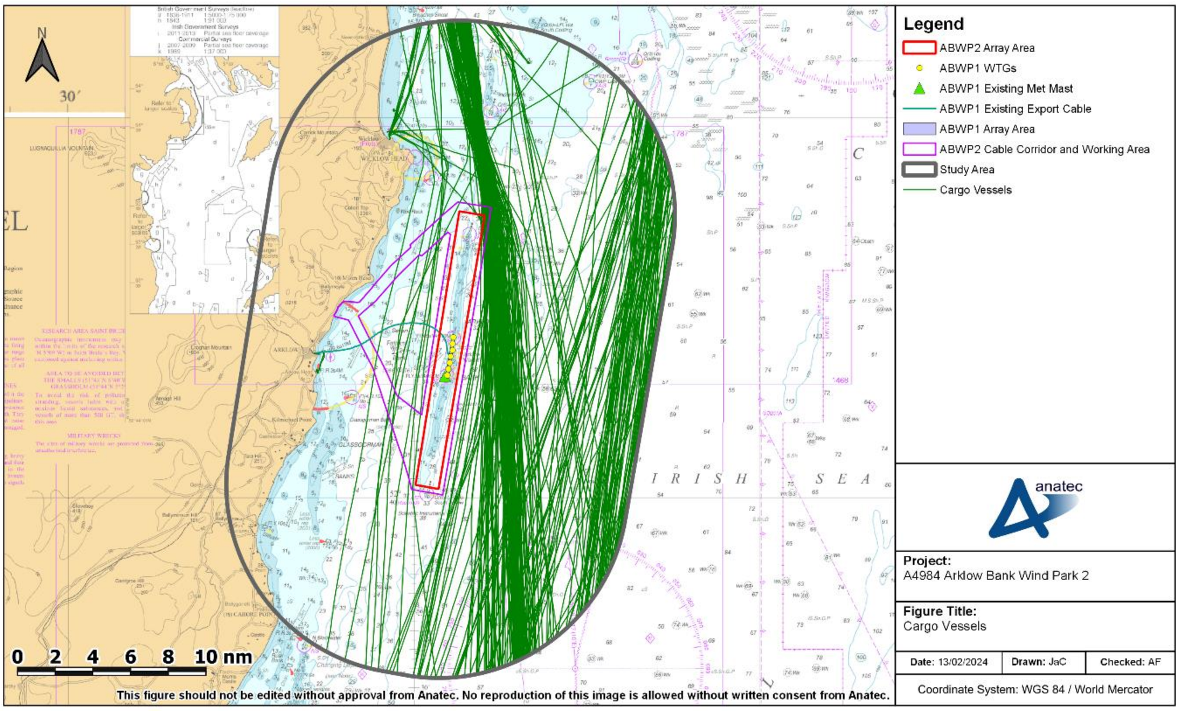

Figure 15.1.45 Cargo Vessels (14 Days, Summer 2022)

Cargo vessels were mainly recorded undertaking either a northwest/southeast route (whose edge intersects the northeastern extent of the Array Area, as seen in Section 13.2.8) or a north/south route at the eastern extent of the Study Area. Various RoRo cargo vessels were seen undertaking the northwest/southeast route (with the key operator being CLdN).

Vessels undertaking the northwest/southeast route were typically recorded travelling between Dublin and either Rotterdam or Zeebrugge. Vessels undertaking the north/south route were recorded travelling to/from a variety of ports including Belgian ports, Irish ports and British ports.

An average of between 15 and 16 unique cargo vessels per day was recorded within the Study Area during the survey period. A total of 15 intersections through the Array Area by cargo vessels was recorded, corresponding to an average of approximately one per day.

13.2.9.2 Fishing Vessels

Figure 15.1.46 presents the fishing vessels recorded within the Study Area during the survey period. Approximately 12% were recorded on Radar.

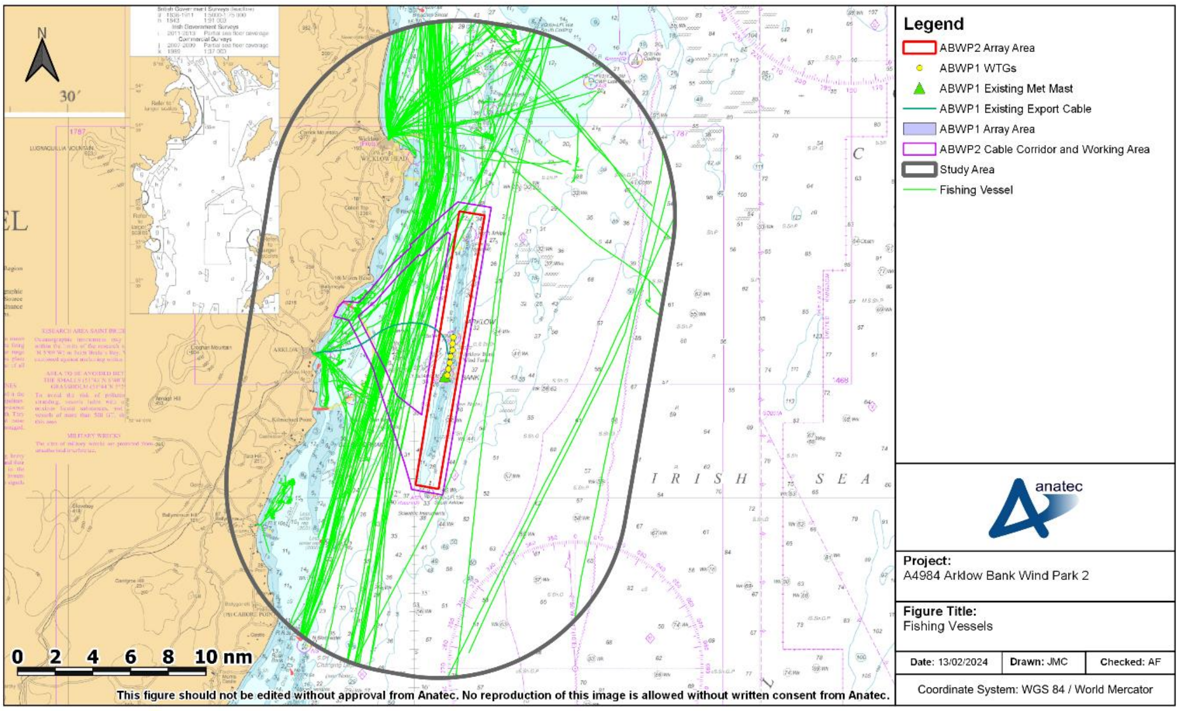

Figure 15.1.46 Fishing Vessels (14 Days, Summer 2022)

Fishing vessels were mainly recorded inshore of the Array Area, either in north/south transit (with destinations including Belfast and Wexford), travelling to/from Arklow (with destinations including Belfast and the Menai Strait) or travelling to/from Wicklow. Potential active fishing activity was observed to the north, west and southwest of the Array Area.

An average of eight unique fishing vessels per day was recorded within the Study Area during the survey period. A total of five intersections through the Array Area from fishing vessels was recorded.

13.2.9.3 Recreational Vessels

Figure 15.1.47 presents the recreational vessels recorded within the Study Area during the survey period. Approximately 14% were recorded on Radar.

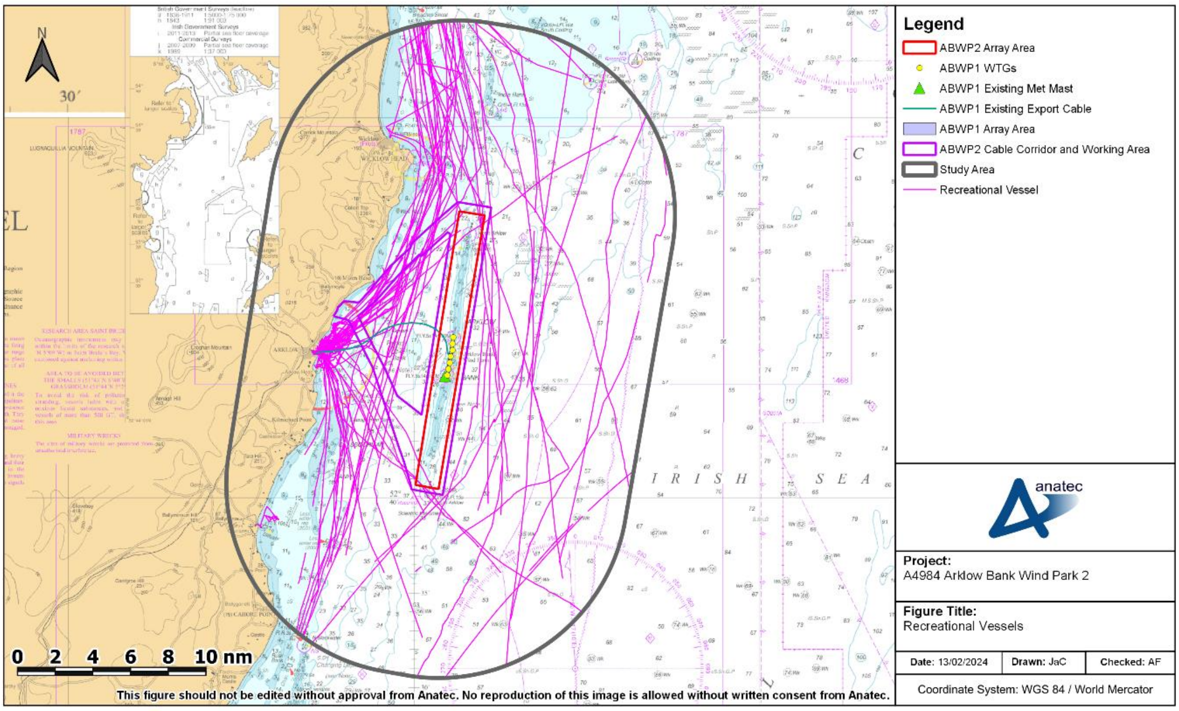

Figure 15.1.47 Recreational Vessels (14 Days, Summer 2022)

Around half of the recreational vessel traffic was recorded travelling to/from Arklow, with the rest of the traffic mostly in northward/southward transit either side of the Array Area.

An average of between five and six unique recreational vessels per day was recorded within the Study Area, with a total of nine intersections through the Array Area during the survey period.

13.2.9.4 Tankers

Figure 15.1.48 presents the tankers recorded within the Study Area during the survey period. All were recorded on AIS.

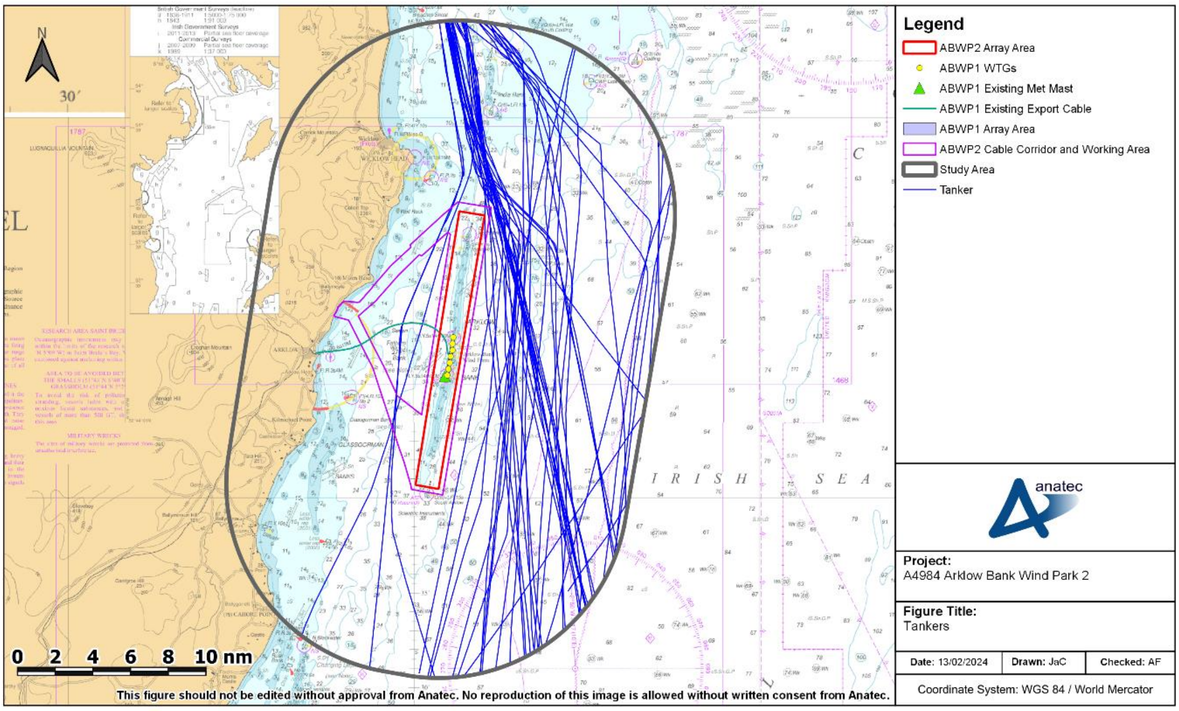

Figure 15.1.48 Tankers (14 Days, Summer 2022)

The significant majority of tanker transits was observed to pass offshore of the Array Area. A large proportion of these tankers were recorded undertaking the southeast/northwest route (with destinations commonly being either Dublin or Pembroke), and the rest were engaged in north/south transit (with Dublin being the most common destination).

An average of three unique tankers per day was recorded within the Study Area during the survey period. No tankers were recorded intersecting the Array Area; the closest a tanker passed to the Array Area was a tanker bound for Dublin, which passed within 50 m of the northeastern extent of the Array Area.

13.2.9.5 Passenger Vessels

Figure 15.1.49 presents the passenger vessels recorded within the Study Area during the survey period. All were recorded on AIS.

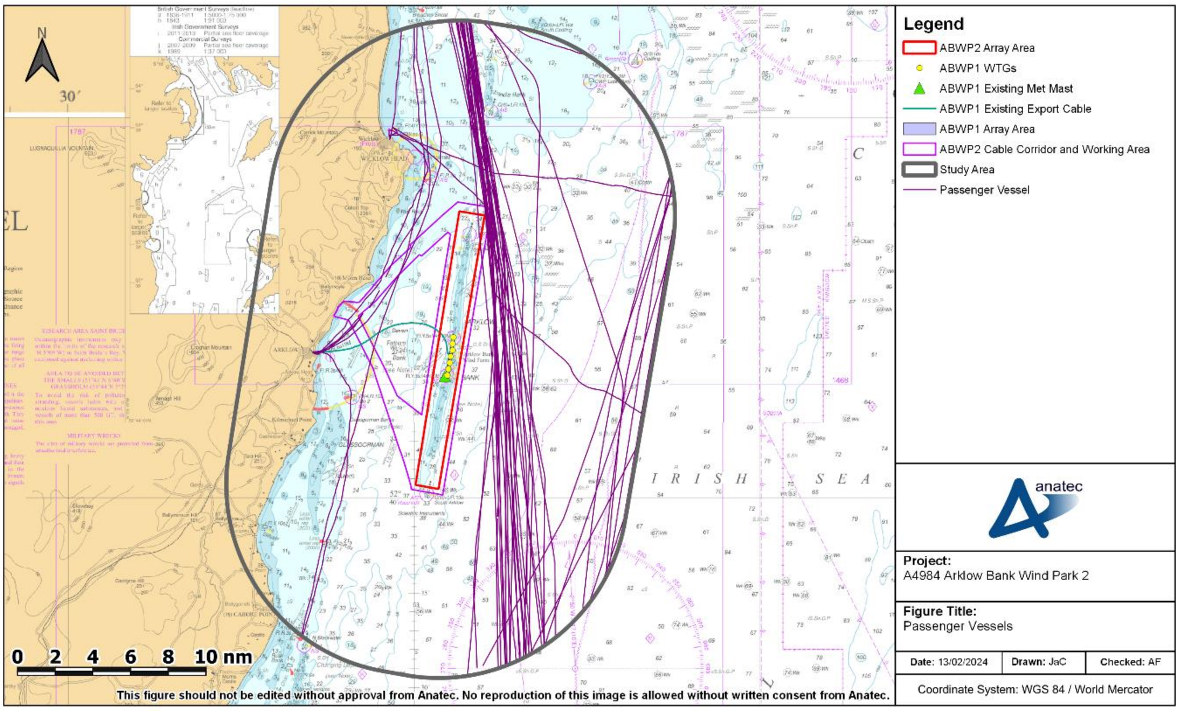

Figure 15.1.49 Passenger Vessels (14 Days, Summer 2022)

Passenger vessels were mainly recorded undertaking the northwest/southeast route offshore of the Array Area; this route was mainly undertaken by two RoRo passenger vessels (both operated by Irish Ferries) each travelling between Cherbourg and Dublin. Passenger vessels were also recorded travelling to/from Arklow or Wicklow, as well as within north/south transit further offshore within the eastern extent of the Study Area. An average of two unique passenger vessels per day was recorded within the Study Area during the survey period. There was a single intersection through the Array Area by a passenger vessel, by one of the vessels undertaking the southeast route to Cherbourg.

13.3 Consultation Input

The following key points in relation to baseline activity were noted during consultation (see Section 6):

- An estimated 10 to 11 fishing vessels operate out of Arklow Harbour with four to five on AIS. The tracks of those fishing vessels on AIS should be representative of the non-AIS traffic.
- Fishing offshore of the Array Area is considered an unlikely occurrence with fishing south of the Array Area more likely.
- Two angling charter vessels operate out of Wicklow Harbour but do not venture as far out as the Array Area.
- Vessels would not deliberately cross the Arklow Bank even in a shallow vessel in perfect conditions. For example, if a local fishing vessel wanted to fish on the eastern side, they would pass around the bank rather than pass across the bank.

- Recreational season is from May to August. Average approximately three to four yachts per day during May increasing to six to eight per day for June, July and August.
- Normal size of visiting yacht is 10 to 12 m with average draft of 2 m.
- Various nationalities but most commonly Irish, British and French.
- Visitors heading South tend to have sailed from Dublin Area, and visitors from South have usually come from Kilmore Quay Marina.
- July is a peak period for recreational activity and includes the SSE Renewables Round Ireland Yacht Race which takes place biannually and results in an influx of yachts from further afield. A plot of the racing vessel tracks from the 2018 race as shown via YB Tracking (Round Ireland, 2018) is provided in Figure 15.1.50.

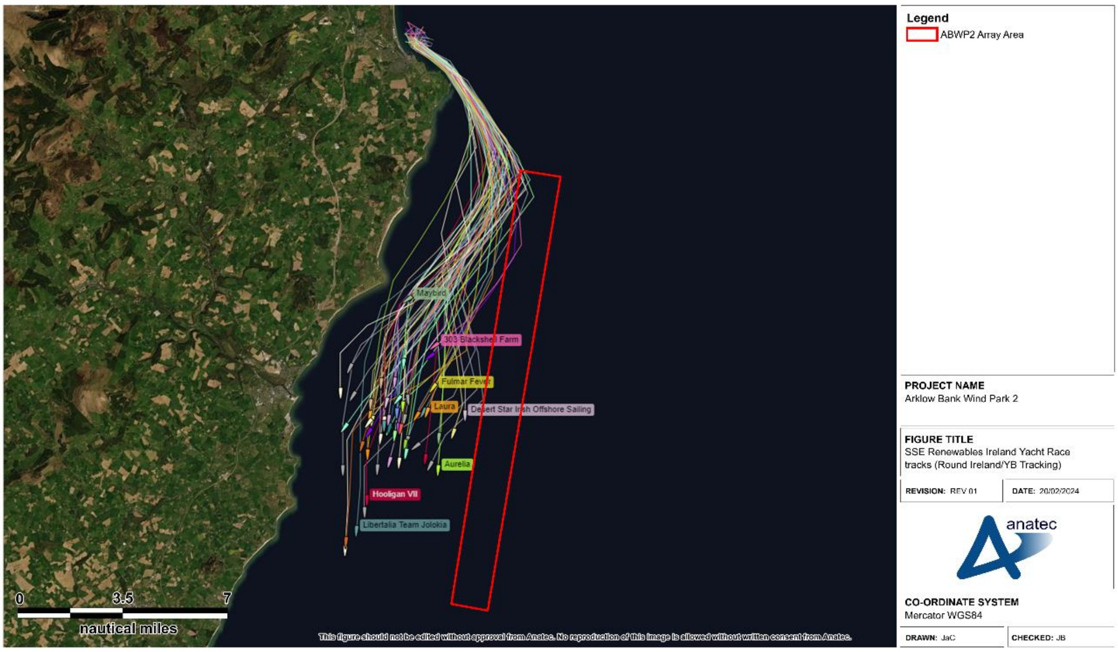

Figure 15.1.50 Volvo Round Ireland Yacht Race Tracks (Round Ireland/YB Tracking, 30 June 2018)

14 Base Case Vessel Routeing

14.1 Definition of a Main Commercial Route

Main commercial routes have been identified using the principles set out in MGN 654 (MCA, 2021). Vessel traffic data are assessed and vessels transiting at similar headings and locations are identified as a main route. To help identify main routes, vessel traffic data can also be interrogated to show vessels (by name and/or operator) that frequently transit those routes. The route width is then calculated using the 90th percentile rule from the mean line of the potential shipping route as shown in Figure 15.1.51.

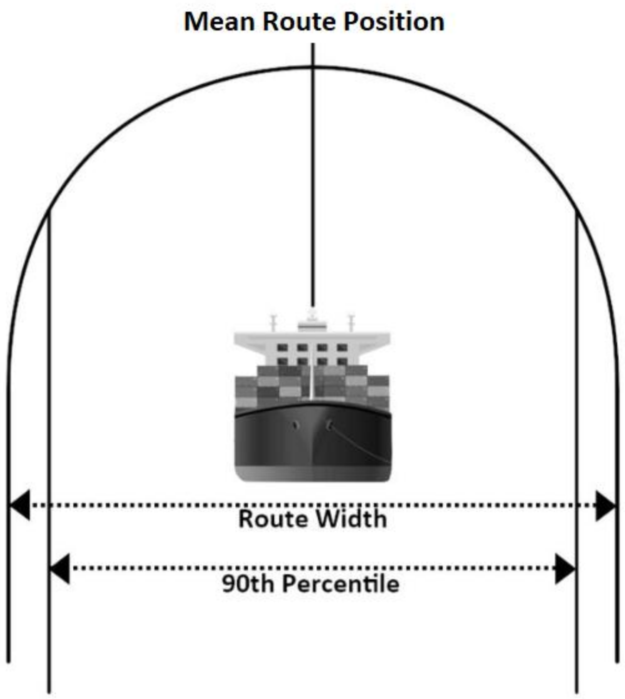

Figure 15.1.51 Illustration of Main Route and 90th Percentile

14.2 Pre Wind Farm Main Commercial Routes

A total of 12 main commercial routes were identified from the long-term vessel traffic data[4]. These main commercial routes and corresponding 90th percentiles within the Study Area are shown relative to the Array Area in Figure 15.1.52. Following this, a description of each route is provided in Table 15.1.20, including the average number of vessels per week, start and end locations, main vessel types and details of commercial ferry routeing (where applicable). It is noted that the start and end locations are based on the most common destinations transmitted via AIS by vessels on those routes. In the case of routes where a TSS is provided

[4] Main commercial routes were identified on the basis of the route having a minimum of a vessel a week.

as the start and/or end location, this is due to there being a wide range of destinations transmitted via AIS by vessels on such routes.

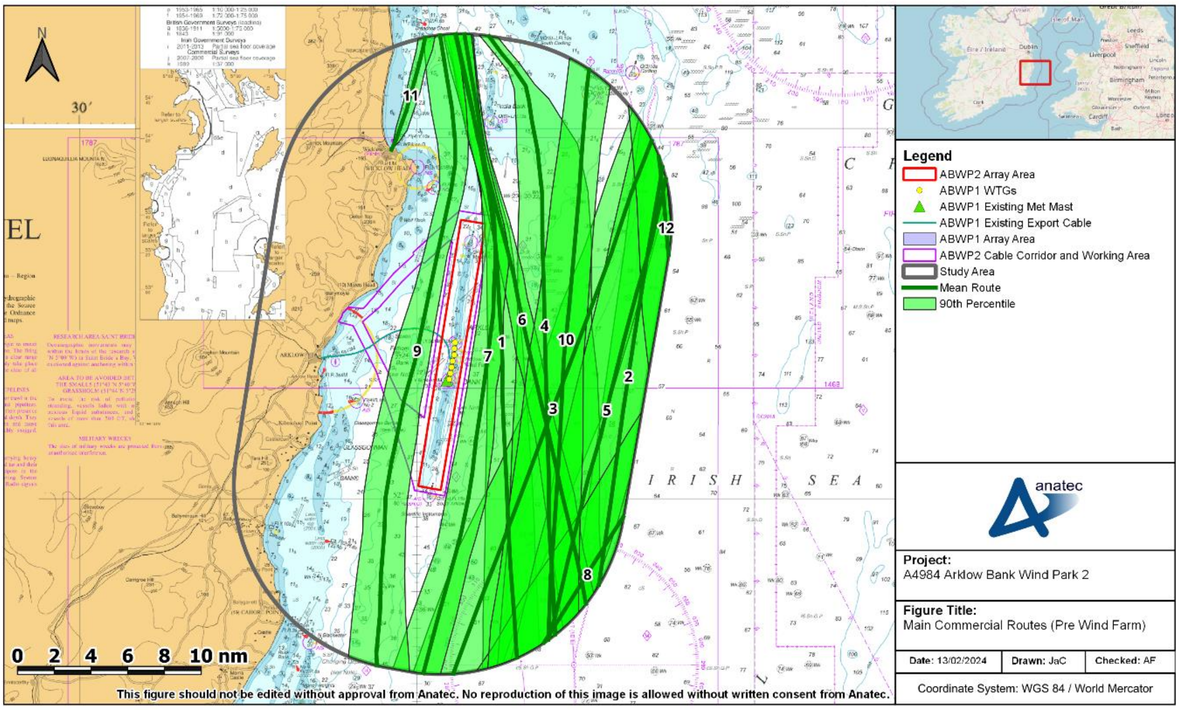

Figure 15.1.52 Main Commercial Route (Pre Wind Farm)

Table 15.1.20 Descriptions of Main Commercial Routes

Route Number	Average Vessels per Week	Average Vessels per Day	Description
1	58 – 59	8 – 9	**Dublin – TSS Off Smalls.** Mainly undertaken by cargo vessels (76%), followed by passenger vessels (14%) and tankers (9%). Approximately 94% of the passenger traffic is comprised of RoPax ferries, operated by Irish Ferries, undertaking regular routeing between Dublin and Cherbourg.
2	25 – 26	3 – 4	**Drogheda – TSS Off Smalls.** Mainly undertaken by cargo vessels (91%) followed by tankers (7%).
3	8 – 9	1	**Various – TSS Off Tuskar Rock.** Mainly undertaken by cargo vessels (79%) followed by tankers (10%).
4	8 – 9	1	**Dublin – TSS Off Smalls.** Mainly undertaken by cargo vessels (57%) followed by tankers (35%).
5	8	1	**Belfast – TSS Off Tuskar Rock.** Mainly undertaken by cargo vessels (85%) followed by tankers (11%).

Route Number	Average Vessels per Week	Average Vessels per Day	Description
6	6	1	**Dublin – Milford Haven.** Mainly undertaken by tankers (65%) followed by cargo vessels (31%).
7	5	< 1	**Dublin – TSS Off Tuskar Rock.** Mainly undertaken by cargo vessels (84%) followed by tankers (13%).
8	3 – 4	< 1	**Liverpool – Limerick.** Mainly undertaken by cargo vessels (64%) followed by tankers (21%).
9	3	< 1	**Dublin – TSS Off Tuskar Rock.** Mainly undertaken by cargo vessels (63%) followed by tankers (18%).
10	2	< 1	**Dublin – TSS Off Smalls.** Mainly undertaken by cargo vessels (79%) followed by tankers (14%).
11	2	< 1	**Wicklow – Various.** Mainly undertaken by cargo vessels (74%) and tugs (17%).
12	1 – 2	< 1	**Warrenpoint - Avonmouth.** Almost entirely undertaken by cargo vessels (98%).

15 Future Case Vessel Traffic

This section characterises the estimated future case vessel traffic in terms of volume in Section 15.1 and in terms of deviations in Section 15.2. These estimations have been used in the collision and allision modelling undertaken in Section 17.

15.1 Future Case Vessel Traffic Levels

Future case is the assessment of risk based upon the predicted future growth in future shipping densities and traffic types as well as foreseeable changes in the marine environment.

Given the uncertainty associated with long term predictions of vessel traffic growth, including the potential for any major new developments in Ireland, a potential for overall growth scenarios in the number of commercial vessel movements of 10% and 25% were estimated over the life of the Proposed Development. This encompasses vessel movements for all traffic, which it is noted is diverse and associated with a range of ports both in Ireland and internationally, as well as any changes in traffic levels associated with the UK's exit from the European Union (Brexit).

From consultation there are no known plans for expansion of the local ports at Arklow or Wicklow. Dun Laoghaire Harbour is planning to expand its commercial traffic, but this is not anticipated to result in a significant volume of port arrivals relative to busy ports in the wider region (e.g., Dublin). Dublin Port Company (DPC) has published a 2012-2040 Master Plan with a goal to increase traffic volumes, which could affect traffic passing the future Arklow Bank site; however, as the 2018 Review indicates (Dublin Port, 2018), this is not guaranteed but aspirational and subject to change. POCC have published there 2050 Masterplan (POCC, 2023) which similarly indicates plans for future aspirational growth. While the Port of Cork is located on the south coast, associated vessels to or from Dublin will likely pass in proximity to the Array Area.

Commercial vessel traffic associated with Irish ports from mainland Europe may increase as a result of Brexit, however this increase is not expected to be significant, therefore any increase in commercial vessel traffic associated with Brexit is considered within the 10% and 25% traffic increases.

For commercial fishing vessels, indicative 10% and 25% increases in transits has also been applied to demonstrate potential impacts (in line with other renewables assessments). This value is again considered conservative as there is limited reliable information available on future activity levels owing to the unpredictable direct and indirect factors which could materially affect the fishing industry. For example, in consultation it was suggested Brexit could affect the fishing patterns of Irish vessels, resulting in more activity in Irish waters.

For recreational vessels there are no known major developments which will increase activity. Therefore, as with other activity, given the lack of reliable information available on future trends, 10% and 25% increases are considered conservative. It is assumed that the SSE Renewables Round Ireland Yacht Race will continue to take place biannually.

It is noted that the 10% increase in vessel movements were discussed with stakeholders at the first Hazard Workshop, noting that this was considered a conservative estimate.

15.2 Post Wind Farm Routeing

15.2.1 Methodology

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

- All alternative routes maintain a minimum mean distance of 1 nm from offshore installations and potential WTG boundaries (i.e. wind farm periphery) in line with the Shipping Route Template contained in Annex 2 of MGN 654 (MCA, 2021). This distance is considered for shipping and navigation from a safety perspective as explained below, however, individual vessel Masters may choose to transit closer or further away than this distance in the absence of statutory safety zones; and
- All mean routes take into account shallow banks, surface infrastructure (such as buoys) and known routeing preferences.

To date, internal and external studies undertaken by Anatec on behalf of the UK Government (Anatec, 2016) and individual clients show that some vessels do pass consistently and safely within 1 nm of established offshore wind farms and these distances vary depending upon the sea room available as well as the prevailing conditions. This evidence also demonstrates that mariners define their own safe passing distances based upon the conditions and nature of the traffic at the time, but they are shown to frequently pass 1 nm off established developments. Evidence also demonstrates that commercial vessels do not transit through wind farm arrays.

15.2.2 Main Commercial Route Deviations

Figure 15.1.53 presents a plot of the anticipated mean positions of the main commercial routes post wind farm within the Study Area.

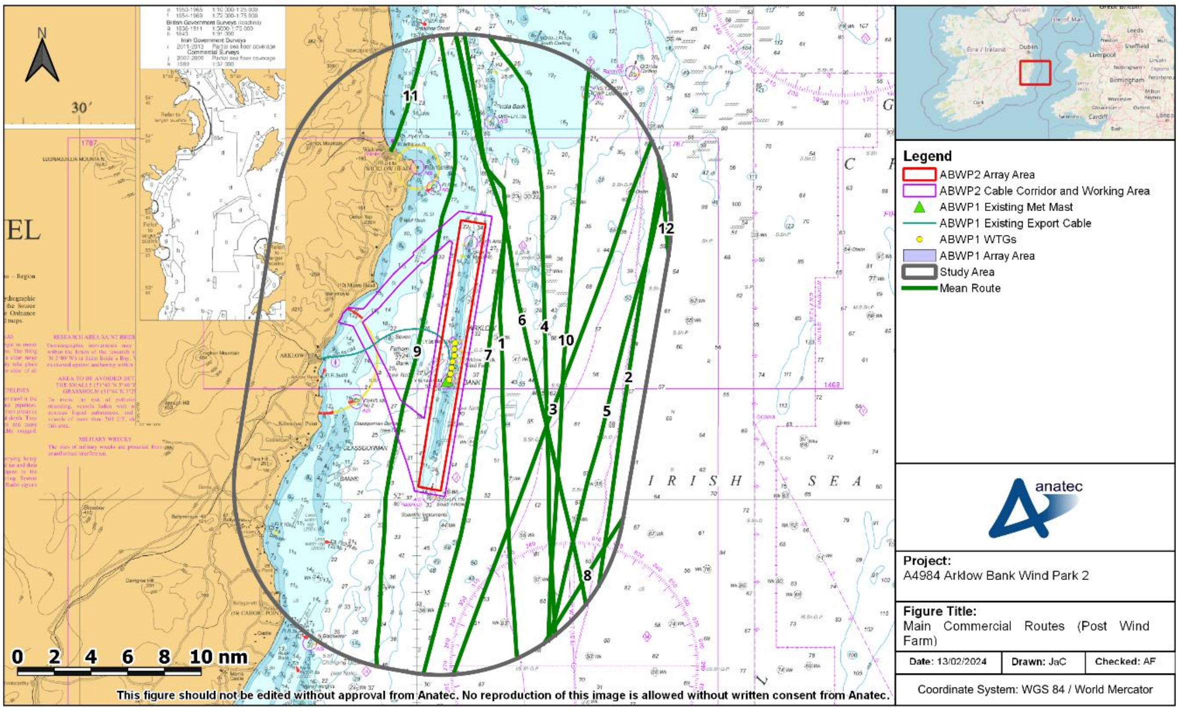

Figure 15.1.53 Main Commercial Routes (Post Wind Farm)

Deviations are anticipated to four out of the 12 main routes identified. However, the magnitude of deviations are all very low (less than 1 nm) as summarised in Table 15.1.21, which presents the vessel numbers on these routes. Further details can be found in Table 15.1.20.

Table 15.1.21 Summary of post wind farm route deviations

Route Number	Average Vessels per Week	Increase in Route Length (nm)
1	58 – 59	< 1
6	6	< 1
7	5	< 1
9	3	< 1

The small extent of the anticipated deviations reflects the fact that the Arklow Bank upon which the Array Area is located is a natural hazard which is already avoided by passing shipping due to the grounding risk. The findings of the deviation assessment align with consultation input received from local vessel operators (see Section 6) including Stena Line and Irish Ferries i.e., deviations will be limited given vessels already avoid the Arklow Bank.

16 Cumulative Routeing Assessment

16.1 Cumulative Tiering

Shipping and navigation hazards associated with the Proposed Development are considered on a cumulative basis alongside other projects. To determine which other projects should be screened into the cumulative routeing assessment and the extent of their consideration, the methodology outlined in Section 3.4 has been applied. The screening process is summarised in Table 15.1.22, noting that as per Section 3.4, projects other than Phase One projects within 50 nm of the array area have been screened out.

Table 15.1.22 Cumulative Tiering

Development	Distance to Array Area (nm)	Screened in as Tier 1	Rationale
Codling Wind Park	9.8	Yes	Routes interacting with Array Area pass inshore of and in close proximity to Codling Wind Park.
Dublin Array	13.9	Yes	Routes interacting with Array Area pass inshore of and in close proximity to Dublin Array.
North Irish Sea Array (NISA)	35.1	No	Routes interacting with the Array Area are southbound from Dublin, and therefore do not also interact with NISA.

16.2 Cumulative Deviations

As per Section Table 15.1.22, Dublin Array and Codling Wind Park are the only two offshore wind farms screened in for cumulative consideration. Given the very limited effects of the Array Area on deviations when the Proposed Development is considered in isolation (see Section 15.2.2), and noting the location of the two screened in projects in proximity on existing shallow banks (i.e., areas where larger commercial vessels on main routes will already avoid), there is not considered likely to be any notable effect on routeing over that assessed in the in isolation case. The deviations assessed in Section 15.2.2 are therefore considered applicable for the cumulative scenario. It is noted that this finding aligns with consultee input (see Section 6).

However, while cumulative deviations are anticipated to be minimal, there may be increased cumulative effects in terms of both allision and collision risks noting the proximity of Codling Wind Park in particular. These impacts have been assessed qualitatively on a cumulative basis in Volume II, Chapter 15: Shipping and Navigation.

17 Collision and Allision Risk Modelling

17.1 Overview

In order to inform the impact assessment a quantitative assessment of the major hazards associated with the Proposed Development has been undertaken. The following subsections outline the inputs and methodology used for the collision and allision risk modelling.

It is noted that both Project Design Option 1 and Project Design Option 2 have been modelled.

17.1.1 Scenarios Considered

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

- Pre wind farm with base case vessel traffic levels;
- Pre wind farm with a future case vessel traffic level defined by a:
  - 10% increase in traffic; and
  - 25% increase in traffic.
- Post wind farm with base case vessel traffic levels; and
- Post wind farm with a future case vessel traffic level defined by a:
  - 10% increase in traffic; and
  - 25% increase in traffic.

Where comparison is made between pre and post wind farm results (i.e. for vessel to vessel collision risk) the worst case difference is considered, this being between the scenarios above.

17.1.2 Hazards Considered

Hazards considered in the quantitative assessment are as follows:

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

The pre wind farm assessment has used the long-term vessel traffic data in combination with the outputs of consultation and other baseline data sources. Conservative assumptions have been made with regard to route deviations to model the post wind farm scenario.

17.1.3 Layout Assumptions

The Proposed Development layouts modelled are shown in Figure 15.1.3 and Figure 15.1.4.

It should be considered when viewing the layouts that the significant structures in terms of collision and allision modelling to regular routed traffic are those located on the periphery, and a layout of additional structures placed within the Array Area will therefore have a limited effect on the collision modelling. Therefore, the effect of each layout on routes and collision risk are considered to be the same on the basis that they share the same Array Area boundary, noting that both layouts have been modelled within this section.

17.2 Pre Wind Farm Modelling

17.2.1 Vessel to Vessel Encounters

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

Figure 15.1.54 presents a heat map based upon the geographical distribution of vessel encounter tracks within a 0.5 nm × 0.5 nm grid.

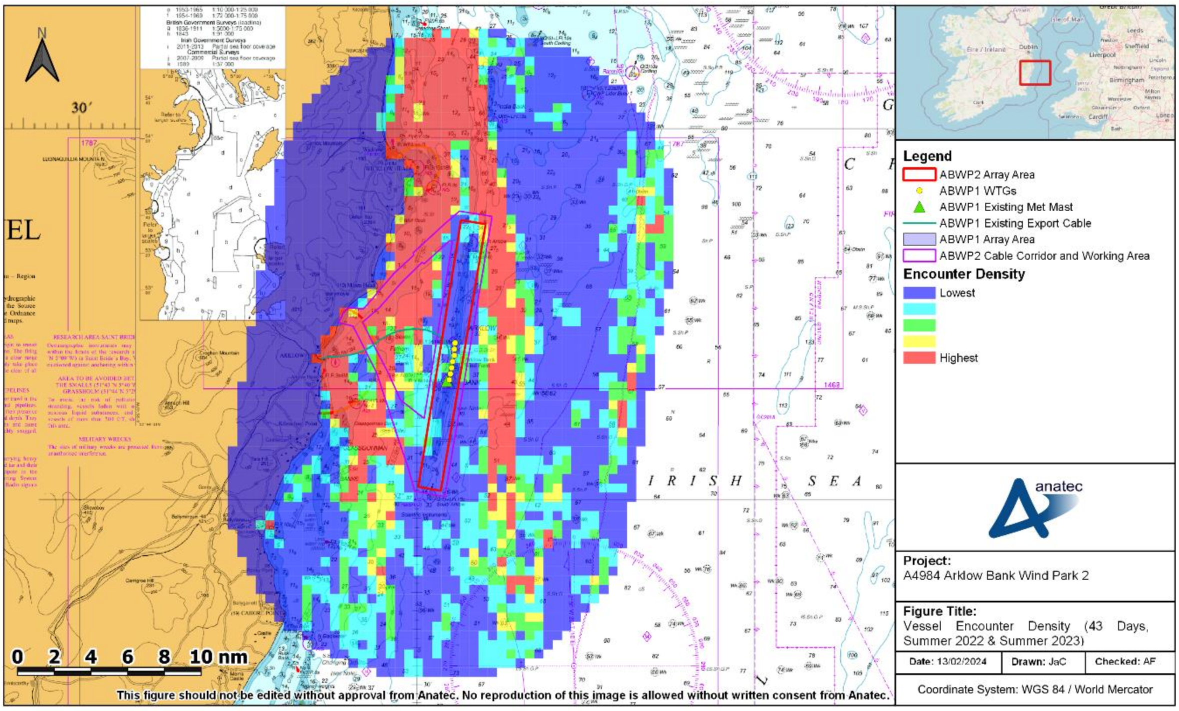

Figure 15.1.54 Vessel Encounter Density (43 days from September 2022 and July/August 2023)

There was an average of 20 to 21 encounters per day within the Study Area during the combined survey period. The majority of encounters were associated with cargo vessels transiting within the main southeast/northwest route offshore of the Array Area, and recreational vessels inshore of the Array Area (which were largely transiting to/from Arklow Harbour). The busiest day for encounters was the 11 July 2023 on which 149 encounters occurred, mainly between recreational vessels.

It is noted that encounters within the Array Area itself were limited in number, reflective of vessels already avoiding the shallow water depths.

17.2.2 Vessel to Vessel Collisions

Using the pre wind farm routeing (as outlined in Section 14) as input, Anatec's COLLRISK model was run to estimate the vessel to vessel collision risk in proximity to the Array Area, noting that the pre wind farm routeing only considers commercial, route-based traffic.

Figure 15.1.55 presents a heat map based upon the geographical distribution of collision risk within a 0.5×0.5 nm grid for the base case scenario.

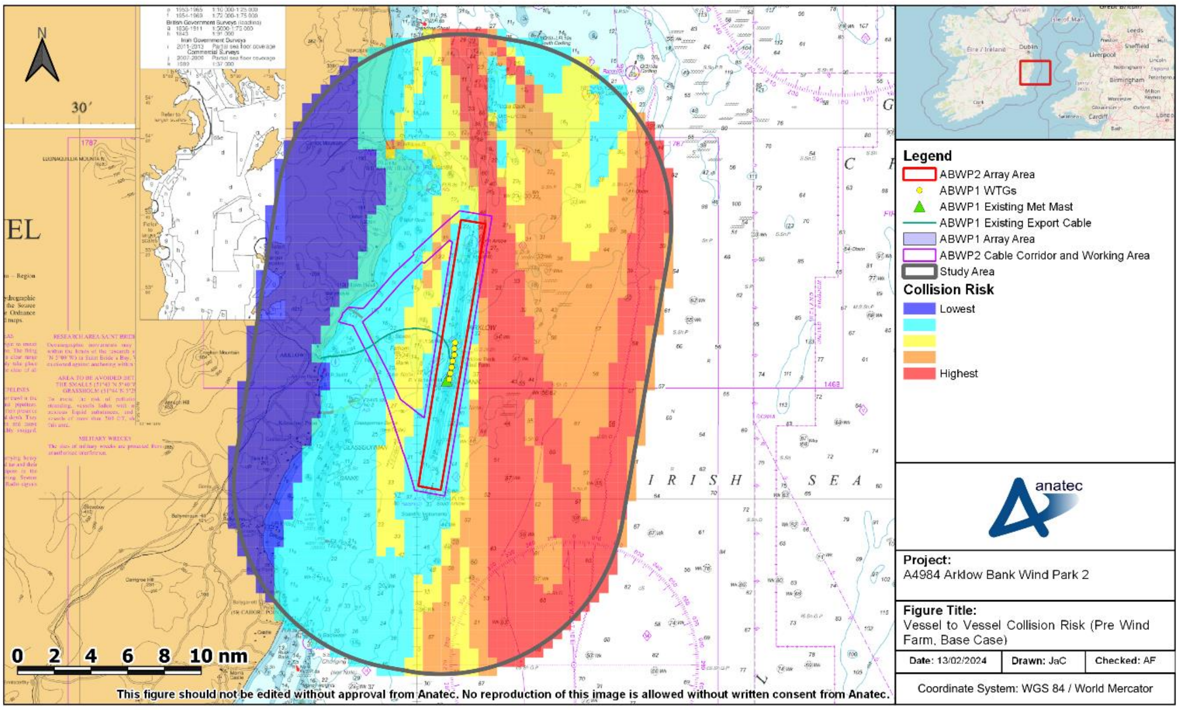

Figure 15.1.55 Vessel to Vessel Collision Risk (Pre Wind Farm, Base Case)

Assuming base case vessel traffic levels, the annual collision frequency pre wind farm was estimated to be 6.40×10^{-3}, corresponding to a collision return period of approximately one in 156 years. Compared to assessments undertaken for other sea areas with proposed offshore wind farm projects this is a relatively high background ship-to-ship collision risk level and is a consequence of the passing routes including the main southbound commercial route out of Dublin, the busiest port in Ireland. With the presence of the Arklow Bank and shallow water inshore, vessel traffic is concentrated to the east of the Arklow Bank, thus resulting in higher encounter rates and hence collision risk.

It is noted that the model is calibrated based upon major incident data at sea which allows for benchmarking but does not cover all incidents, such as minor impacts. Other incident data, which includes minor incidents, is presented in Section 12.

17.3 Post Wind Farm Modelling

17.3.1 Vessel to Vessel Collisions

Using the post wind farm routeing as input, Anatec's COLLRISK model was run to estimate the vessel to vessel collision risk in proximity to the Proposed Development.

Figure 15.1.56 presents a heat map based upon the geographical distribution of collision risk within a 0.5×0.5 nm grid for the base case scenario.

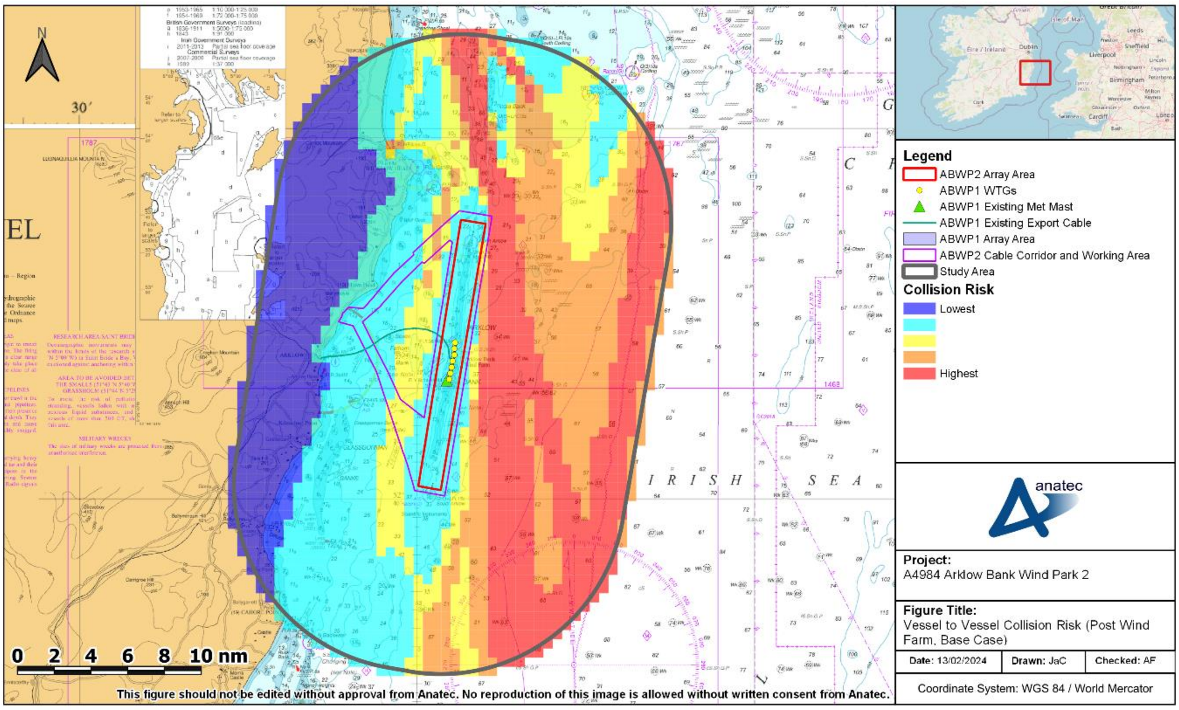

Figure 15.1.56 Vessel to Vessel Collision Risk (Post Wind Farm, Base Case)

Assuming base case vessel traffic levels, the annual collision frequency post wind farm was estimated to be 6.59×10^{-3}, corresponding to a collision return period of approximately one in 152 years.

This represents a 3% increase in collision frequency compared to the base case pre wind farm result; this is a small percentage increase and reflects that the majority of the collision risk is already present i.e. the presence of the Proposed Development has minimal impact.

Results for future case traffic levels are included in Section 17.4.

17.3.2 Powered Vessel to Structure Allision

Based upon the vessel routeing identified in the region, the anticipated change in routeing due to the Proposed Development, and assumptions that effective factored in measures are in place (see Section 5), the frequency of an errant vessel under power deviating from its route to the extent that it comes into proximity with a structure is considered to be low.

Additionally, the presence of the shallow water on the Arklow Bank itself may result in a vessel in such a scenario grounding irrespective of the presence of the Proposed Development, i.e. it is already a hazardous event.

Using the post wind farm routeing, Anatec's COLLRISK model was run to estimate the likelihood of a commercial vessel alliding with one of the structures within the Array Area whilst under power. To ensure conservatism, the model did not take account of the possibility of one structure shielding another, nor did it take account of the possibility of the Arklow Bank itself shielding the structures, i.e. vessels grounding on the bank before alliding with a structure.

17.3.2.1 Project Design Option 1

Figure 15.1.57 presents a plot of the annual powered vessel allision frequency per structure for the Project Design Option 1 layout (assuming base case traffic levels).

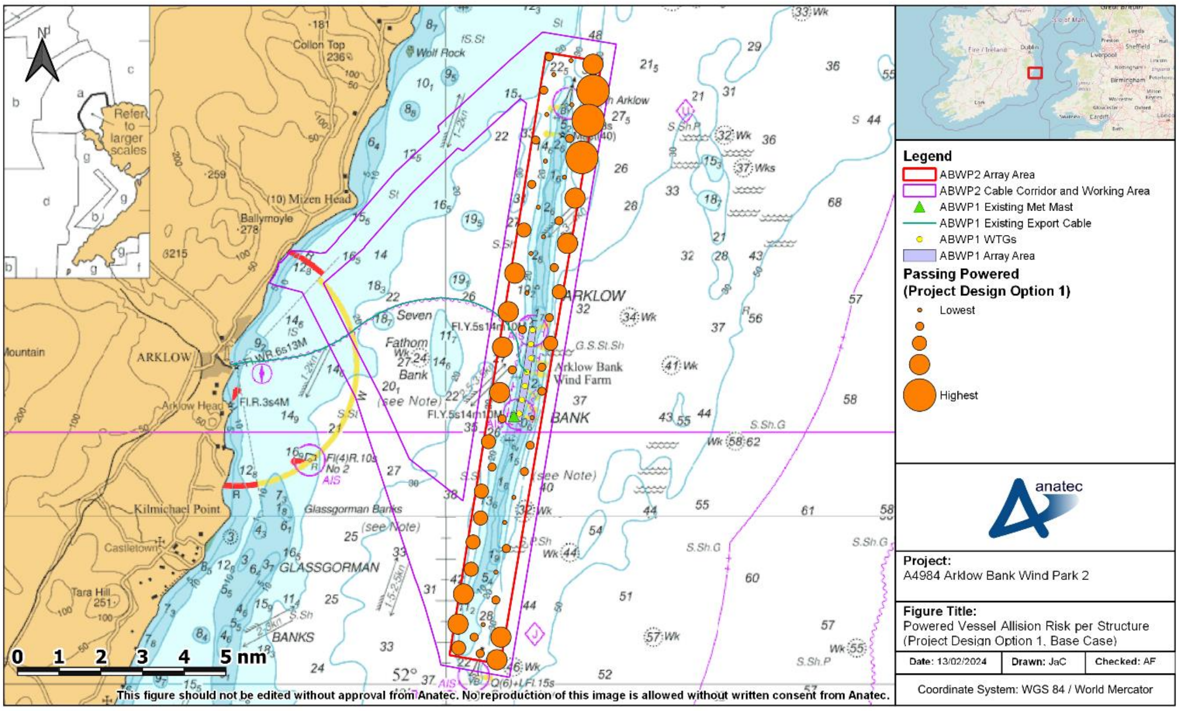

Figure 15.1.57 Powered Vessel Allision Risk per Structure (Project Design Option 1, Base Case)

Assuming base case vessel traffic levels, the annual powered vessel allision frequency was estimated to be 3.67×10^{-4}, corresponding to an allision return period of approximately one in 2,726 years. Results for the future case scenarios are included in Table 15.1.23.

The highest-powered vessel to structure risk was associated with structures on the northeastern extent where multiple routes are deviated to pass a minimum of 1 nm from the Array Area, including the busiest route (see Section 15.2.2). The highest individual allision risk was associated with the northernmost structure on the eastern periphery of the Array Area, with an allision frequency of 3.95×10^{-5} i.e. one in 25,314 years.

17.3.2.2 Project Design Option 2

Figure 15.1.58 presents a plot of the annual powered vessel allision frequency per structure for the Project Design Option 2 layout (assuming base case traffic levels).

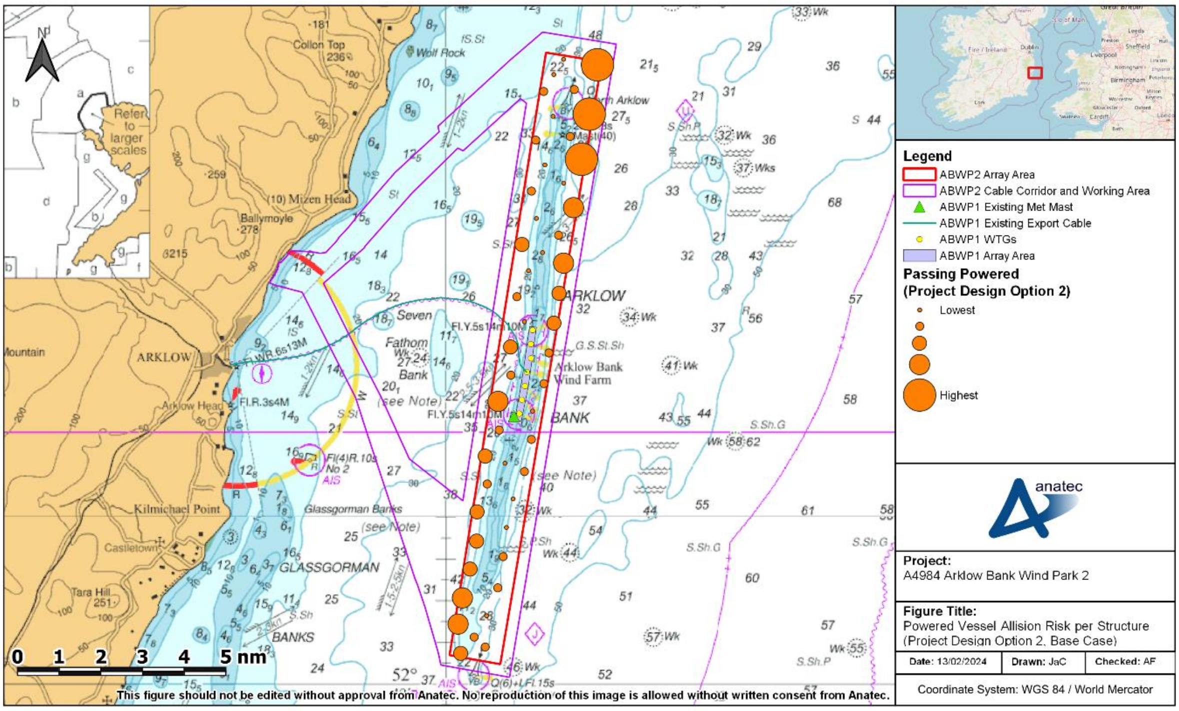

Figure 15.1.58 Powered Vessel Allision Risk per Structure (Project Design Option 2, Base Case)

Assuming base case vessel traffic levels, the annual powered vessel allision frequency was estimated to be 2.87×10^{-4}, corresponding to an allision return period of approximately one in 3,489 years. Results for the future case scenario are included in Table 15.1.24.

The highest-powered vessel to structure risk was associated with structures on the northeastern extent where multiple routes are deviated to pass a minimum of 1 nm from the Array Area, including the busiest route (see Section 15.2.2). The highest individual allision risk was associated with the northernmost structure on the eastern periphery of the Array Area, with an allision frequency of 4.97×10^{-5} i.e. one in 20,112 years.

17.3.3 Drifting Vessel to Structure Allision

Using the post wind farm routeing as input, together with local meteorological ocean data, Anatec's COLLRISK model was run to estimate the likelihood of drifting commercial vessels alliding with structures within the Array Area for each of the layouts under consideration. This model is based on the premise that propulsion on a vessel must fail before a vessel would drift. The model takes account of the type and size of the vessel, the number of engines and the anticipated time required to repair in different conditions. It is noted that, as with the powered allision model, the presence of the shallow water on the Arklow Bank itself is not considered and may result in a drifting vessel grounding prior to any prospective allision incident, reducing the risk to the Proposed Development.

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

Using this information, the overall rate of mechanical failure within the area surrounding the Proposed Development was estimated. The probability of a vessel drifting towards a wind farm structure and the drift speed are dependent upon the prevailing wind, wave, and tidal conditions at the time of the accident. Therefore, three drift scenarios were modelled, each using the meteorological ocean data provided in Section 10:

- wind;
- peak spring flood tide; and
- peak spring ebb tide.

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

After modelling the drift scenarios, it was established that the flood tide dominated scenario produced the worst-case results for each of the two layouts.

17.3.3.1 Project Design Option 1

Figure 15.1.59 presents a plot of the annual drifting vessel allision frequency per structure within the Project Design Option 1 layout (assuming base case traffic levels).

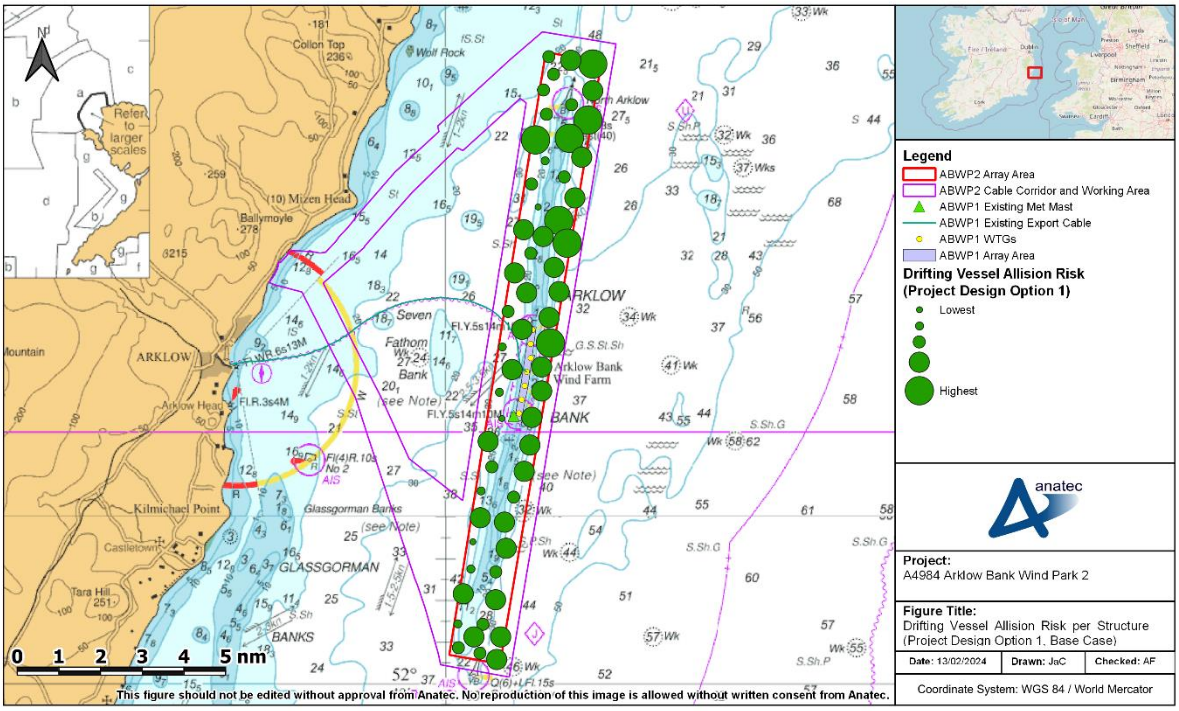

Figure 15.1.59 Drifting vessel allision risk per structure (Project Design Option 1)

Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 2.81×10^{-3}, corresponding to an allision in 356 years. Results for the future case scenario are included in Table 15.1.23.

The highest drifting vessel to structure risks were mainly associated with structures towards the northern extent of the Array Area. The highest allision risk overall for an individual structure is approximately 6.78×10^{-4} or one in 1,474 years.

17.3.3.2 Project Design Option 2

Figure 15.1.59 presents a plot of the annual drifting vessel allision frequency per structure within the Project Design Option 2 layout (assuming base case traffic levels).

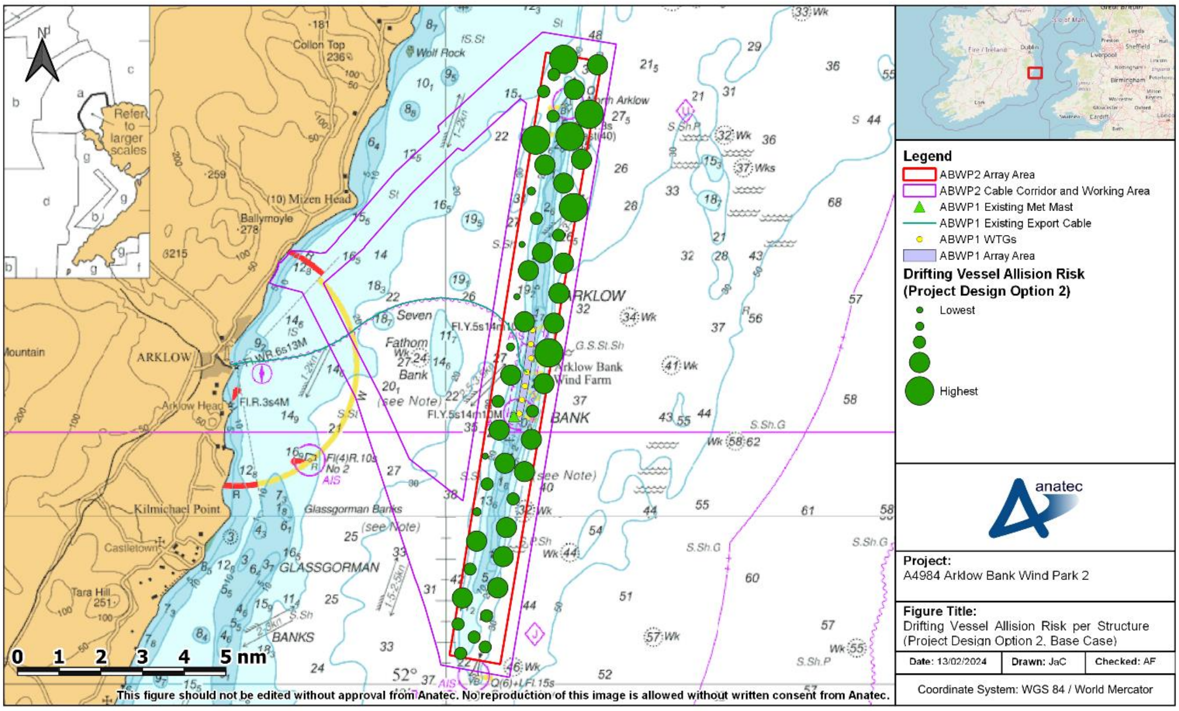

Figure 15.1.60 Drifting Vessel Allision Risk per Structure (Project Design Option 2)

Assuming base case vessel traffic levels, the annual drifting allision frequency was estimated to be 2.37×10^{-3}, corresponding to an allision in 422 years. Results for the future case scenario are included in Table 15.1.24.

The highest drifting vessel to structure risk was associated with structures on the eastern boundary, especially in the northeastern corner, where multiple routes are deviated to pass a minimum of 1 nm from the Array Area. The highest allision risk overall for an individual structure is approximately 5.16×10^{-4} or one in 1,937 years.

17.3.4 Fishing Vessel to Structure Allision

Anatec's COLLRISK model was run to estimate the likelihood of a fishing vessel alliding with one of the wind farm structures within the Array Area, with the long-term data (see Section D.3.3.2) used as input.

A fishing vessel allision is classified separately from other allisions since, unlike in the case of the commercial traffic characterised using the main commercial routes, fishing vessels may be either in transit or actively fishing within the Study Area. Moreover, fishing vessels could be observed internally within the Array Area in addition to externally. Anatec's COLLRISK model uses vessel numbers, sizes (length and beam), array layout and structure dimensions. The likelihood of a major allision incident has been calibrated against historical maritime incident data and historical AIS vessel traffic data within operational offshore wind farm arrays.

It should be noted that the fishing allision model produces a conservative estimation of risk by assuming that the volume and geographic distribution of fishing vessels will not change after installation of all wind farm structures. However, it should also be noted that (as can be seen from the data in Section D.3.3.2) fishing vessels avoid Arklow Bank itself and therefore the presence of the internal wind farm structures may have minimal impact on fishing vessel movements. Therefore, this conservatism mainly applies to those structures closest to the Array Area boundary.

17.3.4.1 Project Design Option 1

A plot of the annual fishing vessel allision frequency per structure for the base case is presented in Figure 15.1.61.

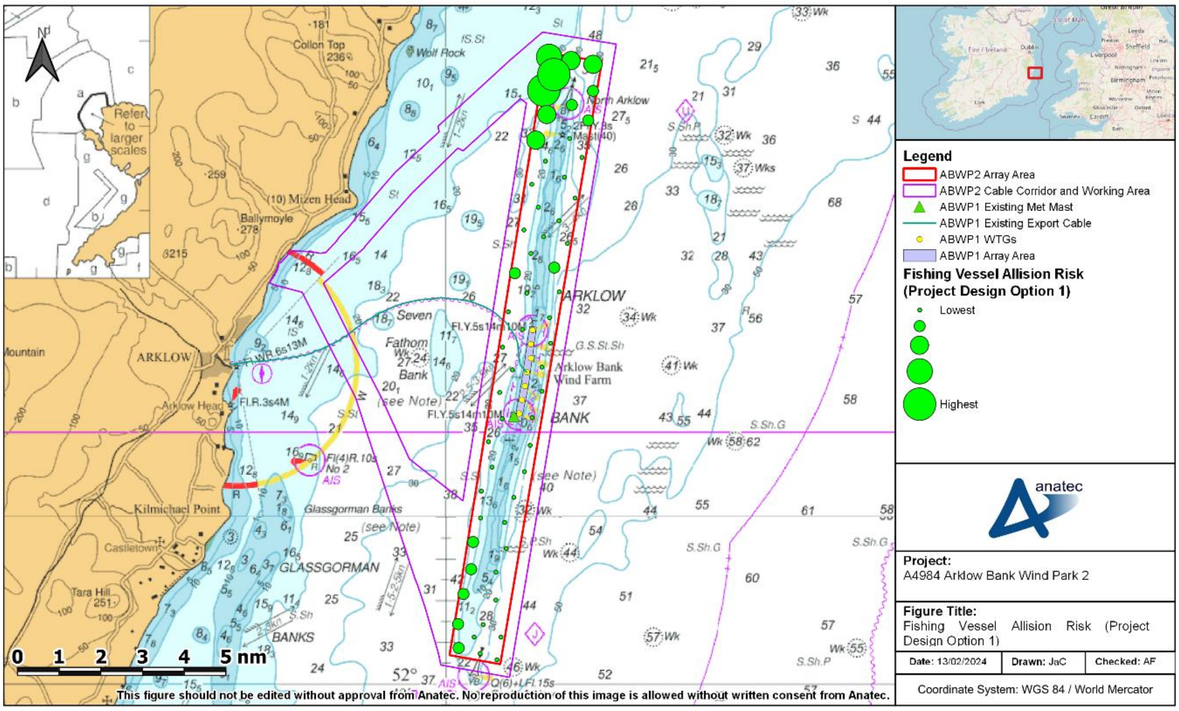

Figure 15.1.61 Fishing Vessel Allision Risk (Project Design Option 1)

Assuming base case vessel traffic levels, the annual fishing vessel to structure allision frequency was estimated to be 2.54×10^{-3}, corresponding to an allision every 393 years.

It can be seen that the fishing vessel allision risk is mainly concentrated towards the structures at the northwestern extent of the Array Area, which fishing vessels have been seen to intersect in transit (see Section D.3.5). The structure with the greatest allision risk was the northern OSP, which had an allision risk of 8.36×10^{-4} i.e. an allision in 1,197 years.

17.3.4.2 Project Design Option 2

A plot of the annual fishing vessel allision frequency per structure for the base case is presented in Figure 15.1.62.

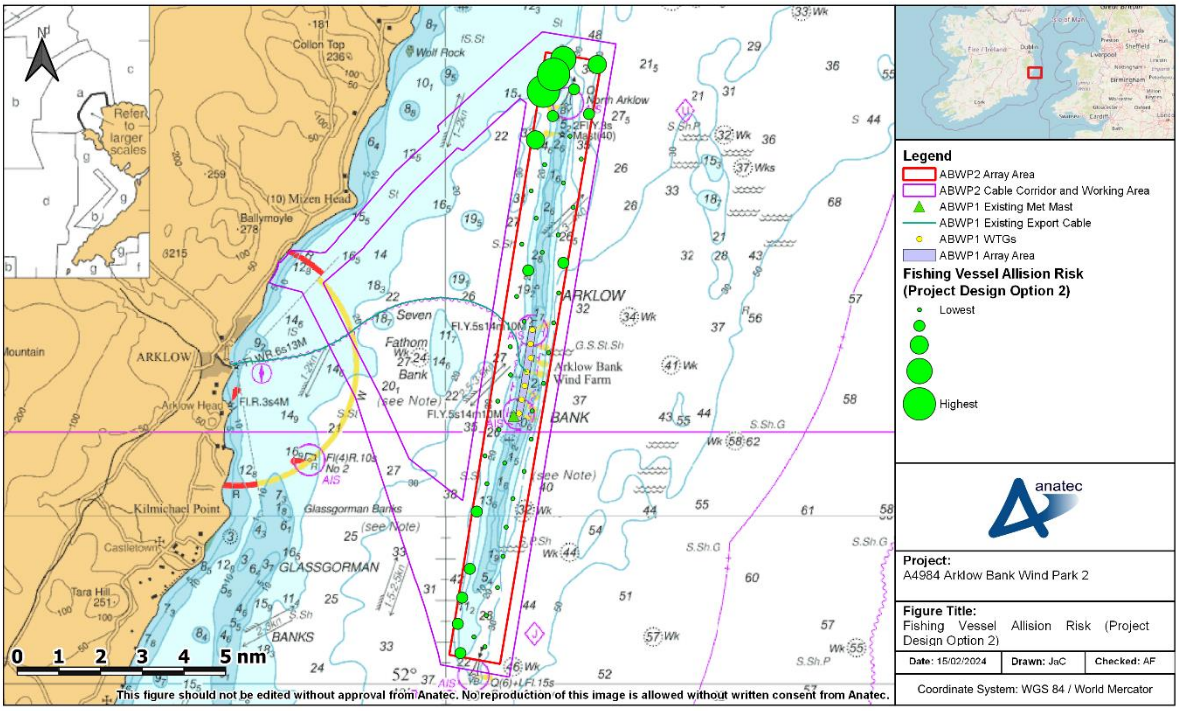

Figure 15.1.62 Fishing Vessel Allision Risk (Project Design Option 2)

Assuming base case vessel traffic levels, the annual fishing vessel to structure allision frequency was estimated to be 2.28×10^{-3}, corresponding to an allision every 438 years.

The distribution of fishing vessel allision risk is similar to that for Project Design Option 1. The structure with the greatest allision risk was the northern OSP, which had the same allision risk that it had within the Project Design Option 1 layout (8.36×10^{-4} i.e. an allision in 1,197 years) due to its fixed position and dimensions between the two layouts.

17.4 Risk Results Summary

The previous sections modelled two scenarios, namely the pre wind farm and post wind farm scenarios, with base case traffic levels. In order to incorporate the potential for future traffic growth, a pre and post wind farm scenario was modelled with future case traffic levels.

Table 15.1.23 and Table 15.1.24 summarises the collision and allision results for the Project Design Option 1 layout and Project Design Option 2 layout respectively.

Table 15.1.23 Risk Results Summary (Project Design Option 1)

Risk	Scenario	Annual Frequency		
		Pre Wind Farm	Post Wind Farm	Increase
Vessel to vessel collision	Base case	6.40×10^{-3} (one in 156 years)	6.59×10^{-3} (one in 152 years)	1.89×10^{-4}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	8.20×10^{-3} (one in 122 years)	2.36×10^{-4}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.05×10^{-2} (one in 95 years)	3.02×10^{-4}
Powered vessel to structure allision	Base case	-	3.67×10^{-4} (one in 2,726 years)	3.67×10^{-4}
	Future case (10%)	-	4.04×10^{-4} (one in 2,478 years)	4.04×10^{-4}
	Future case (25%)	-	4.59×10^{-4} (one in 2,181 years)	4.59×10^{-4}
Drifting vessel to structure allision	Base case	-	2.81×10^{-4} (one in 356 years)	2.81×10^{-4}
	Future case (10%)	-	3.09×10^{-3} (one in 324 years)	3.09×10^{-3}
	Future case (25%)	-	3.51×10^{-4} (one in 285 years)	3.51×10^{-4}
Fishing vessel to structure allision	Base case	-	2.54×10^{-3} (one in 393 years)	2.42×10^{-3}
	Future case (10%)	-	2.78×10^{-3} (one in 359 years)	2.66×10^{-3}
	Future case (25%)	-	3.15×10^{-3} (one in 318 years)	3.03×10^{-3}
Total	**Base case**	6.40×10^{-3} (one in 156 years)	1.23×10^{-2} (one in 81 years)	5.71×10^{-3}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	1.45×10^{-2} (one in 69 years)	6.27×10^{-3}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.76×10^{-2} (one in 57 years)	7.11×10^{-3}

Table 15.1.24 Risk Results Summary (Project Design Option 2)

Risk	Scenario	Annual Frequency		
		Pre Wind Farm	Post Wind Farm	Increase
Vessel to vessel collision	Base case	6.40×10^{-3} (one in 156 years)	6.59×10^{-3} (one in 152 years)	1.89×10^{-4}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	8.20×10^{-3} (one in 122 years)	2.36×10^{-4}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.05×10^{-2} (one in 95 years)	3.02×10^{-4}
Powered vessel to structure allision	Base case	-	2.87×10^{-4} (one in 3,489 years)	2.87×10^{-4}
	Future case (10%)	-	3.15×10^{-4} (one in 3,172 years)	3.15×10^{-4}
	Future case (25%)	-	3.58×10^{-4} (one in 2,791 years)	3.58×10^{-4}
Drifting vessel to structure allision	Base case	-	2.37×10^{-3} (one in 422 years)	2.37×10^{-3}
	Future case (10%)	-	2.60×10^{-3} (one in 384 years)	2.60×10^{-3}
	Future case (25%)	-	2.96×10^{-3} (one in 338 years)	2.96×10^{-3}
Fishing vessel to structure allision	Base case	-	2.28×10^{-3} (one in 438 years)	2.17×10^{-3}
	Future case (10%)	-	2.50×10^{-3} (one in 400 years)	2.39×10^{-3}
	Future case (25%)	-	2.83×10^{-3} (one in 354 years)	2.71×10^{-3}
Total	**Base case**	6.40×10^{-3} (one in 156 years)	1.15×10^{-2} (one in 87 years)	4.94×10^{-3}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	1.36×10^{-2} (one in 73 years)	5.42×10^{-3}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.67×10^{-2} (one in 60 years)	6.14×10^{-3}

18 Navigation, Communication and Position Fixing Equipment

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

18.1 Very High Frequency Communications (Including Digital Selective Calling)

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

The WTGs had no noticeable effect on voice communications within the array or ashore. It was noted that if small craft vessel to vessel and vessel to shore communications were not affected significantly by the presence of WTGs, then it is reasonable to assume that larger vessels with higher powered and more efficient systems would also be unaffected.

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

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

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

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

18.2 Very High Frequency Direction Finding

During the North Hoyle Offshore Wind Farm trials in 2004, the VHF Direction Finding (DF) equipment carried in the trial boats did not function correctly when very close to WTGs (within approximately 50 m). This is deemed to be a relatively small-scale impact due to the limited use of VHF direction finding equipment and will not impact operational or SAR activities (MCA and QinetiQ, 2004).

Throughout the 2005 SAR trials carried out at North Hoyle, the Sea King radio homer system was tested. The Sea King radio homer system utilises the lateral displacement of a vertical bar on an instrument to indicate the sense of a target relative to the aircraft heading. With the aircraft and the target vessel within the array, at a range of approximately 1 nm, the homer system operated as expected with no apparent degradation.

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

18.3 Automatic Identification System

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

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

18.4 Navigational Telex Systems

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

There are two NAVTEX frequencies. All transmissions on NAVTEX 518 Kilohertz (kHz), the international channel, are in English. NAVTEX 518 kHz provides the mariner (both recreational and commercial) with weather forecasts, severe weather warnings and navigation warnings such as obstructions or buoys off station. Depending on the user’s location, other information options may be available such as ice warnings for high latitude sailing.

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

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

18.5 Global Positioning System

Global Positioning System (GPS) is a satellite based navigational system. GPS trials were also undertaken throughout the 2004 trials at North Hoyle Offshore Wind Farm and it was stated that “*no problems with basic GPS reception or positional accuracy were reported during the trials*”.

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

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

18.6 Electromagnetic Interference

A compass, magnetic compass or mariner's compass is a navigational instrument for determining direction relative to the earth's magnetic poles. It consists of a magnetised pointer (usually marked on the north end) free to align itself with the Earth's magnetic field. A compass can be used to calculate heading, used with a sextant to calculate latitude, and with a marine chronometer to calculate longitude.

Like any magnetic device, compasses are affected by nearby ferrous materials as well as by strong local electromagnetic forces, such as magnetic fields emitted from power cables. As the compass still serves as an essential means of navigation in the event of power loss or as a secondary source, it is important that potential impacts from Electromagnetic Field (EMF) are minimised to ensure continued safe navigation.

The vast majority of commercial traffic uses non-magnetic gyrocompasses as the primary means of navigation, which are unaffected by EMF. Therefore, it is considered highly unlikely that any interference from EMF as a result of the presence the Proposed Development will have a significant impact on vessel navigation. However, some smaller craft (fishing or leisure) may rely on it as their sole means of navigation.

18.6.1 Subsea Cables

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

18.6.2 Wind Turbine Generators

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

18.6.3 Experience at Operational Offshore Wind Farms

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

18.7 Marine Radar

This section summarises the results of trials and studies undertaken in relation to Radar effects from offshore wind farms in the UK. It is important to note that since the time of the trials and studies discussed, WTG technology has advanced significantly, most notably in terms of the size of WTGs available to be installed and utilised. The use of these larger WTGs allows for a greater spacing between WTGs than was achievable at the time of the studies being undertaken, which is beneficial in terms of Radar interference effects (and surface navigation in general) as detailed below.

18.7.1 Trials

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

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

Side lobe patterns are produced by small amounts of energy from the transmitted pulses that are radiated outside of the narrow main beam. The effects of side lobes are most noticeable within targets at short range (below 1.5 nm) and with large objects. Side lobe echoes form either an arc on the Radar screen similar to range rings, or a series of echoes forming a broken arc, as illustrated in Figure 15.1.63.

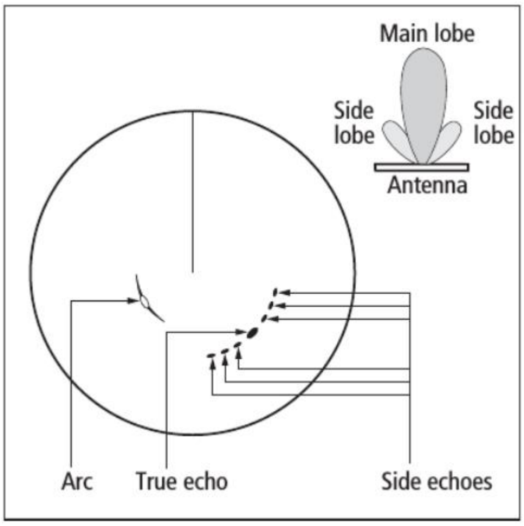

Figure 15.1.63 Illustration of side lobes on Radar screen

Multiple reflected echoes are returned from a real target by reflection from some object in the Radar beam. Indirect echoes or 'ghost' images have the appearance of true echoes but are usually intermittent or poorly defined; such echoes appear at a false bearing and false range, as illustrated in Figure 15.1.64.

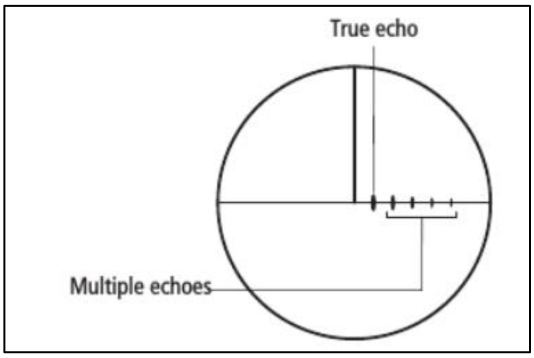

Figure 15.1.64 Illustration of multiple reflected echoes on Radar screen

Based on the results of the North Hoyle trials, the MCA produced a Shipping Route Template designed to give guidance to mariners on the distances which should be established between shipping routes and offshore wind farms. However, as experience of effects associated with use of marine Radar in proximity to offshore wind farms grew, the MCA refined their guidance, offering more flexibility within the most recent Shipping Route Template contained within MGN 654 (MCA, 2021).

A second set of trials conducted at Kentish Flats Offshore Wind Farm in 2006 on behalf of the British Wind Energy Association (BWEA) – now called RenewableUK (BWEA, 2007) – also found that Radar antennas which are sited unfavourably with respect to components of the vessel's structure can exacerbate effects such as side lobes and reflected echoes. Careful adjustment of Radar controls suppressed these spurious Radar returns but mariners were warned that there is a consequent risk of losing targets with a small Radar cross section, which may include buoys or small craft, particularly yachts or Glass Reinforced Plastic (GRP) constructed craft; therefore due care should be taken in making such adjustments.

Theoretical modelling of the effects of the development of the proposed Atlantic Array Offshore Wind Farm, which was to be located off the south coast of Wales, on marine Radar systems was undertaken by the Atlantic Array project (Atlantic Array, 2012) and considered a wider spacing of WTGs than that considered within the early trials[5]. The main outcomes of the modelling were the following:

- Multiple and indirect echoes were detected under all modelled parameters;
- The main effects noticed were stretching of targets in azimuth (horizontal) and appearance of ghost targets;
- There was a significant amount of clear space amongst the returns to ensure recognition of vessels moving amongst the WTGs and safe navigation;
- Even in the worst case with Radar operator settings artificially set to be poor, there is significant clear space around each WTG that does not contain any multipath or side lobe ambiguities to ensure safe navigation and allow differentiation between false and real (both static and moving) targets;
- Overall it was concluded that the amount of shadowing observed was very little (noting that the model considered lattice-type foundations which are sufficiently sparse to allow Radar energy to pass through);
- The lower the density of WTGs the easier it is to interpret the Radar returns and fewer multipath ambiguities are present;
- In dense, target rich environments S-Band Radar scanners suffer more severely from multipath effects in comparison to X-Band Radar scanners;
- It is important for passing vessels to keep a reasonable separation distance between the WTGs in order to minimise the effect of multipath and other ambiguities;
- The Atlantic Array study undertaken in 2012 noted that the potential for Radar interference was mainly a problem during periods of reduced visibility when mariners may not be able to visually confirm the presence of other vessels in proximity (those without AIS installed which are usually fishing and recreational craft). It is noted that this situation would arise with or without WTGs in place; and
- There is potential for the performance of a vessel's Automatic Radar Plotting Aid (ARPA) to be affected when tracking targets in or near the array. Although greater vigilance is required, during the Kentish Flats trials it was shown that false targets were quickly identified as such by the mariners and then by the equipment itself.

In summary, experience in UK waters has shown that mariners have become increasingly aware of any Radar effects as more offshore wind farms become operational. Based on this experience, the mariner can interpret the effects correctly, noting that effects are the same as those experienced by mariners in other environments such as in close proximity to other

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

vessels or structures. Effects can be effectively mitigated by "*careful adjustment of Radar controls*".

The MCA has also produced guidance to mariners operating in proximity to OREIs in the UK which highlights Radar issues amongst others to be taken into account when planning and undertaking voyages in proximity to OREIs (MCA, 2008). The interference buffers presented in Table 15.1.25 are based on MGN 654 (MCA, 2021), MGN 371 (MCA, 2008), MGN 654 (MCA, 2021), MGN 372 (MCA, 2008) and MGN 372 Amendment 1 (MCA, 2022).

Table 15.1.25 Distances at which impacts on marine Radar occur

Distance at Which Effect Occurs (nm)	Identified Effects
0.5	▪ Intolerable impacts can be experienced. ▪ X-Band Radar interference is intolerable under 0.25 nm. ▪ Vessels may generate multiple echoes on shore-based Radars under 0.45 nm.
1.5	▪ Under MGN 654, impacts on Radar are considered to be tolerable with mitigation between 0.5 and 3.5 nm. ▪ S-band Radar interference starts at 1.5 nm. ▪ Echoes develop at approximately 1.5 nm, with progressive deterioration in the Radar display as the range closes. Where a main vessel route passes within this range considerable interference may be expected along a line of WTGs. ▪ The WTGs produce strong Radar echoes giving early warning of their presence. ▪ Target size of the WTG echo increases close to the WTG with a consequent degradation on both X and S-Band Radars.

As noted in Table 15.1.25, the onset range from the WTGs of false returns is approximately 1.5 nm, with progressive deterioration in the Radar display as the range closes. If interfering echoes develop, the requirements of the COLREGs *Rule 6 Safe Speed* are particularly applicable and must be observed with due regard to the prevailing circumstances (IMO, 1972/77). In restricted visibility, *Rule 19 Conduct of Vessels in Restricted Visibility* applies and compliance with *Rule 6* becomes especially relevant. In such conditions mariners are required, under *Rule 5 Look-out* to take into account information from other sources which may include sound signals and VHF information, for example from a Vessel Traffic Service (VTS) or AIS (MCA, 2016).

18.7.2 Experience from Operational Developments

The evidence from mariners operating in proximity to existing offshore wind farms is that they quickly learn to adapt to any effects. Figure 15.1.65 presents the example of the Galloper and Greater Gabbard Offshore Wind Farms, which are located in proximity to IMO routeing measures. Despite this proximity to heavily trafficked TSS lanes, there have been no reported incidents or issues raised by mariners who operate within the vicinity. The interference buffers presented in Figure 15.1.65 are as per Table 15.1.25.

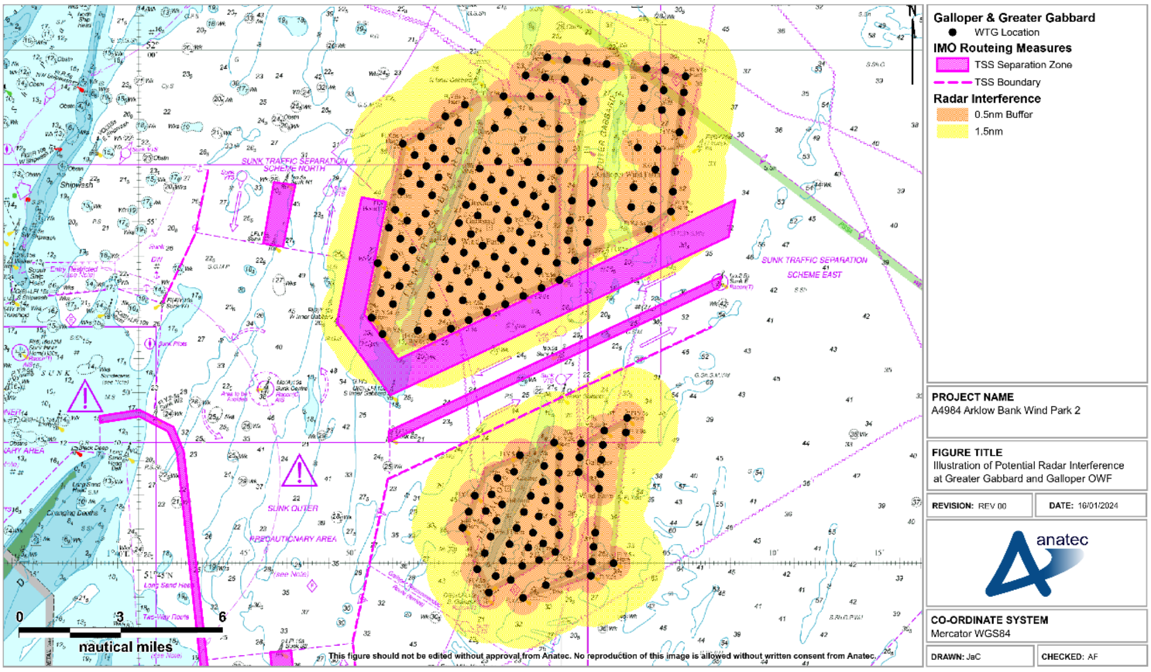

Figure 15.1.65 Illustration of potential Radar interference at Greater Gabbard and Galloper Offshore Wind Farms

As indicated by Figure 15.1.65, vessels utilising these TSS lanes will experience some Radar interference based on the available guidance. Both developments are operational, and each of the lanes is used by a minimum of five vessels per day on average. However, to date, there have been no incidents recorded (including any related to Radar use) or concerns raised by the users.

AIS information can also be used to verify the targets of larger vessels (generally vessels over 15 m length overall (LOA) – the minimum threshold for fishing vessel AIS carriage requirements). Approximately 30% of the vessel traffic recorded within the Study Area was under 15 m LOA, although throughout the vessel traffic surveys approximately 97% of vessel tracks were recorded on AIS, indicating a high level of AIS take-up among vessels for which AIS carriage is not mandatory.

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

18.7.3 Increased Radar Returns

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

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

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

18.7.4 Fixed Radar Antenna Use in Proximity to an Operational Wind Farm

It is noted that there are multiple operational wind farms, including Galloper in the UK, that successfully operate fixed Radar antennas from locations on the periphery of the array. These antennas are able to provide accurate and useful information to onshore coordination centres. (There are no known plans for having such antenna at the Proposed Development.)

18.7.5 Application to the Array Area

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

Figure 15.1.66 and Figure 15.1.67 present an illustration of potential Radar interference due to the Array Area, for Project Design Option 1 and Project Design Option 2 respectively, relative to the post wind farm routeing illustrated in Section 15.2.2.

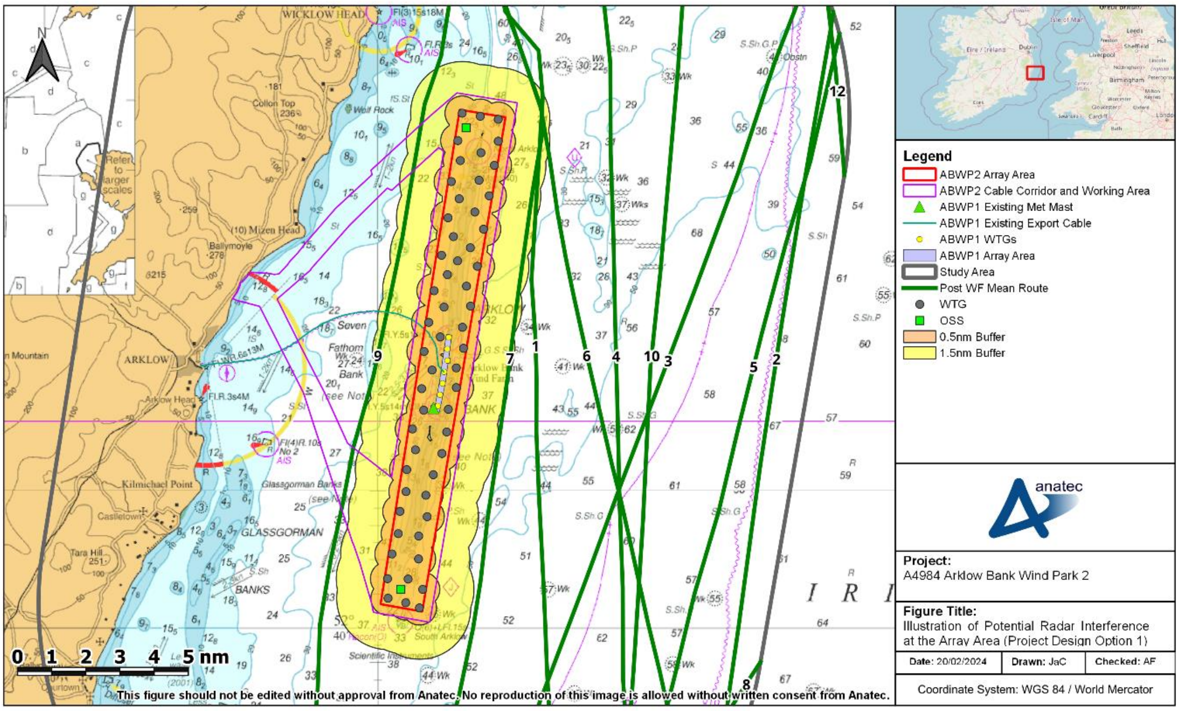

Figure 15.1.66 Illustration of potential Radar interference at the Array Area (Project Design Option 1)

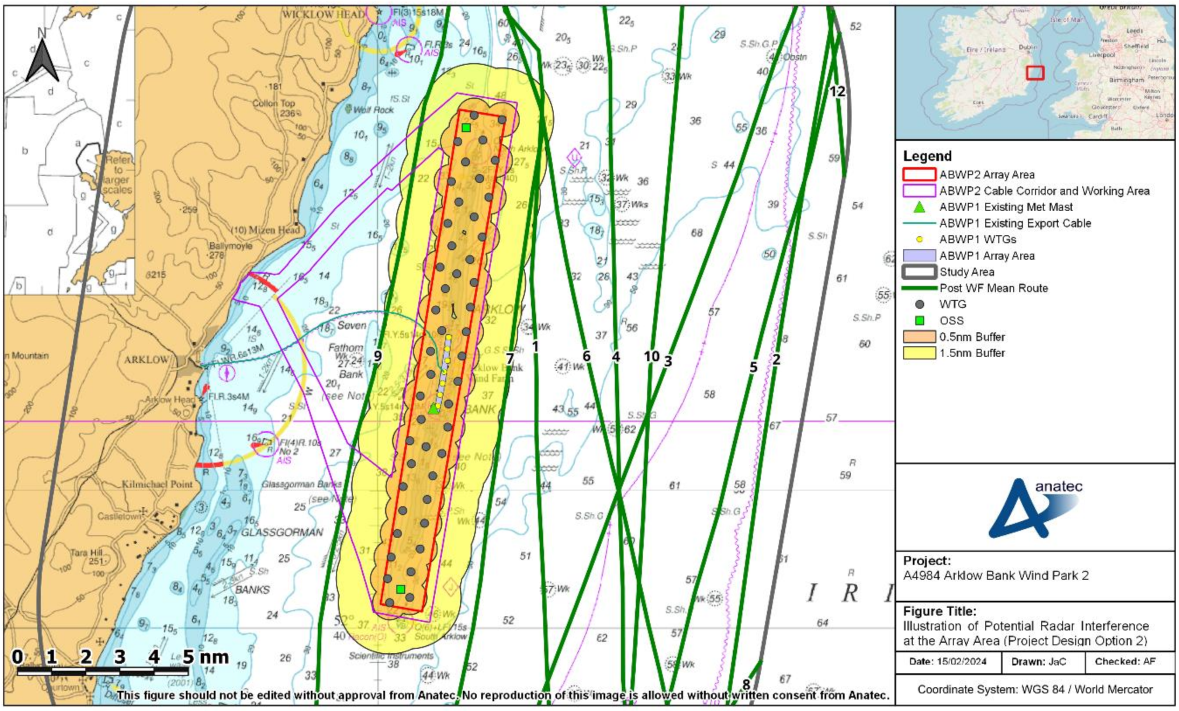

Figure 15.1.67 Illustration of potential Radar interference at the Array Area (Project Design Option 2)

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

Again, looking at existing experience within UK offshore wind farms, vessels do navigate safely within arrays including those with spacing less than at the Array Area. However, given the presence of the Arklow Bank itself, the likelihood of internal navigation within the Array Area is considered low based on consultation (see Table 15.1.11).

It is also noted that there have been no known issues reported by mariners passing in proximity to the existing seven 3.6 MW ABWP1 WTGs commissioned by GE Wind Energy in 2004 as a demonstrator site.

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

18.8 Sound Navigation Ranging (SONAR) Systems

No evidence has been found to date with regard to existing offshore wind farms to suggest that Sound Navigation Ranging (SONAR) systems produce any kind of SONAR interference which is detrimental to the fishing industry, or to military systems. No impact is therefore anticipated in relation to the presence of the Proposed Development.

18.9 Noise

18.9.1 Surface Noise

The sound level from an offshore wind farm at a distance of 350 m has been predicted to be between 51 decibels (dB) and 54 dB. Furthermore, modelling undertaken during the consenting process for the Atlantic Array Offshore Wind Farm showed that the highest predicted sound level due to operational WTG noise (for a 125 m tall 8 MW WTG within 500 m) is around 60 to 70 dB (Atlantic Array, 2012).

A vessel's whistle for a vessel of 7 m should generate in the order of 138 dB and be audible at a range of 1.5 nm (IMO, 1972/77); hence this should be heard above the background noise of the WTGs. Similarly, foghorns (if installed) will also be audible over the background noise of the WTGs.

There are therefore no indications that the sound level of the Proposed Development will have a significant influence on marine safety.

18.9.2 Underwater Noise

In 2005, the underwater noise produced by WTGs of 110 m height and with 2 MW capacity was measured at the Horns Rev Offshore Wind Farm in Denmark. The maximum noise levels recorded underwater at a distance of 100 m from the WTGs was 122 dB or 1 micropascal (µPa) (Institut für technische und angewandte Physik (ITAP), 2006).

Further assessment is provided in Volume III, Appendix 11.1: Subsea Noise Technical Report.

During the operational and maintenance phase of the Proposed Development, the subsea noise levels generated by WTGs will likely be greater than that produced at Horns Rev given the larger WTG size, but nevertheless is not anticipated to have any significant impact on vessels as they are designed to work in pre-existing noisy environments.

18.10 Existing Aids to Navigation

As noted in Section 9.3, there are aids to navigation located at the operational ABWP1 which may require alteration once the Proposed Development is operational. In addition, there are two other aids to navigation located within the Array Area, namely a monopile with a Lidar on top and the North Arklow Light north cardinal buoy. The South Arklow Light south cardinal buoy is located just south of the Array Area.

During consultation with Irish Lights it was noted that these aids to navigation could be relocated following construction and/or aids to navigation placed on the WTGs.

Irish Lights will be consulted on the final layout, to agree the required marking and lighting. Given that there are viable options for how to address this issue there is not considered to be a significant impact.

18.11 Summary of Potential Effects on Use

Based on the detailed technical assessment of the effects due to the presence of the Proposed Development on navigation, communication and position fixing equipment in the previous subsections, Table 15.1.26 summarises the assessment of frequency and consequence and the resulting risk for each component of this impact.

Table 15.1.26 Summary of risk to navigation, communication and position fixing equipment

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

Topic	Frequency	Consequence	Significance of Risk
Noise	Negligible	Minor	Broadly Acceptable

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19 Impact Identification

This section outlines the shipping and navigation hazards which have been identified based upon the NRA process which includes consideration of the baseline data and the consultation undertaken. These hazards have been fed into the FSA undertaken within Volume II, Chapter 15: Shipping and Navigation.

- Vessel displacement;
- Port access restrictions;
- Increased collision risk;
- Increased allision risk
- Cable interaction risk; and
- Diminished Emergency Response Capability.

The FSA within Volume II, Chapter 15: Shipping and Navigation assesses the significance of each hazard for the relevant users and identifies the need for any additional mitigation to ensure the risks are ALARP.

20 Summary

Using a baseline assessment, quantitative assessment and consultation with relevant stakeholders, impacts relating to shipping and navigation have been identified and assessed for the Proposed Development for all phases of the development (construction, operation and maintenance and decommissioning).

The following subsections summarise the key elements of the NRA.

20.1 Consultation

During the NRA process, consultation has been undertaken with regulators and stakeholders, including:

- Arklow Fishing Sector;
- Arklow Marina Ltd;
- Arklow Sailing Club;
- Irish Lights;
- GE Wind Energy;
- IRCG;
- Irish Chamber of Shipping;
- Irish Ferries;
- MSO;
- RNLI; and
- Wicklow Harbour.

Further details on consultation undertaken can be found in Section 6.

20.2 Baseline Characterisation

20.2.1 Navigational Features

Commercial traffic movements through the Irish Sea are regulated to an extent by IMO Routeing Measures. The Off Tuskar Rock and Off Smalls TSSs are located south of the Array Area and regulate vessel traffic passing around the southeastern tip of Ireland and near the English Channel, respectively. The Off Skerries TSS is located northeast of the Array Area which regulates vessel traffic passing around the northwestern tip of Wales.

ABWP1 is an existing offshore wind farm comprising seven WTGs within the Array Area, which has been operational since 2004. Its export cable passes through the Array Area. There is also a subsea cable that passes offshore of the Array Area.

There are no oil and gas features or marine aggregate dredging areas in proximity to the Proposed Development.

There are a number of aids to navigation in proximity to the Proposed Development including a Met Mast (owned by the Developer, the North Arklow Light north cardinal buoy and the

South Arklow Light south cardinal buoy, the first two of which are located within the Array Area.

The two main ports in proximity to the Proposed Development are Arklow and Wicklow, although neither is a major port, with Dublin the nearest large commercial port.

Further details on navigational features can be found in Section 9.

20.2.2 Maritime Incidents

From MCIB incident data, two incidents within the Study Area have been reported since 1992, with one occurring in 2000 and involving a collision between a fishing vessel and a tanker and the other occurring in 2016 and involving a man overboard from a fishing vessel.

From RNLI incident data analysed over a 10-year period, an average of 40 to 41 unique incidents per year occurred within the Study Area, with incidents concentrated nearshore around the ports of Wicklow, Arklow and Courtown; relatively few incidents occurred in open waters.

Further details on maritime incidents can be found in Section 12.

20.2.3 Vessel Traffic Movements

An average of 36 to 37 vessels per day was recorded during the summer 2023 survey period, with 36 vessels per day during the summer 2022 survey period. Cargo vessels were the most common vessel type during both survey periods.

Further details on vessel traffic movements can be found in Section 13.

20.3 Routeing

A total of 12 main commercial routes were identified within the Study Area, with the highest traffic volume route having an average of eight to nine transits per day between Dublin and TSS Off Smalls; this route featured RoPax traffic, operated by Irish Ferries, undertaking regular routeing between Dublin and Cherbourg. Four of these routes are anticipated to deviate, with all deviations being very low (less than 1 nm).

Further details on base case routeing can be found in Section 14. Further details on future case routeing can be found in Section 15.2.

20.4 Collision and Allision Risk Modelling

Six modelling scenarios were assessed:

- Pre wind farm with the base case vessel traffic level;
- Pre wind farm with a future case vessel traffic level defined by:
  - A 10% increase in traffic; and
  - A 25% increase in traffic.
- Post wind farm with the base case traffic level; and

- Post wind farm with a future case vessel traffic level defined by:
  - A 10% increase in traffic; and
  - A 25% increase in traffic.

Table 15.1.27 and Table 15.1.28 summarises the collision and allision results for the Project Design Option 1 and Project Design Option 2 respectively.

Table 15.1.27 Risk Results Summary (Project Design Option 1)

Risk	Scenario	Annual Frequency		
		Pre Wind Farm	Post Wind Farm	Increase
Vessel to vessel collision	Base case	6.40×10^{-3} (one in 156 years)	6.59×10^{-3} (one in 152 years)	1.89×10^{-4}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	8.20×10^{-3} (one in 122 years)	2.36×10^{-4}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.05×10^{-2} (one in 95 years)	3.02×10^{-4}
Powered vessel to structure allision	Base case	-	3.67×10^{-4} (one in 2,726 years)	3.67×10^{-4}
	Future case (10%)	-	4.04×10^{-4} (one in 2,478 years)	4.04×10^{-4}
	Future case (25%)	-	4.59×10^{-4} (one in 2,181 years)	4.59×10^{-4}
Drifting vessel to structure allision	Base case	-	2.81×10^{-4} (one in 356 years)	2.81×10^{-4}
	Future case (10%)	-	3.09×10^{-3} (one in 324 years)	3.09×10^{-3}
	Future case (25%)	-	3.51×10^{-4} (one in 285 years)	3.51×10^{-4}
Fishing vessel to structure allision	Base case	-	2.54×10^{-3} (one in 393 years)	2.42×10^{-3}
	Future case (10%)	-	2.78×10^{-3} (one in 359 years)	2.66×10^{-3}
	Future case (25%)	-	3.15×10^{-3} (one in 318 years)	3.03×10^{-3}
Total	**Base case**	6.40×10^{-3} (one in 156 years)	1.23×10^{-2} (one in 81 years)	5.71×10^{-3}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	1.45×10^{-2} (one in 69 years)	6.27×10^{-3}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.76×10^{-2} (one in 57 years)	7.11×10^{-3}

Table 15.1.28 Risk Results Summary (Project Design Option 2)

Risk	Scenario	Annual Frequency		
		Pre Wind Farm	Post Wind Farm	Increase
Vessel to vessel collision	Base case	6.40×10^{-3} (one in 156 years)	6.59×10^{-3} (one in 152 years)	1.89×10^{-4}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	8.20×10^{-3} (one in 122 years)	2.36×10^{-4}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.05×10^{-2} (one in 95 years)	3.02×10^{-4}
Powered vessel to structure allision	Base case	-	2.87×10^{-4} (one in 3,489 years)	2.87×10^{-4}
	Future case (10%)	-	3.15×10^{-4} (one in 3,172 years)	3.15×10^{-4}
	Future case (25%)	-	3.58×10^{-4} (one in 2,791 years)	3.58×10^{-4}
Drifting vessel to structure allision	Base case	-	2.37×10^{-3} (one in 422 years)	2.37×10^{-3}
	Future case (10%)	-	2.60×10^{-3} (one in 384 years)	2.60×10^{-3}
	Future case (25%)	-	2.96×10^{-3} (one in 338 years)	2.96×10^{-3}
Fishing vessel to structure allision	Base case	-	2.28×10^{-3} (one in 438 years)	2.17×10^{-3}
	Future case (10%)	-	2.50×10^{-3} (one in 400 years)	2.39×10^{-3}
	Future case (25%)	-	2.83×10^{-3} (one in 354 years)	2.71×10^{-3}
Total	**Base case**	6.40×10^{-3} (one in 156 years)	1.15×10^{-2} (one in 87 years)	4.94×10^{-3}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	1.36×10^{-2} (one in 73 years)	5.42×10^{-3}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.67×10^{-2} (one in 60 years)	6.14×10^{-3}

Further details on the collision and allision risk modelling can be found in Section 17.

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Annex A Hazard Log

This appendix provides the full Hazard Log created following the Hazard Workshop held in 2023. For each impact identified, the most likely and worst case consequences were identified and the methodology outlined in Section 3.3 was used to rank them in terms of severity of consequence and frequency of occurrence.

Table A.1 presents the full Hazard Log.

Table A.1 Hazard Log

								Most Likely							Worst Case								Remarks / Questions	
Phase	Hazard Type	Hazard Title	Hazard Detail	Possible Causes	Most Likely Consequence	Worst Case Consequence	Embedded Mitigations	People	Property	Environment	Business	Consequence	Frequency	Risk with Embedded Mitigation	People	Property	Environment	Business	Consequence	Frequency	Risk with Embedded Mitigation	Potential Additional Mitigation	2023	2019
Construction (and Decommissioning)	Displacement	Displacement of commercial vessel routeing	The construction of the project may lead to a displacement of established commercial vessel routes.	Buoyed construction (or decommissioning) area intersecting or in proximity to pre-existing commercial vessel routes.	Minimal increase in journey time / distance with very limited effect on schedule.	Minor increase in journey time / distance with some effect on schedules.	Promulgation of information including notice to mariners, charting and marine coordination.	1	1	1	1	1	4	Broadly Acceptable	1	1	1	2	2	1	Broadly Acceptable	Phased construction may require tailoring of mitigation such as marking & lighting.	Noted the importance of cumulative considerations (on a general basis for all P1 projects). No additional comments on previously agreed rankings.	Effects on commercial vessels limited. Significant majority of vessels avoid the bank (and hence the site) entirely. Limited number of vessels affected and minor deviations required. It was noted that not developing the NE section of the site would reduce displacement, but not seen as essential.
Construction (and Decommissioning)	Displacement	Displacement of small (e.g., fishing/recreational) vessels	Displacement of third party marine activity from small vessels (e.g., recreational, fishing).	Buoyed construction (or decommissioning) area intersecting or in proximity to pre-existing third party marine activity from small vessels.	Increase in journey time for a small vessel with limited impact	Minor displacement of small fishing vessels.	Promulgation of information including notice to mariners, charting and marine coordination, fisheries liaison officer	1	1	1	1	1	4	Broadly Acceptable	1	1	1	3	2	3	Broadly Acceptable	Targets marinas / harbours along east coast of Ireland with information. Include site details in Irish Cruising Club Sailing Directions.	No comments on previously agreed rankings.	Limited third party navigational activity present given proximity of shallow bank.
Construction (and Decommissioning)	Collision	Increased collision risk arising from the construction of the project.	An increase in vessel-to-vessel collision risk arising from the following scenarios: - third party vessel collides with a construction vessel - collision between two third party vessels as a result of displacement	Human error, adverse weather, mechanical failure of vessel, navigational error, vessel displacement, insufficient lighting / marking during construction.	Increased encounter levels between WF vessels and third party vessels resulting in collision between WF vessel and third party vessel with material damage to one or both vessels.	Collision between two vessels leading to loss of stability and possible capsize, with the potential for loss of lives, or pollution spill	Marine coordination, charting and marking of the site, promulgation of information, fishing liaison officer.	2	3	2	2	3	3	Tolerable with mitigation	5	4	4	3	4	1	Broadly Acceptable	Procedures in place for WF vessels when departing or accessing site to ensure minimal impact to third party traffic.	Noted that impacts to recreational vessels from project vessels should be considered. No comments on previously agreed rankings.	Routeing to / from wind farm should be reviewed once base port has been determined.
Construction (and Decommissioning)	Powered Allision	Allision with pre-commissioned structures from a vessel under power	A passing vessel allision with one of the pre-commissioned wind farm structures.	Lack of or failure of lighting / marking, human error, adverse weather, navigational error.	Low impact "glancing" allision resulting in material damage to structure and / or vessel and injury to crew.	Allision of small vessel with structure leading to capsize, or large vessel leading to damage or pollution spill, or loss of multiple lives.	Promulgation of information, lighting and marking sanctioned by Irish Lights, buoyed construction area, marine coordination, guard vessel, safety zone.	2	3	2	2	3	2	Broadly Acceptable	5	4	4	3	4	1	Broadly Acceptable	Phased construction may require tailoring of mitigation such as marking & lighting.	No comments on previously agreed rankings.	Key concern was noted to be "curious" recreational user getting too close to the turbines / bank. Legislation for statutory safety zones may not be available but an advisory distance could be stated in NMs. Guard vessel introduces risks to crew so only if and when considered necessary.
Construction (and Decommissioning)	Drifting Allision	Allision with pre-commissioned structures from a drifting vessel	A drifting vessel allision with one of the pre-commissioned wind farm structures.	Human error, mechanical failure of vessel, adverse weather, navigational error.	Low impact "glancing" allision resulting in material damage to structure and / or vessel and injury to crew.	Allision of small vessel with structure leading to capsize, or large vessel leading to damage or pollution spill, or loss of multiple lives.	Construction vessels providing "self help" resources in the event of a drifting incident, Emergency Response Procedures.	2	3	2	2	3	2	Broadly Acceptable	5	4	4	3	4	1	Broadly Acceptable	Project Emergency Response Procedures in place for drifting incident, to assist where able.	No comments on previously agreed rankings.	Noted that tugs from Dublin may be able to assist depending on how far a vessel were to break down from the bank.
Construction (and Decommissioning)	Impacts on SAR	Reduction of SAR Resources due to increased activity associated with the construction of the project.	The increase of activity associated with the construction of the project leading to an increase in SAR incidents, reducing overall SAR resources in the area.	Increased vessel activity (and hence personnel) associated with the construction of the project.	Limited reduction to SAR Resources given low baseline incident rates.	Multiple incidents occurring within the area over a short period of time, leading to insufficient SAR resources.	Presence of development will provide increased on-site resources during construction, including vessels and trained personnel with Emergency Response Plans.	1	1	1	1	1	3	Broadly Acceptable	5	2	4	3	4	1	Broadly Acceptable	No further mitigation required.	No comments on previously agreed rankings.	

Construction (and Decommissioning)	Snagging	Snagging of anchors on cable	The cables or protection method creates a snagging risk	Cable left exposed prior to cable protection being installed, human error, mechanical anchor failure.	A minor snagging which the vessel frees itself from, leading to very minor cable / gear / anchor damage	Snagging from a small vessel, leading to capsize with the potential for loss of life, or from a large vessel leading to significant damage to the cable	Cable risk assessment, fisheries liaison officer, promulgation of information including charting of the cables, temporary buoyage, or guard vessel.	1	2	1	1	2	2	Broadly Acceptable	4	2	1	3	3	1	Broadly Acceptable	No further mitigation required.	No comments on previously agreed rankings.	Anchoring activity is limited in the area. Fishing is mainly by static gear (potting) which is less likely to interact with subsea cables than mobile gear.
Operation and Maintenance	Displacement	Displacement of commercial vessel routeing	The wind farm structures displace commercial traffic.	Wind farm structures in proximity to pre-existing commercial vessel routes (i.e., those passing near bank).	Minimal increase in journey time / distance with very limited effect on schedule.	Minor increase in journey time / distance with some effect on schedules.	Promulgation of information including notice to mariners, charting and marine coordination.	1	1	1	1	1	3	Broadly Acceptable	1	1	1	2	2	1	Broadly Acceptable	No further mitigation required.	Noted the importance of cumulative considerations (on a general basis for all P1 projects). No additional comments on previously agreed rankings.	Effects on commercial vessels limited. Significant majority of vessels avoid the bank (and hence the site) entirely. By the operational phase deviations will be established.
Operation and Maintenance	Displacement	Displacement of small (e.g., fishing/recreational) vessels	Displacement of third party marine activity from small vessels (e.g., recreational, fishing).	Buoyed construction (or decommissioning) area intersecting or in proximity to pre-existing third party marine activity from small vessels.	Increase in journey time for a small vessel with limited impact	Minor displacement of small fishing vessels.	Promulgation of information including notice to mariners, charting and marine coordination, fisheries liaison officer	1	1	1	2	1	3	Broadly Acceptable	1	1	1	3	2	1	Broadly Acceptable	Targets marinas / harbours along east coast of Ireland with information. Include site details in Irish Cruising Club Sailing Directions.	No comments on previously agreed rankings.	Recreational or fishing vessels may choose to transit through the wind farm during the operational phase, however this is considered an infrequent occurrence based on consultation and study of marine traffic data (i.e., water depths mean traffic over bank is already limited).
Operation and Maintenance	Collision	Increased collision risk arising from the operation of the project.	An increase in vessel-to-vessel collision risk arising from the following scenarios: - third party vessel collision with a WF maintenance vessel - collision between two third party vessels as a result of displacement	Human error, adverse weather, mechanical failure of vessel, navigational error, vessel displacement.	Increased encounter levels between WF vessels and third party vessels resulting in collision between WF vessel and third party vessel with material damage to on or both vessels.	Collision between two vessels leading to loss of stability and possible capsize, with the potential for loss of lives, or pollution spill	Marine coordination, charting and marking of the site, fishing liaison officer, promulgation of information.	2	3	2	2	3	2	Broadly Acceptable	5	4	4	3	4	1	Broadly Acceptable	Procedures in place for WF vessels when departing or accessing site to ensure minimal impact to third party traffic.	Noted that impacts to recreational vessels from project vessels should be considered. No comments on previously agreed rankings.	Wind farm vessel activity during O&M likely to be less than during construction, however, may be to/from a different onshore base.
Operation and Maintenance	Powered Allision	Allision with a wind farm structure from vessel under power	A passing vessel allision with one of the wind farm structures.	Lack of or failure of lighting / marking, human error, adverse weather, navigational error.	Low impact "glancing" allision resulting in material damage to structure and / or vessel and injury to crew.	Allision of small vessel with structure leading to capsize, or large vessel leading to damage or pollution spill, or loss of multiple lives.	Promulgation of information, lighting and marking including Racon for non AIS vessels, marine coordination.	2	3	2	2	3	2	Broadly Acceptable	5	4	4	3	4	1	Broadly Acceptable	No further mitigation required.	No comments on previously agreed rankings.	Key concerns were noted to be "curious" recreational users getting too close to the turbines / bank.
Operation and Maintenance	Drifting Allision	Allision with a wind farm structure from a drifting vessel	A drifting vessel allision with one of the wind farm structures.	Human error, mechanical failure of vessel, adverse weather, navigational error.	Low impact "glancing" allision resulting in material damage to structure and / or vessel and injury to crew.	Allision of small vessel with structure leading to capsize, or large vessel leading to damage or pollution spill, or loss of multiple lives.	WF vessels providing "self help" resources in the event of a drifting incident, Emergency Response Procedures.	2	3	2	2	3	2	Broadly Acceptable	5	4	4	3	4	1	Broadly Acceptable	Project Emergency Response Procedures in place for drifting incident, to assist where able.	No comments on previously agreed rankings.	Noted that tugs from Dublin may be able to assist depending on how far a vessel were to break down from the bank.
Operation and Maintenance	Impacts on SAR	Reduction of SAR resources due to increased activity associated with the operation of the project.	The increase of activity associated with the operation of the project leading to an increase in SAR incidents, reducing overall SAR resources in the area.	Increased vessel activity (and hence personnel) associated with the operation of the project.	Limited reduction to SAR Resources given low baseline incident rates.	Multiple incidents occurring within the area over a short period of time, leading to insufficient SAR resources.	Presence of development will provide increased on site resources such as O&M vessels, trained personnel and Emergency Response Plans.	1	1	1	1	1	2	Broadly Acceptable	5	2	4	3	4	1	Broadly Acceptable	No further mitigation required.	No comments on previously agreed rankings.	Considered lower than during construction and decommissioning due to decreased numbers of vessels/personnel. Liaison required with Irish Coast Guard and CHC to ensure layout does not impede SAR operations.

Operation and Maintenance	Interference	Interference from turbines with marine navigational equipment.	Wind farm structures interfering with vessel marine radar capabilities (e.g., shadowing)	Vessels passing in close proximity to wind farm structures.	Limited effect requiring minimal radar adjustment from passing vessels.	Adjustment of radar settings to reduce "clutter" leading to a small non-AIS vessel being overlooked, resulting in potential collision scenario.	Vessel experience of managing radar effects from existing turbines, promulgation of information.	1	1	1	1	1	4	Broadly Acceptable	3	3	3	3	3	1	Broadly Acceptable	No further mitigation required.	No comments on previously agreed rankings.	Operational projects and research have shown there are no significant impacts for marine navigational equipment, and any effects are manageable. Mariners will already be experiencing these effects when passing close to the existing seven turbines on Arklow Bank and therefore should be familiar with dealing with any issues.
Operation and Maintenance	EMF Interference	Interference from cables with magnetic compasses.	Subsea cables interfering with the reliability of magnetic compasses.	Shallow water, exposed cable.	No notable effect.	Minor interference when a small recreational vessel is directly over cable in a nearshore area.	Cable risk assessment, promulgation of information.	1	1	1	1	1	1	Broadly Acceptable	1	1	1	1	1	1	Broadly Acceptable	No further mitigation required.	No comments on previously agreed rankings.	Only a subset of small recreational vessels would be solely reliant on a magnetic compass for navigation. For reference, deviations of up to 5 degrees within discrete sections of cable are generally considered acceptable in the UK.
Operation and Maintenance	Snagging	Snagging of anchors on cable	The cables or protection method creates a snagging risk	Failure of cable protection leading to exposed cable, human error, mechanical anchor failure	A minor snagging which the vessel frees itself from, leading to very minor cable / gear / anchor damage	Snagging from a small vessel, leading to capsize with the potential for loss of life, or from a large vessel leading to significant damage to the cable	Cable risk assessment, fisheries liaison officer, promulgation of information including charting of the cables	1	2	1	1	2	1	Broadly Acceptable	4	2	1	3	3	1	Broadly Acceptable	No further mitigation required.	No comments on previously agreed rankings.	Anchoring activity is limited in the area. Fishing is mainly by static gear (potting) which is less likely to interact with subsea cables than mobile gear.
Operation and Maintenance	Under keel Clearance	Reduction in under keel clearance	The cables or cable protection leading to a reduction in under keel clearance	External cable protection required in areas of shallow water depth.	No significant changes to water depths in coastal areas	Changes to water depths to a degree affecting navigational transits.	Cable risk assessment, promulgation of information	1	1	1	1	1	3	Broadly Acceptable	3	1	1	1	2	1	Broadly Acceptable	No further mitigation required.	No comments on previously agreed rankings.	For reference, up to 5% reduction in existing chart datum is generally considered acceptable in the UK.

Annex B Consequences Assessment

This annex presents an assessment of the consequences of collision and allision incidents, in terms of people and the environment, due to the impact of the wind farm structures.

The significance of the impact of the Proposed Development is also assessed based upon risk evaluation criteria and comparison with historical data in UK waters[6]. UK data have been used given its extensiveness and availability. Given the international nature of shipping, and the proximity of the UK and Ireland, the findings are considered to be applicable to the Proposed Development.

Separate assessments of consequences have been undertaken for both layout options under consideration (see Section 4.2).

B.1 Risk Evaluation Criteria

B.1.1 Risk to People

With regard to the assessment of risk to people two measures are considered, namely:

- Individual risk; and
- Societal risk.

B.1.1.1 Individual Risk

Individual risk considers whether the risk from an incident to a particular individual changes significantly due to the presence of the Proposed Development. Individual risk considers not only the frequency of the incident and the consequences (e.g. likelihood of death), but also the individual's fractional exposure to that risk, i.e. the probability of the individual being in the given location at the time of the incident.

The purpose of estimating the individual risk is to ensure that individuals who may be affected by the presence of the Proposed Development are not exposed to excessive risks. This is achieved by considering the significance of the change in individual risk resulting from the presence of the Proposed Development relative to the UK background individual risk levels.

Annual risk levels to crew (the annual risk to an average crew member) for different vessel types are presented in Figure B.1, which also includes the upper and lower bounds for risk acceptance criteria as suggested in IMO Maritime Safety Committee 72/16 (IMO, 2001). The annual individual risk level to crew falls within the ALARP region for each of the vessel types presented.

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

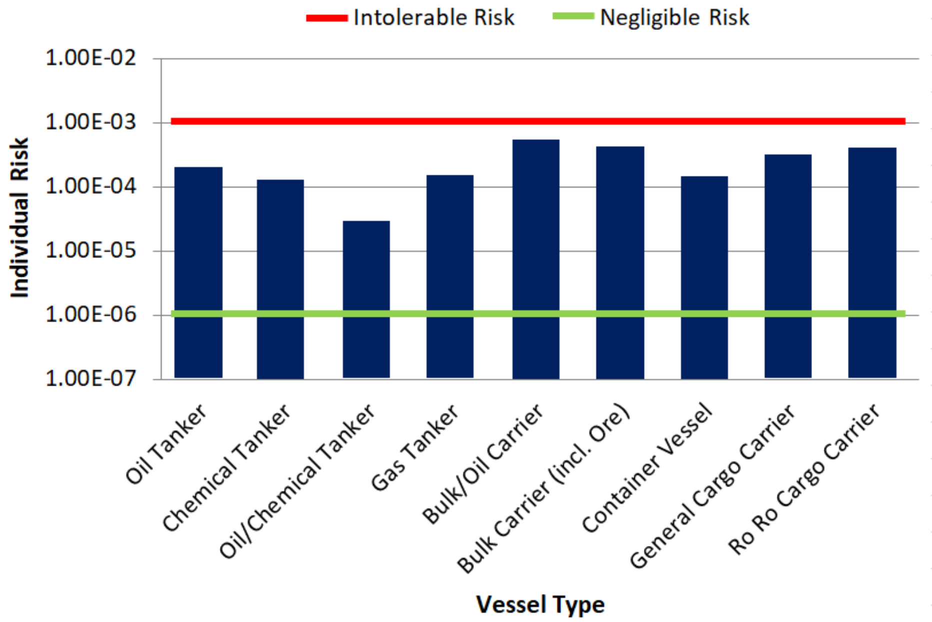

Figure B.1 Individual risk levels and acceptance criteria per vessel type

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

Table B.1 Individual risk ALARP criteria

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

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

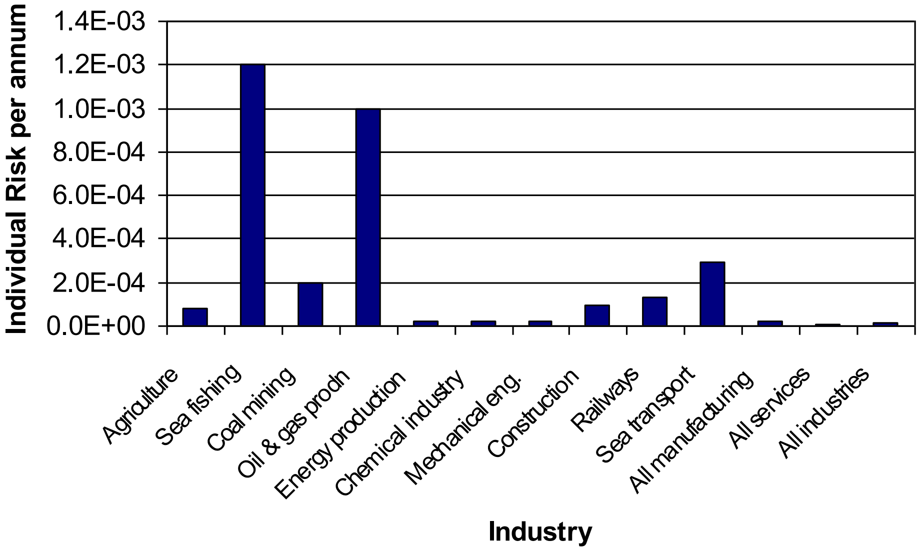

Figure B.2 Individual risk per year for various UK industries

The individual risk for sea transport of 2.9×10^{-4} per year is consistent with the worldwide data presented in Figure B.1, whilst the individual risk for sea fishing of 1.2×10^{-3} per year is the highest across all of the industries listed.

B.1.1.2 Societal Risk

Societal risk is used to estimate risks of accidents affecting many persons, e.g. catastrophes, and acknowledging risk adverse or neutral attitudes. Societal risk includes the risk to every person, even if a person is only exposed on one brief occasion to that risk. For assessing the risk to a large number of affected people, societal risk is desirable because individual risk is insufficient in evaluating risks imposed on large numbers of people.

Within this assessment societal risk (navigational based) can be assessed for the Proposed Development, giving account to the change in risk associated with each incident scenario caused by the introduction of the wind farm structures. Societal risk may be expressed as:

- Annual fatality rate where frequency and fatality are combined into a convenient one-dimensional measure of societal risk, known as Potential Loss of Life (PLL); and
- Frequency vs. number of fatalities (FN) diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

When assessing societal risk this study focuses on PLL, which takes into account the number of people likely to be involved in an incident (which is higher for certain vessel types), and assesses the significance of the change in risk compared to UK background risk levels.

B.1.2 Risk to Environment

For risk to the environment the key criteria considered in terms of the effect of the Proposed Development is the potential quantity of oil spilled from a vessel involved in an incident.

It is recognised that there will be other potential pollution, e.g. hazardous containerised cargoes; however oil is considered the most likely pollutant and the extent of predicted oil spills will provide an indication of the significance of pollution risk due to the Proposed Development compared to UK background pollution risk levels.

B.2 Marine Accident Investigation Branch Incident Data

B.2.1 All Incidents

All British flagged commercial vessels are required to report incidents to the MAIB. Non-British flagged vessels do not have to report an incident to the MAIB unless located at a UK port or within 12 nm territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report incidents to the MAIB; however, a significant proportion of such incidents are reported to and investigated by the MAIB.

The UK MCA, harbour authorities and inland waterway authorities also have a duty to report incidents to the MAIB. Therefore, whilst there may be a degree of underreporting of accidents with minor consequences, those resulting in more serious consequences, such as fatalities, are likely to be reported.

Only incidents occurring in UK waters have been considered within this assessment for which the MAIB data is most comprehensive. It is also noted that incidents occurring in ports/harbours and rivers/canals have been excluded since the causes and consequences may differ considerably from an incident occurring offshore, which is the location of most relevance to the Proposed Development.

Accounting for these criteria, a total of 11,773 accidents, injuries and hazardous incidents were reported to the MAIB in the 20-year period between 2002 and 2021 involving 13,415 vessels (some incidents, such as collisions, involved more than one vessel).

The location of all incidents in proximity to the UK are presented in Figure B.3, colour-coded by incident type. The majority of incidents occur in coastal waters.

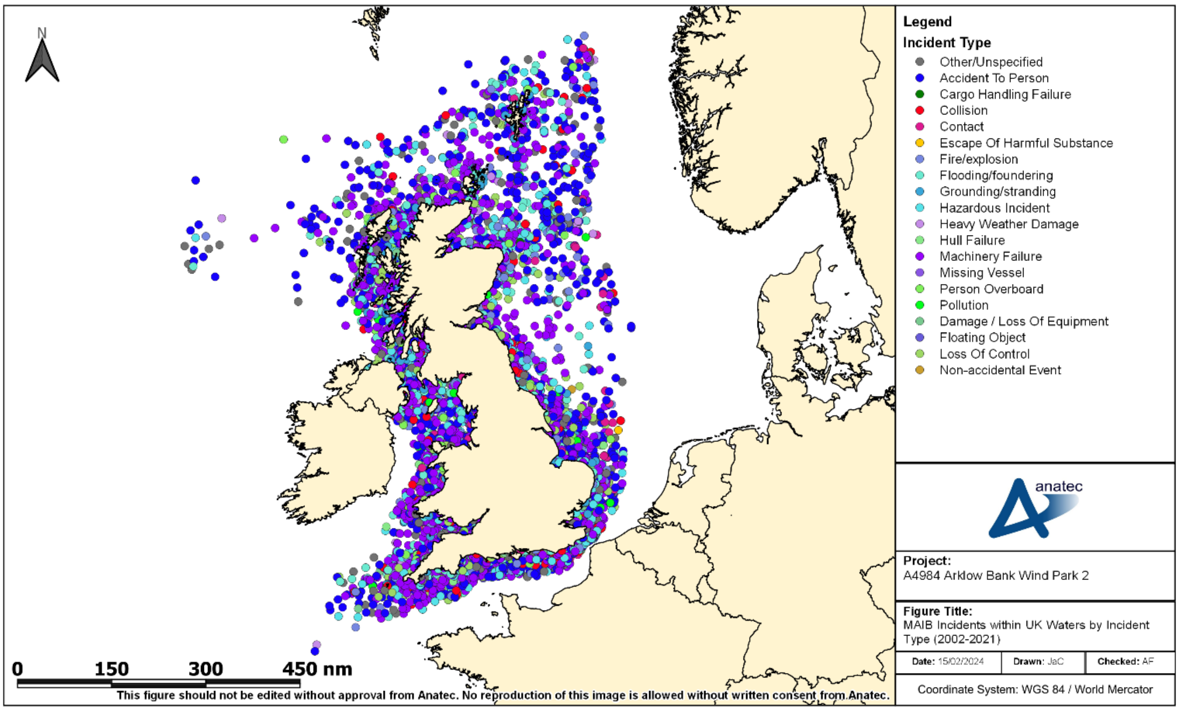

Figure B.3 MAIB incidents within UK waters by incident type (2002 to 2021)

The distribution of unique incidents by year in UK waters is presented in Figure B.4.

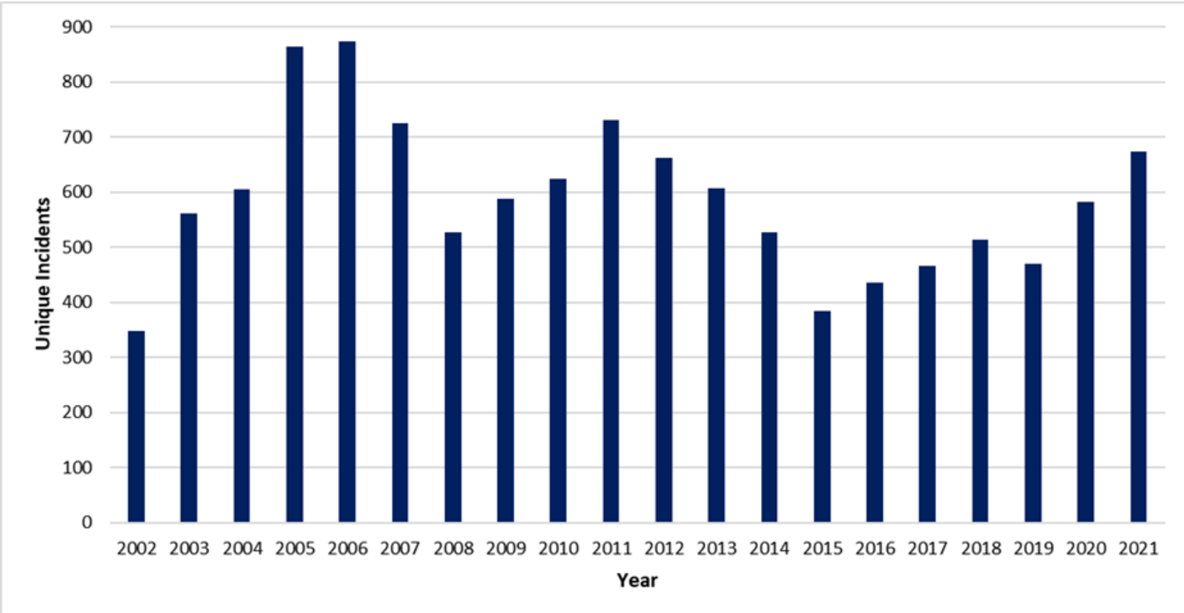

Figure B.4 MAIB unique incidents per year (2002 to 2021)

The average number of unique incidents per year was 589. There has generally been a fluctuating trend in incidents over the 20-year period.

The distribution of incidents in UK waters by incident type is presented in Figure B.5.

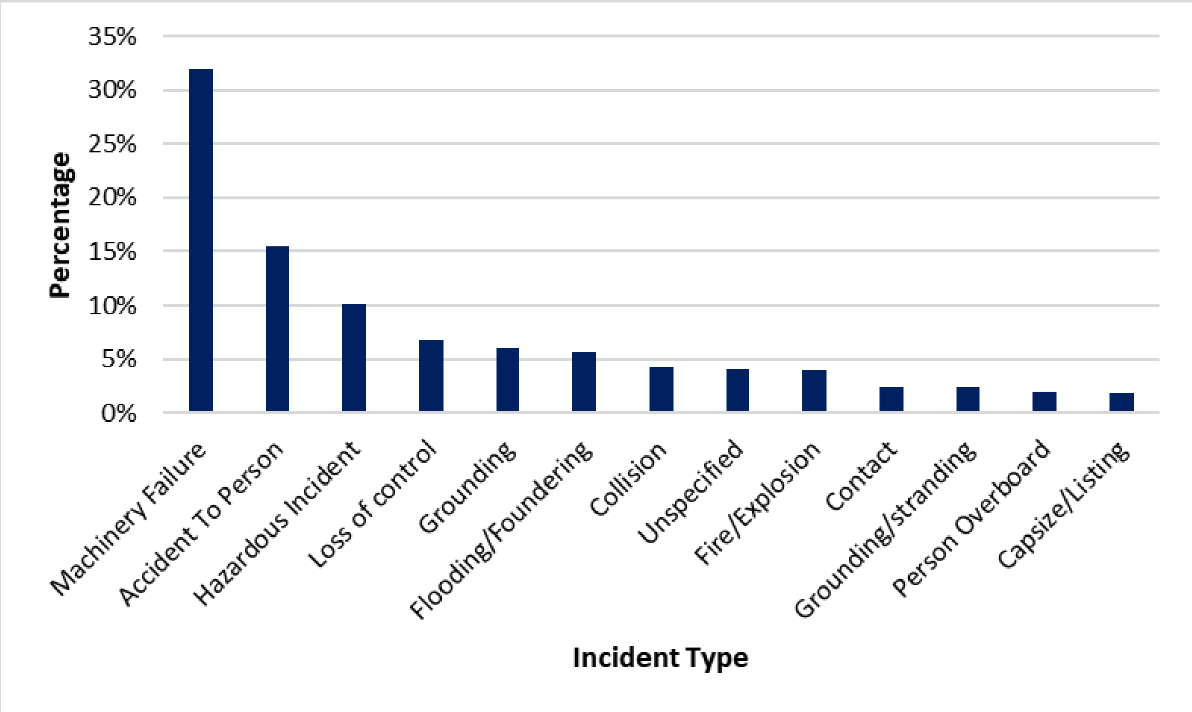

Figure B.5 MAIB incident types breakdown (2002 to 2021)

The most frequent incident types were "machinery failure" (32%), "accident to person" (16%) and "hazardous incident" (10%). "Collision" and "contact" incidents represented 4% and 2% of total incidents, respectively.

The distribution of incidents in UK waters by vessel type is presented in Figure B.6.

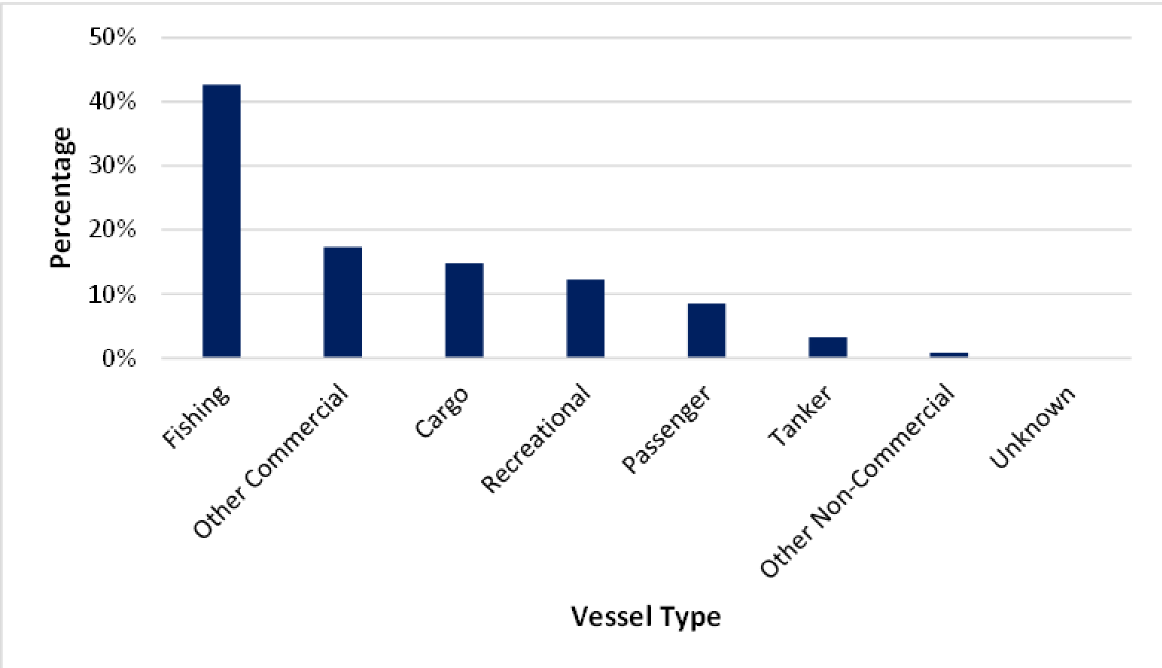

Figure B.6 MAIB incident vessel types breakdown (2002 to 2021)

The most frequent vessel types involved in incidents were fishing vessels (43%), other commercial vessels (17%) (including offshore industry vessels, tugs, workboats and pilot vessels) and cargo vessels (15%).

A total of 414 fatalities were reported in the MAIB incidents within UK waters between 2002 and 2021, corresponding to an average of 21 fatalities per year.

The distribution of fatalities in UK waters by vessel type and person category (namely crew, passenger and other) is presented in Figure B.7.

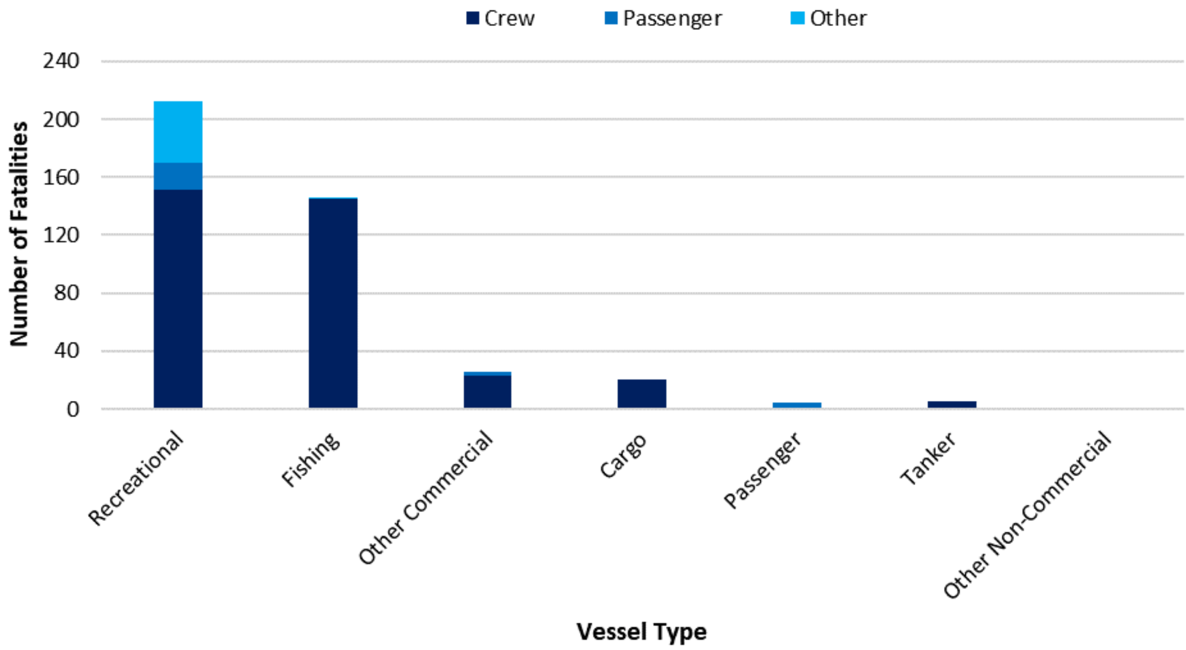

Figure B.7 MAIB fatalities by vessel type (2002 to 2021)

The majority of fatalities occurred to recreational vessels (51%) and fishing vessels (35%), with crew members the main people involved (83%).

B.2.2 Collision Incidents

The MAIB define a collision incident as "ships striking or being struck by another ship, regardless of whether the ships are underway, anchored or moored" (MAIB, 2013).

A total of 504 collision incidents were reported to the MAIB in UK waters between 2002 and 2021 involving 1,068 vessels (in a small number of cases the other vessel involved was not logged).

A plot of the locations of collision incidents reported in proximity to the UK is presented in Figure B.8.

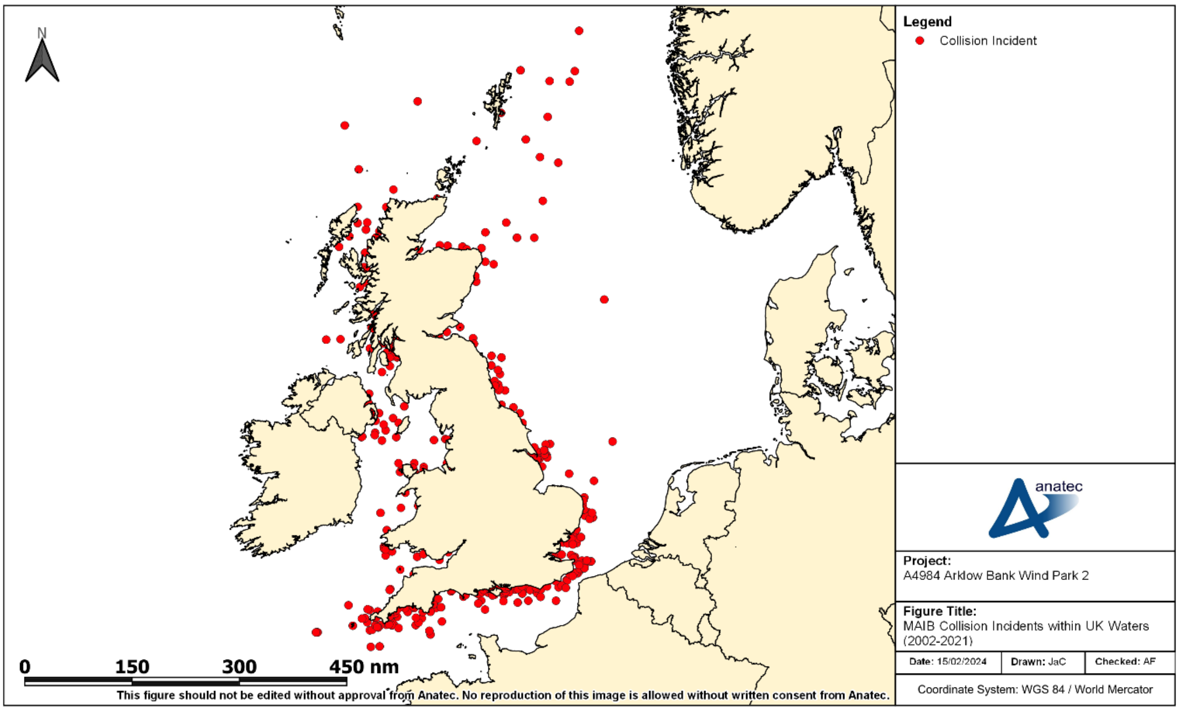

Figure B.8 MAIB collision incident locations (2002 to 2021)

The distribution of collision incidents by year in UK waters is presented in Figure B.9.

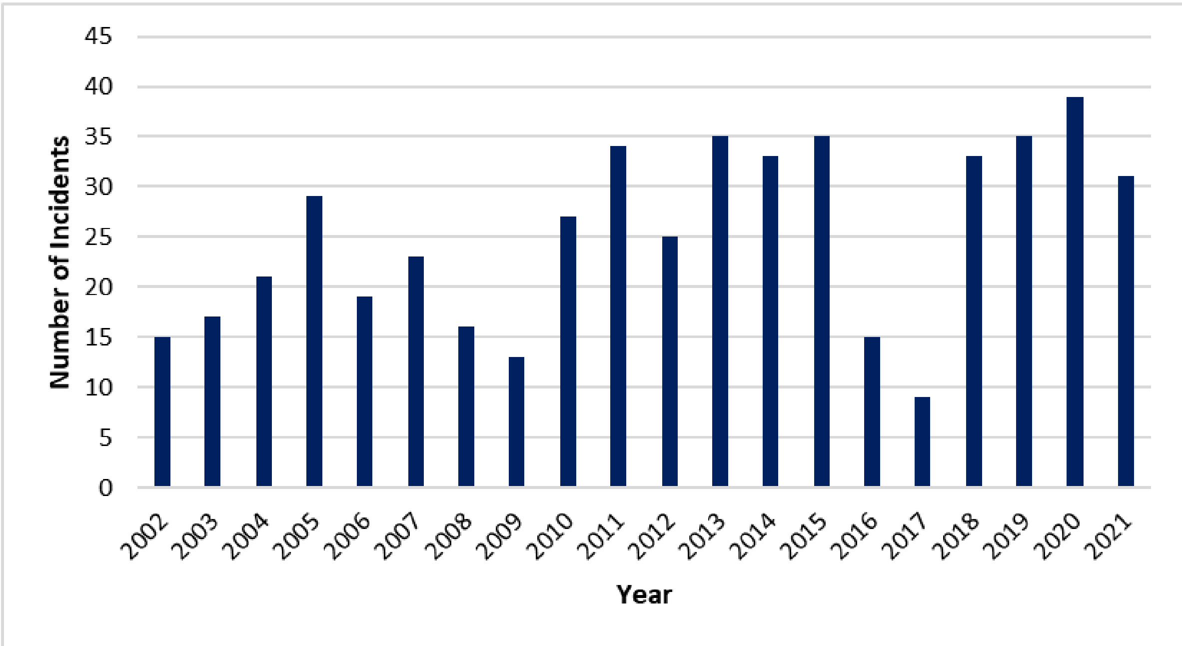

Figure B.9 MAIB collision incidents per year (2002 to 2021)

The average number of collision incidents per year was 25. There has been an overall slight increasing trend in collision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

The distribution of collision incidents in UK waters by vessel type is presented in Figure B.10.

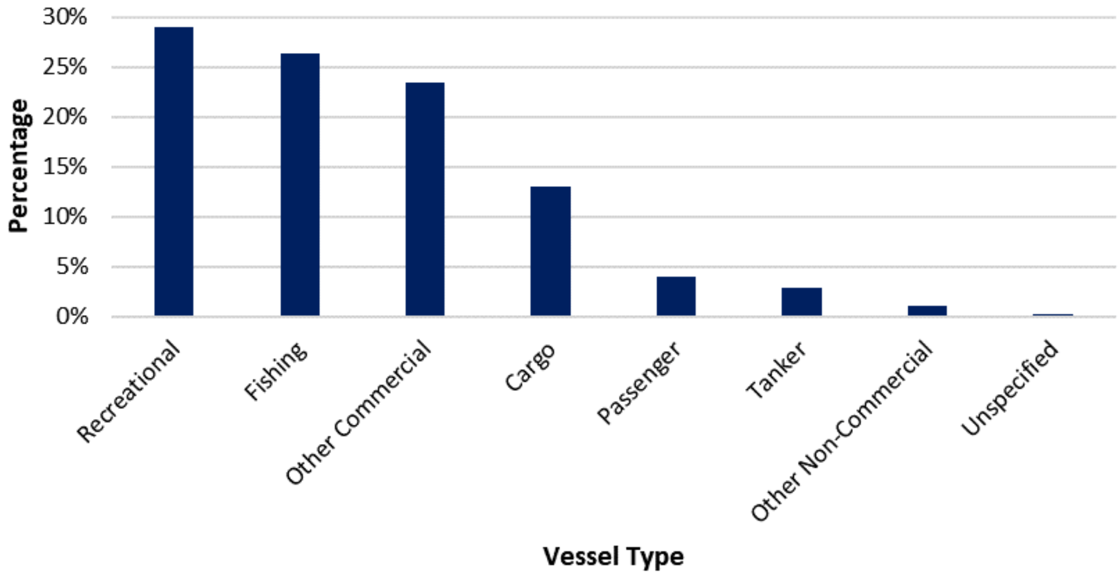

Figure B.10 MAIB collision incident vessel types breakdown (2002 to 2021)

The most frequent vessel types involved in collision incidents were recreational vessels (29%), fishing vessels (26%), other commercial vessels (24%) and cargo vessels (13%).

A total of five fatalities were reported in MAIB collision incidents within UK waters between 2002 and 2021. Details of each of these fatal incidents reported by the MAIB are presented in Table B.2.

Table B.2 Description of Fatal MAIB Collision Incidents (2002 to 2021)

Date	Description	Fatalities
July 2005	Collision between two powerboats at night. Both vessels were unlit and both helmsmen had consumed alcohol. One of the helmsmen died.	1
October 2007	Collision between fishing vessel and coastal general cargo vessel following failure to keep an effective lookout. Fishing vessel sank with three of the four crew members abandoning ship into a life raft but the fourth crew member was not recovered.	1
August 2010	Collision between passenger ferry and fishing vessel. Fishing vessel sank with one of the two crew members recovered from the sea but the other member was not recovered despite an extensive search.	1

Date	Description	Fatalities
June 2015	Collision between Rigid-hulled Inflatable Boat (RIB) and yacht. Believed that around a dozen persons were onboard the motorboat with the majority taken ashore by lifeboat. One person seriously injured and airlifted to hospital before being pronounced dead later.	1
June 2018	Collision between power boats during a race. One of the vessels overturned with the pilot pronounced dead at the scene.	1

B.2.3 Allision Incidents

The MAIB define a contact incident as “ships striking or being struck by an external object. The objects can be: floating object (cargo, ice, other or unknown); fixed object, but not the sea bottom; or flying object” (MAIB, 2013). In line with the NRA as a whole, an allision is considered to involve a moving object and a stationary object at sea, with port infrastructure excluded from consideration; the MAIB contact incidents have been individually inspected and filtered in line with the NRA definition.

A total of 119 allision incidents were reported to the MAIB within UK waters between 2002 and 2021 involving 119 vessels.

The locations of allision incidents reported in proximity to the UK are presented in Figure B.11.

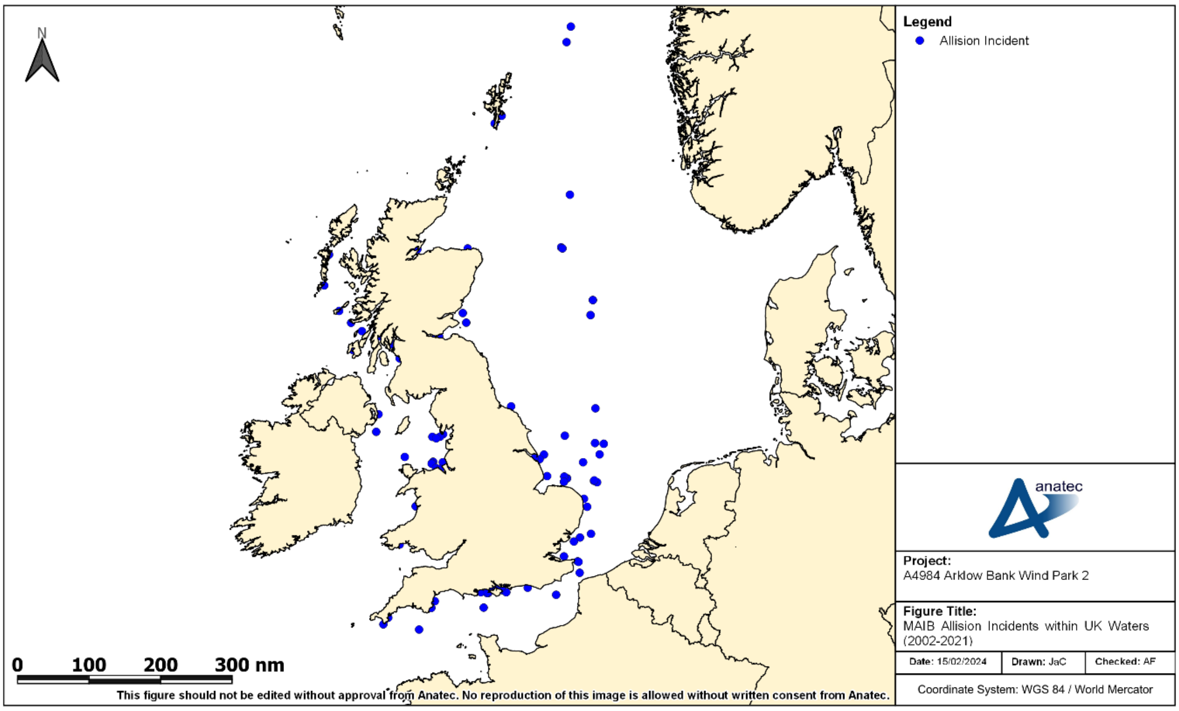

Figure B.11 MAIB Allision Incident Locations within UK waters (2002 to 2021)

The distribution of allision incidents per year is presented in Figure B.12.

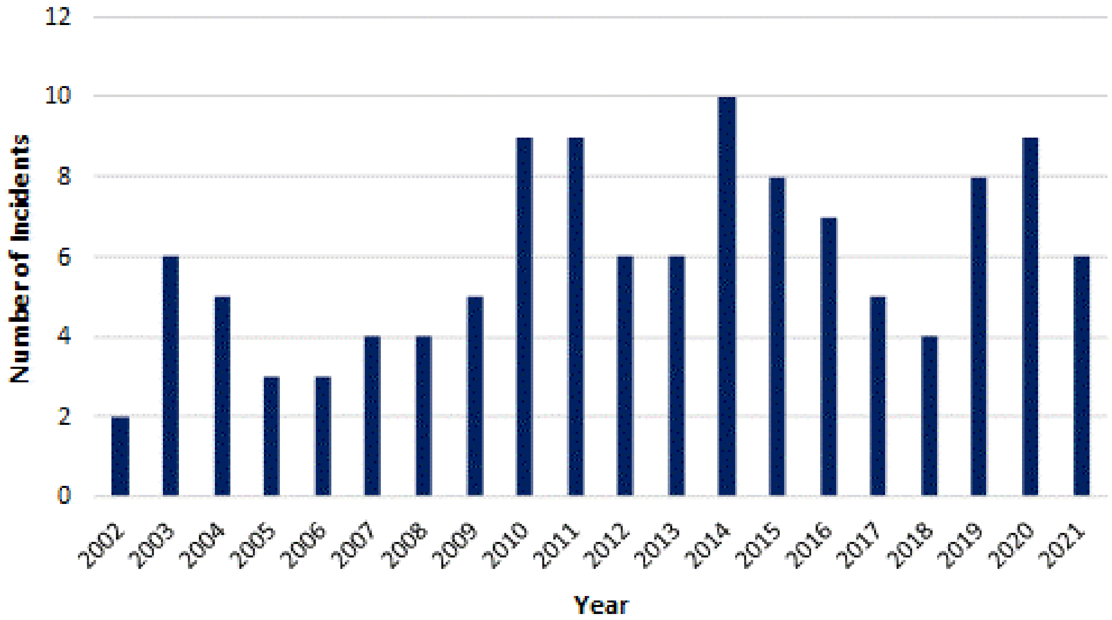

Figure B.12 MAIB contact incidents per year (2002 to 2021)

The average number of allision incidents per year was six. As with collision incidents, there has been an overall slight increasing trend in allision incidents over the 20-year period, which may be due to better reporting of less serious incidents in recent years.

The distribution of vessel types involved in allision incidents is presented in Figure B.13.

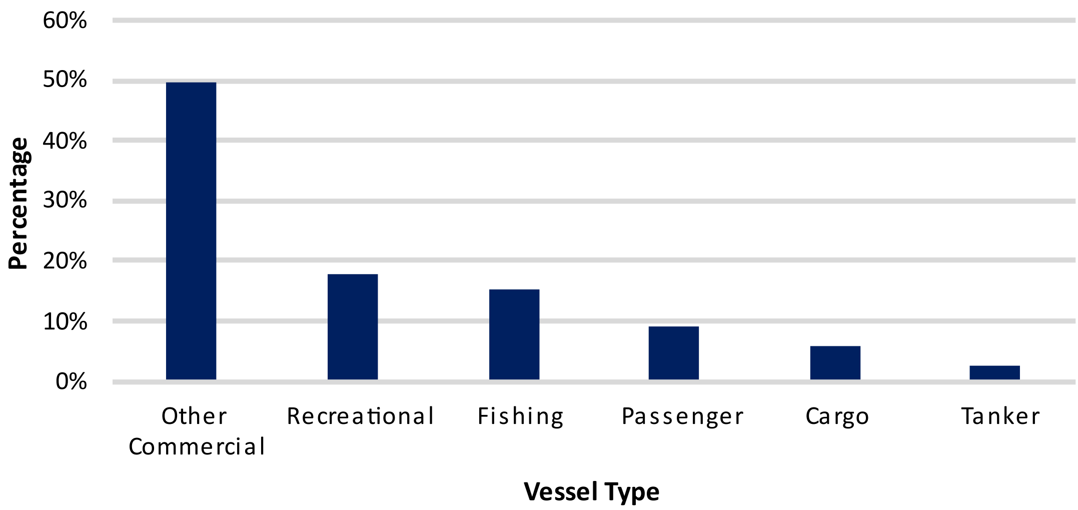

Figure B.13 MAIB Allision Incidents by Vessel Type within UK Waters (2002 to 2021)

The most frequent vessel types involved in allision incidents were other commercial vessels (50%), recreational vessels (18%) and fishing vessels (15%).

No fatalities were reported in MAIB allision incidents within offshore UK waters between 2002 and 2021**.**

B.3 Fatality Risk

B.3.1 Incident Data

This section uses the MAIB incident data along with information on average manning levels per vessel type to estimate the probability of a fatality in a maritime incident associated with the Proposed Development.

The Proposed Development is assessed to have the potential to affect the following incidents:

- Vessel to vessel collision;
- Powered vessel to structure allision;
- Drifting vessel to structure allision; and
- Fishing vessel to structure allision.

Of these incident types, only vessel to vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in Section B.2.2 is considered directly applicable to these types of incidents.

The other scenarios of powered vessel to structure allision, drifting vessel to structure allision and fishing vessel to structure allision are not clearly represented by the MAIB data (as discussed in Section B.2.3). Additionally, none of the allision incidents reported by the MAIB between 2002 and 2021 resulted in a fatality.

Therefore, the MAIB collision fatality risk rate has also been conservatively applied for the allision incident types.

B.3.2 Fatality Probability

Five of the 504 collision incidents reported by the MAIB within UK waters between 2002 and 2021 resulted in one or more fatalities. This gives a 0.99% probability that a collision incident will lead to a fatal accident.

To assess the fatality risk for personnel onboard a vessel (crew, passenger or other) the number of persons involved in the incidents needs to be estimated. Table B.3 presents the average number of People on Board (POB) estimated for each category of vessel navigating in proximity to the Proposed Development. For passenger vessels this is based upon information available for the specific vessels recorded in the vessel traffic survey data. For other vessel categories, this is based upon information available from the MAIB incident data.

Table B.3 Estimated Average POB by Vessel Category

Vessel Category	Sub Categories	Source of Estimated Average POB	Estimated Average POB
Cargo/freight	Dry cargo, other commercial, service ship, etc.	MAIB incident data	16
Tanker	Tanker/combination carrier	MAIB incident data	23
Passenger	RoRo passenger, cruise liner, etc.	Vessel traffic survey data / online information	1,338
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3
Recreational	Yacht, small commercial motor yacht, etc.	MAIB incident data	3.3

It is recognised that these average POB numbers can be substantially higher or lower on an individual vessel basis depending upon the size, subtype, etc. but applying reasonable averages is considered sufficient for this analysis, particularly when noting that the average POB for the dominant vessel category (passenger) is based upon the vessel traffic survey data where possible.

Using the average POB, along with the vessel type information involved in collision incidents reported by the MAIB (see Section B.2.2), there was an estimated 60,963 POB the vessels involved in the collision incidents.

Based upon five fatalities during the period 2002 – 2021, the overall fatality probability in a collision for any individual onboard is approximately 8.2×10^{-5} per collision.

It is considered inappropriate to apply this rate uniformly as the statistics indicate that the fatality probability associated with smaller craft, such as fishing vessels and recreational vessels, is higher. Therefore, the fatality probability has been subdivided into three categories of vessel as presented in Table B.4. In addition, due to zero fatalities resulting from commercial vessel collisions during the period 2002 - 2021, the time period used to assess the fatality probability for commercial vessels has been extended by five years to ensure a meaningful probability is captured.

Table B.4 Collision Incident Fatality Probability by Vessel Category

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability	Time Period
Commercial	Dry cargo, passenger, tanker, etc.	1	21,789	4.6×10^{-5}	1997 to 2021 (25 years)

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability	Time Period
Fishing	Trawler, potter, dredger, etc.	2	922	2.2×10^{-3}	2002 to 2021 (20 years)
Recreational	Yacht, small commercial motor yacht, etc.	3	1,035	2.9×10^{-3}	2002 to 2021 (20 years)

B.3.3 Project Design Option 1

The base case and future case annual collision frequency levels pre and post wind farm are summarised in Table B.5.

Table B.5 Risk Results Summary (Project Design Option 1)

Risk	Scenario	Annual Frequency		
		Pre Wind Farm	Post Wind Farm	Increase
Vessel to vessel collision	Base case	6.40×10^{-3} (one in 156 years)	6.59×10^{-3} (one in 152 years)	1.89×10^{-4}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	8.20×10^{-3} (one in 122 years)	2.36×10^{-4}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.05×10^{-2} (one in 95 years)	3.02×10^{-4}
Powered vessel to structure allision	Base case	-	3.67×10^{-4} (one in 2,726 years)	3.67×10^{-4}
	Future case (10%)	-	4.04×10^{-4} (one in 2,478 years)	4.04×10^{-4}
	Future case (25%)	-	4.59×10^{-4} (one in 2,181 years)	4.59×10^{-4}
Drifting vessel to structure allision	Base case	-	2.81×10^{-4} (one in 356 years)	2.81×10^{-4}
	Future case (10%)	-	3.09×10^{-3} (one in 324 years)	3.09×10^{-3}
	Future case (25%)	-	3.51×10^{-4} (one in 285 years)	3.51×10^{-4}
	Base case	-	2.54×10^{-3} (one in 393 years)	2.42×10^{-3}

Risk	Scenario	Annual Frequency		
		Pre Wind Farm	Post Wind Farm	Increase
Fishing vessel to structure allision	Future case (10%)	-	2.78×10^{-3} (one in 359 years)	2.66×10^{-3}
	Future case (25%)	-	3.15×10^{-3} (one in 318 years)	3.03×10^{-3}
Total	**Base case**	6.40×10^{-3} (one in 156 years)	1.23×10^{-2} (one in 81 years)	5.71×10^{-3}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	1.45×10^{-2} (one in 69 years)	6.27×10^{-3}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.76×10^{-2} (one in 57 years)	7.11×10^{-3}

From the detailed results of the collision and allision risk modelling, the distribution of the predicted change in annual collision and allision frequency by vessel type due to the Proposed Development for the base case and future cases are presented in Figure B.14.

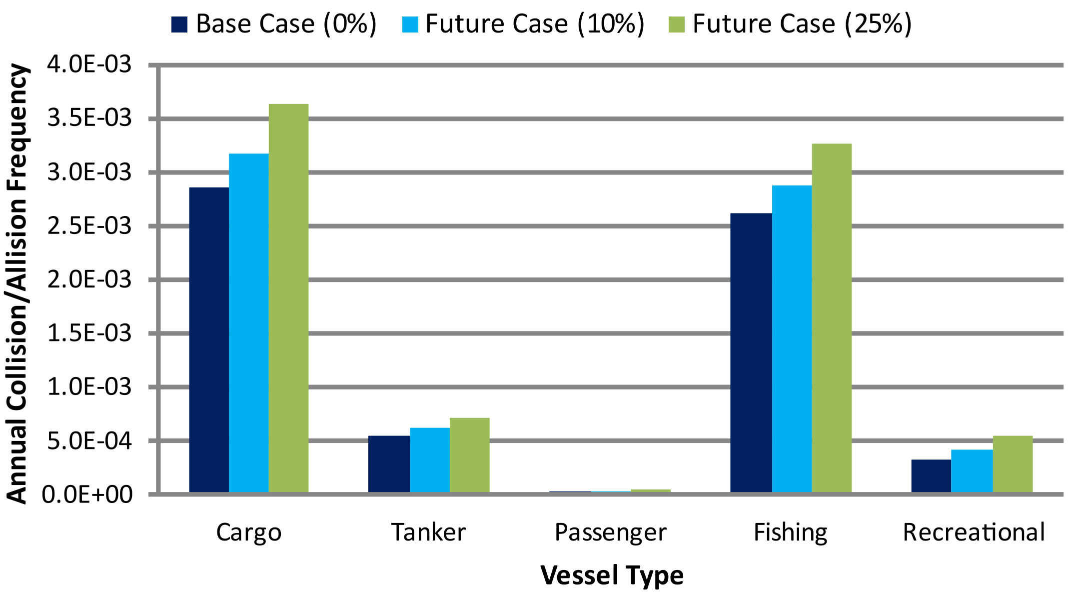

Figure B.14 Estimated Change in Annual Collision and Allision Frequency by Vessel Type (Project Design Option 1)

It can be seen that the vessel types which experience the highest increase in collision/annual frequency are cargo vessels and fishing vessels. This is due to the high amount of cargo traffic and the conservatism of the fishing model.

Combining the annual collision and allision frequency (see Table B.5), estimated number of POB for each vessel type (see Table B.3) and the estimated fatality probability for each vessel type category (see Table B.4), the annual increase in PLL due to the presence of the Proposed Development for the base case (assuming Project Design Option 1) is estimated to be 2.69×10^{-5}, equating to one additional fatality every 37,122 years.

The estimated incremental increases in PLL due to the Proposed Development, distributed by vessel type and for the base case and future cases, are presented in Figure B.15.

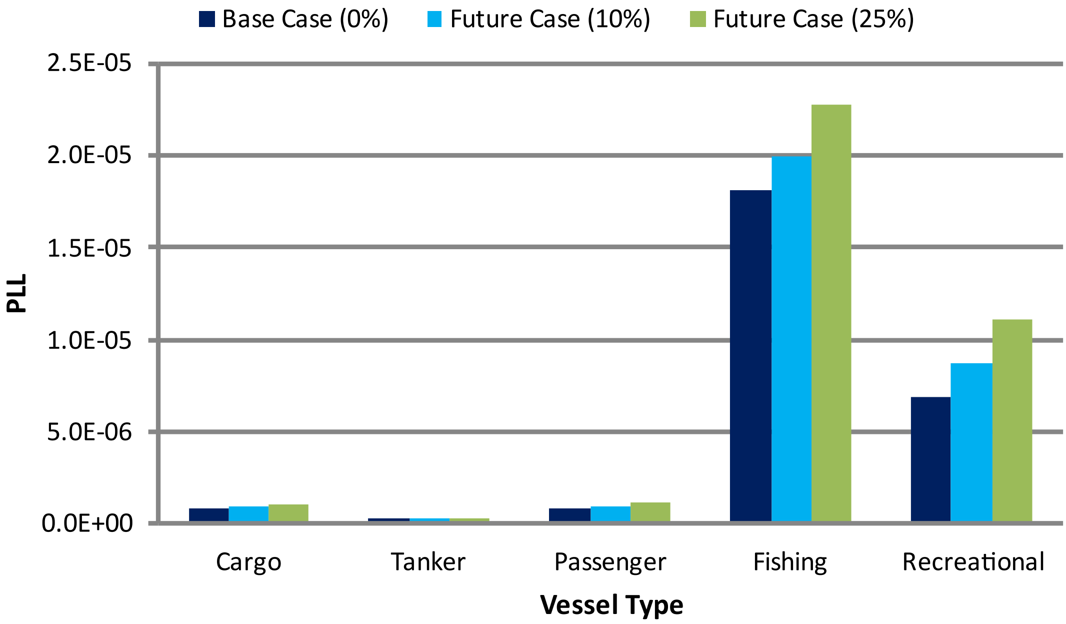

Figure B.15 Estimated Change in Annual PLL by Vessel Type (Project Design Option 1)

The vessel type associated with the greatest change in PLL as a result of the Proposed Development is fishing, which historically have a higher fatality probability than commercial vessels.

Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented in Figure B.16.

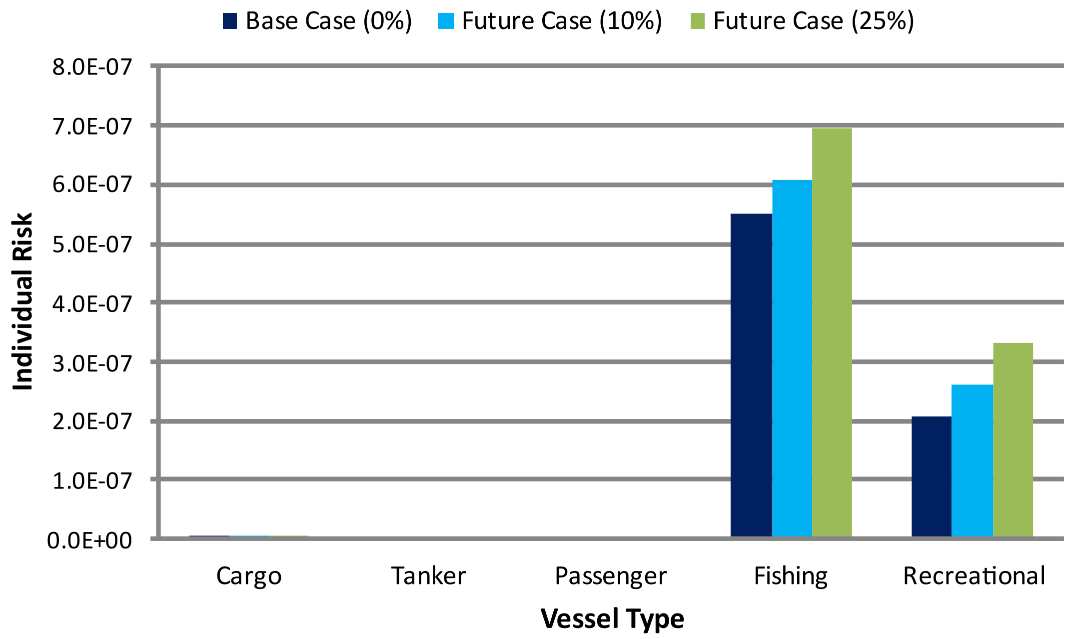

Figure B.16 Estimated Change in Individual Risk by Vessel Type (Project Design Option 1)

It can be seen that the individual risk to people is mainly associated with fishing vessels, reflecting the higher probability of a fatality occurring in the event of an incident involving a fishing vessel in comparison to other vessel types.

B.3.3.2 Significance of Increase in Fatality Risk (Project Design Option 1)

In comparison to MAIB statistics, which indicate an average of 18 to 19 fatalities per year in UK territorial waters during the 20-year period between 2002 and 2021, the overall increase for the base case in PLL of one additional fatality every 37,122 years represents a negligible change.

In terms of individual risk to people, the change for commercial vessels attributed to the Proposed Development (approximately 6.31×10^{-9} for the base case) is negligible compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

For fishing vessels, the change in individual risk attributed to the Proposed Development (approximately 5.51×10^{-7} for the base case) is negligible compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

B.3.4 Project Design Option 2

The base case and future case annual collision frequency levels pre and post wind farm are summarised in Table B.6.

Table B.6 Summary of annual collision and allision frequencies (Project Design Option 2)

Risk	Scenario	Annual Frequency		
		Pre Wind Farm	Post Wind Farm	Increase
Vessel to vessel collision	Base case	6.40×10^{-3} (one in 156 years)	6.59×10^{-3} (one in 152 years)	1.89×10^{-4}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	8.20×10^{-3} (one in 122 years)	2.36×10^{-4}
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.05×10^{-2} (one in 95 years)	3.02×10^{-4}
Powered vessel to structure allision	Base case	-	2.87×10^{-4} (one in 3,489 years)	2.87×10^{-4}
	Future case (10%)	-	3.15×10^{-4} (one in 3,172 years)	3.15×10^{-4}
	Future case (25%)	-	3.58×10^{-4} (one in 2,791 years)	3.58×10^{-4}
Drifting vessel to structure allision	Base case	-	2.37×10^{-3} (one in 422 years)	2.37×10^{-3}
	Future case (10%)	-	2.60×10^{-3} (one in 384 years)	2.60×10^{-3}
	Future case (25%)	-	2.96×10^{-3} (one in 338 years)	2.96×10^{-3}
Fishing vessel to structure allision	Base case	-	2.28×10^{-3} (one in 438 years)	2.17×10^{-3}
	Future case (10%)	-	2.50×10^{-3} (one in 400 years)	2.39×10^{-3}
	Future case (25%)	-	2.83×10^{-3} (one in 354 years)	2.71×10^{-3}
Total	**Base case**	6.40×10^{-3} (one in 156 years)	1.15×10^{-2} (one in 87 years)	4.94×10^{-3}
	Future case (10%)	7.97×10^{-3} (one in 126 years)	1.36×10^{-2} (one in 73 years)	5.42×10^{-3}

Risk	Scenario	Annual Frequency		
		Pre Wind Farm	Post Wind Farm	Increase
	Future case (25%)	1.02×10^{-2} (one in 98 years)	1.67×10^{-2} (one in 60 years)	6.14×10^{-3}

From the detailed results of the collision and allision risk modelling, the distribution of the predicted change in annual collision and allision frequency by vessel type due to the Proposed Development for the base case and future cases are presented in Figure B.17.

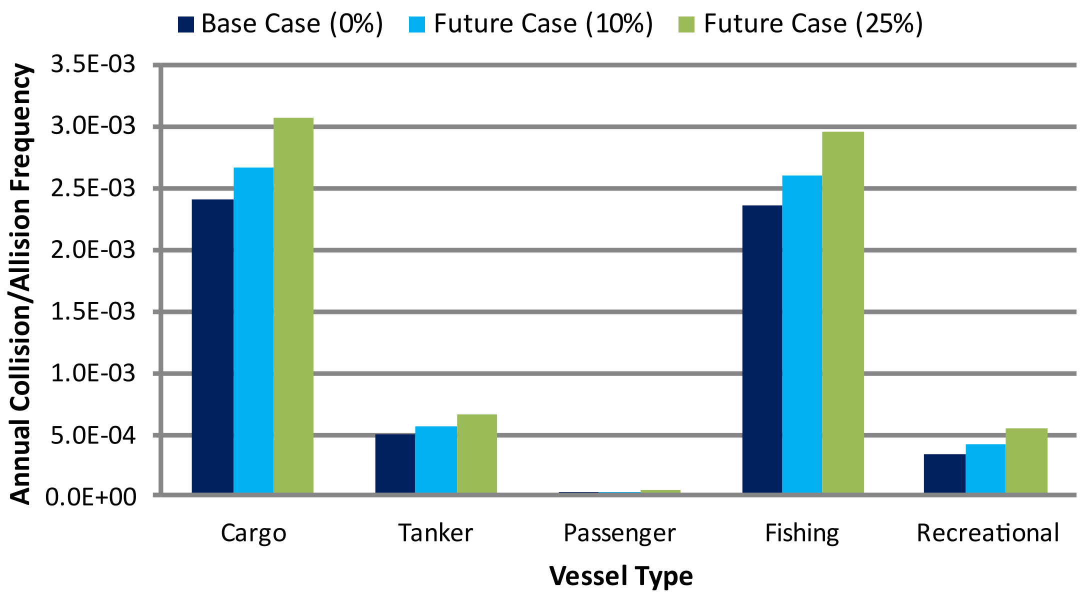

Figure B.17 Estimated Change in Annual Collision and Allision Frequency by Vessel Type (Project Design Option 2)

It can be seen that the vessel types which experience the highest increase in collision/annual frequency are cargo vessels and fishing vessels. This is due to the high amount of cargo traffic and the conservatism of the fishing model.

Combining the annual collision and allision frequency (see Table 4.3), estimated number of POB for each vessel type (see Table 4.1) and the estimated fatality probability for each vessel type category (see Table 4.2), the annual increase in PLL due to the presence of the Proposed Development for the base case (assuming Project Design Option 2) is estimated to be 2.50×10^{-5}, equating to one additional fatality every 40,061 years.

The estimated incremental increases in PLL due to the Proposed Development, distributed by vessel type and for the base case and future cases, are presented in Figure B.18.

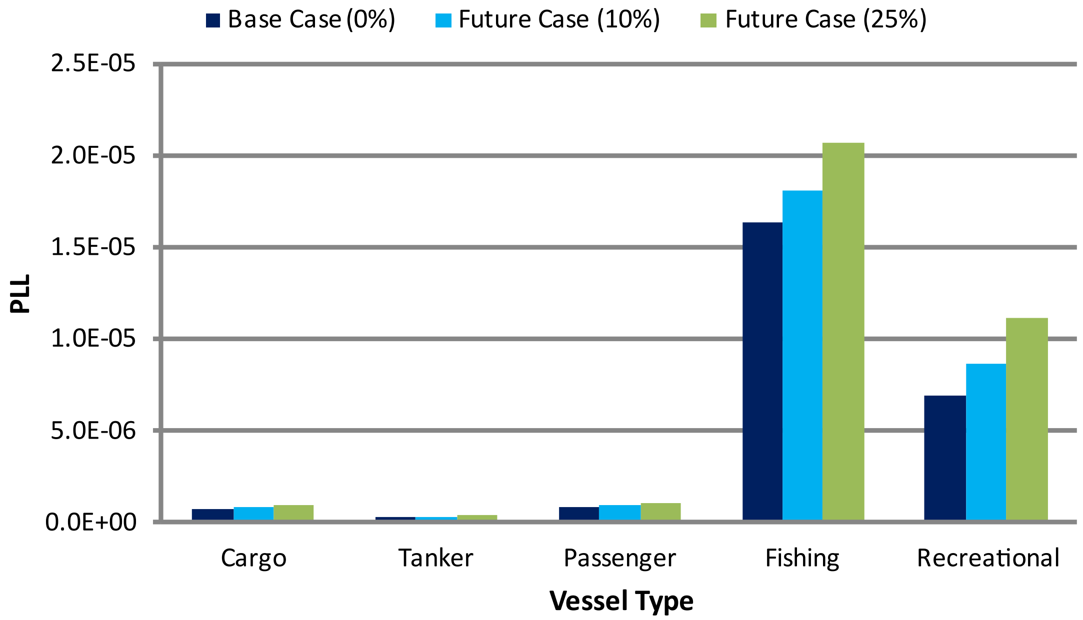

Figure B.18 Estimated Change in Annual PLL by Vessel Type (Project Design Option 2)

The vessel type associated with the greatest change in PLL as a result of the Proposed Development is fishing, which historically have a higher fatality probability than commercial vessels.

Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented in Figure B.19.

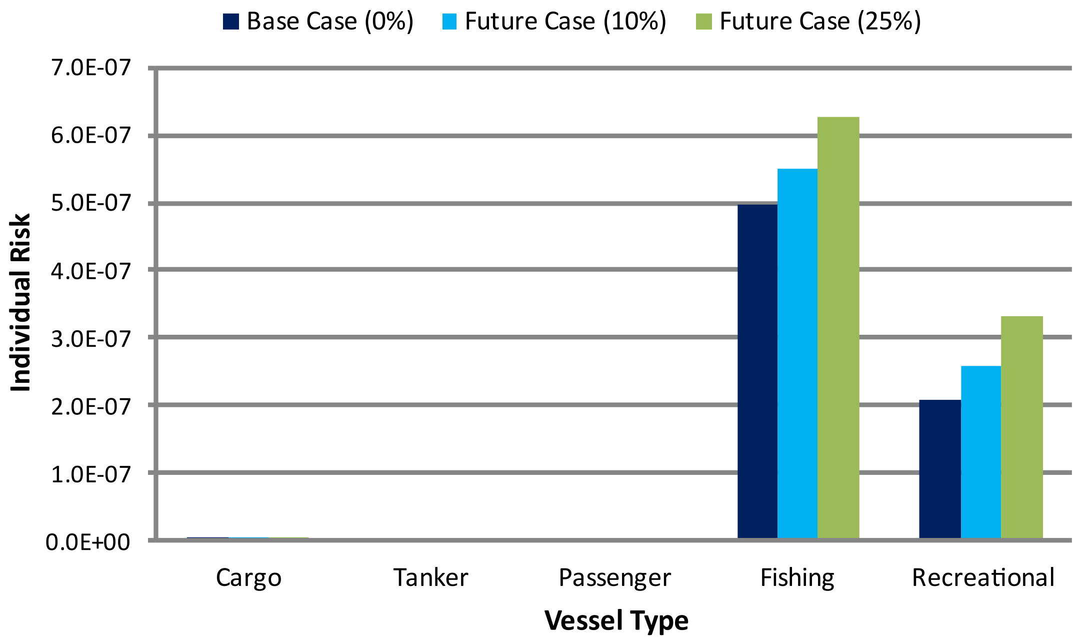

Figure B.19 Estimated Change in Individual Risk by Vessel Type (Project Design Option 2)

It can be seen that the individual risk to people is mainly associated with fishing vessels, reflecting the higher probability of a fatality occurring in the event of an incident involving a fishing vessel in comparison to other vessel types.

B.3.4.2 Significance of Increase in Fatality Risk (Project Design Option 2)

In comparison to MAIB statistics, which indicate an average of 18 to 19 fatalities per year in UK territorial waters during the 20-year period between 2002 and 2021, the overall increase for the base case in PLL of one additional fatality every 41,310 years represents a negligible change.

In terms of individual risk to people, the change for commercial vessels attributed to the Proposed Development (approximately 5.44×10^{-9} for the base case) is negligible compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

For fishing vessels, the change in individual risk attributed to the Proposed Development (approximately 4.98×10^{-7} for the base case) is negligible compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

B.4 Pollution Risk

B.4.1 Historical Analysis

The pollution consequences of a collision in terms of oil spill depend upon the following criteria:

- Spill probability (i.e. the likelihood of outflow following an incident); and
- Spill size (quantity of oil).

Two types of oil spill are considered in this assessment:

- Fuel oil spills from bunkers (all vessel types); and
- Cargo oil spills (laden tankers).

The research undertaken as part of the Department for Transport (DfT)'s MEHRAs project (DfT, 2001) has been used as it was comprehensive and based upon worldwide marine oil spill data analysis. From this research, the overall probability of a spill per incident was calculated based upon historical incident data for each incident type as presented in Figure B.20.

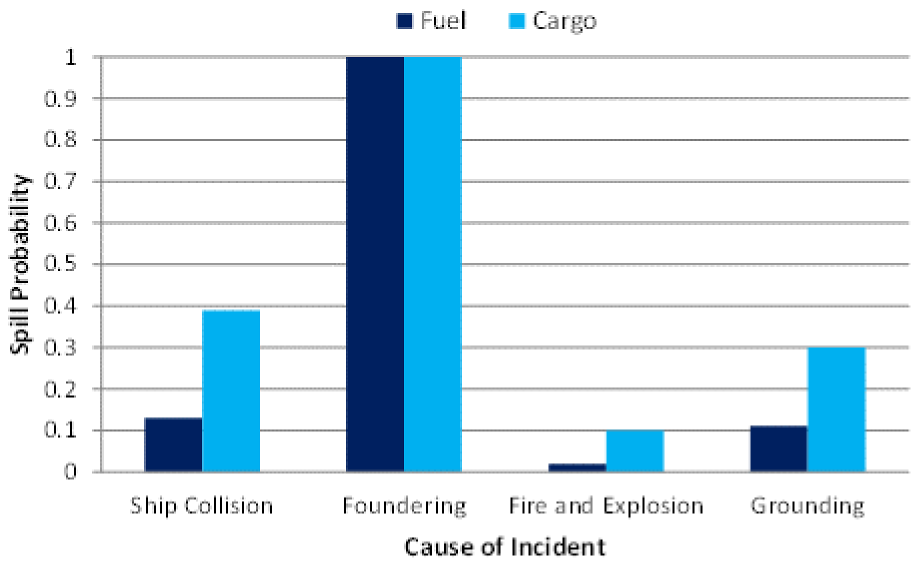

Figure B.20 Probability of an Oil Spill Resulting from an Accident

Therefore, it was estimated that 13% of vessel collisions result in a fuel oil spill and 39% of collisions involving a laden tanker result in a cargo oil spill.

In the event of a bunker spill, the potential outflow of oil depends upon the bunker capacity of the vessel. Historical bunker spills from vessels have generally been limited to a size below 50% of bunker capacity, and in most incidents much lower.

For the types and sizes of vessels exposed to the Proposed Development, an average spill size of 100 tonnes of fuel oil is considered a conservative assumption.

For cargo spills from laden tankers, the spill size can vary significantly. The International Tanker Owners Pollution Federation (ITOPF) reported the following spill size distribution for tanker collisions between 1974 and 2004:

- 31% of spills below seven tonnes;
- 52% of spills between seven and 700 tonnes; and

- 17% of spills greater than 700 tonnes.

Based upon this data and the tankers transiting in proximity to the Proposed Development, an average spill size of 400 tonnes is considered a conservative assumption.

For fishing vessel collisions, comprehensive statistical data is not available. Consequently, it is conservatively assumed that 50% of all collisions involving fishing vessels will lead to oil spill with the quantity spilled being on average five tonnes. Similarly for recreational vessels, due to a lack of data 50% of collisions are conservatively assumed to lead to a spill with an average size of one tonne.

B.4.2 Project Design Option 1

Applying the above probabilities to the annual collision and allision frequency by vessel type presented in Figure B.21 and the average spill size per vessel, the amount of oil spilled per year due to the impact of the Proposed Development (assuming Project Design Option 1) is estimated to be 0.13 tonnes per year for the base case, 0.15 tonnes for the 10% future case and 0.17 tonnes for the 25% future case. It is noted that these values are based on a precautionary modelling approach as detailed in Section 17, and are for potential spillages arising from allision and collision incidents to third party vessels (not vessels associated with the Proposed Development). Further details of the response approach to pollution are provided in Volume III, Appendix 25.1, Annex 4 Resource and Waste Management Plan.

The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base case and future cases are presented in Figure B.21.

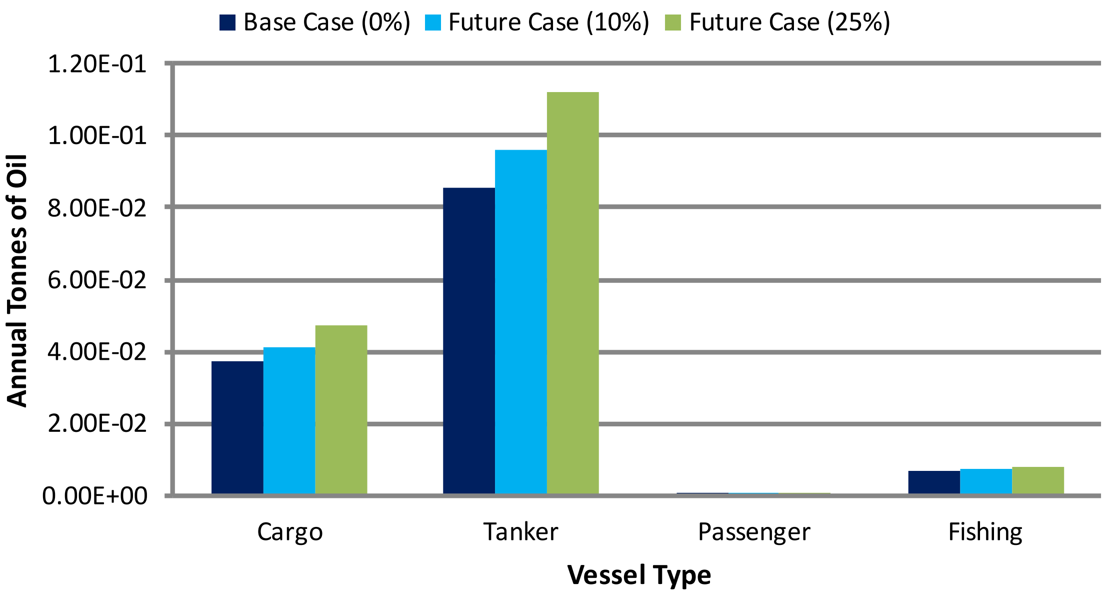

Figure B.21 Estimated Change in Pollution by Vessel Type (Project Design Option 1)

Tankers are associated with the largest contribution to the annual oil spill estimate, which reflects the greater volume of oil spillage anticipated per incident involving tankers.

B.4.2.2 Significance of Increase in Pollution Risk (Project Design Option 1)

To assess the significance of the increased pollution risk from vessels caused by the Proposed Development, historical oil spill data for the UK has been used as a benchmark noting its extensiveness and availability which makes it suitable for use for projects in Irish waters.

From the MEHRAs research, the annual average tonnes of oil spilled in the waters around the UK due to maritime accidents in the 10-year period from 1989 to 1998 was 16,111. This is based on a total of 146 reported oil pollution incidents of greater than one tonne (smaller spills are excluded as are incidents which occurred within port or harbour areas or as a result of operational errors or equipment failure). Commercial vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

The overall increase in pollution estimated due to the Proposed Development of 0.13 tonnes for the base case (arising from allision and collision incidents to third party vessels) represents a > 0.001% increase compared to the historical average pollution quantities from maritime incidents in UK waters (context provided from the UK in the absence of equivalent data in Irish waters).

B.4.3 Project Design Option 2

Applying the above probabilities to the annual collision and allision frequency by vessel type presented in Table 4.3 and the average spill size per vessel, the amount of oil spilled per year due to the impact of the Proposed Development (assuming Project Design Option 2) is estimated to be 0.12 tonnes per year for the base case, 0.13 tonnes for the 10% future case and 0.15 tonnes for the 25% future case. It is noted that these values are based on a precautionary modelling approach as detailed in Section 17, and are for potential spillages arising from allision and collision incidents to third party vessels (not vessels associated with the Proposed Development). Further details of the response approach to pollution are provided in Volume III, Appendix 25.1, Annex 4 Resource and Waste Management Plan

The estimated increase in tonnes of oil spilled, distributed by vessel type, for the base case and future cases are presented in Figure B.22.

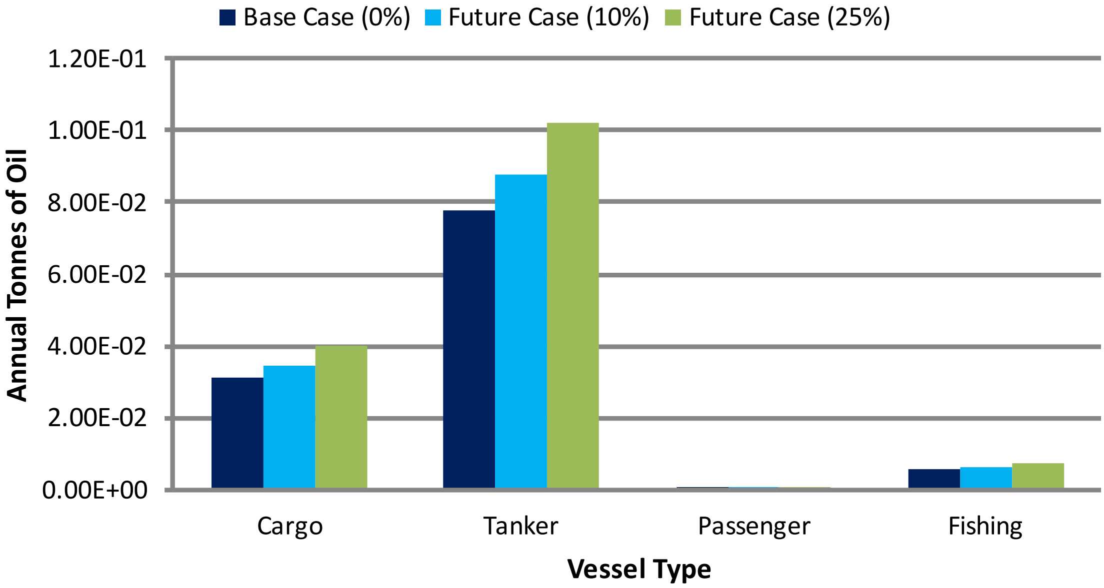

Figure B.22 Estimated Change in Pollution by Vessel Type (Project Design Option 2)

Tankers are associated with the largest contribution to the annual oil spill estimate, which reflects the greater volume of oil spillage anticipated per incident involving tankers.

B.4.3.2 Significance of Increase in Pollution Risk (Project Design Option 2)

To assess the significance of the increased pollution risk from vessels caused by the Proposed Development, historical oil spill data for the UK has been used as a benchmark noting its extensiveness and availability which makes it suitable for use for projects in Irish waters.

From the MEHRAs research, the annual average tonnes of oil spilled in the waters around the UK due to maritime accidents in the 10-year period from 1989 to 1998 was 16,111. This is based on a total of 146 reported oil pollution incidents of greater than one tonne (smaller spills are excluded as are incidents which occurred within port or harbour areas or as a result of operational errors or equipment failure). Commercial vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

The overall increase in pollution estimated due to the Proposed Development of 0.12 tonnes (arising from allision and collision incidents to third party vessels) for the base case represents a > 0.001% increase compared to the historical average pollution quantities from maritime incidents in UK waters (context provided from the UK in the absence of equivalent data in Irish waters).

B.5 Conclusion

This annex has quantitively assessed the fatality and pollution risk associated with the Proposed Development in the event of a collision or allision incident occurring. The assessment indicates that, for both layout options, the fatality risk associated with fishing vessels is the greatest and the pollution risk associated with tankers is the greatest. However, risk increases are very low relative to anticipated background levels.

Overall, the impact of the Proposed Development on people and the environment is relatively low compared to the existing background risk levels in UK waters. However, this is the localised impact of a single offshore wind farm development and there will be additional maritime risks associated with other offshore wind farm developments.

Discussion of relevant mitigation measures and monitoring is provided in Section 5 of the NRA and Volume II, Chapter 15: Shipping and Navigation of the EIAR.

Annex C Regular Operator Consultation

As part of the consultation process for the Proposed Development, regular operators identified (from the 12 months of vessel traffic data) that would be required to deviate their routes due to the Array Area were consulted via electronic mail. An example of the correspondence sent to the regular operators is presented below.

Anatec Ltd.
Cain House
10 Exchange Street
Aberdeen AB11 6PH
Tel: 01224 253700
Email: aberdeen@anatec.com
Web: www.anatec.com

Date: 20/07/2023
Ref: A4984-SSE-RO-1

Opportunity to Participate in Consultation Relating to Shipping and Navigation for the Proposed Arklow Bank Wind Park Phase 2

Dear Stakeholder,

Sure Partners Limited (SPL), a wholly owned subsidiary of SSE plc (SSE) is the developer of Arklow Bank Wind Park 2 (ABWP2) (hereafter 'the Proposed Development'), a planned offshore wind farm located in Irish waters and approximately 3.2 nautical miles (nm) off the coast of County Wicklow. A Navigational Risk Assessment (NRA) in support of the shipping and navigation work is currently being undertaken as part of the overarching application.

As part of this NRA process, we would like to ensure that comprehensive consultation is undertaken and to identify any potential impacts that the project may have upon shipping and navigation. Therefore, shipping movements in the vicinity of the Array Area have been analysed via assessment of 12 months of Automatic Identification System (AIS) data for the purpose of identifying any regular vessel operators in the area.

According to this analysis, your company's vessel(s) have been recorded navigating within and/or in the vicinity of the Array Area. Consequently, your company has been identified as a potential marine stakeholder for the project. We therefore invite your feedback on the project, including any impact it may have upon the navigation of vessels.

Figure 1 presents the proposed Array Area, within which the wind turbine generators and associated structures such as offshore substation platforms will be located. The current export cable corridors under consideration are included for reference.

Further information relating to the project is also available here.

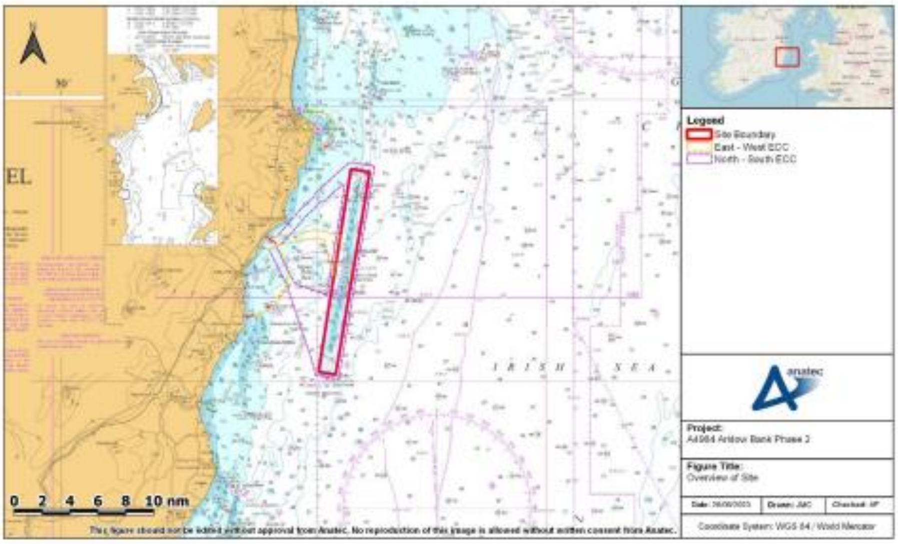

Figure 1 **Overview of Array Area**

We would be grateful if you could provide us with any comments or feedback that you may have, including any impact it may have upon the navigation of vessels, by the 4th August 2023 This will allow us to assess your feedback as part of the NRA which is currently being undertaken. We would also be grateful if you could forward a copy of this information to any other vessel operators/owners you feel may be interested in commenting.

Whilst we welcome all feedback we are particularly interested in any comments or feedback on the following:

1. Whether the proposal to construct the project is likely to impact the routeing of any specific vessels, including the nature of any change in regular passage.
2. Whether any aspect of the project poses any safety concerns to your vessels, including any adverse weather routeing.
3. Whether you would choose to make passage internally through the Array Area (noting its location relative to the shallows of the Arklow Bank).
4. Whether you wish to be retained on our list of marine stakeholders and consulted throughout the NRA process.

Additionally, we would like to invite you to attend a Hazard Workshop for the Proposed Development scheduled to take place in late August. We will be confirming details of the workshop imminently.

We would appreciate if any responses are provided via email to [redacted] as well as an indication of whether you are interested in participating in the Hazard Workshop noted above.

Yours sincerely,

[redacted]
Risk Analyst
Anatec Ltd

Annex D Long-Term AIS Analysis

D.1 Introduction

As noted in Section 2.1, it has been agreed with the relevant stakeholders that MGN 654 should be followed in lieu of equivalent dedicated Irish guidance. MGN 654 requires a minimum of 28 days of up to date vessel traffic data that accounts for non-AIS traffic and seasonal variation. However, short term periods in isolation can omit certain seasonal or infrequent marine activity. Therefore, in line with good practice assessment procedures, 12 months of AIS data covering the entirety of 2022 has also been considered to ensure a comprehensive overview of the vessel traffic baseline can be established, including the inclusion of any seasonal variation. This annex presents the analysis of the long-term data, supplementing the primary vessel traffic analysis undertaken in Section 13.

D.2 Methodology

D.2.1 Study Area

This annex has assessed the long-term vessel traffic data within the Study Area for the Array Area introduced in Section 7.2.

D.2.2 Data Collection Summary

The AIS data was collected from satellite receivers for the entirety of 2022 (1 January – 31 December 2022). Any traffic deemed as temporary in nature (e.g., survey vessels and vessels involved in the construction of a pipeline at Arklow) has been excluded from the assessment in Section 3 to ensure the assessment focuses on routine traffic and activity. Vessels at berth within Arklow and Wicklow have also been excluded from the assessment. Downtime was observed to be limited (less than 1%).

D.2.3 Data Limitations

The assessment undertaken in this report should be considered a high-level assessment with further investigation required to validate the findings as part of the NRA process. In particular, not all vessels are required to carry an AIS transceiver.

AIS carriage is mandatory for all vessels of 300 GT and upwards on international voyages, cargo vessels of 500 GT and upwards not engaged on international voyages and all passenger vessels irrespective of size. In addition, fishing vessels with LOA 15 m and greater must carry AIS. Smaller fishing vessels, recreational vessels and military vessels are not required to broadcast on AIS but may do so voluntarily. Therefore, there is likely to be a proportion of the vessel traffic in the area which is not covered by the AIS data.

D.3 Long-Term Vessel Traffic Movements

This section provides analysis of the 12-month AIS data (as detailed in Section D.2.2).

D.3.1 Overview

An overview of all data recorded during 2022 within the Study Area, colour-coded by vessel type, is presented in Figure D.1.

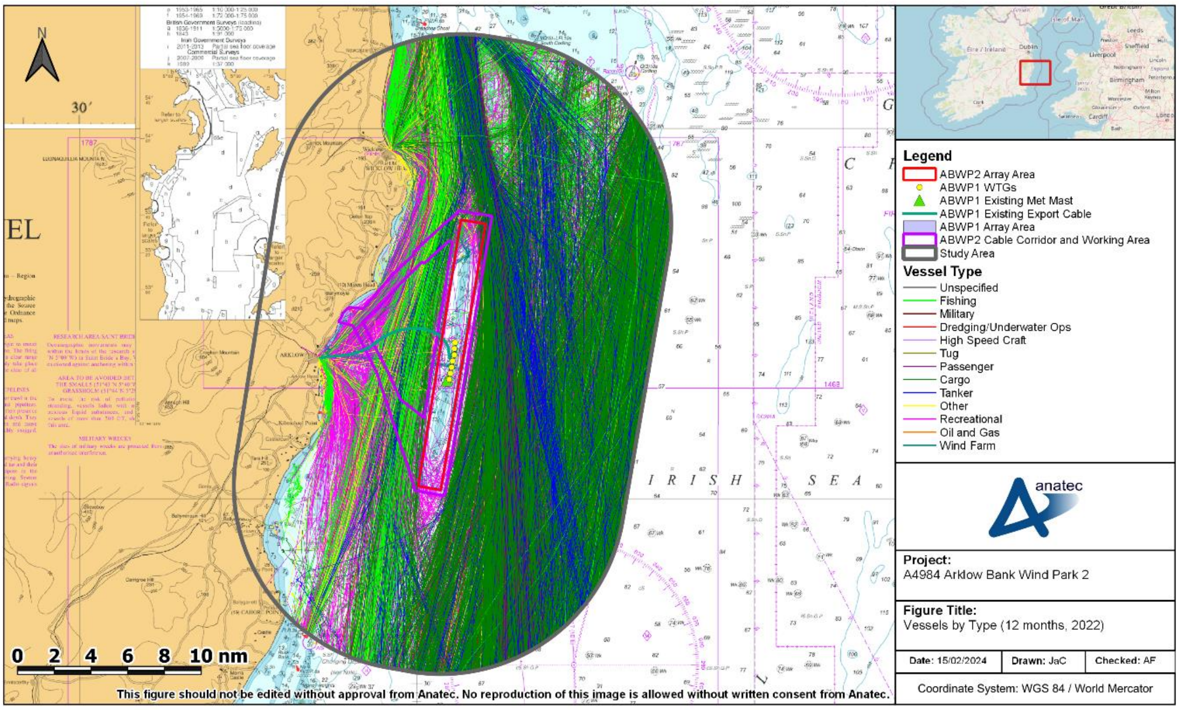

Figure D.1 Vessels by Type (12 months, 2022)

It can be seen that vessels generally avoided the Arklow Bank, with commercial traffic generally passing offshore while fishing vessels and recreational vessels generally passed inshore. Further details on each main vessel type can be found in Section D.3.3.

The density of this traffic is presented within a 500 m × 500 m grid in Figure D.2.

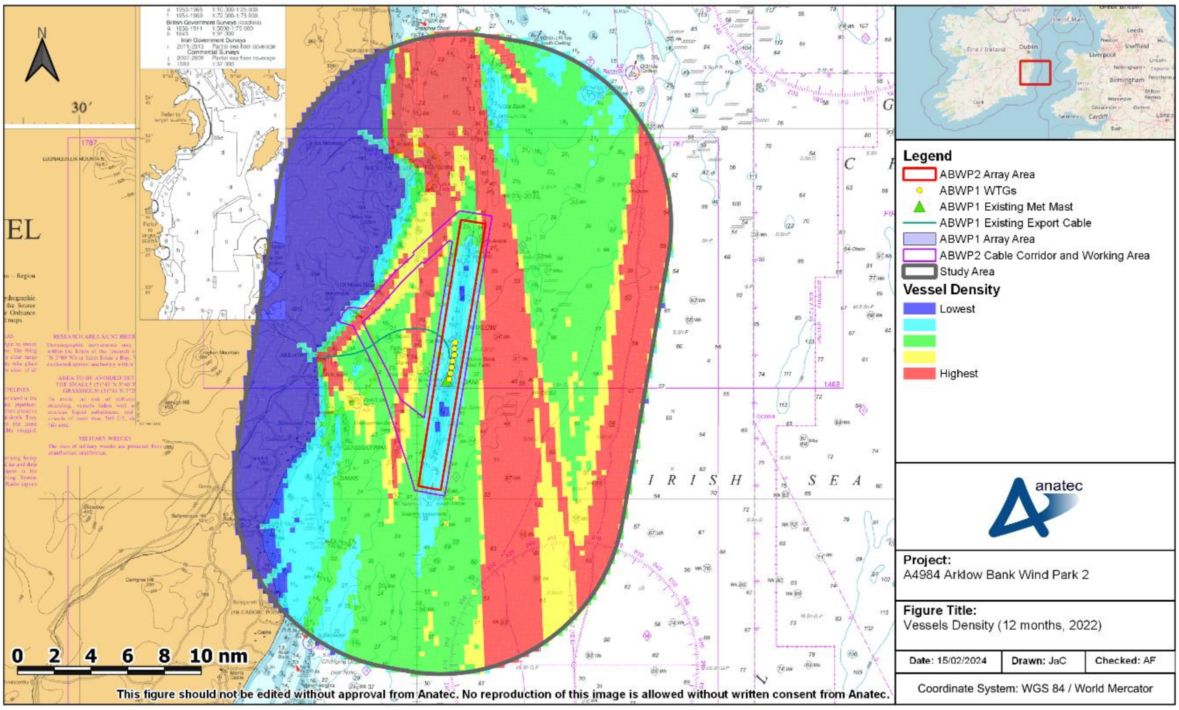

Figure D.2 Vessel Density (12 months, 2022)

It can be seen from Figure D.2 that the main regions of high density are two routes offshore of the Arklow Bank; a northwest/southeast route (that touches the northeastern extent of the Array Area), and a north/south route at the eastern extent of the Study Area. High density can also be seen inshore; mainly northwest of the Array Area and, to a lesser extent, to the west of the Array Area.

As can be seen from Figure D.1, the high-density offshore regions mainly comprise commercial vessels and the high-density inshore regions mainly comprise fishing vessels and recreational vessels.

The distribution of vessel types is presented in Figure D.3.

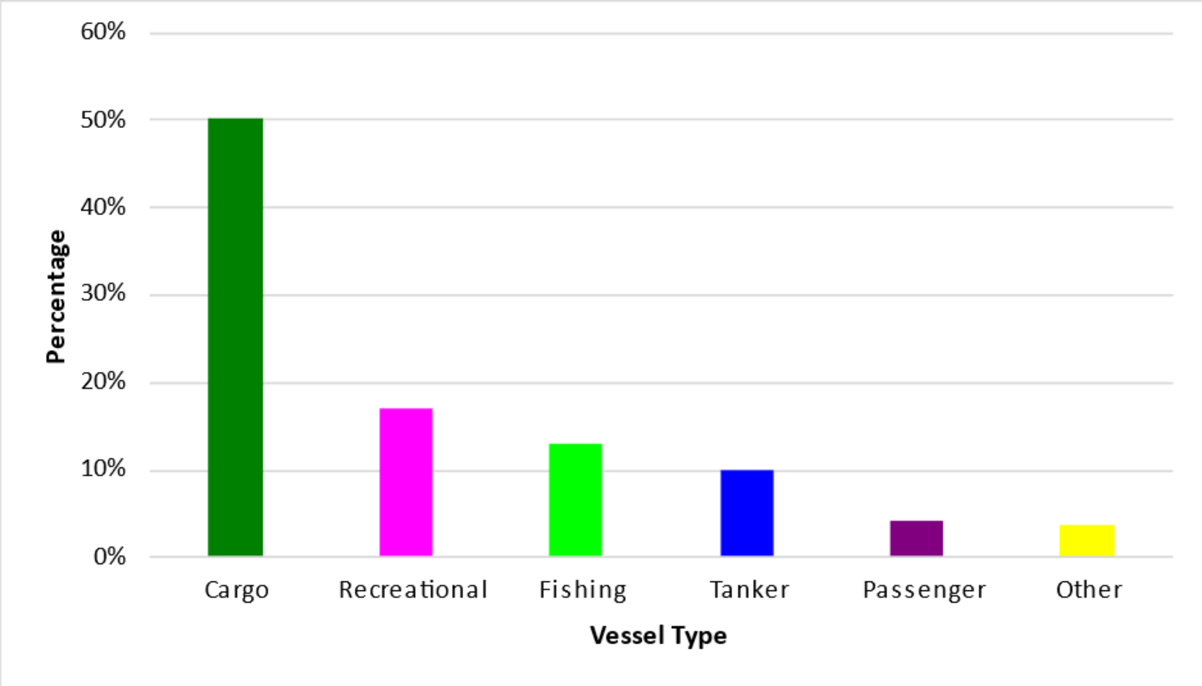

Figure D.3 Distribution of Vessel Types (12 months, 2022)

Cargo was the most common vessel type, accounting for 50% of the traffic. This was followed by recreational vessels (17%), fishing vessels (13%), tankers (10%), passenger vessels (4%) and vessels in the 'other' category (4%). The 'other' category mainly comprised of lifeboats, which accounted for 50% of the category. Wind farm vessels, oil and gas vessels, tugs, dredgers, vessels of unknown type and military vessels were also recorded in small numbers (each accounting for less than 1%).

D.3.2 Vessel Count

The average numbers of unique vessels recorded per day for each month of 2022 within the Study Area are presented in Figure D.4.

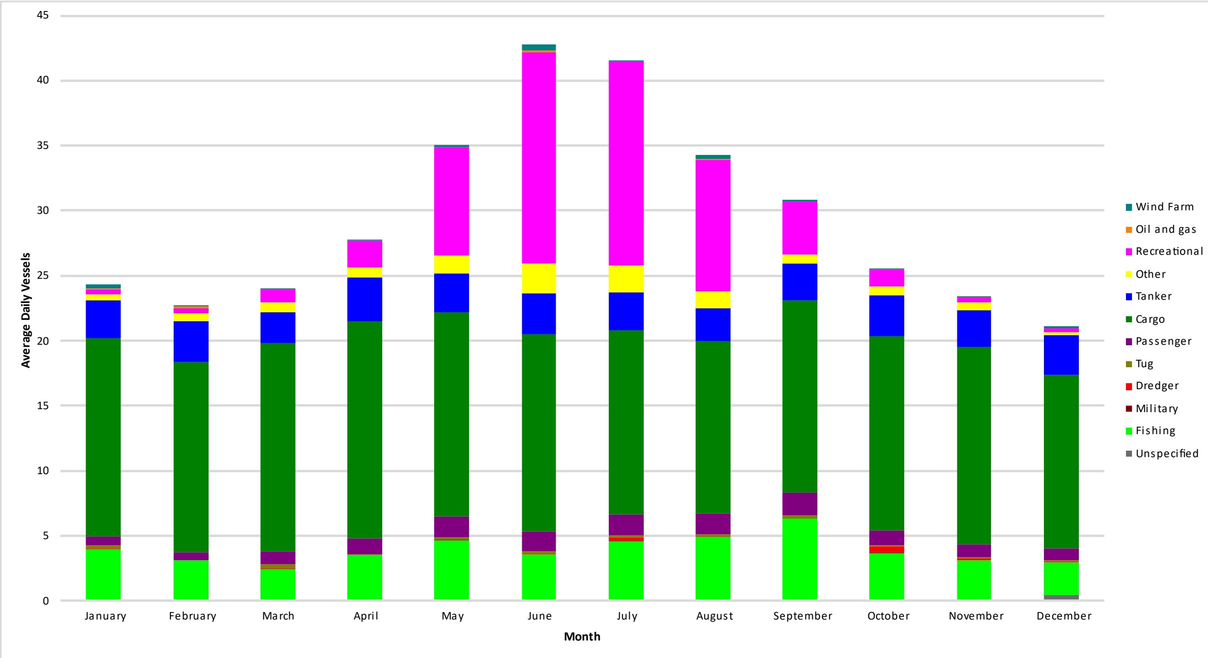

Figure D.4 Average Daily Vessel Counts by Month and Type (12 months, 2022)

There were on average 29 to 30 unique vessels per day recorded within the Study Area during 2022. The busiest month was June, during which an average number of 44 unique vessels per day were recorded. The quietest month was December, during which an average of 21 unique vessels per day were recorded. The increase of traffic volume during the summer months can be mainly attributed to an increase in recreational vessel activity due to the more favourable weather.

D.3.3 Vessel Type

This section presents more detailed analysis of each of the main vessel types recorded within the Study Area during 2022.

D.3.3.1 Commercial Vessels

Figure D.5 presents the commercial vessels (i.e. passenger vessels, cargo vessels and tankers) recorded within the Study Area during 2022, colour-coded by type.

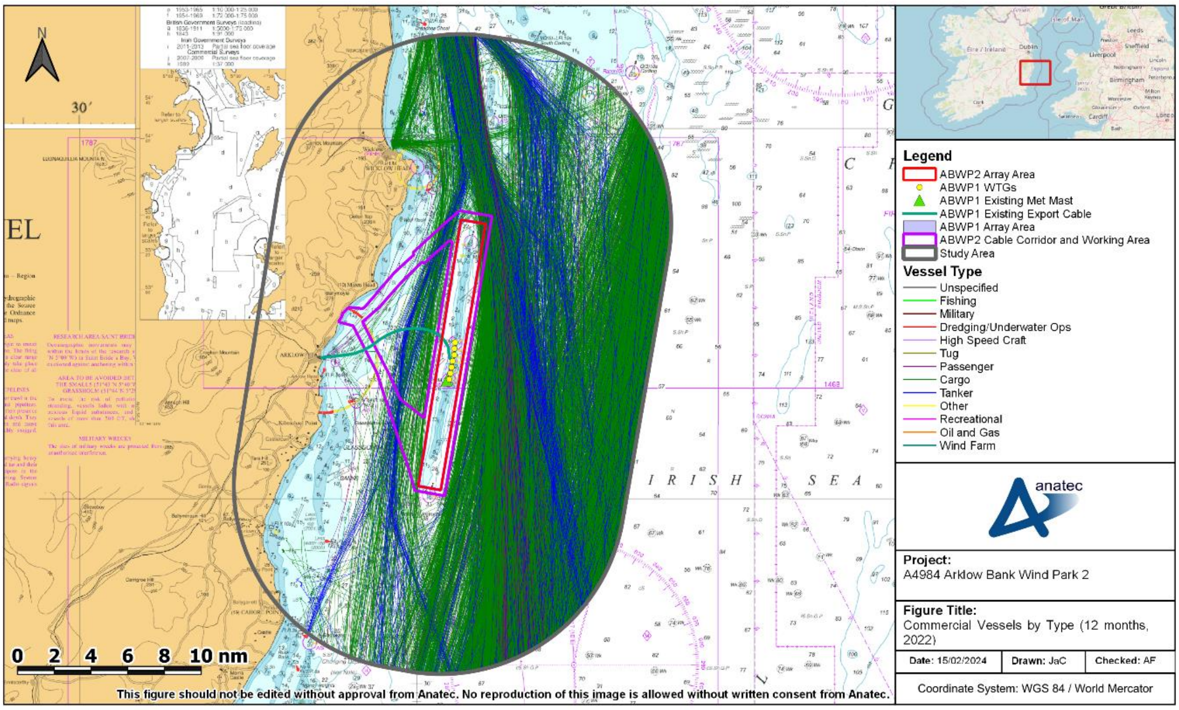

Figure D.5 Commercial Vessels by Type (12 months, 2022)

The majority of commercial vessels pass offshore, avoiding the Arklow Bank, with a smaller proportion passing inshore of the Arklow Bank. Commercial vessels passing offshore most commonly follow two main routes, as discussed in Section 14.2.

An average of 19 commercial vessels per day was recorded within the Study Area during 2022, with one per day intersecting the Array Area.

D.3.3.2 Fishing Vessels

Figure D.6 presents the fishing vessels recorded within the Study Area during 2022, colour-coded by length.

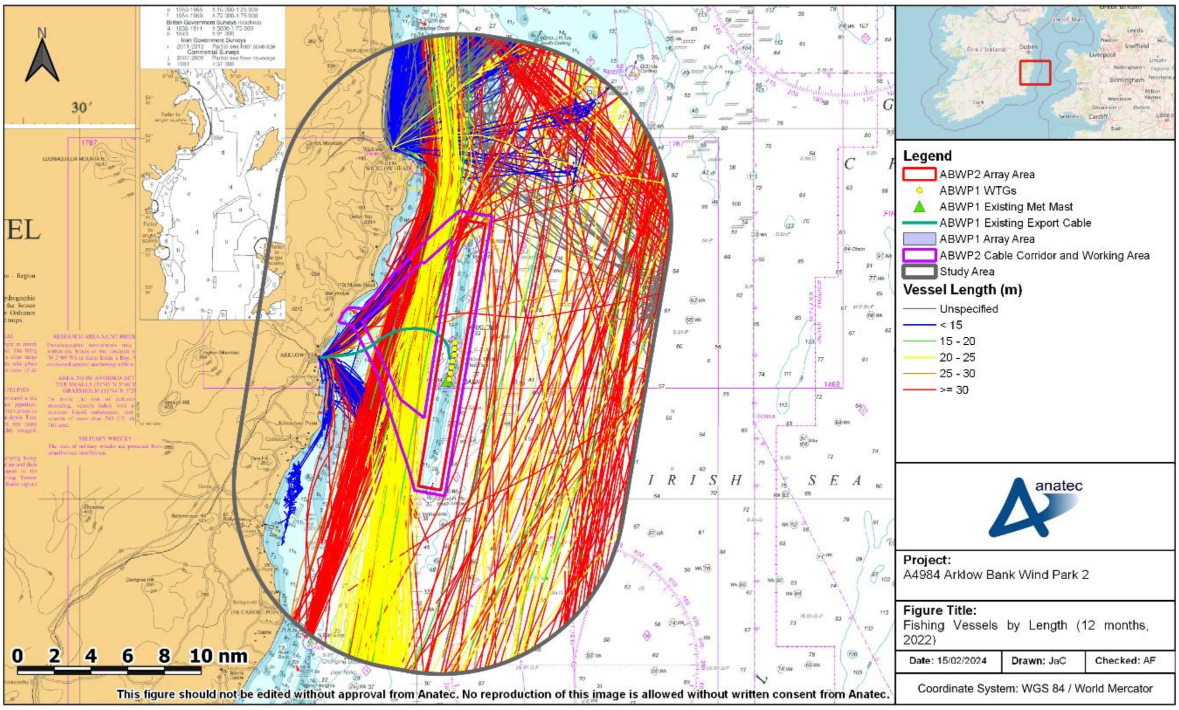

Figure D.6 Fishing Vessels by Length (12 months, 2022)

The majority of fishing vessels were recorded in north/south transit inshore of the Arklow Bank, with the majority of these being between 20 m and 25 m in length. Smaller fishing vessels (less than 15 m) were generally seen transiting to/from Arklow and Wicklow; fishing vessels of this size are not obligated to broadcast on AIS and therefore may be under-represented.

An average of four fishing vessels per day was recorded within the Study Area during 2022, with one every 13 days within the Array Area itself.

D.3.3.3 Recreational Vessels

Figure D.7 presents the recreational vessels recorded within the Study Area during 2022.

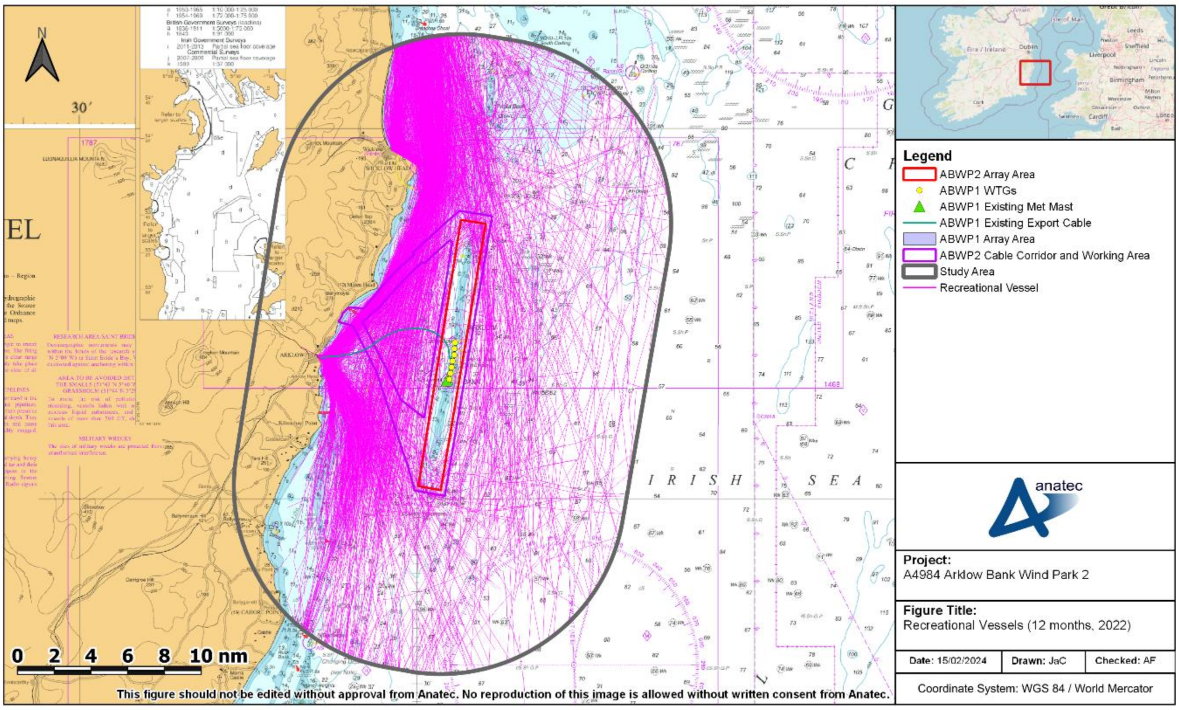

Figure D.7 Recreational Vessels (12 months, 2022)

Recreational vessel activity was concentrated inshore. An average of five recreational vessels per day was recorded within the Study Area during 2022, with one every two to three days being recorded within the Array Area. Recreational vessel activity displayed high seasonality, with the majority (70%) being recorded during the summer months due to the more favourable weather.

D.3.3.4 Summary

Table D.1 provides a summary of the number of unique vessels, per vessel type, recorded within the Study Area during 2022.

Table D.1 Summary of Vessel Numbers Recorded during 2022

Vessel Type	Quietest Month	Busiest Month	Average per Month
Fishing	76	189	117
Military	1	3	< 1
Dredger	2	15	3
Tug	1	8	4 - 5
Passenger	17	53	37 - 38
Cargo	409	501	453 - 454

Vessel Type	Quietest Month	Busiest Month	Average per Month
Tanker	74	101	89 - 90
Other	9	69	30 - 31
Recreational	9	487	153 - 154
Oil and gas	1	3	5
Wind farm	1	14	5

D.3.4 Anchored Vessels

Vessel navigation status information is transmitted via AIS and any cases of a vessel broadcasting as 'At Anchor' within the data were identified and reviewed to confirm the behaviour indicated anchoring activity. However, navigation status is not always up to date since it relies on the officer of the watch. Therefore, as an additional step, AIS tracks from vessels which transmitted a navigation status other than 'At Anchor' were used as input to Anatec's Speed Analysis model. The program detects any tracks of vessels that were travelling with speeds less than one knot for a minimum of 30 minutes. The output was then manually reviewed to check for any additional anchored vessels.

Figure D.8 presents the vessels identified as at anchor within the Study Area during 2022, colour-coded by type.

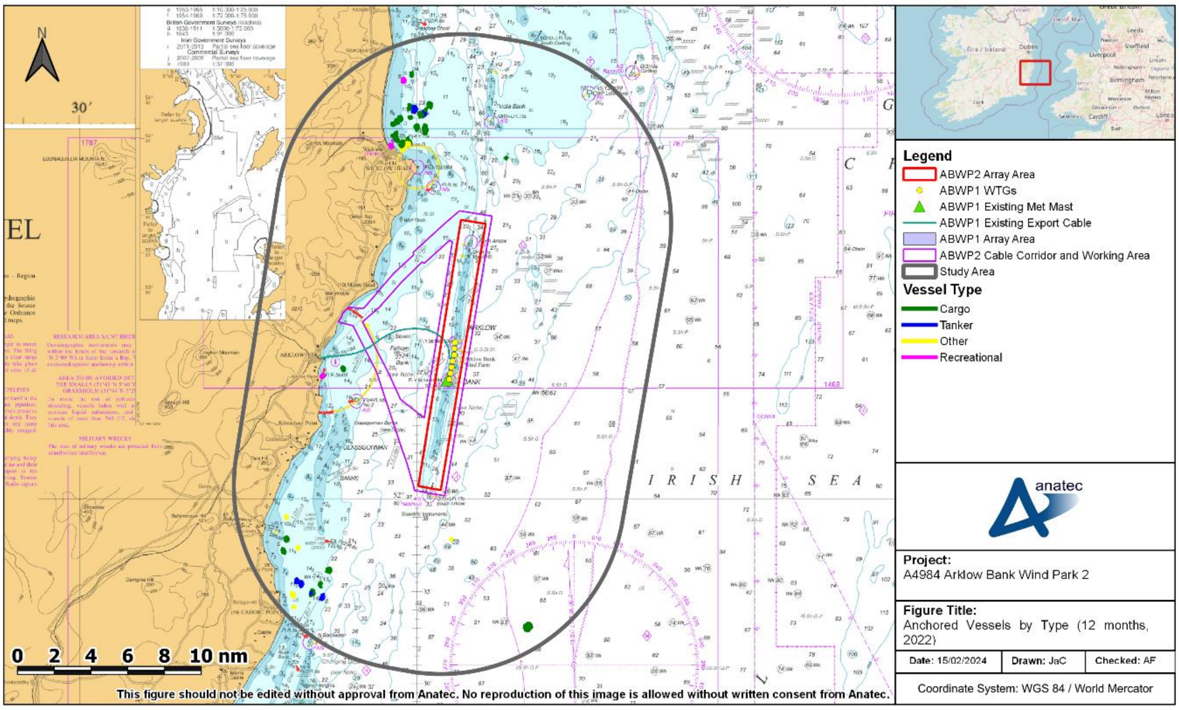

Figure D.8 Anchored Vessels by Type (12 months, 2022)

Anchored vessels were mainly located to the northwest of the Array Area, at the approach to Wicklow, and southwest of the Array Area, at the approach to Riverchapel and Cahore. The majority (51%) of anchored vessels were cargo vessels, followed by recreational vessels (27%).

D.3.5 Vessels Intersecting Array Area

Figure D.9 presents the vessels recorded intersecting the Array Area during 2022, colour-coded by type.

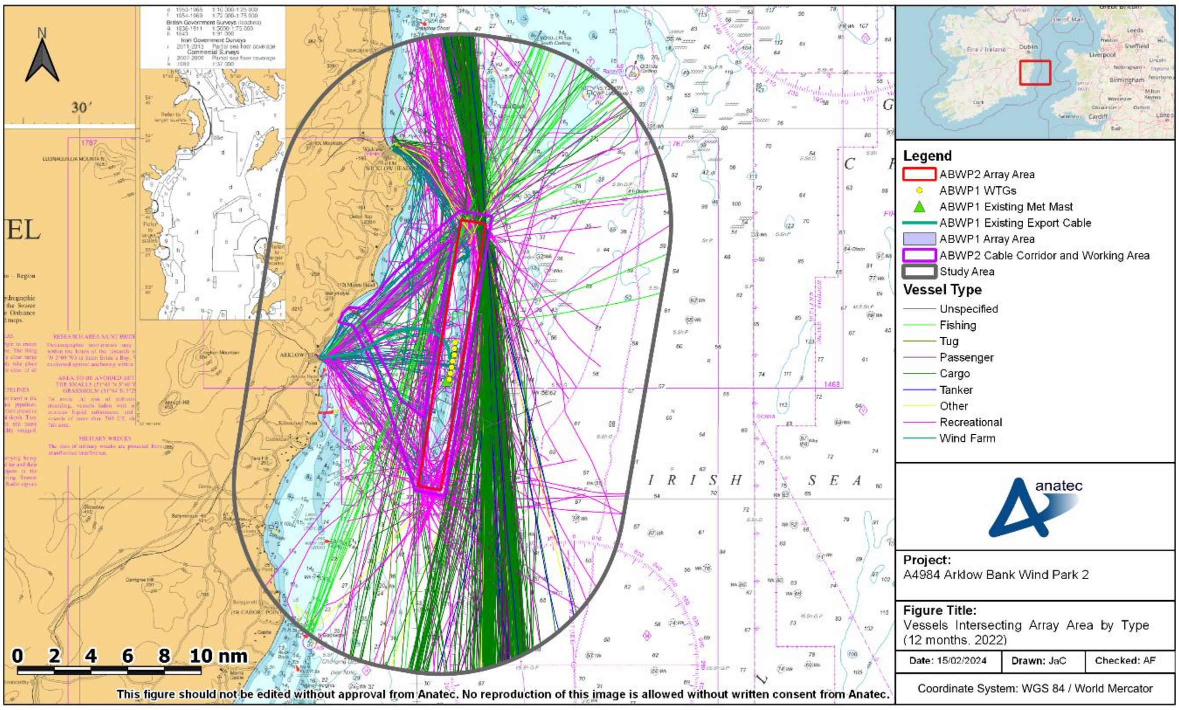

Figure D.9 Vessels Intersecting the Array Area by Type (12 months, 2022)

The majority of vessel intersections comprised of commercial vessels undertaking the main northwest/southeast route, intersecting the Array Area at its northeastern extent. Recreational vessels generally passed through the Array Area at its north and south, and fishing vessels were mainly recorded at its north.

There was an average of one to two intersections per day through the Array Area. The majority (51%) of Array Area intersections were from cargo vessels. This was followed by recreational vessels (28%), wind farm vessels (7%), passenger vessels (6%) and fishing vessels (5%).

D.4 Survey Data Comparison

A summary of the average unique vessels counts per day for the main vessel types within the Study Area during the long-term data period, alongside those for the surveys, are presented in Table D.2.

Table D.2 Summary of Average Unique Vessels per Day for the Long-Term Data Period and Survey Data Periods

Vessel Type	Average Vessels per Day within Study Area		
	Long-term Data Period	Summer 2022 Survey	Summer 2023 Survey
Commercial	19	24	19
Fishing	4	8	3 - 4
Recreational	5	5 - 6	11 - 12
All Vessels	**29 - 30**	**36**	**36 - 37**

It can be seen that higher daily levels of recreational traffic was recorded during the summer 2023 survey compared to both the summer 2022 survey and long-term data period. This is likely due to the fact that the summer 2023 survey took place in July/August, at the peak of annual favourable weather.

D.5 Summary and Conclusion

This annex has analysed a long-term 12-month AIS vessel traffic data set and compared the traffic behaviour, vessel numbers, and vessel types to those recorded in the vessel traffic survey data.

It was seen that vessels generally avoid the Arklow Bank, with commercial vessels passing offshore while fishing and recreational vessels pass inshore.

There was an average of 29 to 30 unique vessels recorded per day within the Study Area during 2022, with June being the busiest and December being the quietest. The seasonal variation can be largely attributed to recreational traffic levels. Commercial vessels accounted for 64% of total traffic, with cargo in particular accounting for 50% of total traffic. This was followed by recreational vessels (17%) and fishing vessels (13%).

An average of 19 commercial vessels per day was recorded within the Study Area, with one per day intersecting the Array Area. Commercial vessels mainly undertook one of two routes; a northwest/southeast route that intersects the northeastern extent of the Array Area and a north/south route at the eastern extent of the Study Area.

There was an average of four fishing vessels recorded per day within the Study Area during 2022, with one every 13 days within the Array Area. The majority of fishing vessels were in north/south transit inshore of the Arklow Bank, with smaller fishing vessels transiting to/from Wicklow and Arklow. Limited active fishing behaviour was observed.

Recreational activity was concentrated inshore, with an average of five per day within the Study Area and one every two to three days within the Array Area. The majority (70%) were recorded during the summer months due to the more favourable weather.

Anchored vessels were typically situated to the northwest of the Array Area, at the approach to Wicklow, and to the southwest of the Array Area, at the approach to Riverchapel and Cahore. The majority of anchored vessels were cargo and recreational vessels.

The majority of intersections through the Array Area were from commercial vessels undertaking the main northwest/southeast route, intersecting the Array Area at its northeastern extent. There was an average of one to two intersections per day through the Array Area, mainly from cargo vessels (accounting for 51%).

Annex E Vessel Traffic Survey (2019)

E.1 Introduction

Anatec was commissioned by SPL to undertake a vessel traffic survey during a geophysical vessel survey of the Proposed Development located off the Wicklow coast in the Irish Sea.

The survey was carried out during July and August 2019 by the *AMS Retriever* (Callsign MEHI8), a multi-purpose, shallow draft tug.

AIS data was recorded automatically by fitting a recording laptop to the vessel's ship-based AIS unit. Manual observations were made of non-AIS vessels based on visual sightings by the crew and/or reference to Radar (when operational).

This appendix summarises details of the survey data collected, which has been referenced within Section 13 where appropriate.

E.2 Survey Methodology

The traffic survey was carried out by the *AMS Retriever* (see Figure E.1) which was carrying out a geophysical survey of the area on behalf of SPL.

Figure E.1 Image of the *AMS Retriever* survey vessel (copyright: MarineTraffic.com)

The AIS survey period ran from 13 July 2019 to 27 August 2019, with some downtime on the 14 July 2019 (approximately 14 hours) and 15 July 2019 (approximately 8 hours) when the vessel was in port with AIS powered down. At other times when the *AMS Retriever* was in port, AIS continued to record and generally achieved good coverage of the Study Area (its berth in port being approximately 21 nm from the furthest edge of the Study Area boundary).

The Study Area was a 10 nm buffer of the Array Area, as per the vessel traffic analysis undertaken in Section 13.

The tracks of the *AMS Retriever* during the survey period, recorded on AIS, are shown in Figure E.2.

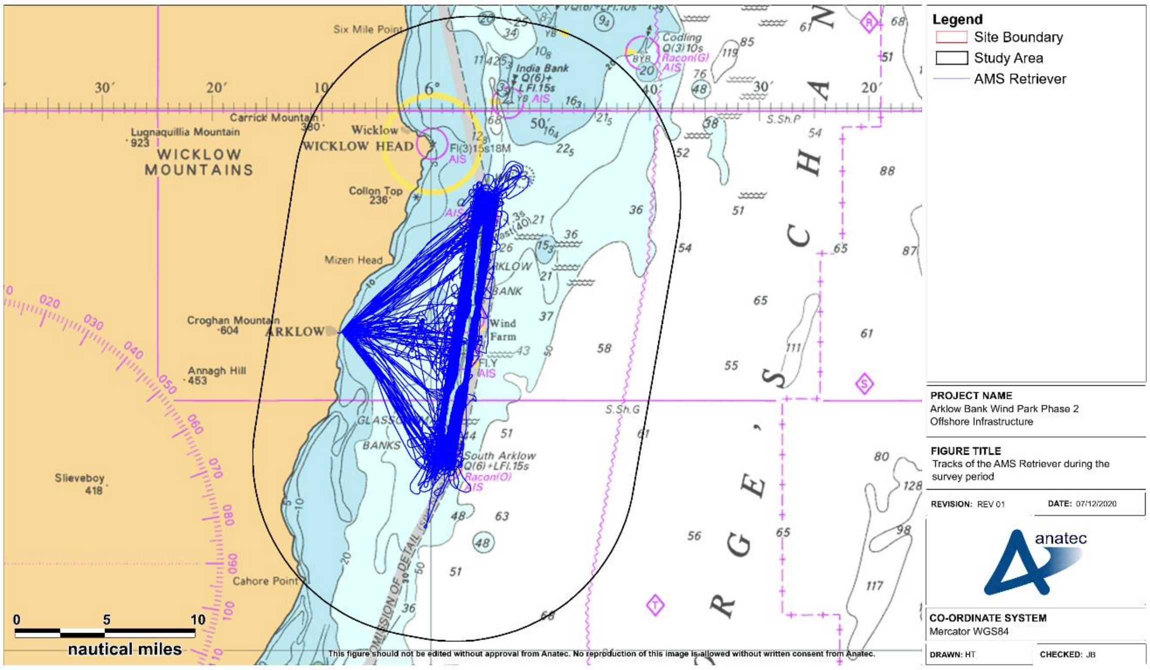

Figure E.2 Tracks of the *AMS Retriever* during the survey period

The manual observations of non-AIS targets were made based on visual observations by the crew relative to own-ship, and/or from the Radar screen when possible (range/bearing). The Radar did not have a facility for automatically recording targets and the scanner was not operational for most of the survey for safety reasons, due to the positioning of the marine mammal observer.

The effective period of manual observations was dependent on the time the *AMS Retriever* spent out at the site (as opposed to in port) as this dictated when non-AIS vessels could be sighted, given the range limitations associated with manual sightings (see Section E.4.4).

Figure E.3 shows the hours spent per day in port (including hours of downtime on the 14 July 2019 and 15 July 2019), according to both their navigation status and AIS tracks.

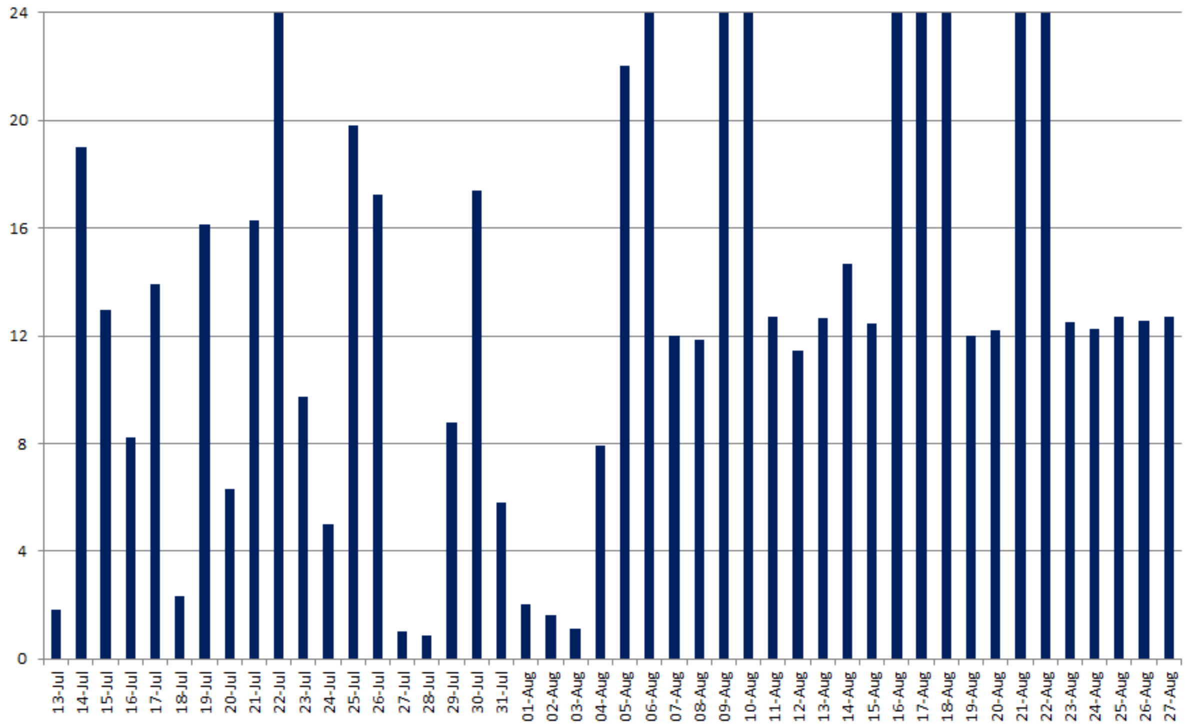

Figure E.3 Time spent in port by *AMS Retriever*

During the 46-day survey period, the *AMS Retriever* spent nine full days in port and was in port for part of the time on the other 37 days. The effective survey period for manual observations of non-AIS targets was 21 days (496 hours).

The non-AIS targets were recorded by the *AMS Retriever* crew on specially designed log forms, as shown in Figure E.4 (the crew were briefed not to log AIS targets to avoid duplication).

Non-AIS Radar Target Log Sheet –Arklow Bank Area 2019

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Page: ___

Please fill out a separate column for each non-AIS target only, i.e., vessels that can only be tracked by radar because they are not broadcasting on AIS.

Sighting No.									
Date									
Time									
Name or Description									
Vessel Type									
Length (m)									
Speed (kts)									
Course									
Waypoint*	**Time**	**Latitude**	**Longitude**	**Time**	**Latitude**	**Longitude**	**Time**	**Latitude**	**Longitude**
1									
2									
3									
4									
5									
6									
Comments									

* Please specify coordinates in degrees and decimal minutes. Try to record a minimum of 3 positions as the target passes across the radar range (more if changing course).

Figure E.4 Non-AIS target log form provided by *AMS Retriever* crew

E.3 Vessel Traffic Analysis – AIS

This section analyses the AIS data recorded within the Study Area.

E.3.1 AIS Description

Regulation 19 of the International Convention for the SOLAS Chapter V - Carriage requirements for vessel borne navigational systems and equipment - sets out navigational equipment to be carried on board vessels, according to vessel type. In 2000, the IMO adopted a new requirement (as part of a revised new chapter V) for vessels to carry AIS. AIS is a system by which vessels transmit data concerning their position, Mobile Maritime Service Identity (MMSI) etc. on two individual VHF channels to the shore and other vessels, at very frequent intervals. The data is transmitted automatically via VHF to other vessels and coastal stations/authorities.

The regulation requires AIS to be fitted aboard all vessels of 300 gross tonnage and upwards engaged on international voyages, cargo vessels of 500 gross tonnage and upwards not engaged on international voyages and passenger vessels irrespective of size built on or after 1 July 2002. It also applies to vessels engaged on international voyages constructed before 1 July 2002, according to the following timetable:

- Passenger vessels, not later than 1 July 2003;

- Tankers, not later than the first survey for safety equipment on or after 1 July 2003; and
- Vessels, other than passenger vessels and tankers, of 50,000 gross tonnage and upwards, not later than 1 July 2004.

An amendment adopted by the Diplomatic Conference on Maritime Security in December 2002 states that vessels, other than passenger vessels and tankers, of 300 gross tonnage and upwards but less than 50,000 gross tonnage, will be required to fit AIS not later than the first safety equipment survey after 1 July 2004 or by 31 December 2004, whichever occurs earlier. Vessels fitted with AIS shall maintain AIS in operation at all times except where international agreements, rules or standards provide for the protection of navigational information.

The regulation requires that AIS shall:

- Provide information – including the vessel's identity, type, position, course, speed, navigational status and other safety-related information – automatically to appropriately equipped shore stations, other vessels and aircraft;
- Receive automatically such information from similarly fitted vessels; exchange data with shore-based facilities.

European Union fishing vessels of 15 m length and over have been required to carry AIS since 31 May 2014. A proportion of smaller vessels also carry AIS voluntarily but may not broadcast continuously.

Recreational vessels are also not required to broadcast on AIS but a proportion do so voluntarily.

E.3.2 Overview of AIS Data

A plot of the vessel tracks recorded across the survey period (45 days effective survey period on AIS), colour-coded by vessel type is shown in Figure E.5.

E.3.2.1 Excluded Tracks

The tracks of the *AMS Retriever* have been removed from further analysis since this was only in the area to carry out the temporary survey work.

Similarly the tracks of the *AMS Panther,* a 17 m wind farm support catamaran also involved in the hydrographic and geophysical surveys of Arklow Bank, have been filtered out as temporary.

Finally, the tracks of the *Husky* were removed as this vessel was also performing a temporary survey in the area.

The filtered out tracks are shown in Figure E.6.

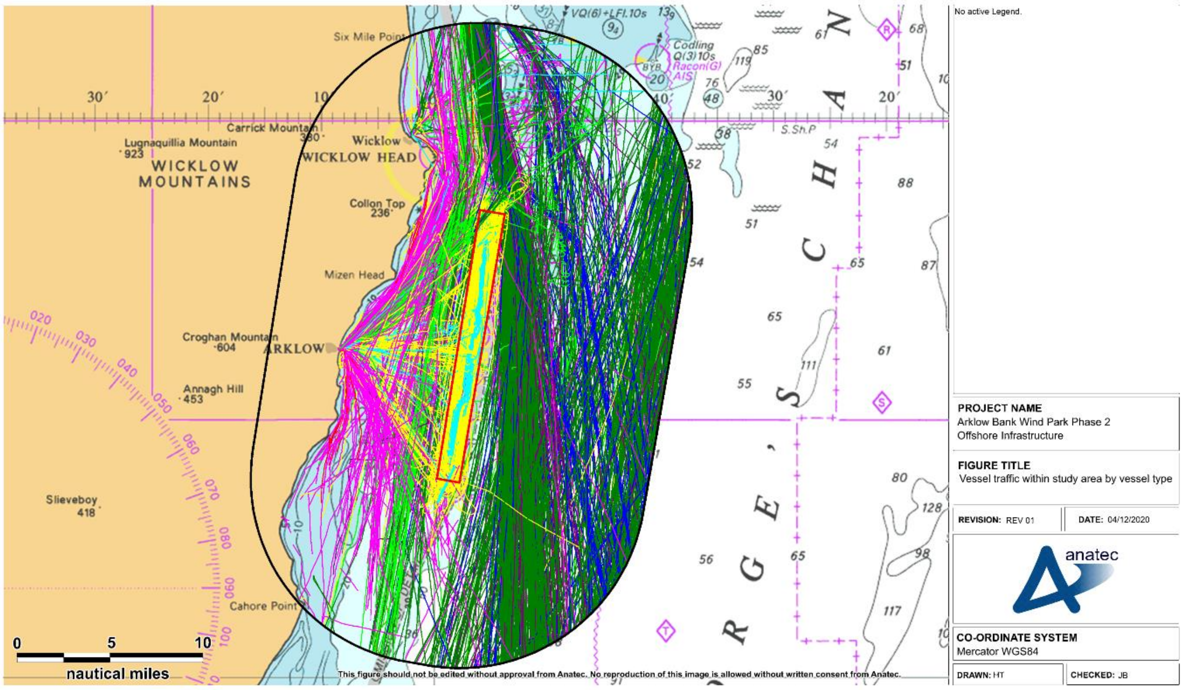

Figure E.5 Vessels by Type including Temporary Traffic (46 Days, Summer 2019)

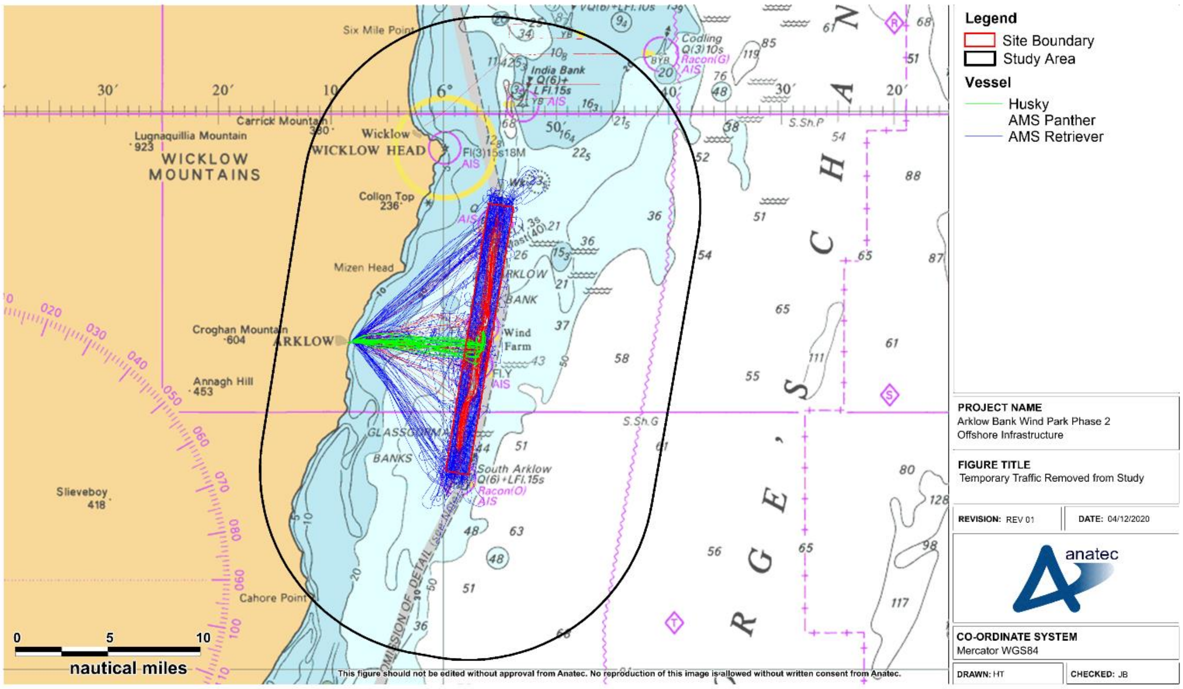

Figure E.6 Excluded Temporary Traffic

E.3.3 Vessel Types

Figure E.7 shows the remaining tracks after the removal of temporary traffic, colour-coded by type.

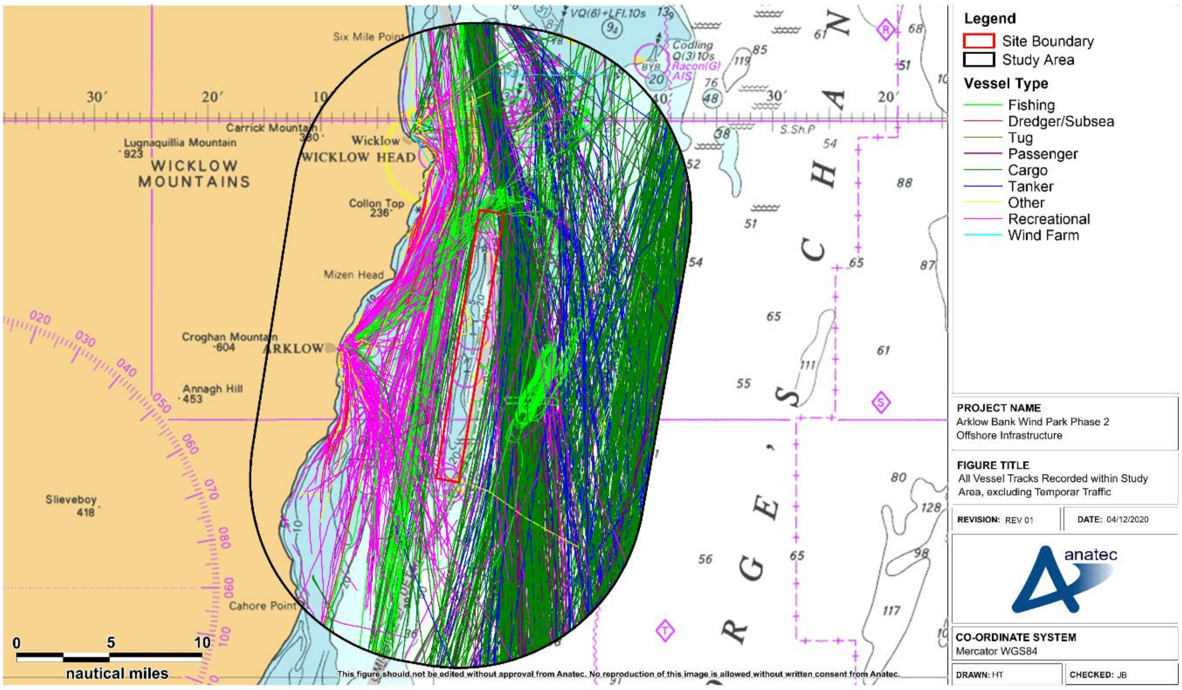

Figure E.7 Vessels by Type (46 Days, Summer 2019)

The percentage distribution of the main vessel types recorded passing within the Study Area is presented in Figure E.8.

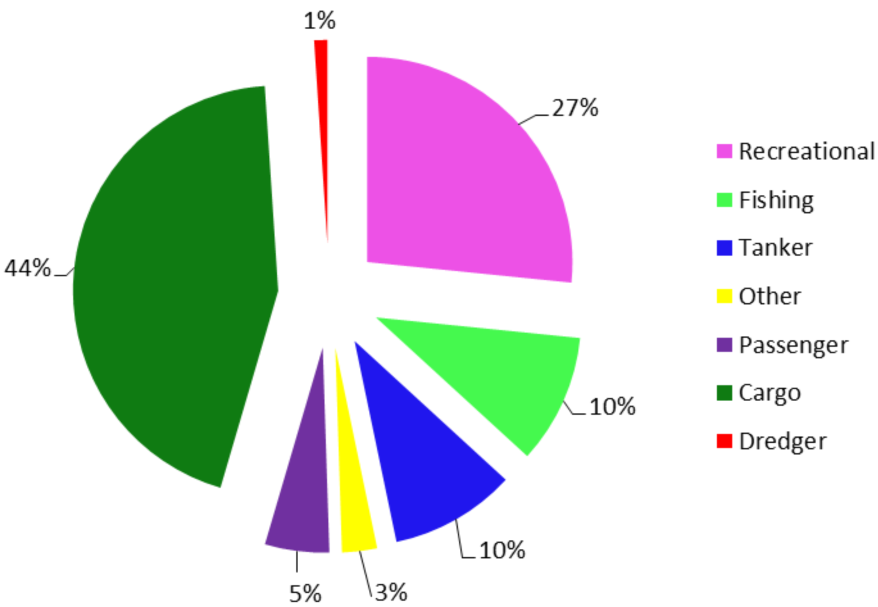

Figure E.8 Distribution of Vessel Types (46 Days, Summer 2019)

The main vessel types were cargo vessels (44%), recreational vessels (27%), tankers (10%) and fishing vessels (10%). “Other” vessels contributed 3%, which mainly consisted of RNLI lifeboats. Wind farm vessels and tugs have been merged with "other" in Figure E.8 as both were less than 1%.

The most common vessel type intersecting the Array Area was cargo, predominantly passing through the northeast corner of the Array Area (avoiding Arklow Bank). A number of fishing and recreational vessels entered the Array Area during the survey period. Aside from these, small numbers of tankers, passenger vessels and other vessels (mainly consisting of RNLI lifeboats) were recorded intersecting the Array Area. Figure E.9 presents a detailed illustration of the vessels in close proximity to the Array Area boundary.

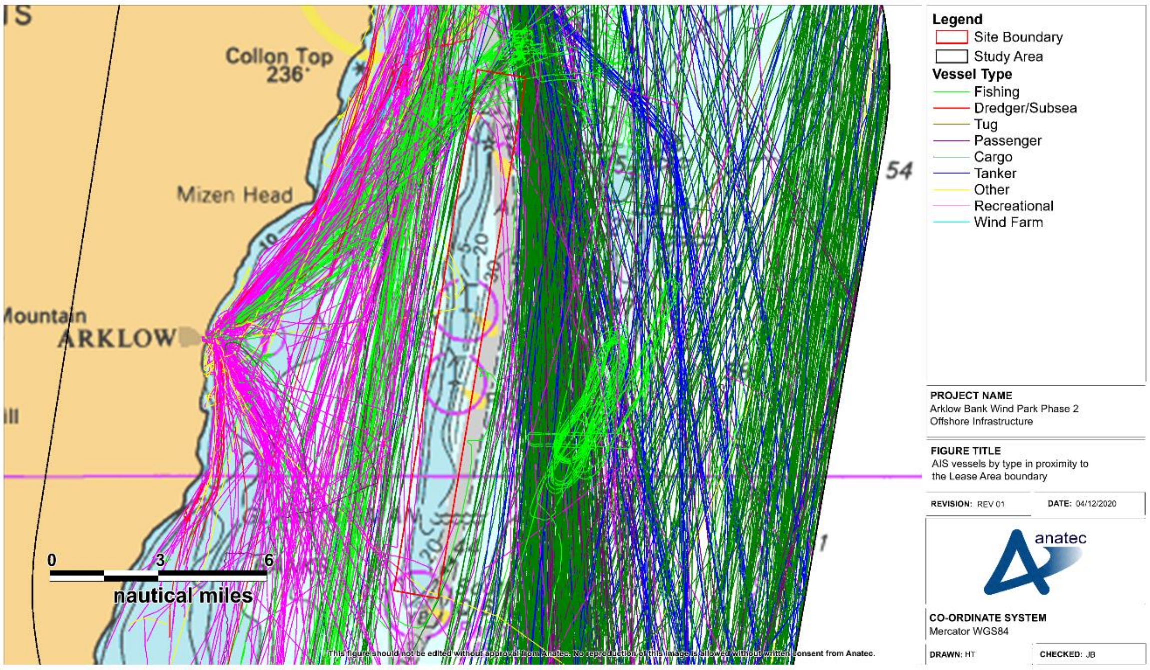

Figure E.9 Vessels by Type in Proximity to Array Area (46 Days, Summer 2019)

E.3.4 Vessel Count

Figure E.10 illustrates the daily number of unique vessels recorded on AIS within the entire Study Area as well as passing through the Array Area during the study period.

An average of 29 vessels per day was recorded within the Study Area based on an effective 45-day survey period. The busiest day within the Study Area was the 15 August 2019 when 51 unique vessels were recorded.

An average of two vessels per day was recorded within the Array Area, with a maximum of seven vessels on the 12 August 2019.

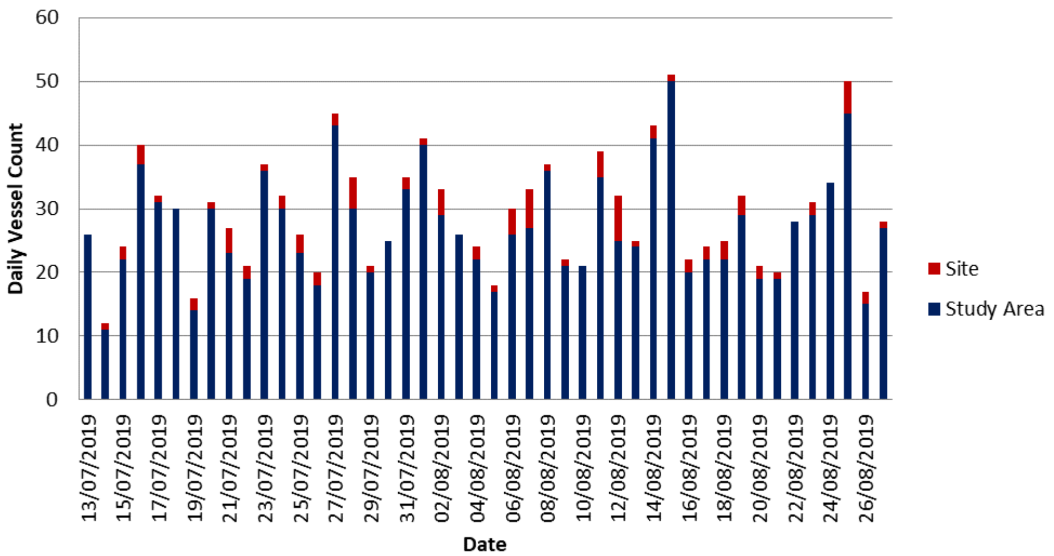

Figure E.10 Number of Vessels per Day (46 Days, Summer 2019)

E.3.5 Vessel Density

A vessel density heat map is presented in Figure E.11.

The highest density route runs to the east of the Array Area, with vessels destined for ports such as Dublin to the north, or Kilmore Quay to the south. High levels of activity were also observed to/from Arklow port; mainly by fishing and recreational vessels.

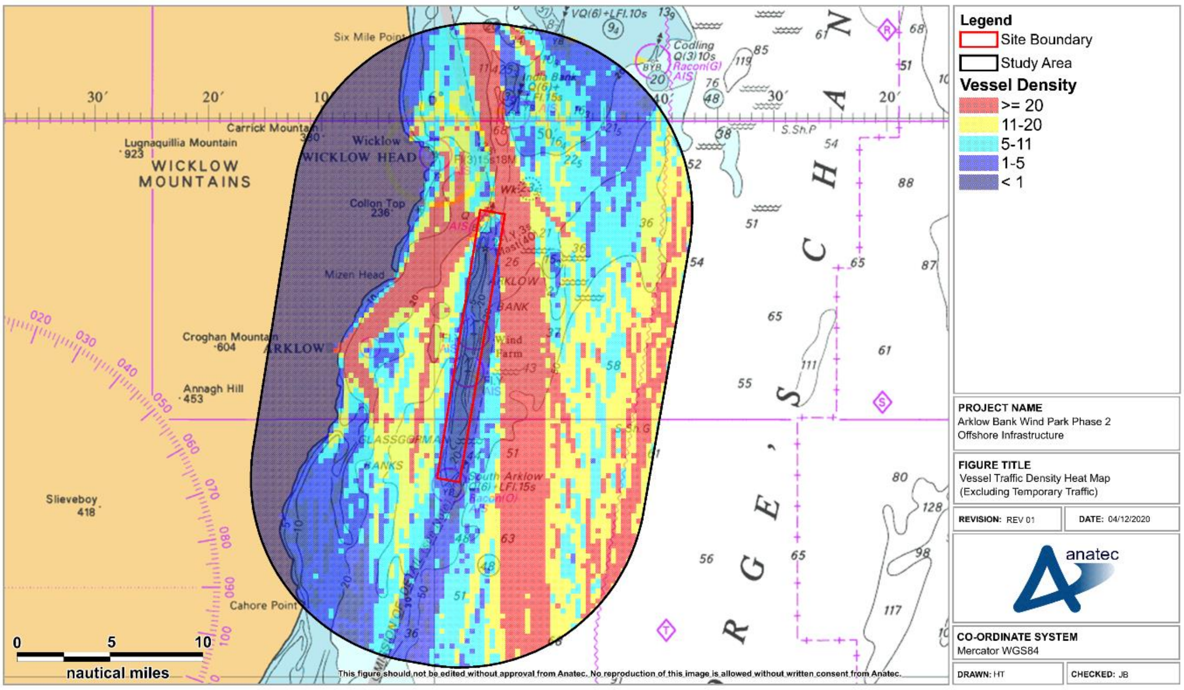

Figure E.11 Vessel Density (46 Days, Summer 2019)

E.4 Vessel Traffic Analysis – Non-AIS

This section summarises the analysis of non-AIS vessels logged by the *AMS Retriever* during the survey.

A total of 25 non-AIS targets were logged, corresponding to just over one per day based on the effective survey period of 21 days excluding time in port (it is noted that a small number of duplicate AIS targets were logged, but these have been filtered out of the analysis).

Using the log form entries, the vessel sightings were plotted on a chart. Usually this was based on range versus bearing relative to the own-ship position at the time, or relative to a fixed position such as the North Arklow north cardinal buoy. However, it should be noted that positions were approximate.

E.4.1 Overview of Non-AIS Data

Non-AIS vessels recorded during the study period are presented in Figure E.12. Vessels with a specified course are represented as arrows showing the direction of travel, whilst vessels with unspecified course are plotted as circular symbols only.

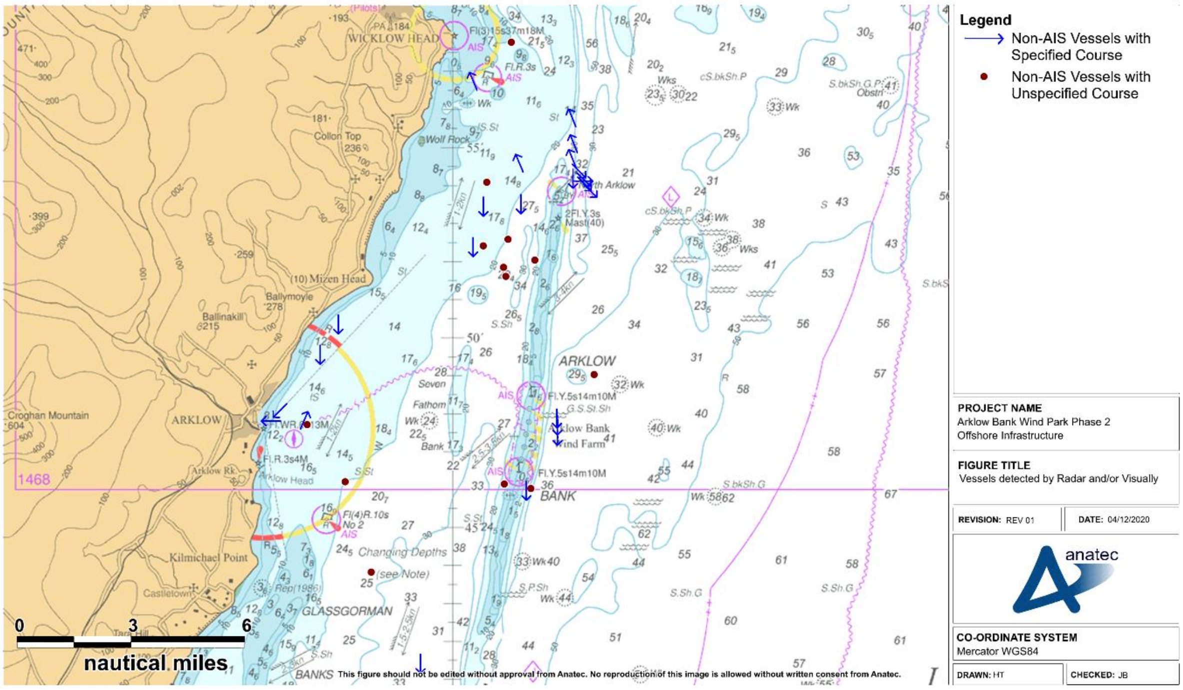

Figure E.12 Vessels detected by Radar and/or visually

E.4.2 Vessel Types

Figure E.13 shows the vessels colour-coded by vessel type. Tracks have been drawn between positions where the vessel was logged on multiple occasions.

The *Windcat 2* was recorded on one occasion working at the existing ABWP1. Excluding this industry vessel, 54% of the visual sightings were recreational vessels and 46% fishing vessels. Based on the additional information in the log sheets, the majority of fishing vessels that were specified by gear type were potters.

The following subsections analyse the fishing and recreational vessel sightings in more detail.

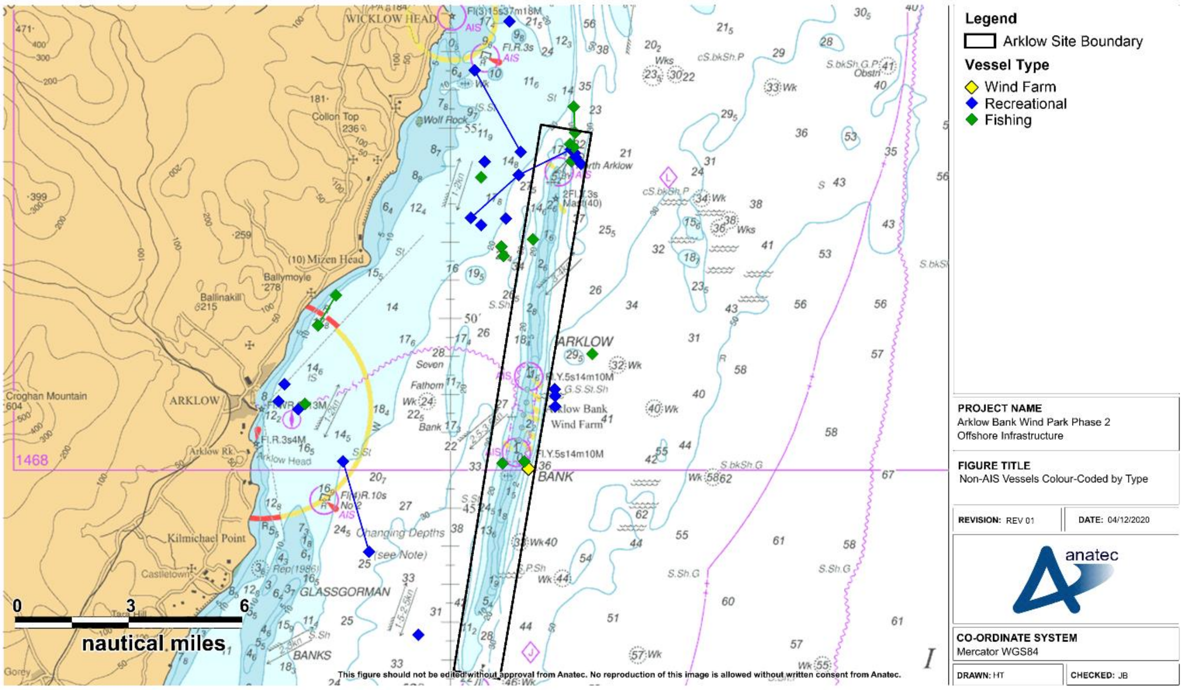

Figure E.13 Non-AIS vessel tracks during survey period

E.4.3 Vessel Count

Figure E.14 illustrates the daily number of unique fishing and recreational vessels recorded within the Study Area during the survey period.

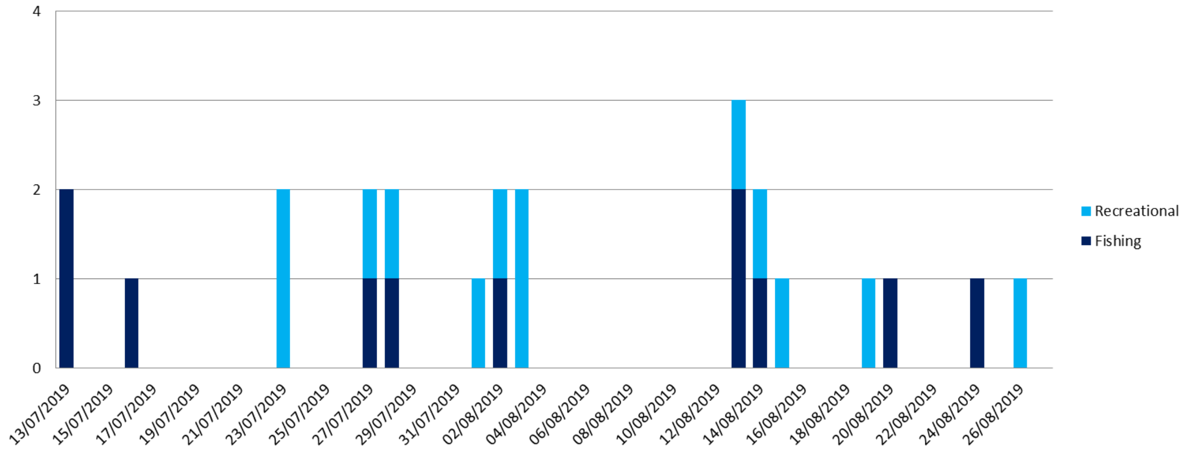

Figure E.14 Non-AIS unique daily vessel count

Excluding the wind farm vessel, there were 24 non-AIS manual sightings logged in 21 (effective) days, comprising 13 recreational vessels and 11 fishing vessels.

The busiest day was 13 August 2019 when three non-AIS vessels were recorded.

Nine vessels intersected the Array Area, with the majority of these just north of the Arklow Bank north cardinal mark.

E.4.4 Range of Sighting

Figure E.15 presents the range at which non-AIS vessels were logged from the *AMS Retriever*.

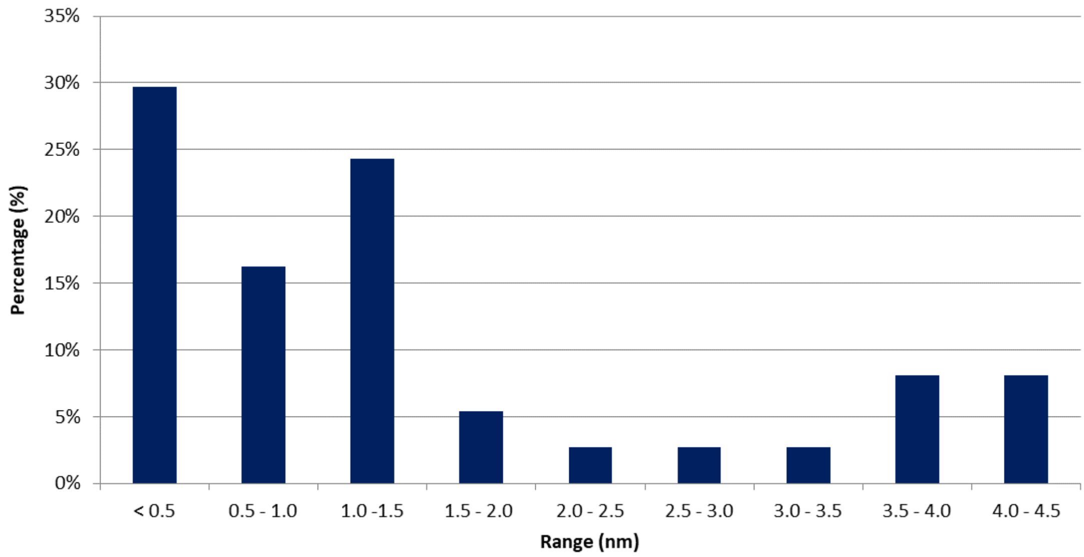

Figure E.15 Range of non-AIS sightings

The vast majority of non-AIS sightings were logged within 2 nm of the *AMS Retriever*. The maximum range was 4.3 nm.

E.4.5 Comparison of AIS and Non-AIS Data

This section compares the AIS and non-AIS data. All commercial vessels were recorded on AIS and therefore the focus of this section is fishing vessels and recreational vessels.

E.4.6 Fishing Vessels

All fishing vessels recorded during the study period are presented in Figure E.16.

It can be seen that the majority passes inshore of the Arklow Bank, transiting north/south off the coast, and in many cases calling at Arklow Port.

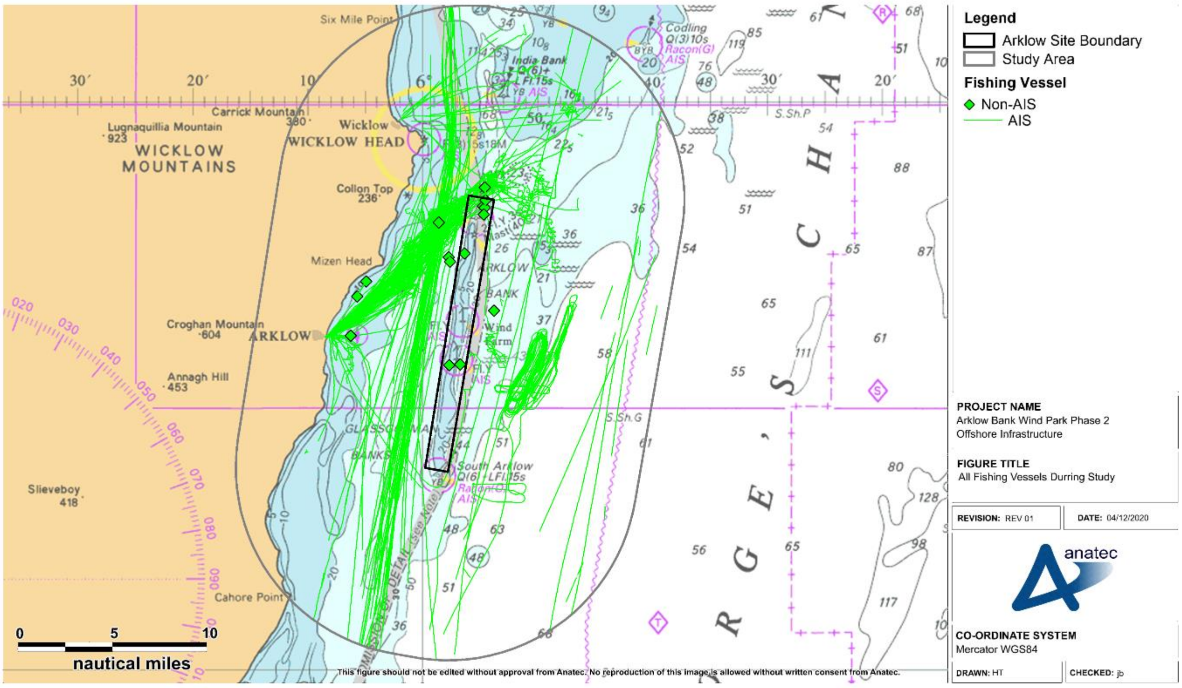

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Figure E.16 Fishing Vessels (46 Days, Summer 2019)

The daily numbers of fishing vessels (AIS and non-AIS) are presented in Figure E.17.

Fishing vessels recorded on AIS made up 93% of the total fishing vessels recorded during the survey, whilst manual sightings accounted for 7%. The busiest days had seven fishing vessels in the Study Area.

The most active single fishing vessel during the survey period (on AIS) was a potter recorded on 34 different days.

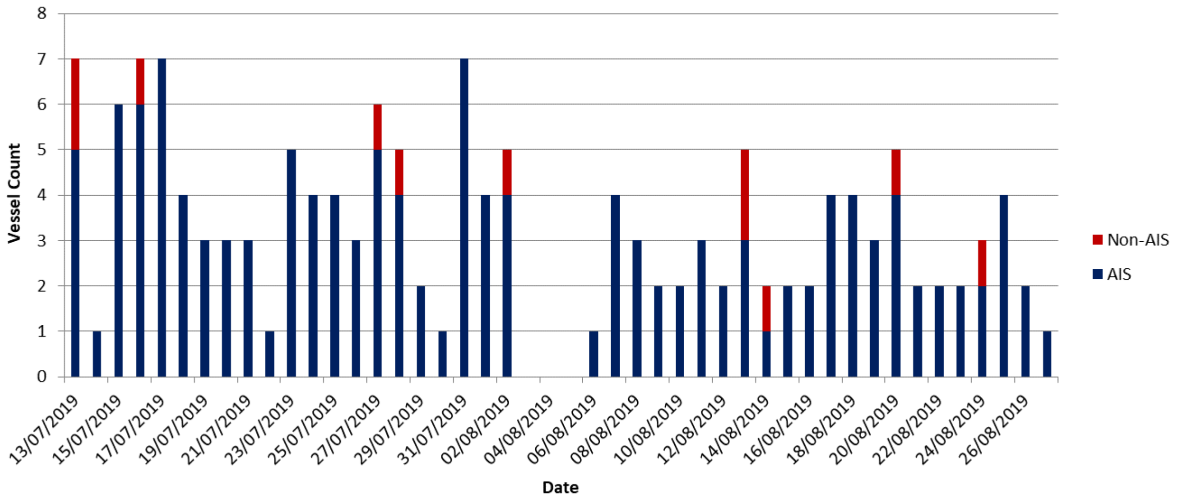

Figure E.17 Comparison of AIS and non-AIS unique daily fishing vessel count

E.4.7 Recreational Vessels

All recreational vessels recorded during the study period are shown in Figure E.18.

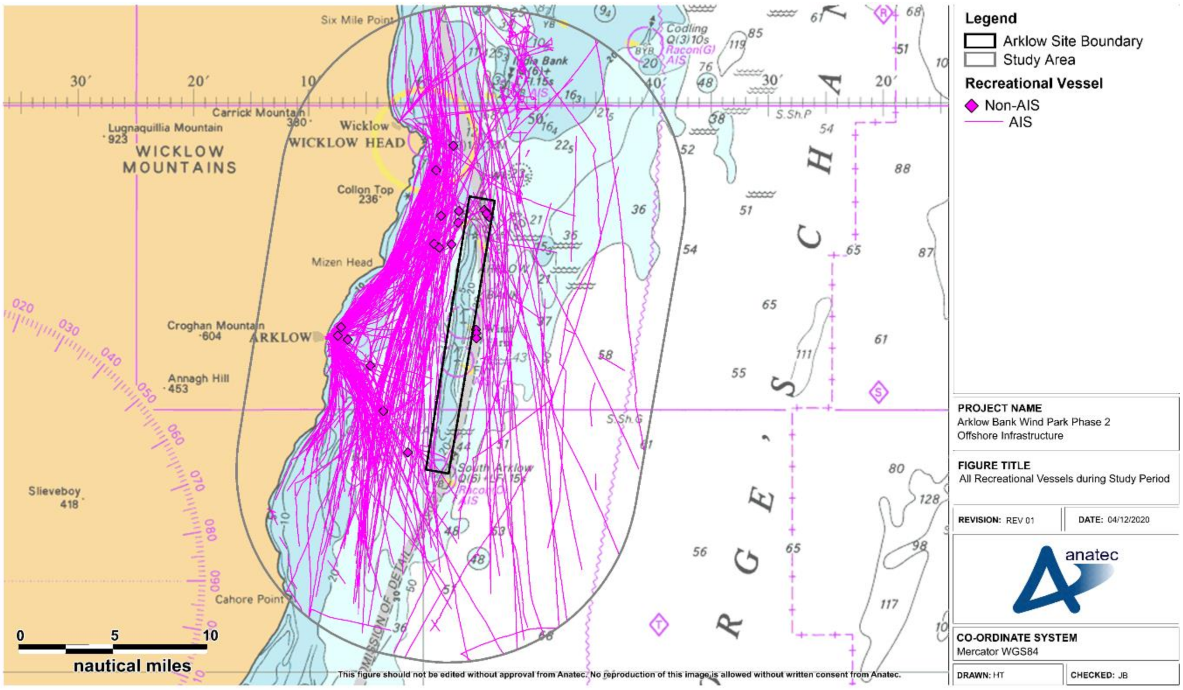

Figure E.18 Recreational Vessels (46 Days, Summer 2019)

A daily comparison of recreational vessels on AIS and non-AIS is presented in Figure E.19.

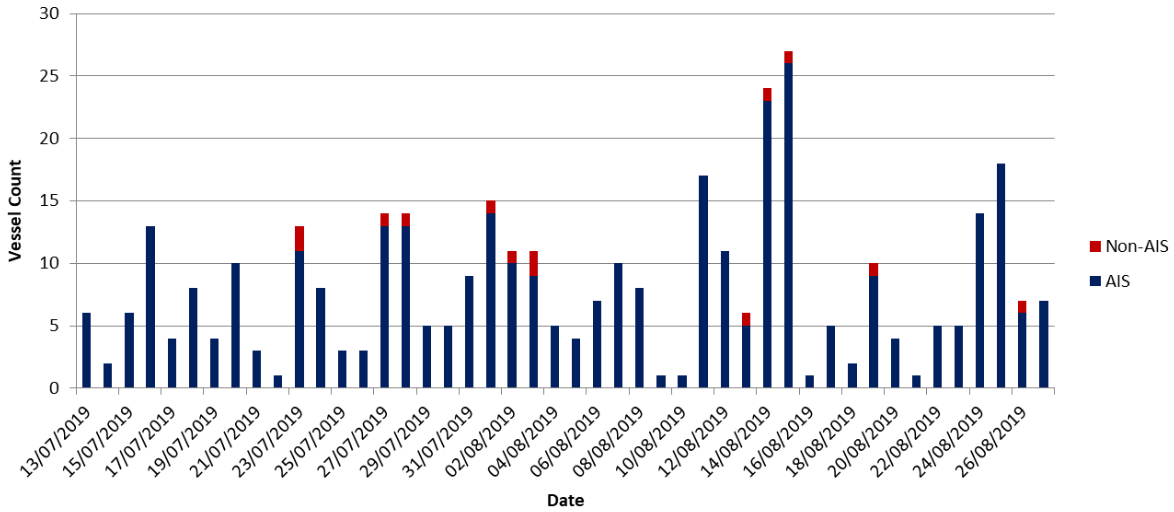

Figure E.19 Comparison of AIS and non-AIS unique daily recreational vessel count

Recreational vessels recorded on AIS made up 96% of the total, with 4% being manual sightings, not broadcasting on AIS.

The busiest day for recreational vessels was 15 August 2019 when 27 vessels were recorded.

The majority of recreational vessels passed inshore of the Arklow Bank, including many calling at Arklow Marina.

E.4.8 Conclusion

This survey has presented AIS and non-AIS vessel traffic survey data from 13 July 2019 to 27 August 2019, recorded by the *AMS Retriever* during geophysical survey work at the location of the Proposed Development.

Taking into account AIS downtime, the effective survey period was 45 days. An average of 29 unique vessels per day was tracked on AIS. The main types were cargo vessels (44%) and recreational vessels (27%).

The effective study period for non-AIS data recording was 21 days, excluding time in port. An average of just over one sighting per day was recorded, divided relatively equally between fishing vessels and recreational vessels.

Of the total fishing vessels recorded, 93% were broadcasting on AIS and 7% were non-AIS targets logged manually. For recreational vessels, 96% were on AIS and 4% were logged manually. However, logging of non-AIS vessels was limited to an extent by the range of the survey.