Dublin Array
Generation for generations

EIAR Volume 4: Offshore Infrastructure Technical Appendices
Appendix 4.3.10-1
Navigation Risk Assessment

Kish Offshore Wind Ltd

RWE SLR GoBe APEM Group

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Dublin Array Offshore Wind Farm Navigation Risk Assessment

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00	18/12/2020	Initial draft.
01	09/02/2021	Internal updates following initial draft.
02	22/10/2021	Internal updates.
03	17/12/2021	Minor updates based on final 2021 review.
04	05/12/2023	2023 Updates.
05	06/05/2024	2024 Updates.
06	20/09/2024	Updates following client feedback.
07	09/01/2025	Final version.

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Abbreviations Table

Abbreviation	Definition
°	Degree
µPa	Micropascal
AC	Alternating Current
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ALB	All-Weather Lifeboat
ARPA	Automatic Radar Plotting Aid
AtoN	Aid to Navigation
BIM	Bord Iascaigh Mhara
BWEA	British Wind Energy Association
CA	Cruising Association
CBA	Cost Benefit Analysis
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effect Assessment
CHIRP	Confidential Human Factors Incident Reporting Programme
COLREGS	Convention on International Regulations for Preventing Collisions at Sea
CTV	Crew Transfer Vessel
dB	Decibels
DC	Direct Current
DD(D)MM.mmmm	Degree Decimal Minutes
DF	Direction Finding
DfT	Department for Transport
DoD	Department of Defence
DSC	Digital Selective Calling
DTTAS	Department of Transport, Tourism and Sport
ECC	Export Cable Corridor
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment

Abbreviation	Definition
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic Field
EU	European Union
FLO	Fisheries Liaison Officer
FSA	Formal Safety Assessment
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GRP	Glass Reinforced Plastic
GT	Gross Tonnage
HAS	Health and Safety Authority
IAA	Irish Aviation Authority
IALA	International Association of Marine Aids to Navigation and Lighthouse Authority
ICS	Irish Chamber of Shipping
ILB	Inshore Lifeboats
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
Irish Lights	Commissioner of Irish Lights
IRPA	Individual Risk per Annum
OREIs	Offshore Renewable Energy Installations
ISORA	Irish Sea Offshore Racing Association
ITAP	Institut für technische und angewandte Physik
ITOPF	International Tanker Owners Pollution Federation
kHz	Kilohertz
km	Kilometres
km^2	Square kilometres
kt	Knots
LOA	Length Overall
m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency

Abbreviation	Definition
MCIB	Marine Casualty Investigation Board
MEHRAs	Marine Environmental High Risk Areas
MEPC	Marine Environment Protection Committee
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MIDA	Marine Irish Digital Atlas
MOD	Ministry of Defence
MSC	Maritime Safety Council
MSI	Maritime Safety Information
MSO	Marine Survey Office
MW	Megawatts
N	North
NAVTEX	Navigational Telex
nm	Nautical Mile
nm^2	Square Nautical Miles
NMOC	National Maritime Operations Centre
NRA	Navigational Risk Assessment
OREI	Offshore Renewable Energy Installation
OSP	Offshore Substation Platform
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
OWF	Offshore Wind Farm
PLA	Port of London Authority
PLL	Potential Loss of Life
POB	People on Board
REZ	Renewable Energy Zone
RNLI	Royal National Lifeboat Institution
RoI	Republic of Ireland
RYA	Royal Yachting Association
SAR	Search and Rescue
SI	Statutory Instrument

Abbreviation	Definition
SOLAS	Safety of Life at Sea
SONAR	Sound Navigation Ranging
TCE	The Crown Estate
TSS	Traffic Separation Scheme
UKHO	UK Hydrographic Office
VHF	Very High Frequency
VMS	Vessel Monitoring System
W	West
WGS 84	World Geodetic System 1984
WTG	Wind Turbine Generator

1 Introduction

1. Anatec was commissioned by Kish Offshore Wind Limited and Bray Offshore Wind Limited (hereafter 'the Applicant') to undertake a Navigational Risk Assessment (NRA) for the proposed Dublin Array Offshore Wind Farm offshore infrastructure (hereafter 'Dublin Array'), which consists of the array area (the 'array area'), and Offshore Export Cable Corridor (Offshore ECC).

2. The NRA presents information regarding baseline features and activity of relevance to Dublin Array and considers potential effects of the wind farm to shipping and navigation users. The findings of the NRA are then used to inform the impact assessment undertaken in Volume 3, Chapter 10: Shipping and Navigation of the Environmental Impact Assessment Report (EIAR).

1.1 Navigation Risk Assessment

3. An Environmental Impact Assessment (EIA) is a process which identifies the environmental effects of a project, both positive and negative, in accordance with European Union (EU) directives (Directive 2011/92/EU, as amended by Directive 2014/52/EU) and as transposed into Irish law[1]. EIA is undertaken by the competent authority. The Applicant has prepared an EIAR, for evaluation by the competent authority. An important component of the EIA for offshore projects is the NRA, given impacts to shipping and navigation users must be properly considered and assessed.

4. Following the recommendation by Marine Survey Office (MSO), the relevant Maritime and Coastguard Agency (MCA) Methodology and Marine Guidance Note (MGN) have been utilised to inform this NRA. At the time of consultation this was MGN 543 (MCA, 2016), however this has since been superseded by MGN 654 (MCA, 2021) in April 2021. MGN 654 has therefore been used as primary guidance as detailed within Section 4. This is considered an appropriate approach given equivalent guidance in Ireland is still in draft consultation form at the time of writing (November 2024), noting the draft form closely resembles MGN 654.

5. In line with MGN 654 the NRA includes the following:

- Overview of existing environment;
- Consideration of consultation;
- Vessel traffic surveys;
- Assessment of navigational risk pre and post development of Dublin Array;
- Implications for marine navigation and communication equipment;
- Quantification of allision and collision risk; and
- Emergency response.

[1] European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No 296 of 2018) of (hereafter referred to as the EIA Regulations 2018).

6. This NRA assesses the criteria which will be assessed through a Formal Safety Assessment (FSA) (see Section 3.1) within the EIAR with each impact being assessed for each phase of Dublin Array as follows:

- Construction;
- Operation and Maintenance; and
- Decommissioning.

7. The assessment of Dublin Array offshore infrastructure is based upon the design options under consideration, which are provided in Section 6. Suitable parameters have been selected to ensure maximum risk is estimated within the NRA.

2 Guidance and Legislation

2.1 Primary Guidance

8. Consultation has been undertaken with the key statutory marine stakeholders for the purposes of agreeing an appropriate approach to NRA guidance, noting that comprehensive Irish guidance for NRA production is being drafted, and is not currently in place. It is understood that guidance specific to shipping and navigation assessment will be published in the near future, and that this guidance is likely to closely resemble MGN 654 (MCA, 2021) which is the primary guidance used for equivalent assessment for United Kingdom (UK) Offshore Renewable Energy Installations (OREIs).

9. On this basis and as per Section 4, the Irish Coastguard, MSO, and Commissioner of Irish Lights ('Irish Lights') all agreed that the use of the relevant MCA MGN (MCA, 2021) should be considered as the primary NRA guidance document for the Dublin NRA. This is considered an appropriate approach given that the UK guidance is well established, noting the prominence of the UK within the worldwide offshore renewables industry.

10. MGN 654 highlights issues that should be considered when assessing the effect on navigational safety from offshore renewable energy developments proposed in UK waters. While Dublin Array is not based in UK waters, as above MGN 654 is considered as providing comprehensive, applicable and most appropriate form of guidance for the Dublin NRA to adhere to.

11. It should be considered that given MGN 654 is UK based guidance, not all aspects are directly applicable to Dublin Array i.e., Search and Rescue (SAR) requirements and hydrographic data requirements given the regulators will define these parameters specifically for Irish waters. However, the contents of relevance have been considered, and the general NRA approach discussed with key stakeholders as per Section 4.

12. MGN 654 is supplemented by the MCA Methodology (Annex 1), which sets out the methodology by which an NRA should be undertaken. The methodology requires an FSA approach (International Maritime Organization (IMO), 2018) be utilised (see Section 3.1) when undertaking associated risk assessment.

13. Therefore, the primary guidance documents considered throughout the NRA process are as follows:

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

2.2 Secondary Guidance

14. Other guidance documents used during the assessment on a secondary basis 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)** – although this document does not provide guidance to the developer of an offshore wind farm it does provide guidance to the Mariner which is used to identify future traffic trends and routeing;
- **International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 and Guidance G1162 on The Marking of Man-Made Offshore Structures (IALA, 2021)** – sets out standard recommendations for how offshore structures (including offshore wind farms) should be lit and marked (noting final lighting and marking will be agreed with Irish Lights); and
- **The Royal Yachting Association's (RYA's) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy. 5th Edition - (RYA, 2019**) – sets out the RYA position on offshore wind farms including recommended blade clearance.

2.3 Lessons Learnt

15. There is considerable benefit to developers in the sharing of lessons learnt within the offshore renewables industry. The NRA 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 of offshore wind to date in the UK relative to the equivalent Irish industry.

3 Navigation Risk Assessment Methodology

3.1 Assumptions

16. The shipping and navigation baseline and risk assessment has been undertaken based upon the available information and consultation received at the time of preparation. Details of data limitations are provided in Section 5.3.

3.2 Formal Safety Assessment Methodology

17. A shipping and navigation receptor can only be affected by a hazard if there is a pathway through which the hazard can be transmitted between the source activity (cause) and the user. In cases where a user is exposed to a hazard, the overall severity of consequence to the user is determined. This process incorporates a degree of subjectivity. Therefore, the assessments presented herein for shipping and navigation users have considered various criteria including the following:

- Baseline data and assessment;
- Expert opinion[2];
- Outputs of the Hazard Workshops;
- Level of stakeholder concern;
- Number of transits of specific vessels and/or vessel types;
- Effect of any vessel deviation;
- Number of transits of specific vessel and/or vessel type; and
- Lessons learnt from existing offshore developments.

18. It is noted that, with regards to commercial fishing vessels, the methodology and assessment has been applied to hazards considering commercial fishing vessels in transit. A separate methodology and assessment has been applied in Volume 3, Chapter 9: Commercial Fisheries to consider hazards on commercial fishing vessels including in relation to safety which are directly related to commercial fishing activity (rather than fishing vessels in transit) and risks of a commercial nature.

3.3 Formal Safety Assessment Process

19. The IMO FSA process (IMO, 2018) as amended by the IMO in 2018 under Maritime Safety Council (MSC) Marine Environment Protection Committee (MEPC).2/Circ. 2/Rev2 was applied within the Hazard Workshop by using the five steps outlined below, and subsequently within the matrices used to assess impacts in Volume 3, Chapter 10: Shipping and Navigation of the EIAR.

[2] Expert competencies and experience are summarised in Volume 2: Chapter 1, Introduction.

20. 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).

21. The five basic steps for the IMO FSA process are presented in Figure 3-1 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 1-4).

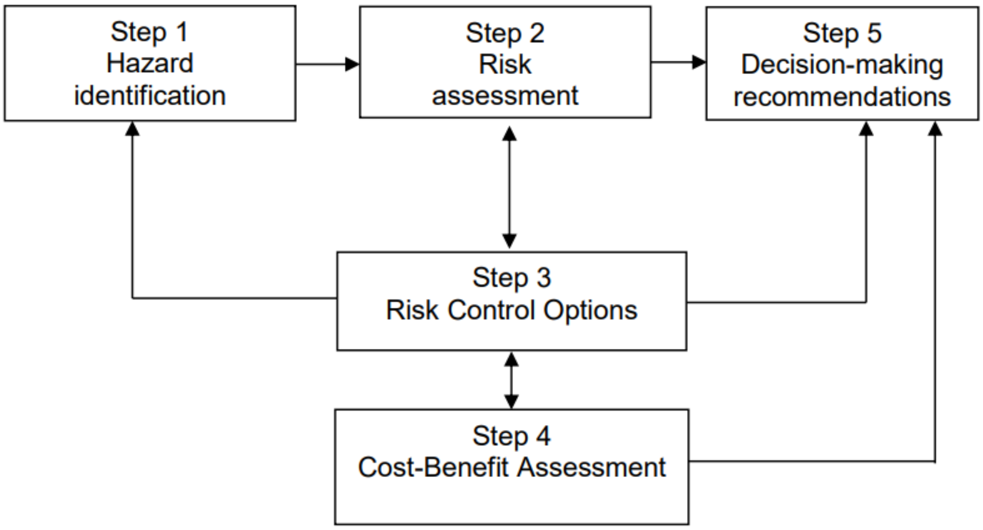

Figure 3-1: Flow Chart of the FSA Methodology (IMO, 2018)

3.3.1.1 Hazard Workshop Methodology

22. A key tool used in the NRA is the Hazard Workshop process, which ensures that all risks are identified and discussed with local interested parties prior to the assessment being undertaken. Levels of stakeholder concern are then considered within the NRA process and in Volume 3, Chapter 10: Shipping and Navigation via the Hazard Log, which forms the record of the Hazard Workshop. Further details are given in Section 38, with the Hazard Log itself presented in Annex D.

23. Table 3-1 and Table 3-2 identify how the severity of consequence and the frequency of occurrence are defined within the Hazard Log.

Table 3-1: Severity of Consequence

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

Table 3-2: Frequency of Occurrence

Rank	Description	Definition
1	Negligible	<1 occurrence per 10,000 years
2	Extremely Unlikely	1 per 100 – 10,000 years
3	Remote	1 per 10 -100 years
4	Reasonably Probable	1 per 1 – 10 years
5	Frequent	Yearly

24. The severity of consequence and frequency of occurrence are then considered collectively using the ranking system to provide the level of tolerability of an impact based on the tolerability matrix as presented in Table 3-3. The tolerability of an impact is defined as Broadly Acceptable (low risk), Tolerable (intermediate risk), or Unacceptable (high risk).

Table 3-3: Tolerability Matrix

Consequence	Major					
	Serious					
	Moderate					
	Minor					
	Negligible					
		Negligible	Extremely Unlikely	Remote	Reasonably Probable	Frequent
		Frequency				

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

25. Once identified, the tolerability of an impact is assessed to ensure it is ALARP. Risks which are determined to be "Broadly Acceptable" or "Tolerable" are considered to be ALARP whereas risks determined to be "Unacceptable" are not considered to be ALARP. Therefore, further risk control measures may be required to further mitigate an impact in accordance with the ALARP principles.

26. The Hazard Log has been used as evidence to support and refine the risk assessment contained within Volume 3, Chapter 10: Shipping and Navigation.

3.4 Methodology for Cumulative Risk Assessment

27. The impacts identified in the FSA are also assessed for cumulative effects with the inclusion of other projects and proposed developments – known as the Cumulative Effect Assessment (CEA). For shipping and navigation, given the international nature of shipping, other developments within 50 nautical miles (nm) are considered and screened as part of the NRA process. Where any impact pathway is found, an impact assessment is undertaken in the EIAR. The 50 nm radius allows consideration of vessels as they approach and depart the local regional area to identify where vessel may have multiple deviations associated with different (cumulative) developments. Other deviations associated with developments further than 50 nm are considered to be mitigated by the length of the transit/journey.

3.5 Study Area

28. A buffer of 10 nm has been applied around the array area as the study area for shipping and navigation (hereafter the 'study area') and is presented in Figure 3-2. The radius of

10 nm is standard for shipping and navigation assessment and has been used in the majority of publicly available UK offshore wind farms NRAs.

29. This study area has been defined in order to provide local context to the analysis of risks by capturing the relevant routes, vessel traffic movements, and historical incident data within and in proximity to the array area. Navigational features wholly or partially outside the study area are considered where appropriate. It is noted that the offshore ECC and the Temporary Occupation Area are fully encompassed within the 10 nm study area.

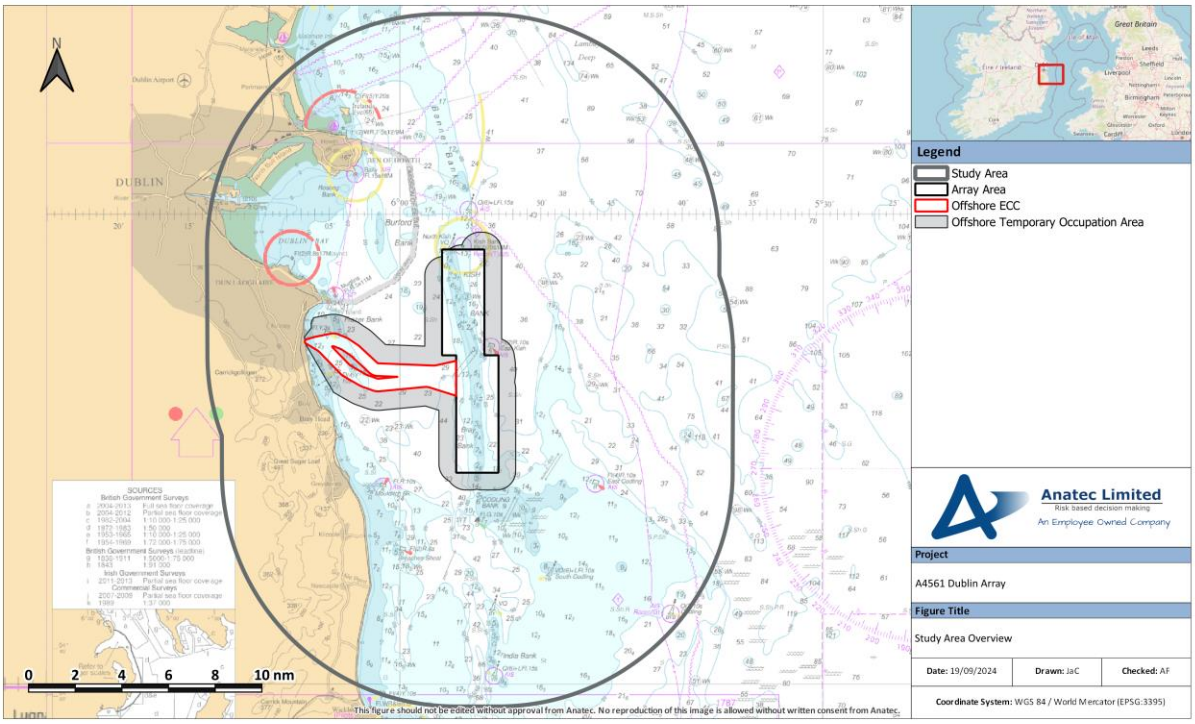

Figure 3-2: Study Area Overview

4 Consultation

4.1 Scoping

30. Responses received to the Dublin Array EIA Scoping Report (RWE, 2020) are detailed in Table 4-1.

Table 4-1: Scoping Report

Consultee	Summary Points	Where Addressed
Department of Defence (DoD)	Notice To Mariners should be created prior to commencement of any construction. These NTM's should indicate any restrictions around the area during construction, such as a minimum restricted proximity to the site.	As per Section 17, details of Dublin Array will be promulgated as required. Advisory safe passing distances may be utilised, but there will be no formal restrictions on access.
	Is there going to be a speed restriction around the area and how close is this restriction to construction?	There are no intentions to enforce speed reductions, however advisory safe passing distances may be utilised (see Section 17).
Royal National Lifeboat Institution (RNLI)	The RNLI raises no objections, or additional observations to the Dublin Array project.	Noted.
	The RNLI wishes to remain positively engaged with RWE, and requests that we are included in appropriate engagement activities and communications. Led by our Community Engagement team, the RNLI seeks to explore community partnership opportunities with RWE	The Applicant will continue to engage with the RNLI, noting promulgation of information is considered embedded mitigation as per Section 17.
	The RNLI is interested in which harbour location(s) RWE chooses as its engineering support base(s), as this may have secondary impact for the RNLI. We would be most grateful if kept informed when a final decision is published.	The Applicant will continue to engage with the RNLI including in relation to working ports, noting promulgation of information is considered embedded mitigation as per Section 17.
	In conjunction with the Irish Coast Guard, the RNLI is keen to engage with RWE in developing appropriate emergency response plans. Potentially including joint emergency response exercising and operational familiarisation activity.	Emergency response planning is considered embedded mitigation as per Section 17. The Applicant will continue to engage with the RNLI in this regard.

Consultee	Summary Points	Where Addressed
Dublin Port	Dublin Port will require access to the hydrographic soundings and nature of seabed data undertaken for the project. The appropriate measure is to submit the data to the UK Hydrographic Office (UKHO) for the benefit of all marine users.	The stated data will be provided to UKHO and can be made available to Dublin Port.
	During the vibrocore and grab sampling periods the vessel / jack-up will require a significant communications plan for passing shipping and Dublin Port Vessel Traffic Service. This should include transmission via Automatic Identification System (AIS).	As per Section 17.2 it proposed that: ▪ A communications plan with Dublin Port will be in place; and ▪ All vessels associated with Dublin Array will broadcast via AIS.
	As cable operations take place close or within the southern Traffic Separation Scheme (TSS) of Dublin Bay, there will be disruption to shipping in that the route may be closed or the Pilot stations will not be accessible for ships to manoeuvre and embark / disembark pilots. It is not the case that these vessels can route out via the north as the overriding factor is the wind, sea and swell directions that lead to the choosing of the safest aspect to conduct pilot operations. They will need to know; the weather and sea limitations of the craft so we can plan bad weather pilotage, and if the southern TSS is blocked or partially blocked there will be considerable re-routing of vessels to the northern TSS which is a busier transit as it already accommodates all the UK ferry traffic.	As per Section 17.2 it proposed that a communications plan with Dublin Port will be in place including in relation to the offshore ECC and TSS. It is noted that following feedback from Dublin Port, the Offshore ECC option into Dublin Bay is no longer being progressed.
	Consultation should be undertaken with Irish Sea Offshore Racing Association (ISORA).	ISORA have been consulted including participation in the Hazard Workshops (see Section 38).

Consultee	Summary Points	Where Addressed
	Dublin Port noted the area south of the outer channel and Great South Wall is dense with yacht racing marks (seasonal – April to October) and with fishing pots. Considerable consultation will be required with relevant fishing and recreational stakeholders.	Racing marks are shown in 7.8.1. An extensive recreational consultation campaign was undertaken as per Section 4.6, and with the fishing community as per Volume 3, Chapter 9: Commercial Fisheries. Representatives from the recreational and fishing sector were also present at the Hazard Workshop as per Section 38.
Royal Irish Yacht Club (RIYC)	RIYC fully support the notion and principles of energy conservation and wind energy generation, however are aware of the potential for technical issues and details which may develop and change over time (e.g., layout, cable landfall). Noted importance of a full and detailed decommissioning plan.	Impacts associated with recreational users of relevance to shipping and navigation are assessed in Volume 3, Chapter 10: Shipping and Navigation.

4.2 Hazard Workshops

31. Full details of the hazard workshop process are provided in Section 4.7. Relevant aspects noted within the minutes from the sessions are given in Table 4-2, Table 4-3 and Table 4-4. It is noted that the first hazard workshop sessions in 2020 were undertaken prior to the removal of the Poolbeg export cable route option into Dublin Bay was still included in the project design.

Table 4-2: Commercial Hazard Workshop 2020

Consultee	Summary Points	Where Addressed
Dublin Port	Noted pilot boarding areas had recently been amended and these new locations should be considered.	Pilot boarding stations are presented and considered in Section 7.
	Yacht clubs use race markers that are placed on a seasonal basis between April and October, which are not removed between races.	Races have been considered in Section 10.4.3. Known marks are shown in Section 7.8.1.
	Dublin port vessel numbers are predicted to increase in the future.	Future case vessel traffic increases associated with ports is considered in Section 14.2.
	Anchorage area associated with Dublin is currently often full, and vessels have begun to anchor coastally to the south of Dublin Bay.	Anchorage areas are presented in Section 7, and vessel anchoring is considered in Section 10.6.

Consultee	Summary Points	Where Addressed
	Access to the southern TSS and the nearby pilot boarding areas within Dublin Bay may be restricted during construction and when surveys are planned, noting the location of the southern ECC. This would be a particular concern during periods of adverse weather when routeing options are limited.	Port access is assessed in Volume 3: Chapter 10: Shipping and Navigation. It is noted that the removal of the Poolbeg export cable route option into Dublin Bay means there is no longer an impact on the southern TSS from the cable installation.
	Cable burial depth should be great enough to withstand an anchor drop, which may be performed in an emergency. Particular concern was raised of this occurring within the TSS due to increased traffic volumes.	Cable burial depths shall be assessed in the Cable Burial Risk Assessment (CBRA) (see Section 17). It is noted that the removal of the Poolbeg export cable route option into Dublin Bay means there will no longer be cables in proximity to the TSS.
Irish Lights	Commercial vessels passing the south west corner of the site may choose to route further west once structures are present.	Future case routeing is considered in Section 14.6. The presence of structures has been considered in the post wind farm routeing.
	Vessels displaced to the west will be operating in reduced searoom and routeing may also be affected by other projects in the area.	Section 13 considers the increase in vessel to vessel collision associated with the reduced searoom. Cumulative routeing is considered in Section 13.2.
RNLI	RNLI requested to be consulted with as the project progresses.	Liaison will be ongoing (see Section 16).
	RNLI are interested in which harbour location(s) are chosen as the engineering support base(s); as this may have a secondary impact for the RNLI.	Engineering support base(s) (operations and maintenance base(s)) will be determined post consent and RNLI will be informed of the harbour(s) chosen.
	An appropriate emergency response plan should be developed. Potentially including joint emergency response exercising and operational familiarisation.	Emergency response plans will be developed post consent (see Section 17).

Table 4-3: Local Users Hazard Workshop 2020

Summary Points	Where Addressed
Inshore racing marks are present within the area.	Races have been considered in Section 10.4.3. Known marks are shown in Section 7.8.1.
MGN 372 would be useful guidance to be referenced.	MGN 372 is referenced in Section 2.2. MGN 372 provides guidance to the Mariner operating in the vicinity of an OREI.
Information should be published in the relevant Irish Sailing Directions / leisure almanacs.	Information will be published in the relevant Irish Sailing Directions / leisure almanacs as per Section 17.
Small fishing vessels may not be accounted for in AIS data and fishing activity can vary between years.	Extensive consultation has been undertaken to gain an understanding of the behaviour of non-AIS vessels (Section 4). All surveys (Section 5.2.1) incorporated non-AIS and visual observation data.

Summary Points	Where Addressed
AIS has only been compulsory for the 2020 ISORA race season with this season only involving the coastal races.	This has been considered in Section 10.
The site may encourage recreational 'sightseers' to the area.	Potential increases in recreational traffic has been considered in Section 14.4. Associated impacts are assessed in Volume 3, Chapter 10: Shipping and Navigation.
Dive boats regularly transit to the banks and to areas west of the banks.	Relevant transits are considered in Section 10.4.3. Associated impacts are assessed in Volume 3, Chapter 10: Shipping and Navigation.
Raised concerns over work boats colliding with recreational users.	This is assessed in Volume 3, Chapter 10: Shipping and Navigation.
20 m above Mean High Water Springs (MHWS) may not allow some vessels to transit under the structures.	Dublin Array have committed to 28 m MHWS.
How will the site be lit?	Lighting and marking will be discussed and agreed with Irish Lights post-consent as per Section 17.1.
A number of wrecks are present on the banks, and the RMS Leinster is located 6-7 kilometres (km) east of the site and is visited by divers most weekends.	Relevant transits were considered in Section 10.4.3.

Table 4-4: Hazard Workshop Refresh Session 2024

Consultee	Summary Points	Where Addressed
Dublin Port	A key consideration is commercial vessels approaching the area from the south, which typically pick up pilots near the Burford Banks, and are likely to be travelling relatively quickly on approach. This will be particularly key during the construction phase, including during cable installation. Promulgation of information and early warnings of ongoing activities was considered a key mitigation.	Impacts on vessel routeing including port approaches are assessed in Volume 3, Chapter 10: Shipping and Navigation.
	Emphasised the importance of promulgating as much information as possible to fishing vessels in the area	Assumed as embedded mitigation (see Section 17).
	Noted the importance of collaboration and liaison between the cumulative wind farm developers from a navigational safety point of view.	The Applicant will continue to liaise with neighbouring wind farm developments where it is necessary to do so to ensure navigational safety.
Bord Iascaigh Mhara	Noted the areas in proximity to turbines where tides are strongest may impact on smaller vessels.	Allision risk is assessed in Volume 3, Chapter 10: Shipping and Navigation.

Consultee	Summary Points	Where Addressed
	When alerting sea users to updates to Dublin Array during construction (i.e., if a cable has been left exposed or rock armouring is necessary for cable protection), a database of local fishing vessels to contact would be helpful.	The Fisheries Mitigation and Management Strategy (FMMS) Volume 7: 7.3 outlines the approach to communication with the fishing sector. Any changes to cable locations and burial will be communicated by Marine Coordination Team via the Fisheries Liaison Officer.
StenaLine	Noted that project vessels may interact with other third party routeing depending on base port locations.	Impacts on vessel routeing including from project vessels are assessed in Volume 3, Chapter 10: Shipping and Navigation.

4.3 Key Stakeholder Meetings

32. Table 4-5 summarises the key outputs of the consultation meetings that have been undertaken for Dublin Array during the NRA process. Reference to where each point raised has been addressed are included.

Table 4-5: Consultation Meeting Summary

Date / Type	Summary Points	Where Addressed
Meeting with Irish Coastguard -23rd April 2019	The Irish Coast Guard confirmed that they would like to be kept informed but at present had no specific guidance. Guidance was likely to be similar to that published by the MCA.	MGN 654 has been used as primary guidance as detailed in Section 2.1.
Meeting with Irish Lights -24th April 2019	Key guidance is IALA-O139.	IALA-O139 has been considered as per Section 2.1.
	Agreed that marine traffic survey requirements contained within MGN 543 would be sensible in the absence of any specific Irish guidance.	Marine traffic survey methodology (Section 5.2) used MGN 654 (current equivalent of MGN 543) as primary guidance, noting that final methodology has been discussed with key stakeholders and is as per the Project Action Plan (see Section 4.4). Additional validation surveys have also been undertaken (see Section 5.1).
	Irish Lights noted that Radar data for this area would be essential.	Radar data was collected during the marine traffic survey (Section 5.2), and as agreed within the Project Action Plan (see Section 4.4), extensive consultation (Section 4) has also been undertaken to ensure non-AIS traffic behaviour is adequately captured. Additional validation surveys have also been undertaken (see Section 5.1).

Date / Type	Summary Points	Where Addressed
	Irish Lights are open to novel technologies (e.g., AIS transmitters) as Aids to Navigation (AtoN).	Lighting and marking will be discussed and agreed with Irish Lights post-consent as per Section 17.1.
	Final lighting and marking will be defined post consent once a final layout is agreed.	Lighting and marking will be discussed and agreed with Irish Lights post-consent as per Section 17.1.
	If Republic of Ireland (RoI) Guidance were to be developed this would come from Department of Transport, Tourism, and Sport (DTTAS).	Lighting and marking will be discussed and agreed with Irish Lights post-consent as per Section 17.1. Guidance to be utilised has been discussed with key stakeholders and is as per Section 2.1, noting that at time of writing DTTAS have not published any guidance regarding lighting and marking.
	Irish Lights confirmed that buoyed construction area was a sensible and appropriate mitigation.	Lighting and marking will be discussed and agreed with Irish Lights post-consent as per Section 17.1, including buoyage.
	Any Aids to Navigation placed on site would be at the cost of the developer including ensuring maintenance.	Noted by the Applicant.
	A paper statutory sanction form must be completed 3 months in advance of any deployment.	The Applicant will submit the required sanction forms as stated.
	Irish Lights noted that there was lengthy debate regarding aviation lighting requirements for other Irish projects - Irish Lights preference would be for flashing Morse W. Once Dublin Array has agreed lighting requirements with IAA, Irish Lights would need to approve.	Lighting and marking will be discussed and agreed with Irish Lights post-consent as per Section 17.1, noting that aviation lighting will also be discussed with the IAA.
	Irish Lights may wish to comment on the lighting and marking of export cables depending on the burial depth, protection method used and/or the location. Again, this can be considered post consent as part of a cable burial risk assessment (CBRA).	This will be considered post-consent in the CBRA as per Section 17.1. Any required marking would be agreed with Irish Lights post consent.
	Overall Irish Lights had no major concerns over the project and noted that the likely interest would be from the recreational community (with respect to shipping and navigation).	This was welcomed by the Applicant. Recreational users have been consulted (Section 4.6) and were represented at the hazard workshops (Section 38).
	Irish Lights advised to consult with Bord Iascaigh Mhara (BIM).	BIM were represented at the hazard workshops (Section 38).

Date / Type	Summary Points	Where Addressed
	Irish Lights have a contract with PDG for helicopter access to facilities. Currently in discussion to resolve Brexit issues but once that is done then PDG should be contacted to discuss operating procedures with respect to access of Kish Lighthouse.	Noted. Discussions are ongoing. The Potential Impact of the Offshore Infrastructure on Helicopter Operations to the Kish Tower – Helicopter One Engine Inoperative Case (Anatec, 2024): Volume 5, Appendix 5.3.12-3 of the EIAR. This includes reference to all consultation that has taken place with PDG.
Meeting with MSO - 24th April 2019	No guidance or remit on who should survey the offshore wind farm area pre or post construction. If effects on bathymetry from construction of the wind farm are anticipated, areas may need to be resurveyed.	Noted – liaison will be ongoing with MSO, and the Applicant will ensure any required survey results are provided to the relevant parties.
	Advised that BIM should be consulted.	BIM were represented at the hazard workshops (Section 38).
	Radar and visual observations would be required for the area given the high level of recreational but also fishing vessel activity.	Radar data was collected during the marine traffic survey (Section 5.2), and as agreed within the Project Action Plan (see Section 4.4), extensive consultation (Section 4) has also been undertaken to understand how non-AIS vessels use the area.
	Did not believe that fishing occurred on the bank and noted that the main activity in the area was potting. It was noted that only 200 of 2000 registered fishing boats under Irish Flag were required to mandatorily carry AIS.	Radar data was collected during the marine traffic survey (Section 5.2), and as agreed within the Project Action Plan (see Section 4.4), extensive consultation (Section 4) has also been undertaken to understand how non-AIS vessels use the area.
	NRA for Dublin Array Offshore Wind Farm will follow the requirements detailed within MGN 543.	Section 2 sets out the guidance used within this NRA, including MGN 654 (current equivalent of MGN 543) as a primary guidance document.
	Suggested that identifying in the Emergency Response Plans, local landing points with ambulance and helicopter access would be useful.	Emergency response plans will be considered and agreed post-consent as per Section 17.1.
	Would need Statutory Instrument (SI) to be implemented for statutory safety zones. Currently, dangerous behaviour near turbine should be reported to MSO, who would seek prosecution via Merchant Shipping Act if appropriate.	Approach to safety zones and advisory safe passing distances is as per Section 17.1.

Date / Type	Summary Points	Where Addressed
	Consultation with local yacht clubs was essential, Irish Chamber of Shipping (ICS) may also be interested in being involved in a hazard workshop. Dublin Port would be interested in burial methodology and depths.	Local yacht clubs and Dublin Port were all contacted, and were represented at the hazard workshops (Section 4).
	Wind farm support or construction vessels would need to be appropriately certified.	All vessels will be suitably certified as per Section 17.1 (mitigation).
Meeting with Dublin Port – 17th July 2019	Presented proposed NRA approach to Dublin Port.	See Section 3.
Meeting with Irish Coastguard – 10th August 2020	Recommended that the assessment should reference the National Contingency Plan and demonstrate how the project's emergency planning will interface with the Coastguard and wider Government emergency response plans.	Emergency response plans will be considered and agreed post-consent as per Section 17.1.
Meeting with MSO - 18th September 2020	MSO were content with marine traffic survey approach and agreed that any data collected during 2020 would not necessarily be valid (e.g., restrictions placed on leisure and cruise visits).	Agreed survey methodology provided in Section 5.2.
	Noted that the wind farm may dissuade vessels from attempting to cross the bank, and would therefore be of benefit to navigational safety".	Impacts associated with deviation are assessed within Volume 3, Chapter 10: Shipping and Navigation of the EIAR.
Meeting with the RNLI – 20th October 2020	Project will likely be considered an SAR resource and potentially tasked through the Coastguard, similar to the RNLI. Associated Coastguard plans / requirements are still being looked at, but it is expected that an emergency response plan will be developed similar to those seen in the UK.	Emergency response plans will be considered and agreed post-consent as per Section 17.1.
Meeting with Dublin Port Authority – 8th December 2020	Discussions were held with regards to an appropriate assumption for a future case increase of vessel traffic.	It was agreed with Dublin Port that a 25% increase would be included within the NRA (see Section 1).

Date / Type	Summary Points	Where Addressed
Meeting with Irish Lights - 18th January 2021	Discussions around vessel access to the Kish Bank light. Irish Lights stated there may be some impact during periods of adverse weather by these were considered manageable.	Considered in Volume 3, Chapter 10: Shipping and Navigation.
Meeting with Dublin Port – 6th October 2021	Discussions around use of Traffic Management Procedures to manage cumulative impacts.	Cumulative impacts are assessed in Volume 3, Chapter 10: Shipping and Navigation.
Meeting with IRCG – 18th January 2024	Discussions held around impacts on SAR operations from Dublin Array.	Impacts to SAR operations are assessed in Volume 3, Chapter 10: Shipping and Navigation.
Meeting with Irish Lights – 14th February 2024	Discussions held around lighting and marking of Dublin Array.	A Lighting and Marking Plan (LMP) has been produced (Appendix 4.3.11-6).
Meeting with Dun Laoghaire – 1st March 2023	Discussions around project vessel movements within Dun Laoghaire harbour limits.	Impacts from project vessels are assessed in Volume 3, Chapter 10: Shipping and Navigation.
Meeting with Dublin Port Company – 10th April 2024	General discussion held around potential mitigations that could be implemented to manage risks to vessels on approach to Dublin Port past the array area including promulgation of information and use of guard vessels.	Impacts on port access are assessed in Volume 3, Chapter 10: Shipping and Navigation.
Meeting with Irish Lights – June 2024	Irish Lights requested a commitment to engage with Irish Lights in the event of any wind farm activities within the Temporary Occupation Area encroaching within 500m from the centre point of the Kish Light. A work plan, including risk assessment and detailed method statement will be provided within a suitable time frame to inform Irish Lights approval process and adoption of any further mitigations that are considered necessary.	Associated impacts and considerations are assessed in Volume 3, Chapter 10: Shipping and Navigation. This commitment has been made.

Date / Type	Summary Points	Where Addressed
Meeting with IRCG - 18th July 2024	IRCG stated that a SAR checklist process should be undertaken with IRCG post consent. Suggested the OSP location in the Design Scenario Option A layout be moved north to increase width of the adjacent SAR lane.	Impacts on SAR are assessed in Volume 3, Chapter 10: Shipping and Navigation including in relation to the SAR checklist. An updated Design Scenario Option A layout with amended OSP location was provided to the IRCG in August 2024.

4.4 Project Action Plan

33. Dublin Array promulgated a Project Action Plan to key stakeholders in September 2020, including MSO, Irish Lights, and the Dublin Port Authority. The Project Action Plan outlined the approach to be taken to the NRA, notably in terms of guidance, and vessel traffic survey methodology. Key comments received are provided in Table 4-6.

Table 4-6: Project Action Plan

Stakeholder	Summary Points	Where Addressed
Irish Lights	The difficulties around the conducting a full summer survey in 2020 are noted, as are the additional consultation measures intended to mitigate this data deficit. It is stated that 'the project will then consult with the regulators as part of the NRA process to ascertain whether a further 14 days of summer survey data should be collected for validation purposes in 2021, or if the baseline is considered representative as it stands'. Whilst understanding that a baseline will be established for the NRA based on current data, Irish Lights would consider it prudent to conduct this further 14 days of summer data survey in order to definitively ascertain if there are any notable changes from the baseline given the volume of recreational and non-AIS fishing activity in this particular area during this seasonal period.	Dublin Array has collected additional summer 2021 survey data (inclusive of both AIS and non AIS vessels – see Section 5.1).

Stakeholder	Summary Points	Where Addressed
	Irish Lights recommends that particular attention be paid to the south-west corner of the proposed site given its proximity (~2.5 nm) to the shallows of the Moulditch bank and associated buoy. If it is assumed that deviated routes will keep a distance of at least 1 nm from the site boundary, and will also keep 0.5-1 nm distance from Moulditch, then this only leaves 0.5-1 nm total routeing width. This is a potential choke point if 4 ships should be able to pass each other (as guided by MGN 543).	Available space has been assessed in terms of deviations in Section 14.6 and collision risk in Section 15.2.2. Allision risk has also been considered (Section 15.3.2 for powered, Section 15.3.3 for drifting). Impact assessment is undertaken in Volume 3, Chapter 10: Shipping and Navigation of the EIAR.
	In recognising the intention to consider cumulative effects, Irish Lights recommends particular attention be paid to the cumulative effects of other planned OREIs, particularly to the south of the planned site, which may have a cumulative effect on navigation routeing, safe passing distances, converging traffic, salvage/emergency requirements etc.	Cumulative effects on routeing are considered in Section 13.2. CEA is undertaken in Volume 3, Chapter 10: Shipping and Navigation of the EIAR.
	With regards to the Kish Bank Light, consider impacts around light maintenance/access, allision risk etc.	Impacts associated with the Kish Bank Light have been assessed within Volume 3, Chapter 10: Shipping and Navigation of the EIAR (where relevant / appropriate).
	Consider the risk of Not Under Command vessels being set into danger by the north/south-flowing tidal stream, including requirements/measures in event of a salvage/emergency and the availability/time-requirements of local sea-going tugs to reach a casualty.	Drifting risk is assessed on a quantitative basis in Section 15.3.3, noting that this considers tidal stream rates / directions15.2.2. Associated impact assessment is undertaken in Volume 3, Chapter 10: Shipping and Navigation of the EIAR.
	Irish Lights recommends considering if there may be any potential resultant impact on navigable depths to the west, reducing navigable area (e.g. during seabed levelling resulting in the generation of surplus material which may be side-cast and subject to natural on-going dispersal into the navigable channel).	This is assessed in Volume 3, Chapter 1 Physical Processes.

Stakeholder	Summary Points	Where Addressed
	Irish Lights recommends consideration of cable hazards associated with vessels (commercial/leisure/fishing) potentially anchoring in Dublin Bay, Killiney Bay, or in proximity to Dún Laoghaire harbour (e.g. cruise ships tendering to Dún Laoghaire).	Baseline anchoring activity is assessed in Section 10.6. Associated impact assessment is undertaken in Volume 3, Chapter 10: Shipping and Navigation of the EIAR.
	Noting value of lower blade tip height above Mean High Water Springs (MHWS) of 20 m, note that MGN543 guidance recommends not less than 22 m, unless there is evidence that risks to any vessel type with air drafts greater than [the minimum] are minimised.	Dublin Array have committed to exceeding the 22 m value.

4.5 Regular Operators

34. The vessel traffic survey data studied (see Section 10) was used to identify regular commercial vessel operators of the area. These operators were subsequently contacted to request comment on Dublin Array. Responses received are provided in Table 4-7.

35. The letter sent to the operators is provided in Annex B for reference.

Table 4-7: Regular Operators Comments Log

Operator	Summary Points	Where Addressed
Aasen Shipping	Aasen Shipping operated vessels always use pilots when heading into port. Suggested to enter a dialogue with the pilots.	Dublin Port have been consulted with directly and note that pilot representatives were present at the Hazard Workshop (see Section 38). Pilot station locations have been considered in Section 7.
Irish Ferries / Matrix Ship Management	Proposed site location is adjacent to some of Irish Ferries routes specifically: • Dublin to Holyhead routes which passes between the Kish Lighthouse and Bennet bank buoy; and • Dublin to Cherbourg and North to South container routes which pass within the western Section of the study area.	Vessel routeing is analysed in Section 11, and includes Irish Ferry transits. These routes also form the basis of the modelling inputs in Section 13.

Operator	Summary Points	Where Addressed
	Will there be any new navigational lights or marks used during construction and operation?	Lighting and marking has been considered during consultation with Irish Lights (Section 4.1) with final lighting and marking to be determined post consent as per Section 17.1.
	Is silting envisioned between Kish and Bray Banks and the coast lines?	Silting has been assessed and is not considered to be significant in EIA terms. Full details are provided in Volume 3, Chapter 1 Physical Processes.
Kess	Noted that vessels should be able to pass safely in good weather conditions but if a machinery breakdown occurred during easterly or westerly gales then the vessels safety may be impeded.	Modelling scenarios have been run (Section 15.3.3) which incorporate the possibility of a drifting vessel due to machinery failure together with adverse meteorological weather conditions in the area.
P&O ferries	No real issues for P&O ferry routes.	N/A.
Seatruck	Site is located on shallow banks that would be marked as 'no go' areas therefore no impact would be expected on day to day operations.	Vessel routeing (Section 11) considers current routeing preferences.
	Noted that the installation would increase traffic levels.	Increases in traffic associated with the development have been considered in Section 14.5. Associated impacts are assessed in Volume 3, Chapter 10: Shipping and Navigation.
Stena Lines	Noted that if speed restrictions or 'safe passing distances' were in place during construction some routes could be affected.	Recommended safe passing distances will be used during construction (see Section 16) and vessel routeing has been considered in Section 11.

4.6 Recreational Users

36. Table 4-8 summarises the recreational clubs and safety organisations providing services to recreational users that were identified as potential users of the area, any points that were raised, and where they are addressed within this NRA.

37. The consultation letter sent to recreational users is provided in Annex C for reference.

Table 4-8: Recreational Consultation Comments Log

Club	Summary Points	Where Addressed
Irish Water Safety	Requested to be retained as a stakeholder and invited to the hazard workshop.	Irish Water Safety attended the hazard workshop (Section 38).
RNLI Dún Laoghaire	Keen to support and facilitate stakeholder engagement.	RNLI Dún Laoghaire attended the hazard workshop (Section 38).
Howth Yacht Club	Mainly use the area currently for fishing and tacking.	Section 10 details AIS vessels within the study area during the study area. Non-AIS vessels are also considered where appropriate throughout.
	May sail through the area occasionally.	
Irish Sailing Association	Raised concern over exclusion/safety zones around the wind farm that may prohibit recreational vessels from navigating through.	Advisory safe passing distances will be in place during construction and periods of maintenance (see Section17), but vessel access will not be prohibited.
Marline Sub-aqua	Noted a number of shipwrecks and debris had been detected on the Kish, Bray, and Codling Banks.	Wrecks are detailed in Section 7.6.
Bray Harbour	Noted area is currently used for sailing and fishing.	Section 10 details both AIS and non-AIS vessels within the study area during the study period. This input has been considered in the baseline establishment.
Atlantic Youth Trust	No comment	N/A
Dún Laoghaire Power Boat School	No comment	N/A

38. Additional consultation input was also provided by ISORA, and the Royal Irish Yacht Club via email correspondence in 2021 and via a meeting held in March 2024. Details are provided in Table 4-9.

Table 4-9: ISORA Consultation

Forum	Summary Points	Where Addressed
Email correspondence 2021	ISORA indicated traditional cross channel racing was anticipated to resume in the near future. Dublin Array could impact coastal races. The Royal Irish Yacht Club provided details of general race timings and plans, noting that these were dependent on COVID restriction levels.	Impacts associated with historical vessel racing are assessed in Volume 3, Chapter 10: Shipping and Navigation of the EIAR.

Forum	Summary Points	Where Addressed
Meeting, 4th March 2024	Outlined key queries were around impacts to ISORA activities from the construction works and the operational structures.	Impacts associated with historical vessel racing are assessed in Volume 3, Chapter 10: Shipping and Navigation of the EIAR.
	Noted any buoyage present may be of use for racing mark purposes.	The LMP (Appendix 4.3.11-6) includes discussion of approach to buoyage.

4.7 Hazard Workshop

39. A key element of the consultation phase was the Hazard Workshop, a meeting of local and national marine stakeholders to identify and discuss potential shipping and navigation hazards. Using the information gathered from the Hazard Workshop, a Hazard Log was produced for use as input into the risk assessment undertaken in Volume 3, Chapter 10: 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.

4.7.1 Hazard Workshop Attendance

40. The Hazard Workshop was held virtually on Microsoft Teams on 4th November 2020. Organisations were invited to attend representing various sectors relevant to shipping and navigation including regulators, commercial bodies, port operators, recreational clubs and bodies, and SAR responders.

41. The Hazard Workshop was attended by:

- Dublin Port Pilots;
- Dublin Port Vessel Traffic System;
- Matrix Management;
- Irish Lights;
- Dublin Port;
- Stena Lines;
- RNLI;
- Seatruck;
- Irish South and East Fishermen's Organisation;
- Bray Harbour Joint Development Committee;
- Bord Iascaigh Mhara (BIM);
- Water Safety Ireland;
- Royal Irish Yacht Club;
- ISORA; and
- Diving Ireland.

42. Operators that attended the virtual Hazard Workshop did not identify any other operators not in attendance or previously contacted that should be consulted.

4.7.2 Hazard Workshop Process and Log

43. During the Hazard Workshop, key maritime hazards associated with the construction, O&M and decommissioning of Dublin Array 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.

44. Following the 2020 Hazard Workshops, the risks associated with the identified hazards were ranked in the Hazard Log based upon the discussions during the workshop, with appropriate embedded mitigation measures identified, including any additional measures required to reduce the risks to ALARP. The Hazard Log was then provided to the Hazard Workshop attendees for comment and their feedback incorporated into the NRA. The hazard log was also discussed and distributed for comment following the second hazard workshop session in 2024.

45. The Hazard Log is provided in full in Annex D.

5 Data Sources

5.1 Summary

46. The key data sources considered within the NRA are summarised in Table 5-1, which includes what aspect of the baseline has been derived from each source.

Table 5-1 Data Sources

<table>
<tr><th>Data</th><th>Source</th><th>Purpose</th></tr>
<tr><td rowspan="7">Vessel Traffic</td><td>14 days of AIS, Radar and visual observation data collected during November 2019.</td><td rowspan="4">Characterising vessel traffic movements within, and in proximity to, the array area and ECC.</td></tr>
<tr><td>14 days of AIS, Radar and visual observation data collected during August/September 2021.</td></tr>
<tr><td>14 days of AIS, Radar and visual observation data collected during March 2022.</td></tr>
<tr><td>14 days of AIS, Radar and visual observation data collected during August 2023.</td></tr>
<tr><td>Vessel Monitoring Service (VMS) data from 2014 to 2018 – Marine Institute Ireland Marine Atlas</td><td rowspan="3">Validation of the vessel traffic surveys and characterising seasonal variations.</td></tr>
<tr><td>VMS data - 2017</td></tr>
<tr><td>2023 Route Data – ISORA</td></tr>
<tr><td rowspan="3">Maritime Incidents</td><td>Marine Casualty Investigation Board (MCIB) incident reports (1992 to 2022)</td><td rowspan="3">Review of maritime incidents within, and in proximity to, the array area and ECC.</td></tr>
<tr><td>Marine Accident Investigation Branch (MAIB) incident data (1994 to 2014)</td></tr>
<tr><td>RNLI incident data (2013 to 2022)</td></tr>
<tr><td rowspan="3">Other navigational features</td><td>East & North Coasts of Ireland Sailing Directions (Irish Cruising Club, 2014)</td><td rowspan="3">Characterising other navigational features in proximity to the array area and ECC.</td></tr>
<tr><td>Marine Irish Digital Atlas (MIDA) (MIDA, revised 2018)</td></tr>
<tr><td>Admiralty Sailing Directions Irish Coast Pilot NP40 (United Kingdom Hydrographic Office (UKHO), 2019)</td></tr>
</table>

Data	Source	Purpose
	UK Admiralty Charts 1410, 1411, and 1415 (United Kingdom Hydrographic Office (UKHO), 2023)	
Weather Data	Wind data collected from Kish Lighthouse – 2011 to 2015	Characterising weather conditions in proximity to the array area for use as input to the collision and allision risk modelling.
	Wave data collected from Marine Ireland M2 buoy	
	Visibility data taken from Admiralty Sailing Directions Irish Coast Pilot NP40 (UKHO, 2019)	
	Tidal stream data taken from Admiralty Charts 1411 and 1415 (UKHO, 2023)	

5.2 Vessel Traffic Survey Methodology

47. This Section outlines the survey methodology as proposed within the Project Action Plan (see Section 4.4).

48. As agreed with key stakeholders, MGN 654 has been as used as guidance with regards to the marine traffic survey and identification of the baseline conditions (see Section 4), as at the time of writing no equivalent Irish document is available.

5.2.1 Winter 2022 Survey

49. Baseline shipping activity during winter for the array area was assessed using Automatic Identification System (AIS), Radar, and visual observations recorded over 14 days[3] from the Baily Lighthouse (Howth), between 1100 on the 2nd March and 1100 on the 16th March 2022. The Baily Lighthouse location was selected as it provided at height coverage of the array area and allowed both Radar and visual observations to be recorded.

50. The primary objective of the survey was to identify and validate the routeing of vessels and the level of activity within the study area during winter. This was achieved by recording, in real-time, the positions of vessels within range of the AIS receiver and Automatic Radar Plotting Aid (ARPA), supplemented by observations of vessels within visual range to obtain information on the type and size of vessels where this information was not available from AIS.

51. Figure 5-1 presents an overview of the survey location, which is directly on the coastline offering a good line of sight of the survey area.

[3] 14 x 24 hour periods as opposed to calendar days.

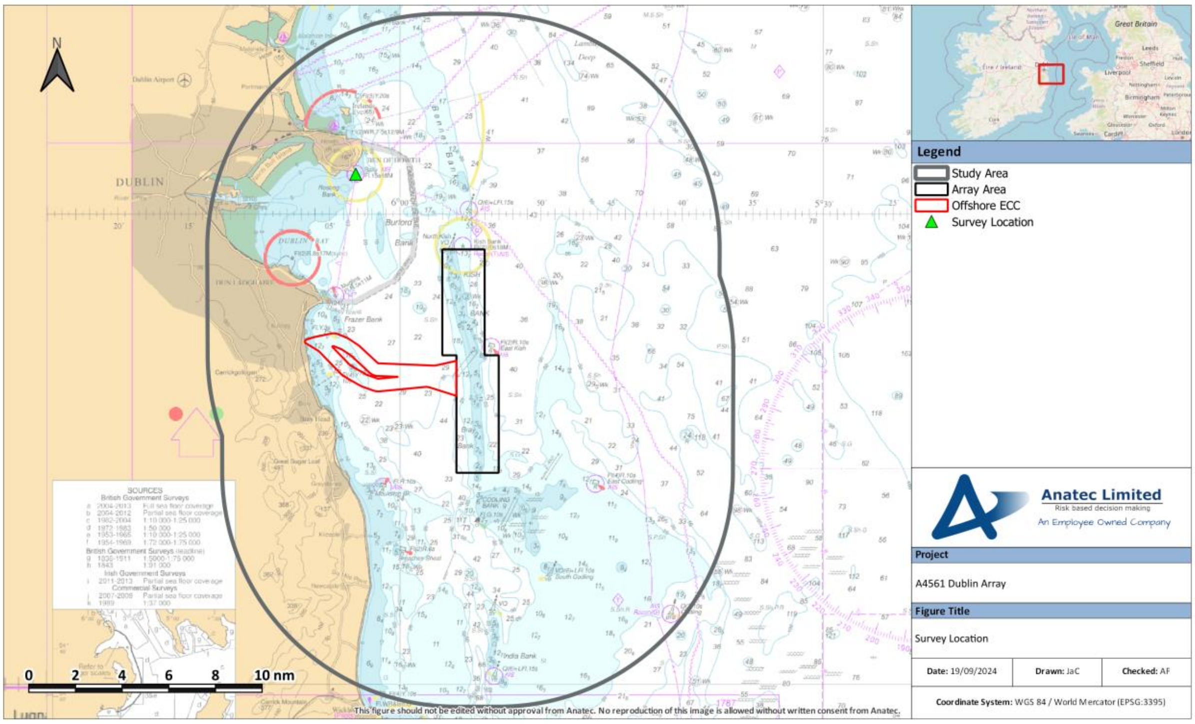

Figure 5-1: Survey Location

52. It is noted that the on-site data has been supplemented with additional AIS collected from other local coastal receivers to ensure as comprehensive coverage of the area as practicable.

5.2.2 Summer 2023 Survey

53. Baseline shipping activity during summer for the array area was assessed using AIS, Radar, and visual observations recorded over 14 days from the Baily Lighthouse (see Section 5.2.1), between 1100 on the 17th August and 1100 on the 31st August 2023.

5.3 Data Limitations

5.3.1 Automatic Identification System Data

54. The carriage of AIS is required on board all vessels of greater than 300 Gross Tonnage (GT) engaged on international voyages, cargo vessels of more than 500 GT not engaged on international voyages, passenger vessels irrespective of size built on or after 1 July 2002, and fishing vessels over 15 m length overall.

55. Therefore, for the vessel traffic surveys, larger vessels were recorded on AIS, while smaller vessels without AIS installed (including fishing vessels under 15 m in length and recreational craft) were recorded, where possible, on the Automatic Radar Plotting Aid (ARPA). A proportion of smaller vessels also carry AIS voluntarily, typically utilising a Class B device.

56. Throughout the winter survey, 69% of vessel tracks were recorded via AIS with the remaining 31% recorded via Radar – this value was high due to the number of fishing vessels. Throughout the summer survey, approximately 98% of vessel tracks were recorded via AIS with the remaining 2% recorded via Radar.

5.3.2 Historical Incident Data

57. The Royal National Lifeboat Institution (RNLI) incident data cannot be considered comprehensive of all incidents in the study area. Although hoaxes and false alarms are excluded, any incident to which any RNLI resource was not mobilised has not been accounted for in this dataset.

58. Similarly, the Marine Casualty Investigation Board (MCIB) incident data only accounts for completed investigations. Any incident that has not been investigated or whose investigation was ongoing at the time of writing was not accounted for. In addition, precise location data is not available for all incidents within the dataset.

5.3.3 United Kingdom Hydrographic Office Admiralty Charts

59. The United Kingdom Hydrographic Office (UKHO) admiralty charts are updated periodically and therefore the information shown may not reflect the real time features within the region with total accuracy. However, during consultation, input has been sought from relevant stakeholders regarding the navigational features baseline.

6 Project Description Relevant to Shipping and Navigation

60. This Section provides an overview of the key parameters of the design options under consideration deemed of relevance to the NRA. Full details of the assessment parameters are provided in Volume 3, Chapter 10: Shipping and Navigation.

6.1 Project

61. The array area is located approximately 5 nm east of Bray Head, as can be seen in Figure 6-1. Key corner coordinates are then shown in Table 6-1, the positions of which are provided in Figure 6-1.

62. The array area covers an area of approximately 17.5 square nautical miles (nm^2) (approximately 59 square kilometres (km^2)), and is positioned over the Kish and Bray Banks, as shown in Figure 6-1, which shows the charted 5 m contours of these banks relative to the site. Charted water depths within the site range from 1.6 m to 30 m.

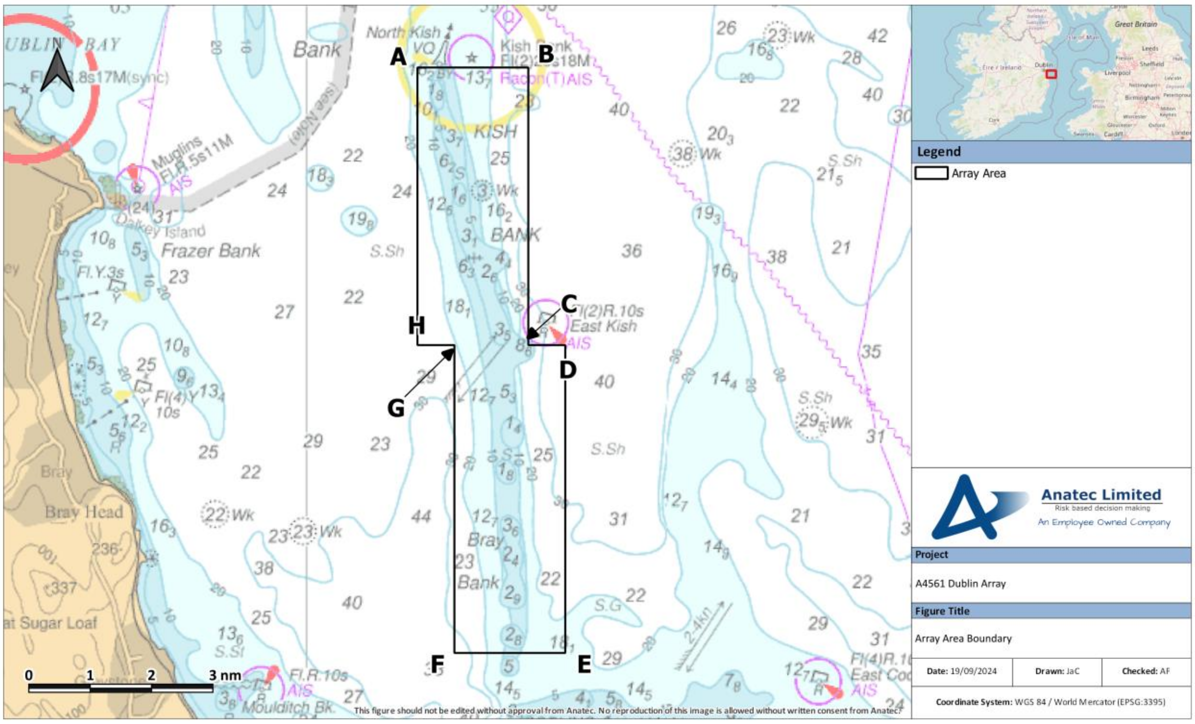

Figure 6-1: Array Area Boundary

Table 6-1: List of Coordinates for the Site in World Geodetic System 1984 (WGS 84)

Point	Latitude (Degree Decimal Minutes (DD(D)MM.mmmm))	Longitude (DD(D)MM.mmmm)
A	53° 18.4996" N	005° 57.0004" W
B	53° 18.4997" N	005° 54.0008" W
C	53° 13.9999" N	005° 54.0002" W
D	53° 13.9996" N	005° 53.0000" W
E	53° 08.9999" N	005° 53.0003" W
F	53° 08.9998" N	005° 56.0006" W
G	53° 13.9999" N	005° 56.0006" W
H	53° 14.0000" N	005° 56.9999" W

6.2 Infrastructure

6.2.1 Layout

63. Three layout options corresponding to each of the proposed turbine classes A, B and C are being considered, full details are provided in Volume 2, Chapter 6Project Description. The three layouts are shown in Sections 6.2.1.1, 6.2.1.2, and 6.2.1.3. The NRA modelling has been based on the layout option that includes the greatest number of turbines (Layout A) to ensure the greatest allision and collision risk is modelled. This approach aligns with standard practise given it maximises the allision risk.

6.2.1.1 Option A

64. Option A consists of the layout with the highest number of turbines, but smallest rotor diameter. The details of the number of structures is shown in Table 6-2, with the layout presented in Figure 6-2.

Table 6-2: Number of Structures (Option A)

Structure	Maximum Number
Wind Turbine Generator (WTG)	50
Offshore Substation Platforms (OSPs)	1

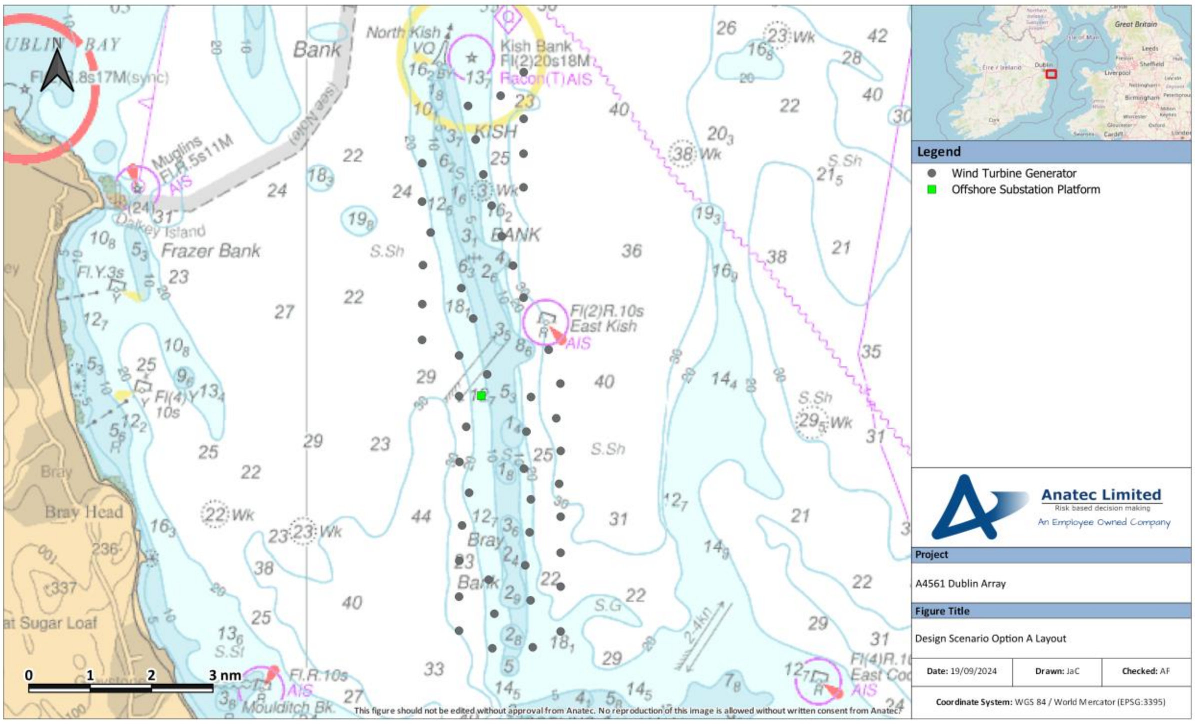

Figure 6-2: Design Scenario Option A Layout[4]

6.2.1.2 Option B

65. Option B consists of the layout with both number of turbines and rotor diameter values between those described for options A and C. The details of the number of structures is shown in Table 6-3, with the layout presented in Figure 6-3.

Table 6-3: Number of Structures (Option B)

Structure	Maximum Number
WTG	45
OSP	1

[4] Noted that the OSP location for Design Scenario Option A is approximately 30m north of the location used within the NRA modelling. This change was made in line with IRCG feedback on the layout. Given the low magnitude of change and noting the OSP is internal, the modelled location is considered representative and the change does not influence the significance rankings determined within Volume 3, Chapter 10: Shipping and Navigation.

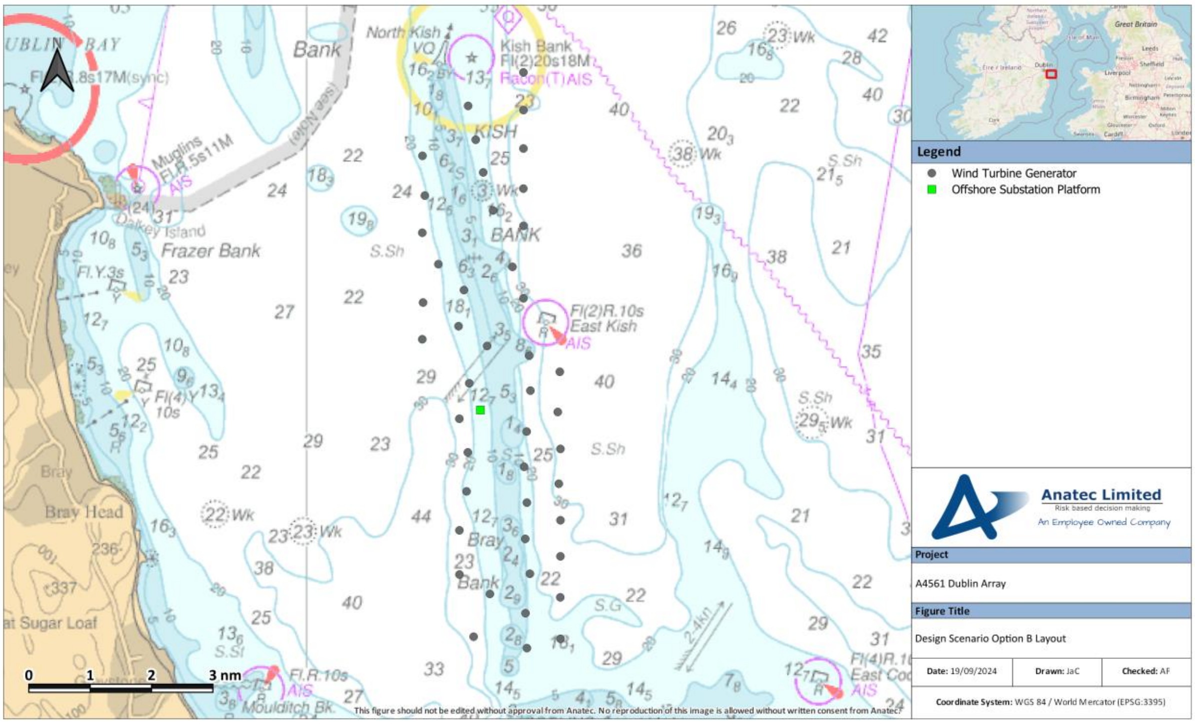

Figure 6-3: Design Scenario Option B Layout

6.2.1.3 Option C

66. Option C consists of the layout with the fewest structures, but largest rotor diameter. The details of the number of structures is shown in Table 6-4, with the layout presented in Figure 6-4.

Table 6-4: Number of Structures (Option C)

Structure	Maximum Number
WTG	39
OSP	1

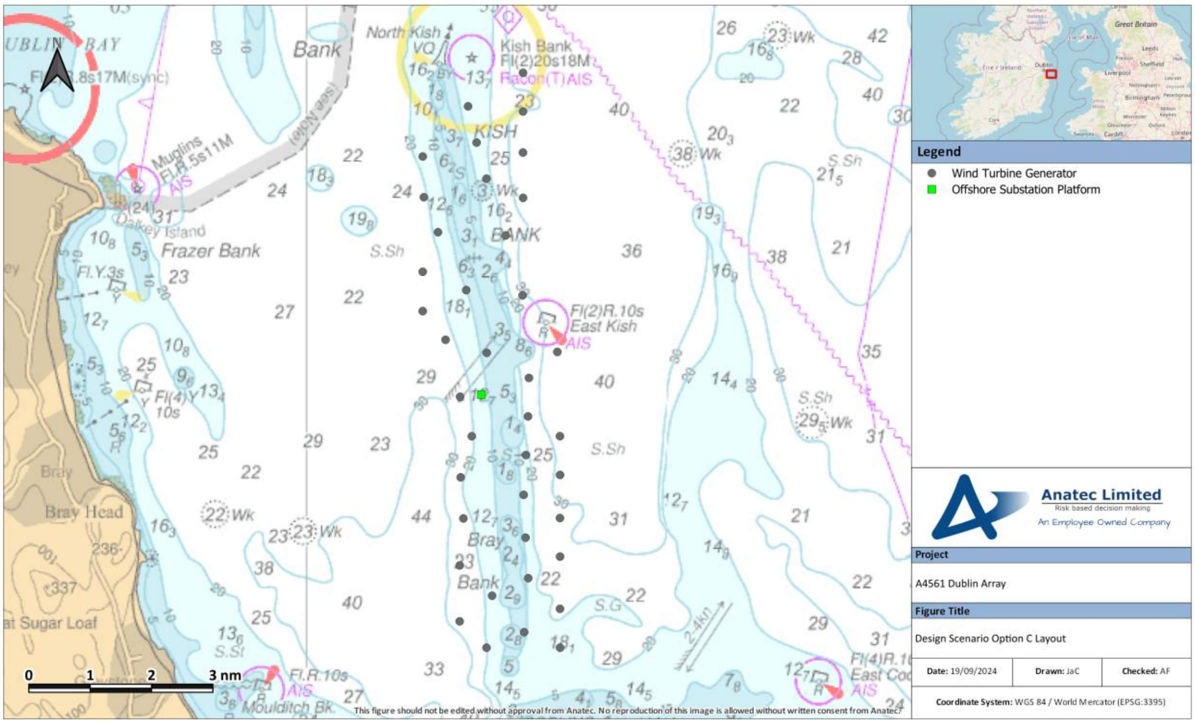

Figure 6-4: Design Scenario Option C Layout

6.2.2 Wind Turbine Generators

67. Multileg (4-legged) foundations have been considered for shipping and navigation for the WTGs as these foundation types provide the maximum structure dimensions at sea surface. The WTG measurements assuming use of multileg foundations are provided in Table 6-5, noting that this corresponds to the smallest size of WTG (i.e., maximum number of structures).

Table 6-5: WTG Parameters (assumes smallest WTG size under Consideration)

Parameter	Specification for Layout
Foundation Types	Multileg foundations
Dimensions at sea surface (dependent upon water depth, geology, and WTG type)	45 x 45 m
Minimum blade tip height (above MHWS)	28 m
Maximum rotor blade diameter	236 m

68. Other foundation types under consideration include monopiles and suction bucket multileg. Descriptions of each of these foundation types are provided in Volume 2, Chapter 5 Project Description of the EIAR.

69. It is noted that the RYA Position Paper (one of four) (RYA, 2019) and MGN 654 recommend a blade clearance of 22 m above Mean High Water Springs (MHWS) to

ensure the majority of recreational vessel masts are not at risk of interaction with the blades. The minimum of 28 m given in Table 6-5 exceeds this.

6.2.3 OSPs

70. The number of OSPs, their maximum dimension in relation to the layout presented in Figure 6-2, and the corresponding maximum parameters are presented in Table 6-6.

Table 6-6: Other Infrastructure

Structure	Number	Maximum Dimensions at Sea Level (m)	Foundations
OSP	1	45x 45	Multileg

6.2.4 Cables

71. A maximum of two export cable routes will be used with an approximate cable diameter of 330 milometers (mm). It is anticipated that the maximum length of export cable will be 37 km (assumes maximum number of cables installed each with a maximum length of 18.35 km). All export cables will be installed within the offshore ECC shown in Figure 3-2.

72. A maximum length of 120 km of inter-array cables will be used to link up the WTGs and OSPs, with an approximate cable diameter of 220 mm.

73. Height of cable protection will be up to 1m.

6.2.5 Floating Pontoon

74. It is intended that a pontoon will be installed within Dun Laoghaire harbour at the quayside to facilitate boarding and un-boarding of Crew Transfer Vessels (CTV). It is anticipated that this could be up to 90 m in length.

6.2.6 Construction Phase

75. The construction phase for Dublin Array will commence in Q1 of 2030 at the earliest. It is anticipated that the latest possible completion of construction will be Q4 2032, noting that this will depend on when construction commences. Maximum construction duration is anticipated to be 30 months.

76. During the construction phase, construction works associated will be undertaken in the Temporary Occupation Area, array area, and offshore ECC shown in Figure 6-5. It is anticipated that construction buoyage will be within 500m of the WTGs.

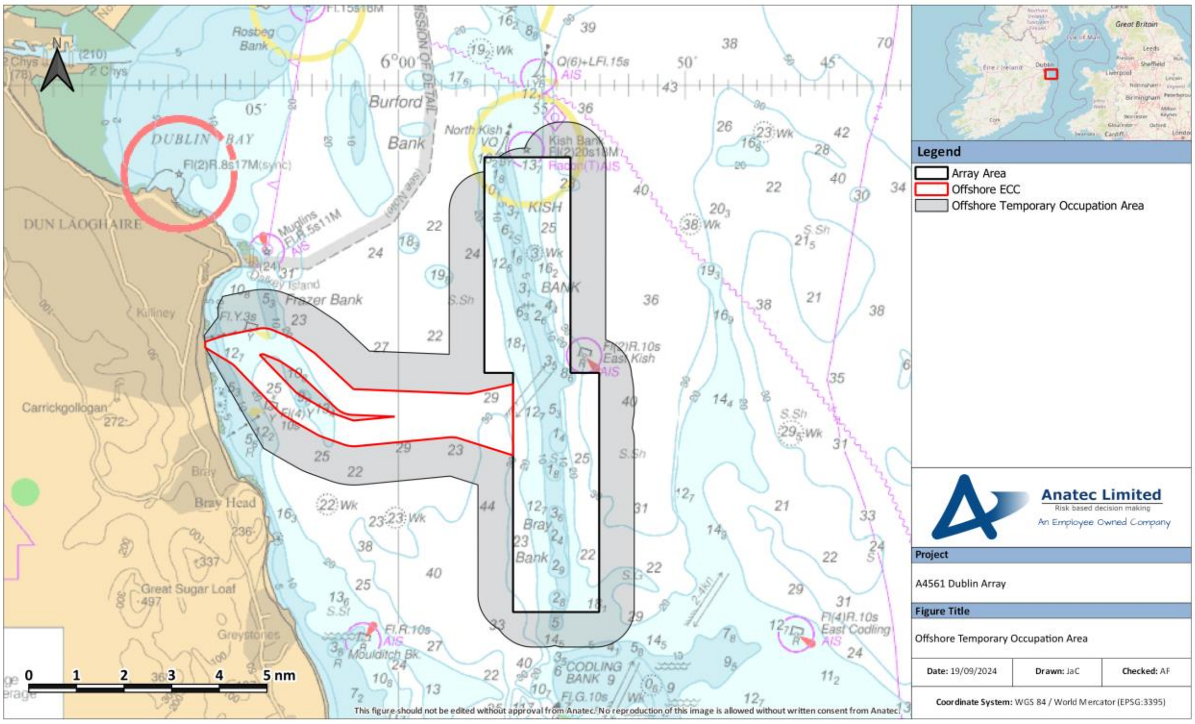

Figure 6-5: Temporary Occupation Area

7 Navigational Features

77. A summary plot of navigational features in proximity to the array area and offshore ECC, which have been identified using the most detailed UKHO Admiralty Charts and data available, is presented in Figure 7-1. Each of the features shown is discussed in the following subsections in more detail.

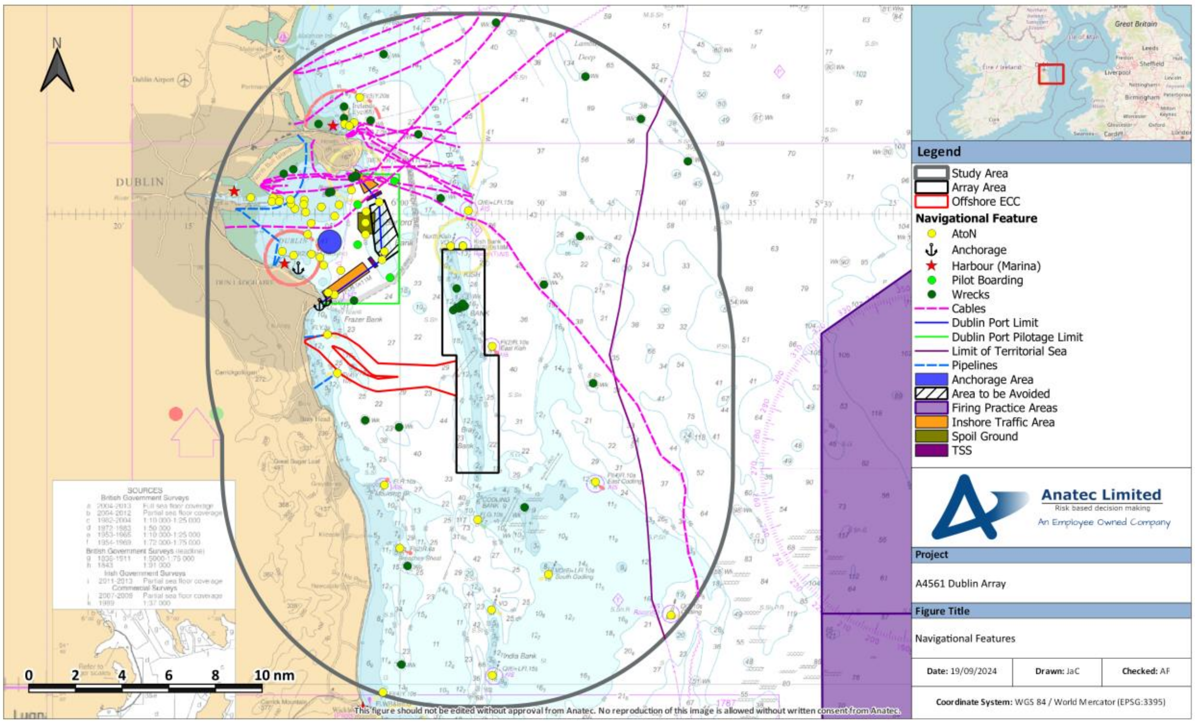

Figure 7-1: Navigational Features

7.1 Ports

78. The key local ports identified as being of relevance to Dublin Array are shown in Figure 7-1. Further relevant details of each are then provided in Table 7-1, which shows the distance of the ports from the array area, and the key vessel types accommodated.

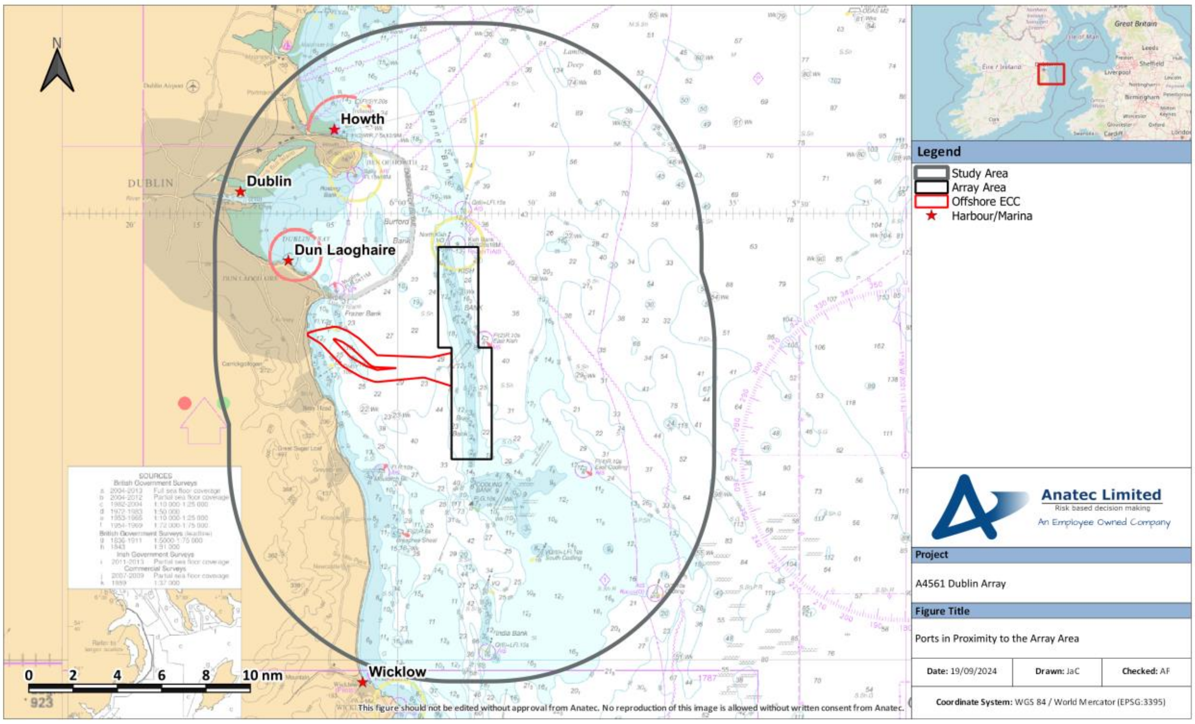

Figure 7-2: Ports in the Proximity of Array Area

Table 7-1: Ports in Proximity of Array Area

Port	Distance to Array Area (nm)	Vessel Types
Dún Laoghaire	6.8	Fishing and Recreational
Dublin	9.2	Commercial
Wicklow	10.8	Fishing and Recreational
Howth	7.0	Fishing and Recreational

79. The key port in the area in terms of vessel numbers is Dublin, which reported a total of 7,402 vessel arrivals in 2022 (Central Statistics Office (CSO), 2023). Vessel arrivals at Dublin Port for the period between 2014 and 2022 are shown in Figure 7-3.

80. Dún Laoghaire is also of note given its status as the primary centre for yachting in Ireland. A total of 820 berths are available in the marina, in addition to moorings belonging to the local clubs.

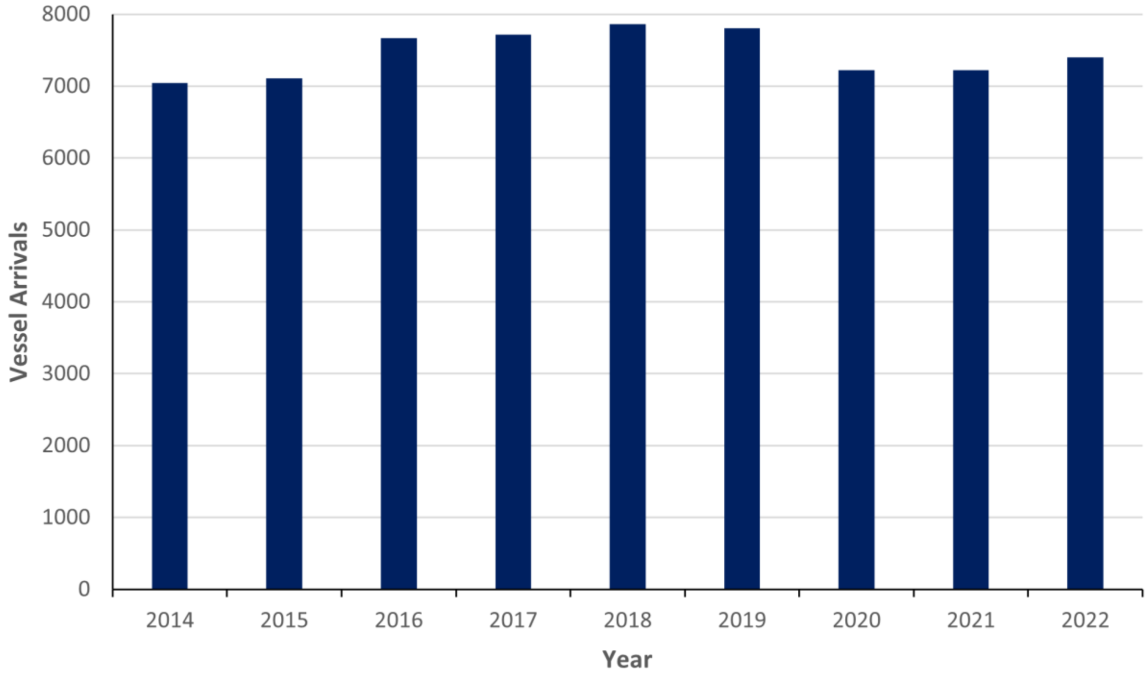

Figure 7-3: Dublin Port Vessel Arrivals (CSO, 2023)

7.2 Routeing Measures

81. Two Traffic Separation Schemes (TSS) are present on the approach to Dublin Port and are located 2.7 nm west (South Burford TSS) and 3.5 nm north west (North Burford TSS) of the array area, as shown in Figure 7-4.

82. The two TSS border an Area to be Avoided (see Section 7.4), and each has an associated Inshore Traffic Zone.

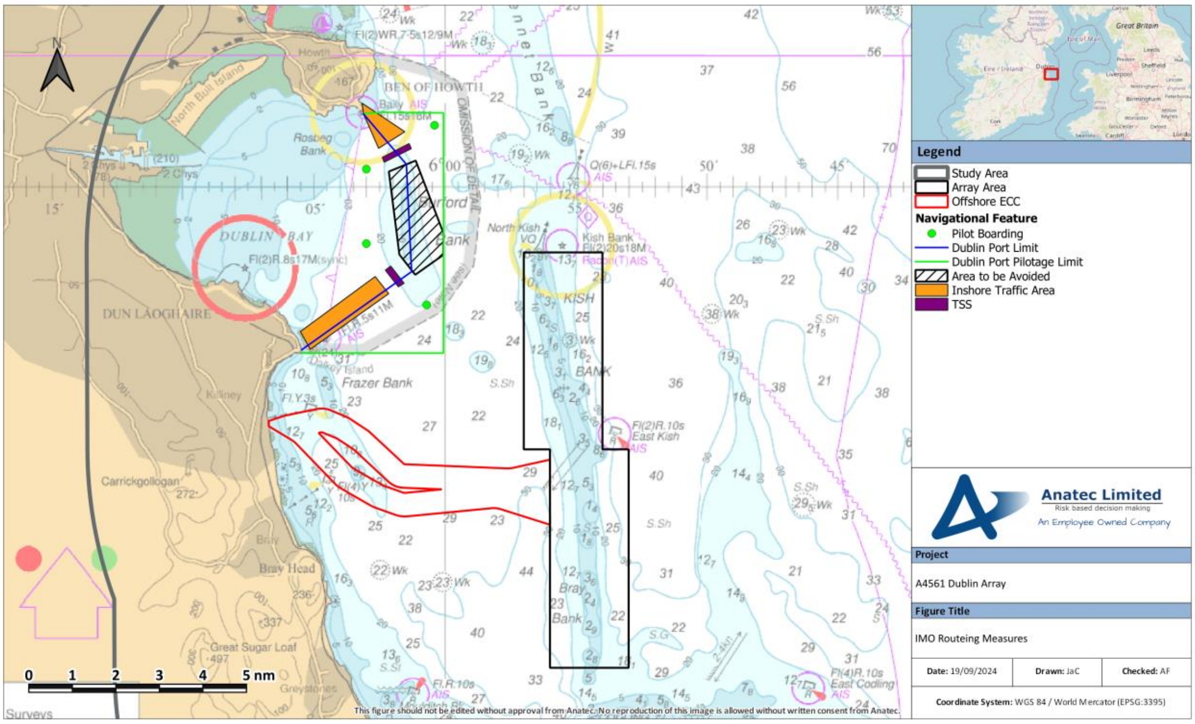

Figure 7-4: IMO Routeing Measures

7.3 Pilotage and Vessel Traffic Service

83. As shown in Figure 7-4, there are four charted pilot boarding areas associated with Dublin Bay. These are located at either end of both the North Burford TSS and South Burford TSS. Dublin Port also operates a Vessel Traffic Service (VTS). All vessels navigating to and from Dublin Port should establish early contact with the VTS and maintain a listening watch on Very High Frequency (VHF) channel 12. This includes small craft, which must make contact with the VTS for traffic clearance.

7.4 Area to be Avoided

84. An Area to be Avoided is located approximately 1.8 nm west of the array area on the approach to Dublin Port between the two associated TSS (see Section 7.2), as shown in Figure 7-4. This area is associated with the Burford bank, noting the associated shallow water depths pose a navigational risk to passing vessels.

7.5 Existing Wind Farms

85. The only operational wind farm of relevance to Dublin Array is Arklow Phase 1, which is located approximately 20 nm to the south of the site. This project consists of seven WTGs located on the Arklow Bank, as shown in Figure 7-5.

86. Planned developments are considered on a cumulative basis in Section 13.

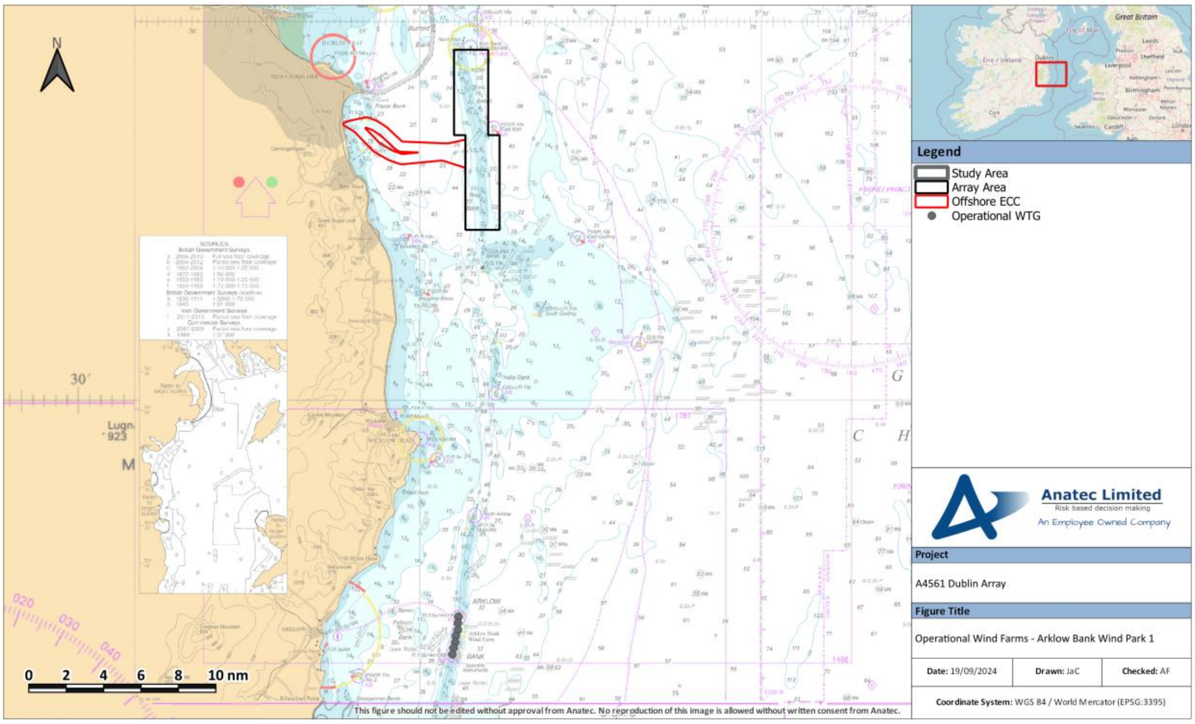

Figure 7-5: Operational Wind Farms – Arklow Phase 1

7.6 Wrecks

87. Numerous charted wrecks are located within the study area with nine charted wrecks located within the array area itself, as shown in Figure 7-1. The closest charted wreck outside of the site is located approximately 1.9 nm from the south-east corner. No charted wrecks are located within the offshore ECC.

88. It was noted during consultation that dive clubs regularly visit the wrecks on the Kish and Bray Banks, and also transit to the RMS Leinster wreck located approximately 7 km to the east of the site.

7.7 Cables and Pipelines

89. Numerous cables are present within the study area with the majority of these passing north of the array area, as shown in Figure 7-1. The closest cable is the 'Hibernia D', a telecoms cable which passes 0.9 nm from the north east corner of the array area.

90. In addition, two pipeline outfalls terminate in proximity to the offshore ECC, related to the Shanganagh-Bray wastewater treatment works.

7.8 Aids to Navigation

91. Aids to Navigation (AtoN)[5] in the vicinity of the array area are shown in Figure 7-6. These include AtoN marking shallow banks in the area, and the approach to Dublin Port also has numerous AtoNs marking the recommended passage vessels should take when entering or leaving the port, including the fairway where a depth of 7.8 m is maintained for larger vessel access. It is noted that small craft are instructed to remain outside of the buoyed area, and if they are required to cross should do so only with the permission of the VTS, and as close to right angles as practicable.

92. The closest AtoN to the array area is the North Kish Bank buoy, located directly north of the array area, noting that the eastern extent of the bank is marked by the East Kish buoy. Of further note is the Kish Bank Light, which is located north of the site and transmits via Racon and AIS.

93. The Moulditch Buoy is positioned approximately 3 nm to the west of the southern extent of the array area, and is of relevance noting Irish Lights (see Section 4) raised potential for a reduction in searoom between this buoy and the Kish Bank as a result of Dublin Array (see Section 14.6 for anticipated post wind farm routeing).

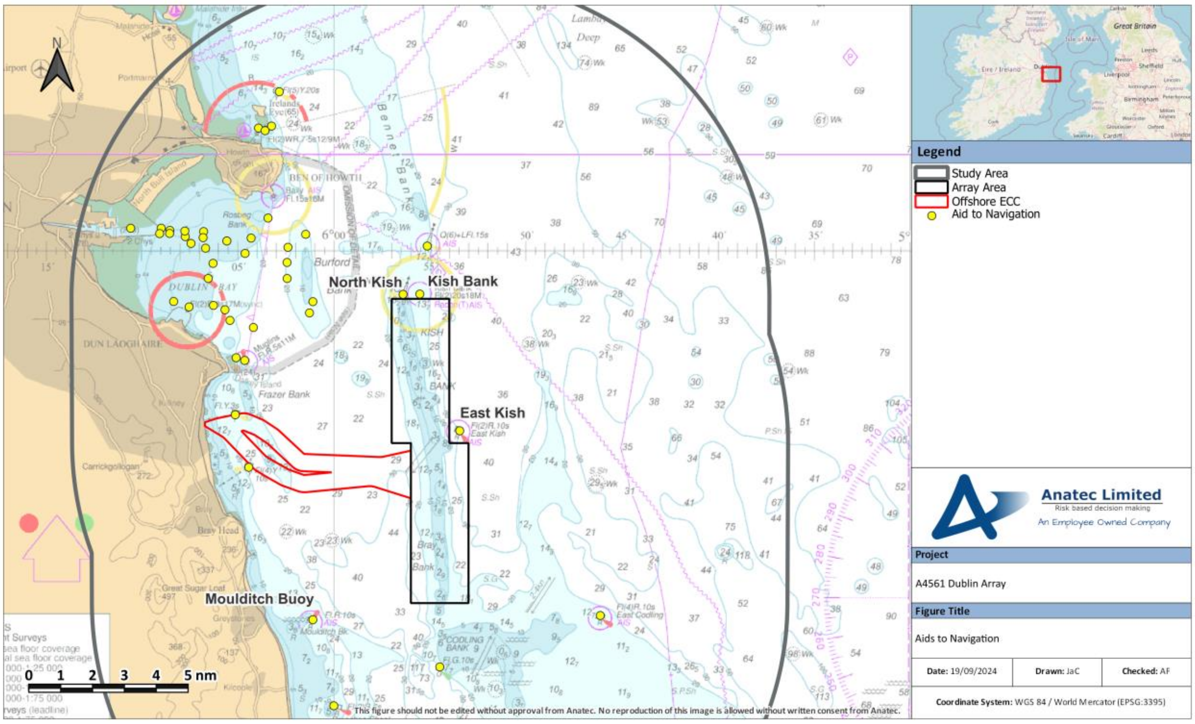

Figure 7-6: AtoN

[5] IALA defines an AtoN as - A device, system or service, external to vessels, designed and operated to enhance safe and efficient navigation of individual vessels and/or vessel traffic such as buoys, lights and marks

7.8.1 Racing Marks

94. It is noted that racing / recreational marks are typically in place between April and October. Known positions utilised during 2023 (non-exhaustive) are shown in Figure 7-7.

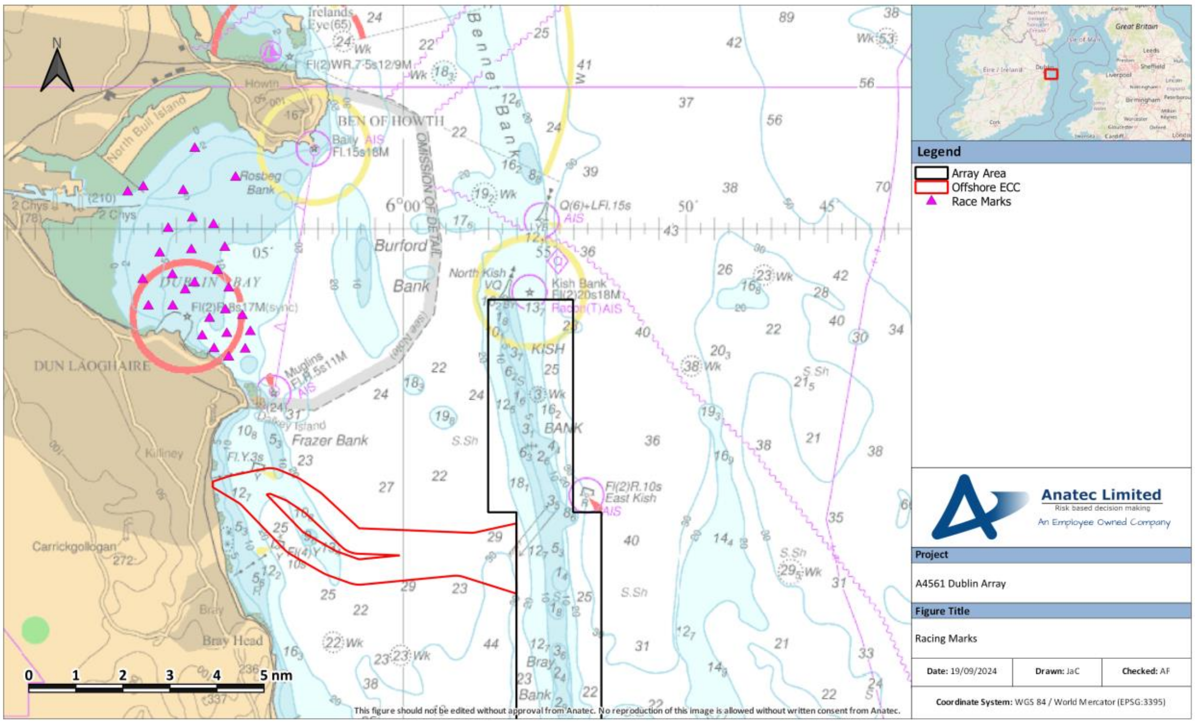

Figure 7-7: Racing / Recreational Marks

7.9 Anchorage Areas

95. There are four anchorages located within the study area, most notably the charted anchorage associated with Dublin Port, which is located within Dublin Bay as per Figure 7-8. It was noted during consultation, and from the vessel traffic surveys (see Section 10.6) that due to the Dublin anchorage often being at capacity, vessels have also been observed to anchor further to the south.

96. The remaining three areas are historic / preferred anchorages. Of note is the anchorage associated with Dún Laoghaire. Anchoring is not permitted within the harbour itself, however suitable anchorage is charted outside the harbour limits.

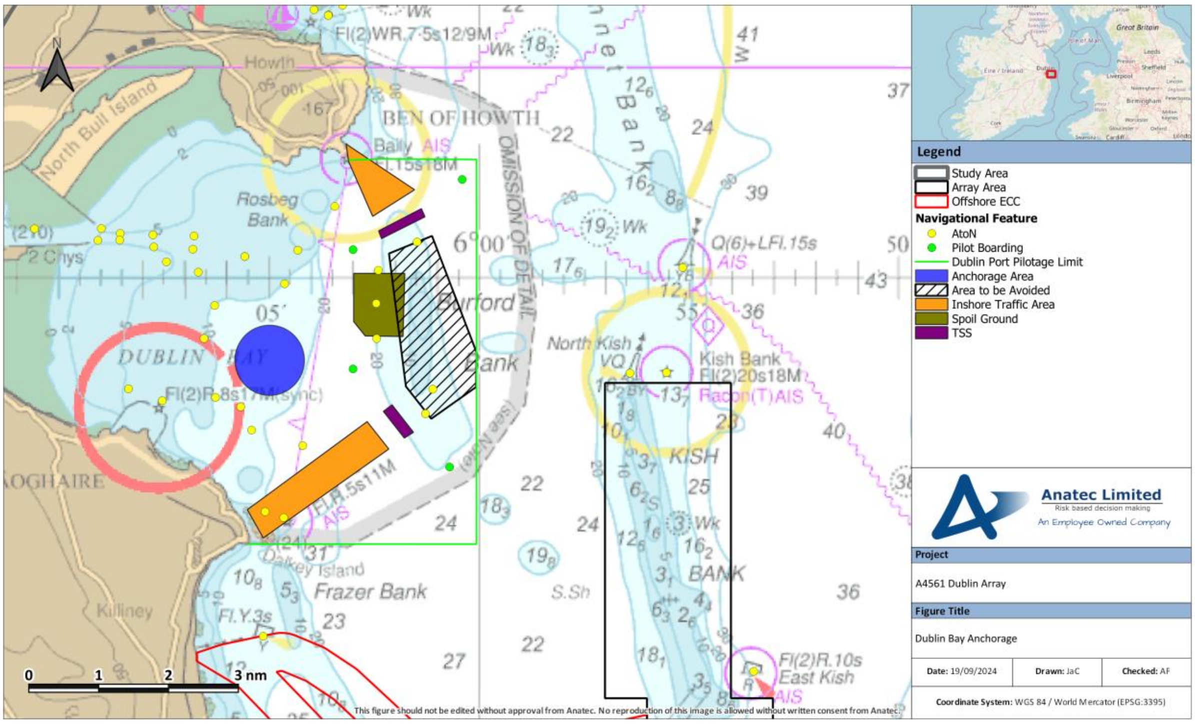

Figure 7-8: Dublin Bay Anchorage

7.10 Military Practice and Exercise Areas

97. The D201B UK Ministry of Defence (MOD) firing practice area is located approximately 13.7 nm east of the array area, with the D201 firing practice area located south of D201B.

8 Meteorological Ocean Data

98. This Section presents meteorological and oceanographic statistics collected for the area. The data presented in this Section has been used as input into the risk assessment within this NRA, and in particular is used within the collision and allision risk modelling (see Section 13).

8.1 Wind

99. Wind data has been collected from a LiDar on the Kish Lighthouse sourced from a combination of data collected from the Kish Lighthouse from between 2011 and 2015 and local reanalysis based data sources, noting that additional validation based on local data sources has also been undertaken.

100. Table 8-1 presents the proportion of the wind direction within each 30-degree interval based on the Kish Lighthouse data.

Table 8-1: Wind Direction Data

Wind Direction (°)	Proportion (%)
0	5
30	4
60	5
90	4
120	6
150	10
180	14
210	12
240	12
270	13
300	9
330	6

8.2 Wave

101. The sea state within each of the defined ranges detailed in Table 8-2 have been determined from Significant Wave Height data collected data from the Marine Ireland M2 buoy (Met Eireann, 2021).

Table 8-2: Sea State Data

Sea State	Proportion (%)
Calm (<1m)	50.4
Moderate (1–5m)	49.5
Severe (>5m)	0.1

8.3 Visibility

102. The annual average incidence of poor visibility (defined as less than 1 km) for the Section of the Irish Sea within which the array area is located is approximately 0.02 (i.e., 2% of the year) (UKHO, 2019).

8.4 Tide

103. From the UKHO Admiralty Chart 1411 (tidal diamond “T”, “P”, and “U” located approximately 7.4 nm south east, 14.6 nm north east, and 15.4 nm south, respectively) and UKHO Admiralty Chart 1415 (tidal diamond “A” located approximately 0.8 nm north), currents in proximity to the site are generally in a north direction on the flood tide and a south direction on the ebb tide, with a peak flood tidal rate of 3.8 knots (kt) and a peak ebb tidal rate of 3.8 kt. Table 8-3presents details for tidal diamond “A” from the UKHO Admiralty Chart 1415, given its proximity to the site.

Table 8-3: UKHO Admiralty Chart Tidal Diamond A

Hours		Direction of Streams (degree (°))	Rates at Spring Tide (kt)	Rate at Neap Tide (kt)
Before high water	6	002	1.3	0.7
	5	002	2.1	1.1
	4	002	2.1	1.2
	3	002	1.5	0.9
	2	002	0.8	0.5
	1	182	0.1	0.0
High water		182	1.1	0.6
After high water	1	182	2.0	1.1
	2	182	2.2	1.2
	3	182	1.8	1.0
	4	182	1.0	0.5
	5	182	0.1	0.0
	6	002	0.9	0.5

9 Emergency Response Resources

104. This Section summarises the existing emergency response resources (including SAR) and reviews historical maritime incident data to assess baseline incident rates in proximity to the array area.

9.1 Search and Rescue Helicopters

105. The IRCG is responsible for the response to, and coordination of, maritime accidents which require SAR, counter-pollution operations, and ship casualty operations. A new 10-year aviation services contract was awarded to Bristow Ireland Limited by the Department of Transport in August 2023 and provides for year-round, day and night Search and Rescue helicopter services. This service will be delivered through a fleet of six SAR configured AW189 helicopters located in Dublin, Shannon, Sligo and Waterford.

106. The locations of these bases are presented in Figure 9-1.

Figure 9-1: Irish Coast Guard SAR Helicopter Base and Marine Rescue Centre Locations

107. The closest base to the array area, and most likely to respond to an incident requiring helicopter assistance at Dublin Array, is the Dublin Airport base, approximately 13 nm north-west of the site.

9.2 Marine Rescue Coordination Centres

108. The Irish Coast Guard operates three Maritime Rescue Coordination Centres (MRCC) around Irish waters, based in Dublin, Malin Head, and Valentia Island. The locations of these bases are presented in Figure 9-1. The closest of these centres to the array area is Dublin (a National Maritime Operations Centre (NMOC)) which provides marine SAR

response services and co-ordinates the response to marine casualty incidents within the Irish Exclusive Economic Zone (EEZ).

9.3 Royal National Lifeboat Institution

109. The RNLI is organised into six divisions, with the relevant region for Dublin Array being "Scotland and Ireland". Based out of more than 230 stations around the UK and Ireland, there are around 350 lifeboats across the RNLI fleet, including All-Weather Lifeboats (ALB) which can be operated in all weather conditions and Inshore Lifeboats (ILB) suitable for coastal operations.

110. Figure 9-2 presents the locations of RNLI stations in proximity to the array area. Following this, Table 9-1 summarises the types of lifeboat operated by the RNLI out of these stations.

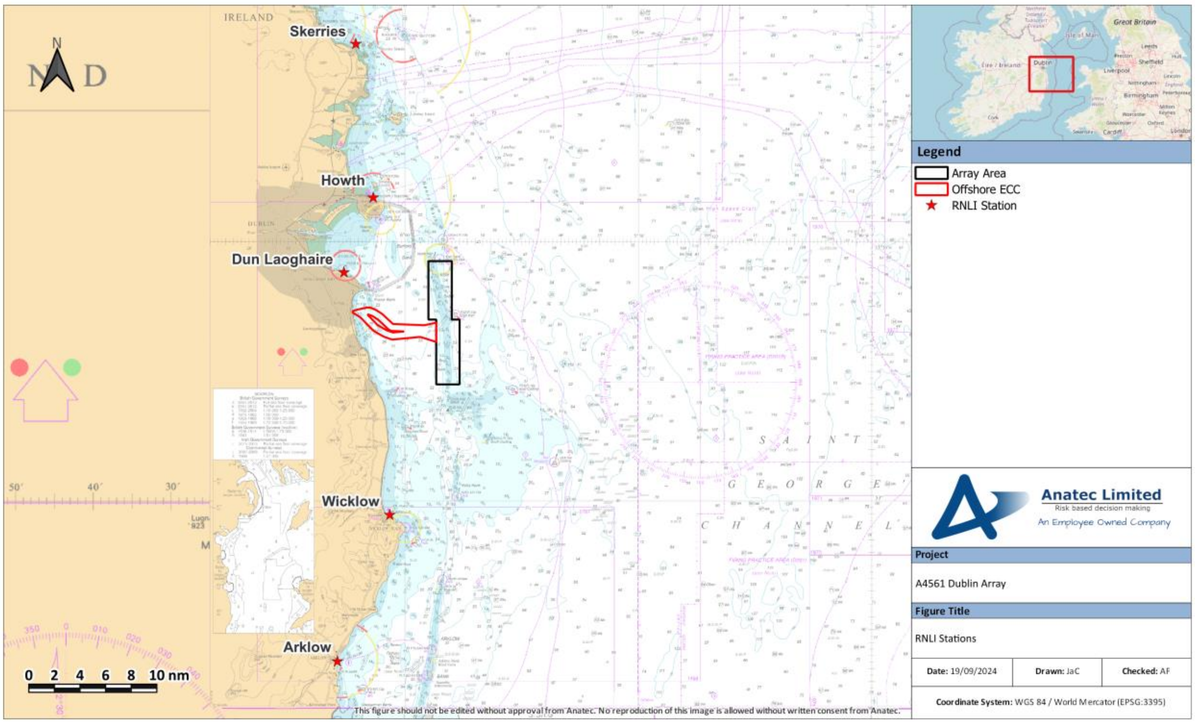

Figure 9-2: RNLI Station Locations

Table 9-1: Types of Lifeboat Held at RNLI Stations

Station	Lifeboat(s)	ALB Class	ILB Class	Distance to Site (nm)
Howth	ALB and ILB	Trent	D Class	6.4
Dún Laoghaire	ALB and ILB	Trent	D Class	6.7
Wicklow	ILB	–	D Class	10.8
Skerries	ILB	–	B Class	17.5
Arklow	ALB	Trent	–	22.8

111. 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.

112. The locations of incidents are presented in Figure 9-3, colour-coded by incident type. The same data is presented in Figure 9-4, colour-coded by casualty type.

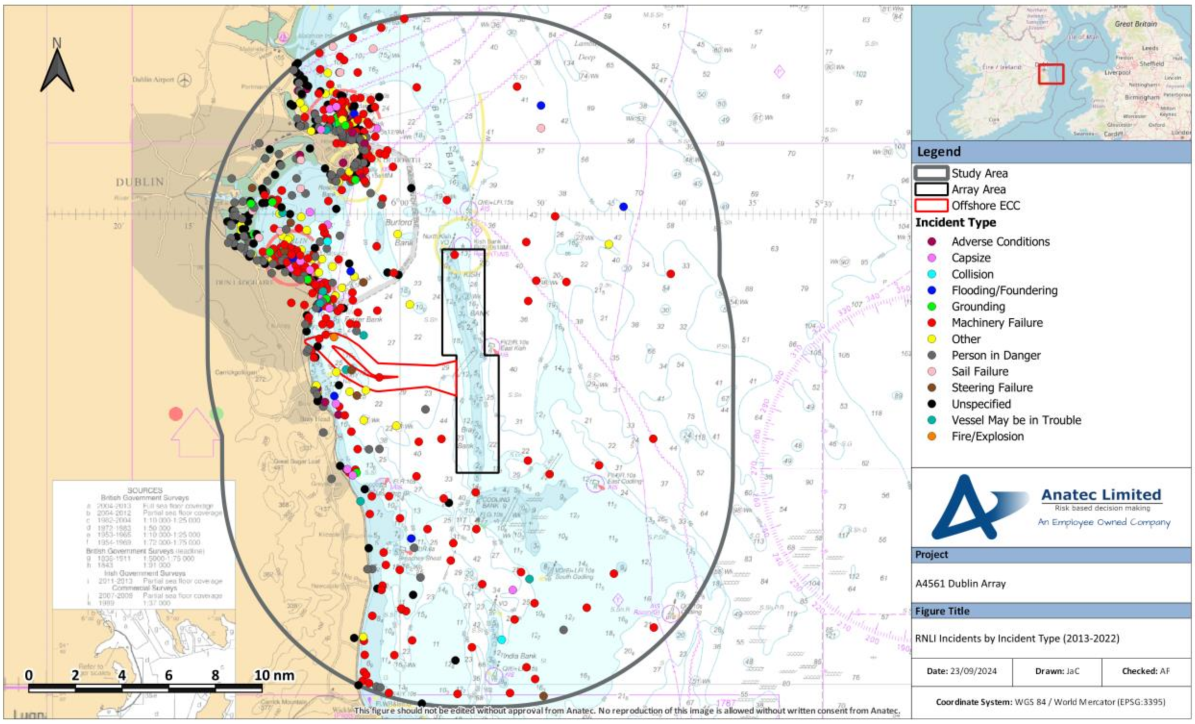

Figure 9-3: RNLI Incident Locations by Incident Type (2013-2022)

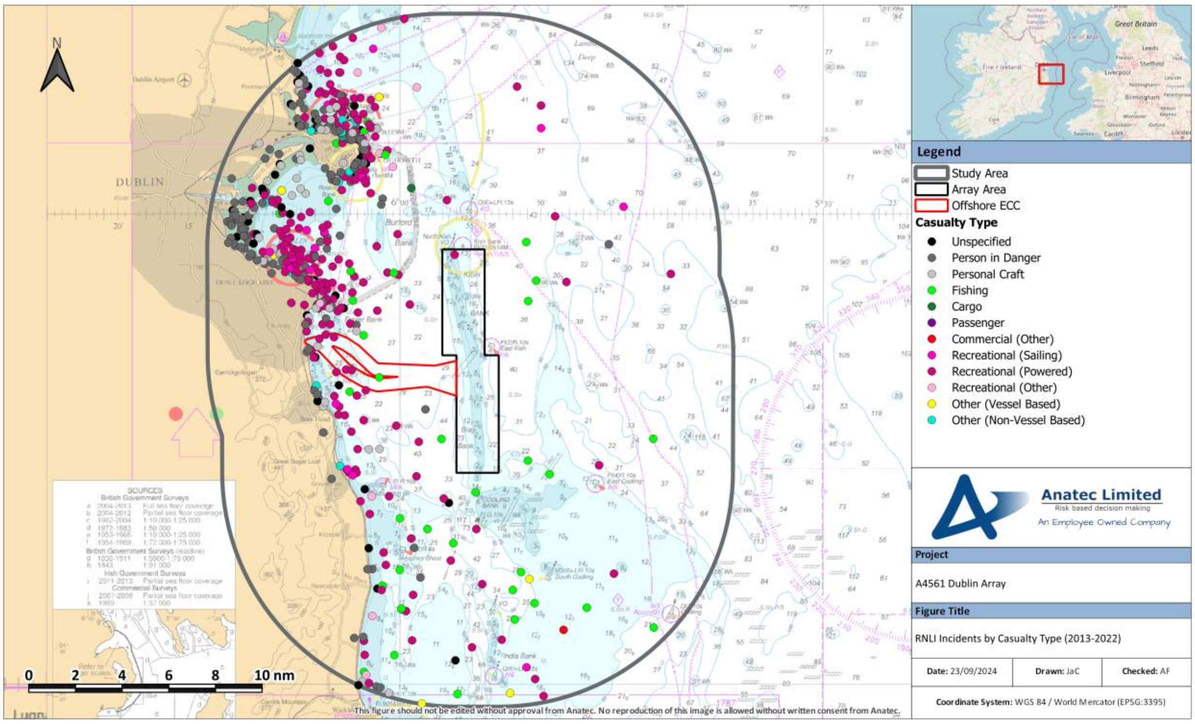

Figure 9-4: RNLI Incident Locations by Casualty Type (2013-2022)

113. A total of 898 RNLI lifeboat launches to 838 unique incidents were reported within the study area, corresponding to an average of 84 unique incidents per year. Incidents were concentrated around Dún Laoghaire, Howth, and Dublin with relatively few incidents occurring in open waters.

114. It is noted that one incident occurred within the site, classed as involving a cargo vessel undergoing machinery failure.

115. The most frequent incident type throughout the study area was 'machinery failure' (41%) followed by 'person in danger' (29%) and 'other' (11%). Excluding 'person in danger' and non-vessel incidents, the most frequent casualty type was powered recreational vessels (57%) followed by personal craft (19%), fishing vessels (8%), and recreational sailing vessels (8%).

116. The majority of RNLI lifeboat launches were from three stations – Dún Laoghaire (54%), Howth (37%), and Wicklow (9%). Two launches were from the Skerries station, with one launch each from Lough Swilly and Rosslare Harbour.

9.4 Marine Casualty Investigation Board

117. 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.

118. Although the MCIB do not publish comprehensive incident data in the public domain, they do publish investigation reports online (MCIB, 2023). From a full search of the publicly available database of incident reports and news articles, Table 9-2 outlines relevant incidents in proximity to the array area for which the MCIB have published an incident report between 1992 and 2023.

Table 9-2: MCIB Incident Summary

Incident Type	Year	Summary
Collision	2000	Collision between the fishing vessel *Clara* and the tanker *Coral Antillarum* off the coast of Wicklow.
Collision	2001	Collision between the recreational vessel D*ai Mouse* and the work boat *Voe Trader* within Dublin Bay. Serious injuries were caused to the crew of the *Dai Mouse.*
Collision	2001	Collision between the cargo vessel *Bluebird* and the yacht *Debonair* within Dublin Bay leading to the foundering of the yacht and four fatalities.
Grounding	2000	Grounding of the car carrier *Asian Parade* on the Codling Bank. Haphazard passage planning and an excessive amount of responsibility for navigation taken by the Master given the confined waters were noted as causes.
Grounding	2005	Grounding of the oil tanker *Bro Traveller* within Dublin Bay, approximately 6.4nm west northwest of the array area. The vessel took less than an hour to refloat.
Grounding	2006	Engine failure of the fishing vessel *Felucca* whilst departing Dublin Port leading to grounding on the south side of the channel. Following the grounding the vessel's engine was successfully restarted after one attempt.
Capsize	2020	Three kayakers, in a double and single kayak, were separated from their group whilst on a sea tour from Bulloch Head to Dalkey Island. The kayaker in the single kayak encountered difficulty with the sea conditions, and the single kayak was overturned. The kayaker was able to hold onto the kayak whilst successful assistance was rendered.

9.5 Third-Party Assistance

119. Companies operating offshore (e.g., offshore wind farm developers) typically have resources including 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 Safety of Life at Sea (SOLAS) (IMO, 1974) as amended, are required to render assistance to any person or vessel in distress if safely able to do so.

120. Emergency response and cooperation procedures between Dublin Array and the Irish Coastguard will be agreed prior to construction as per Section 17.1.

9.6 Global Maritime Distress and Safety System

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

122. There are four GMDSS sea areas, and in Ireland it is the responsibility of the IRCG to ensure VHF coverage from coastal stations within sea area A1. The array area is located within sea area A1, as shown in Figure 9-5, and therefore in the event of an emergency any vessel located in proximity to the array area would be able to contact IRCG via VHF.

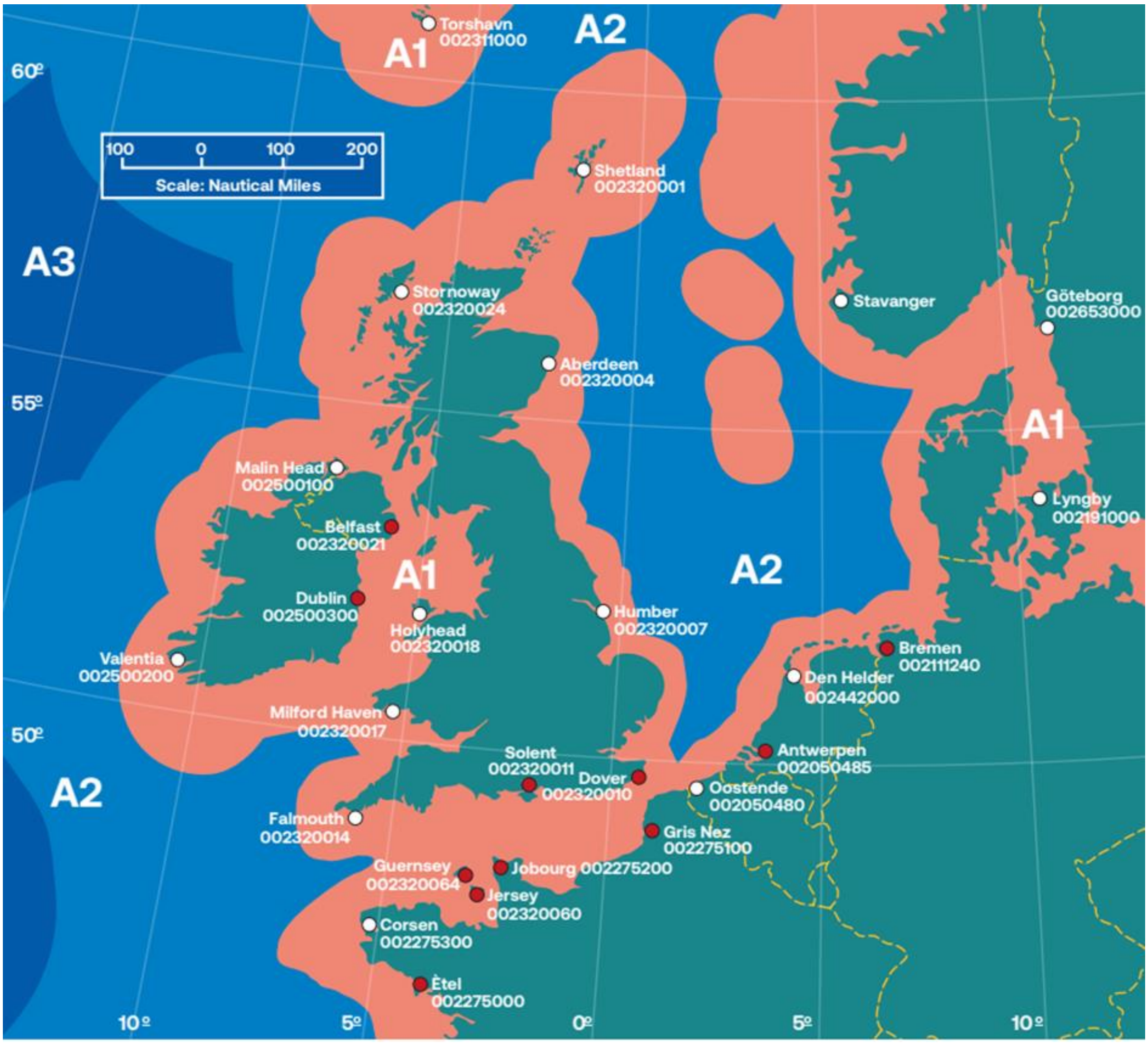

Figure 9-5: GMDSS Sea Areas (MCA, 2021)

9.7 Historical Offshore Wind Farm Incidents

123. Given the early stage of offshore wind farm development in Ireland there is no historical incident data available. Therefore, UK experience has been considered in this Section given it provides a wide range of incidents relating to offshore wind development in a similar regulatory framework. Other European countries have more regulations restricting access to arrays which can distort results.

124. Therefore, UK experience has been considered in this Section given that incidents relating to offshore wind farm development in a similar regulatory framework can be considered over a long-term period.

9.7.1 Incidents Involving UK Offshore Wind Farm Developments

125. As of November 2023, there are 42 operational offshore wind farms in the UK, ranging from the North Hoyle Offshore Wind Farm (fully commissioned in 2003) to the Hornsea Project Two Offshore Wind Farm (fully commissioned in 2022). Between them these developments encompass approximately 22,050 fully operational wind turbine years.

126. Various sources have been used to collate a list of historical collision and allision incidents involving UK offshore wind farm developments including the Marine Accident Investigation Branch (MAIB) incident database. The list of historical collision and allision incidents involving UK offshore wind farm developments is presented in Table 9-3.

Table 9-3: 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	Wind turbine installation vessel allision with wind turbine base whilst manoeuvring alongside it. Minor damage sustained to a gangway on the vessel, the wind turbine tower and a wind turbine blade.	Minor damage to gangway on the vessel	None	MAIB
Project	Allision	29 September 2006	Offshore services vessel allision with rotating wind turbine 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

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Harm to Persons	Source
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 wind turbine foundation following watchkeeping failure. Two hull breaches to vessel.	Major	None	MAIB
Project / project	Collision	2 June 2012	CTV allision with flotel. Nine persons safely evacuated and transferred to nearby vessel before being brought back in to port.	Moderate	None	UK Confidential Human Factors Incident Reporting Programme (CHIRP)
Project	Allision	20 October 2012	Project vessel allision with wind turbine monopile following human error (misjudgement of distance). Minor damage sustained by vessel.	Minor	None	MAIB
Project	Allision	21 November 2012	Passenger transfer catamaran allision with buoy following navigational error. Vessel abandoned by crew of 12 having been holed, causing extensive flooding but no injuries sustained.	Major	None	MAIB
Project	Allision	21 November 2012	Work boat allision with unlit WTG transition piece at moderate speed following navigational error. Vessel able to proceed to port unassisted with no water ingress but some structural damage sustained.	Moderate	None	MAIB
Project	Allision	1 July 2013	Service vessel allision with wind turbine foundation following machinery failure. Minor damage sustained by vessel.	Minor	None	International Marine Contractors Association (IMCA) Safety Flash
Project	Allision	14 August 2014	Standby safety vessel allision with wind turbine pile. Oil leaked by vessel which moved away from environmentally sensitive areas until leak was stopped.	Minor with pollution	None	CHIRP

Incident Vessel	Incident Type	Date	Description of Incident	Vessel Damage	Harm to Persons	Source
Third-party	Allision	26 May 2016	Third-party fishing vessel allision with wind turbine following human error (autopilot). Lifeboat attended the incident.	Moderate	Injury	Web search (RNLI, 2016)
Project	Allision	14 February 2019	Survey vessel contacted with wind turbine jacket whilst autopilot was engaged.	Minor	None	MAIB
Project	Allision	17 January 2020	Project vessel allision with wind turbine. 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 wind turbine. Minor damage to vessel and wind turbine sustained, with no personal injuries.	Minor	None	Marine Safety Forum
Third-party	Allision	9 June 2022	Fishing vessel allision with wind turbine 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)

127. 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.

128. As of November 2023, 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.

129. As of November 2023, there have been 13 reported cases of an allision between a vessel and a wind turbine (under construction, operational or disused) in the UK, with all but one involving a support vessel for the development and the errant vessel in each case under power rather than drifting. Therefore, there has been an average of 1,696 wind turbine years per allision incident in the UK, noting that this is a conservative calculation given that only operational wind turbine hours have been included (whereas allision incidents counted include non-operational wind turbines).

9.7.2 Incidents Involving Non-UK Offshore Wind Farms

130. 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. Some non-UK countries also have more stringent

regulations restricting access to arrays and so a direct comparison to UK or Irish incidents is not feasible.

131. 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. Having broken free from its anchor, the vessel then continued to drift towards shore including through an under-construction offshore wind farm where it allided with a wind turbine foundation and a platform foundation before being taken under tow.

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

132. 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 9-4. The initial cause of these incidents is not related to the offshore wind farm in question.

133. Table 9-4 comprises known incidents that were responded to by a UK 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 9-4: 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	His Majesty's Coastguard (HMCG) issued mayday relay broadcast following trimaran capsize. Support vessel for Walney arrived and recovered two persons from the water who were then winched onboard a Coastguard helicopter.	Web search (4C Offshore, 2018)
Capsize	5 November 2018	Race Bank	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)

Incident Type	Date	Related Development	Description of Incident	Source
Vessel in distress	15 May 2019	London Array	Yacht in difficulty sought shelter by tying up to a wind turbine but suffered damage and a person in the water. Support vessel for London Array identified and secured the casualty vessel and recovered the person in the water. The support vessel raised the alarm to the Coastguard. The Coastguard later instructed the support vessel to return to port and seek medical assistance for the casualty vessel's occupant.	Web search (The Isle of Thanet News, 2019)
Drifting	7 July 2019	Gwynt y Môr	Speedboat suffered mechanical failure stranding four persons. Support vessel for Gwynt y Môr responded to an 'all-ships' broadcast from the Coastguard and prevented the casualty vessel drifting into the Gwynt y Môr array. The support vessel later towed the casualty vessel back towards port.	Web search (Renews, 2019)
Machinery failure	28 September 2019	Race Bank	Fishing vessel suffered mechanical failure and launched flares. Guard vessel and SOV for Race Bank both immediately offered assistance until the MCA's arrival on-scene.	Internal daily progress report received by Anatec
Vessel in distress	13 December 2019	Race Bank	Passing vessel got into difficulty and guard vessel for Race Bank was requested to assist. The Coastguard later requested that the guard vessel tow the casualty vessel into port.	Internal daily progress report received by Anatec
Search	21 May 2020	Walney	Coastguard contacted guard vessel for Walney reporting red flare sighting at the 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	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 wind turbine 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)

10 Vessel Traffic

10.1 Introduction

134. This Section presents the vessel tracks recorded within the study area (Section 3.5) during the following periods:

- 14 days AIS, radar, and visual observation during March 2022[6] (see Section 5.2.1 for further details); and
- 14 days AIS, radar, and visual observation during August 2023 (see Section 5.2.2 for more details).

135. It is noted that an additional validation survey of AIS, radar, and visual observation data was undertaken in winter 2019, as well as a survey (inclusive of non AIS data) undertaken in Summer 2021 (see Section 5.1).

136. A number of vessel tracks recorded during the survey periods were classified as temporary traffic (non-routine). Any such traffic has been removed.

10.2 Overview

137. Figure 10-1 presents the vessels, excluding temporary traffic, recorded during the study periods within the study area colour-coded by vessel type[7]. A 0.5 nm x 0.5 nm density heat map of the vessel tracks is presented in Figure 10-2.

[6]For any instances of a vessel being recorded via both AIS and Radar, the track providing the most complete coverage has been utilised. Noting, for the majority of tracks this was AIS.
[7] A small number of vessels (<1%) detected via radar which the type of the vessel could not be identified visually have been assigned as unspecified.

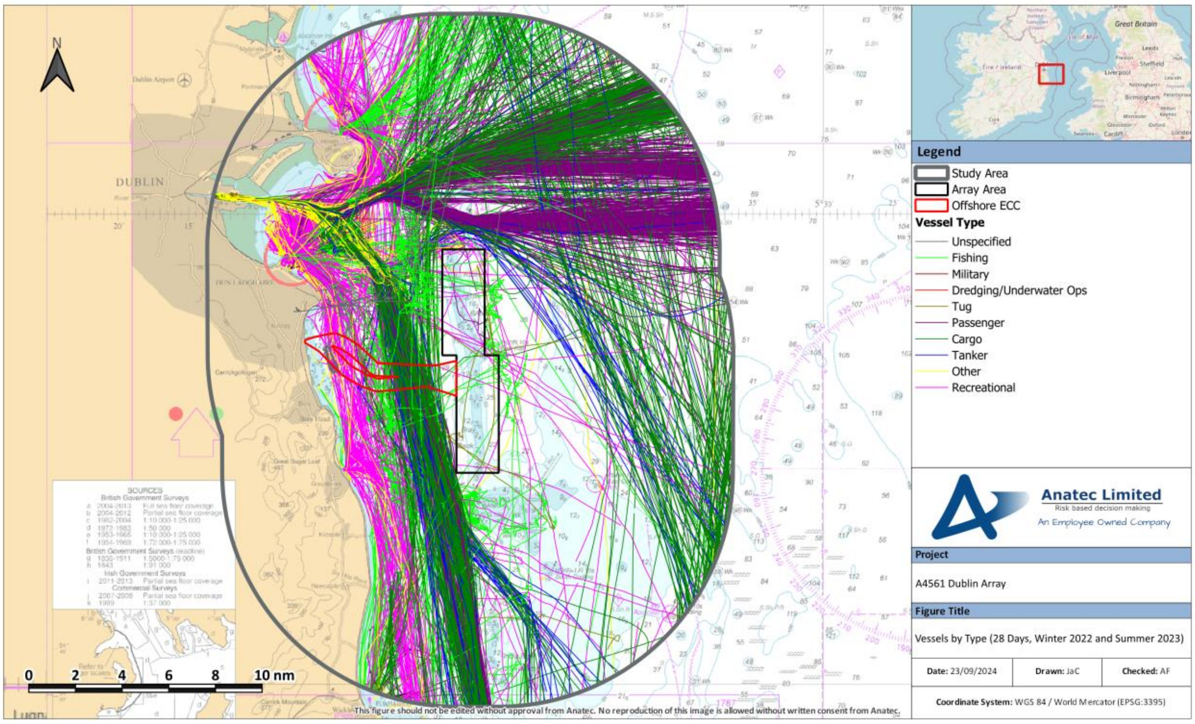

Figure 10-1: 28 Days Marine Traffic Winter 2022 and Summer 2023 (Vessel Type)

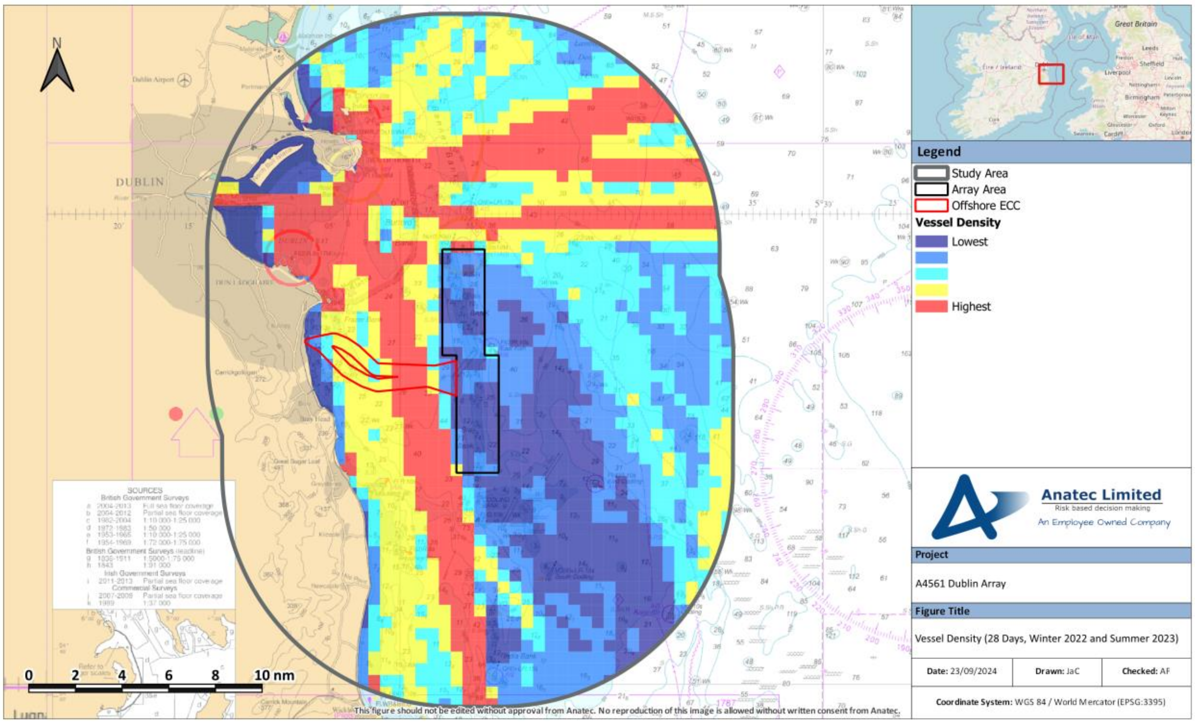

Figure 10-2: 28 Days Marine Traffic Winter 2022 and Summer 2023 (Vessel Density)

10.3 Vessel Count

138. Figure 10-3 and Figure 10-4 present the number of unique vessels per day recorded within the study area throughout the winter and summer survey periods recorded on AIS, Radar and via visual observations, respectively.

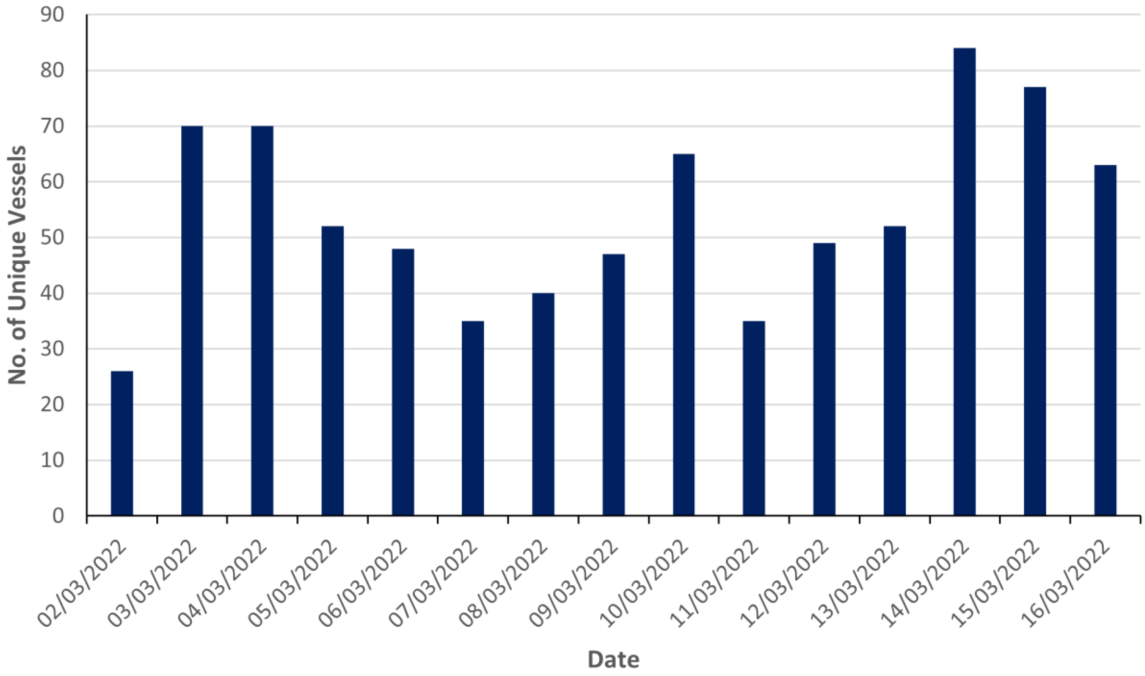

Figure 10-3: Unique Vessels per Day - Winter 2022

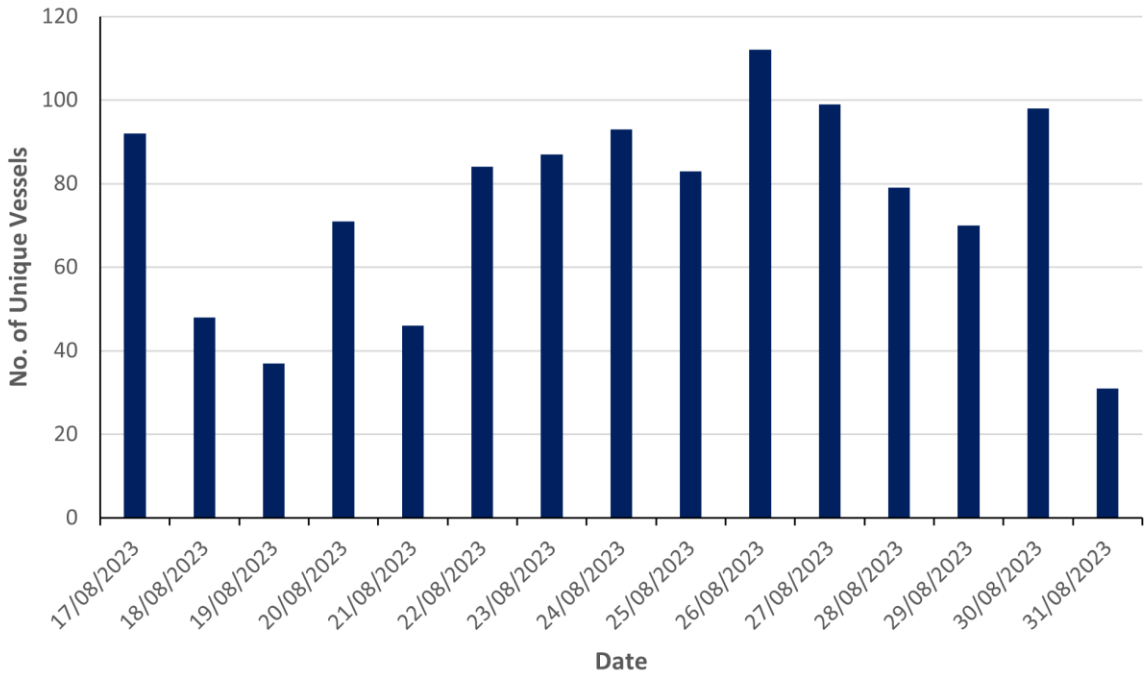

Figure 10-4: Unique Vessels per Day – Summer 2023

139. On average, 58 unique vessels per day were recorded within the study area during the winter survey period. The busiest day for the winter survey period was the 14th March 2022 on which 84 vessels were recorded. The quietest full days for the winter survey period were the 7th and 11th March 2022 on which 35 unique vessels were recorded each.

140. On average, 81 unique vessels per day were recorded within the study area during the summer survey period. The busiest day for the summer survey period was the 26th August 2023 on which 112 unique vessels were recorded. The quietest full day for the summer survey period was 19th August 2023 on which 37 unique vessels were recorded.

10.4 Vessel Types

141. The distribution of vessel types recorded within the study area during the survey periods is presented in Figure 10-5. Note vessel types[8] that were observed in limited proportions (<1%) have been grouped under "other" in Figure 10-5.

[8] Including military vessels and marine aggregate dredgers.

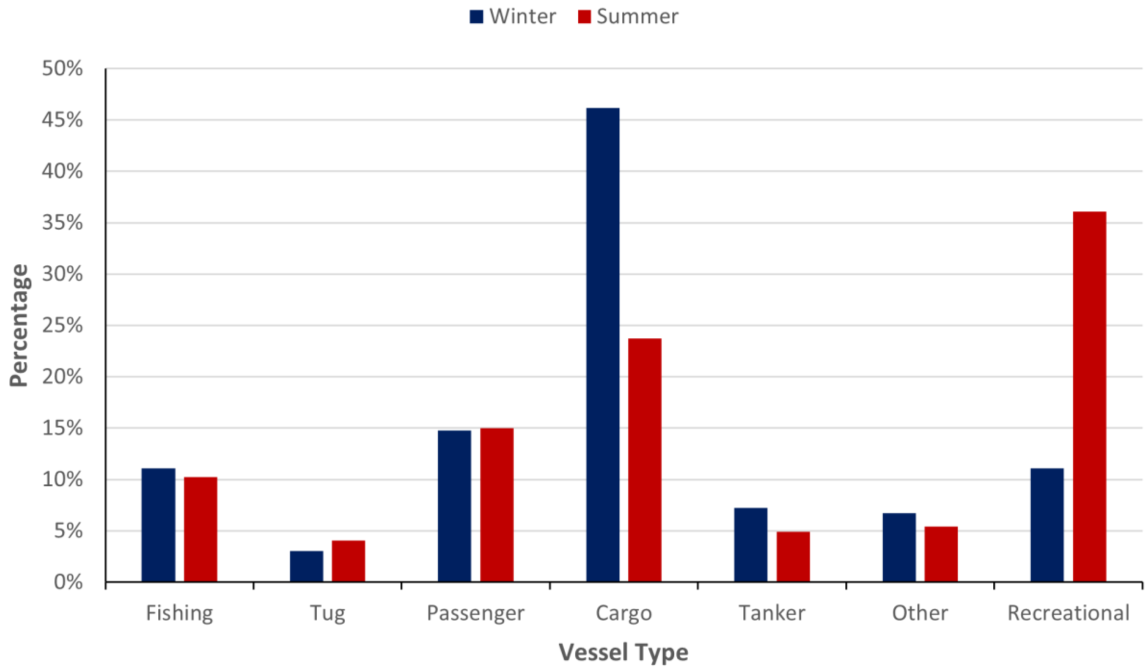

Figure 10-5: Vessel Type Distribution within Study Area during the Study Periods

142. The most common vessel types recorded within the study area during the winter survey period were cargo vessels (46%), passenger vessels (15%), fishing vessels (11%), and recreational vessels (121%). The most common vessel types recorded within the study area during the summer study period were recreational vessels (36%), cargo vessels (24%), passenger vessels (15%), and fishing vessels (10%).

10.4.1 Commercial Vessels

143. Figure 10-6 presents the commercial vessels recorded during the survey periods within the study area.

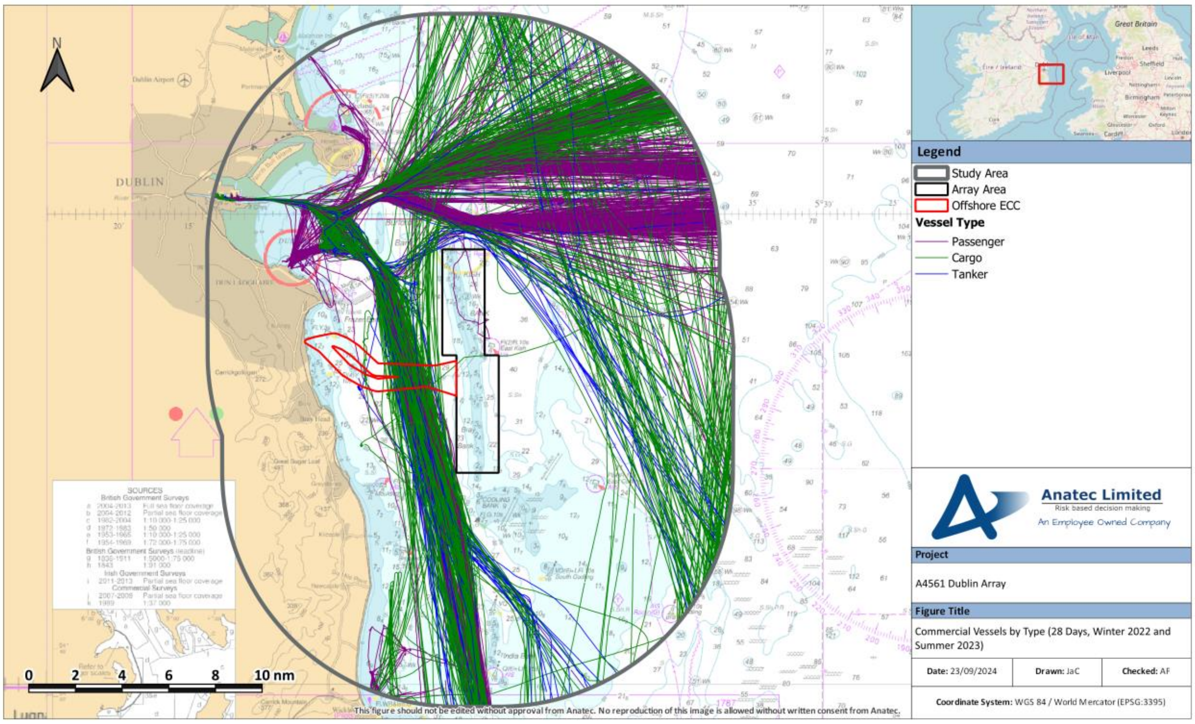

Figure 10-6: Commercial Vessels 28 Days Winter 2022 and Summer 2023

144. The majority of commercial traffic was observed to be utilising main routes (see Section 11), noting that these routes also avoided the shallow banks. Figure 10-7 and Figure 10-8 present the unique number of passenger vessels, cargo vessels, and tankers within the study area per day during the winter and summer study periods, respectively.

145. RoRo vessels undergoing regular passage were recorded. These primarily involved Seatruck and Stena Lines-operated vessels transiting between Dublin and Liverpool, with CLdN-operated RoRo vessels also recorded transiting between Dublin and Dutch/Belgian ports.

146. The majority of passenger vessels were recorded transiting in an east-west bearing between Dublin and ports such as Holyhead and Liverpool, with these including RoPax vessels operated by Stena Line and Irish Ferries regularly routeing between Dublin and Holyhead; and operated by P&O Ferries regularly routeing between Dublin and Liverpool. Irish Ferries-operated RoPax vessels were recorded regularly routeing between Dublin and Cherbourg.

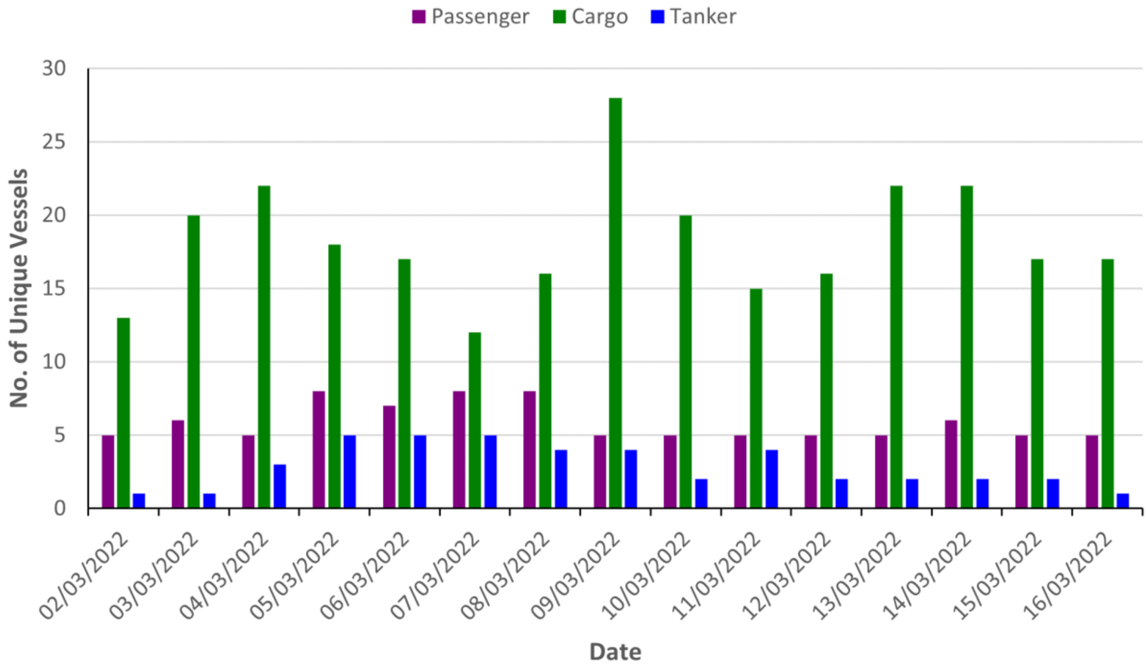

Figure 10-7: Number of Commercial Vessels per Day (Winter 2022)

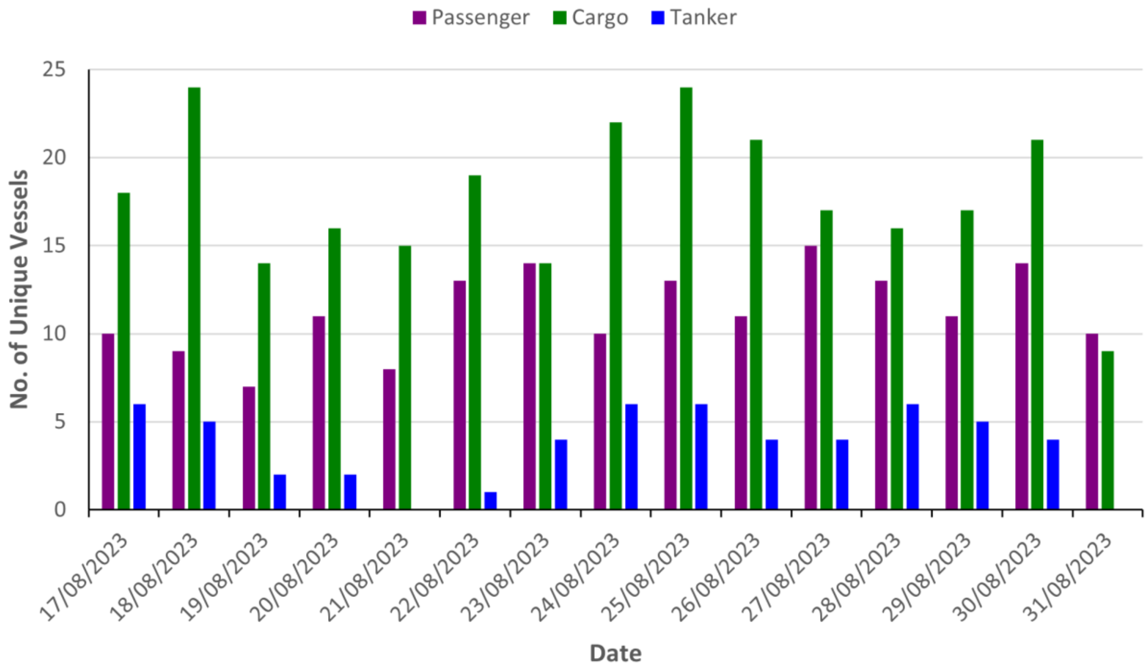

Figure 10-8: Number of Commercial Vessels per Day (Summer 2023)

147. Table 10-1 and Table 10-2 summarise the average number, maximum number, and minimum number of passenger vessels, cargo vessels, and tankers per day (excluding

partial days) within the study area for the winter and summer study periods, respectively.

Table 10-1: Commercial Vessel Numbers (Winter 2022)

Vessel Type	Minimum Vessels per Day	Maximum Vessels per Day	Average Vessels per Day
Passenger	5	8	6
Cargo	12	28	19-20
Tanker	1	5	3

Table 10-2: Commercial Vessel numbers (Summer 2023)

Vessel Type	Minimum Vessels per Day	Maximum Vessels per Day	Average Vessels per Day
Passenger	7	15	12
Cargo	14	24	19
Tanker	0	6	4

10.4.2 Fishing Vessels

148. Figure 10-9 presents the fishing vessels recorded during the survey periods within the study area.

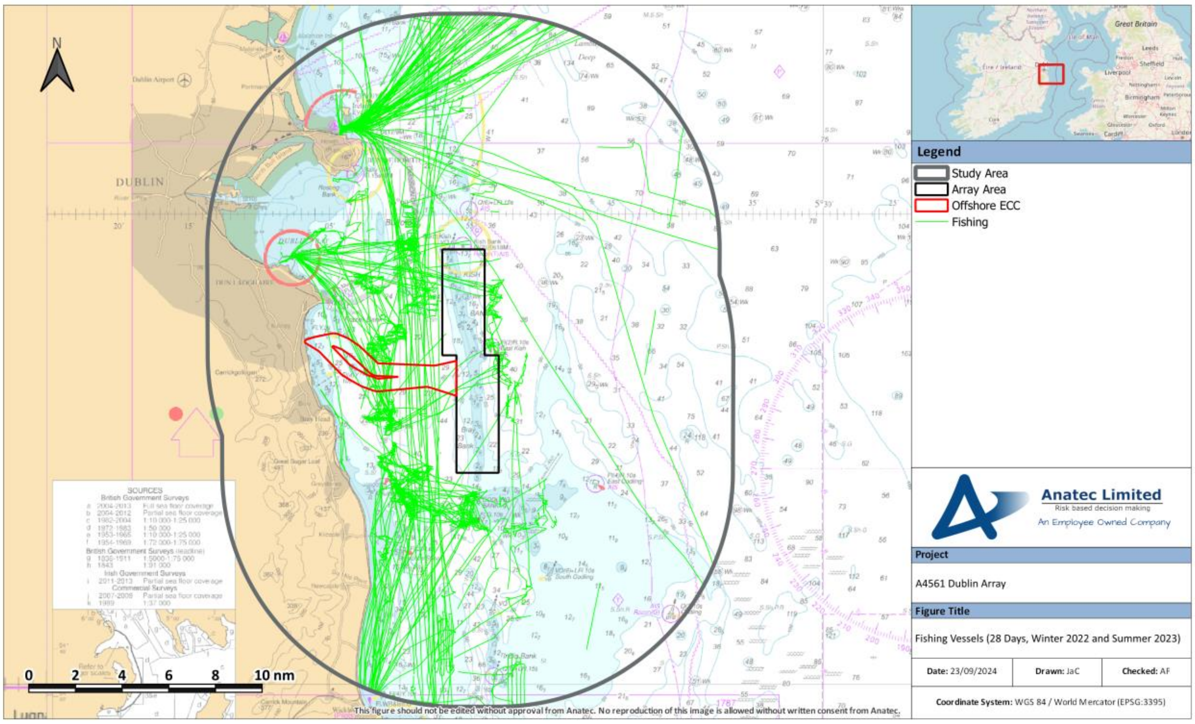

Figure 10-9: Fishing Vessel 28 Days Winter 2022 and Summer 2023

149. Fishing vessels were generally observed within the coastal regions of the study area, especially transiting to / from harbours located on the coast. A small number of fishing vessels were observed to transit through the array area, especially the northern Section.

150. The majority of fishing vessels were transiting through the study area; however, some active fishing was also observed. On average, throughout the summer study period eight unique fishing vessels were observed per day compared to an average of four to five per day within the winter study period.

151. VMS data from 2017 for the area has been investigated, with supplementary data from 2014 to 2018 also considered for validation (see Section 5). The VMS data analysed during 2017 is presented in Figure 10-10. The data is presented as a density grid, with each cell showing the number of hours of fishing vessel activity recorded during 2017. It is noted that VMS is primarily carried on fishing vessels over 12m in length. Of note was the activity recorded directly to the east of the site, where a total of 422 hours of fishing was recorded during 2017. This activity was observed to be primarily from dredgers.

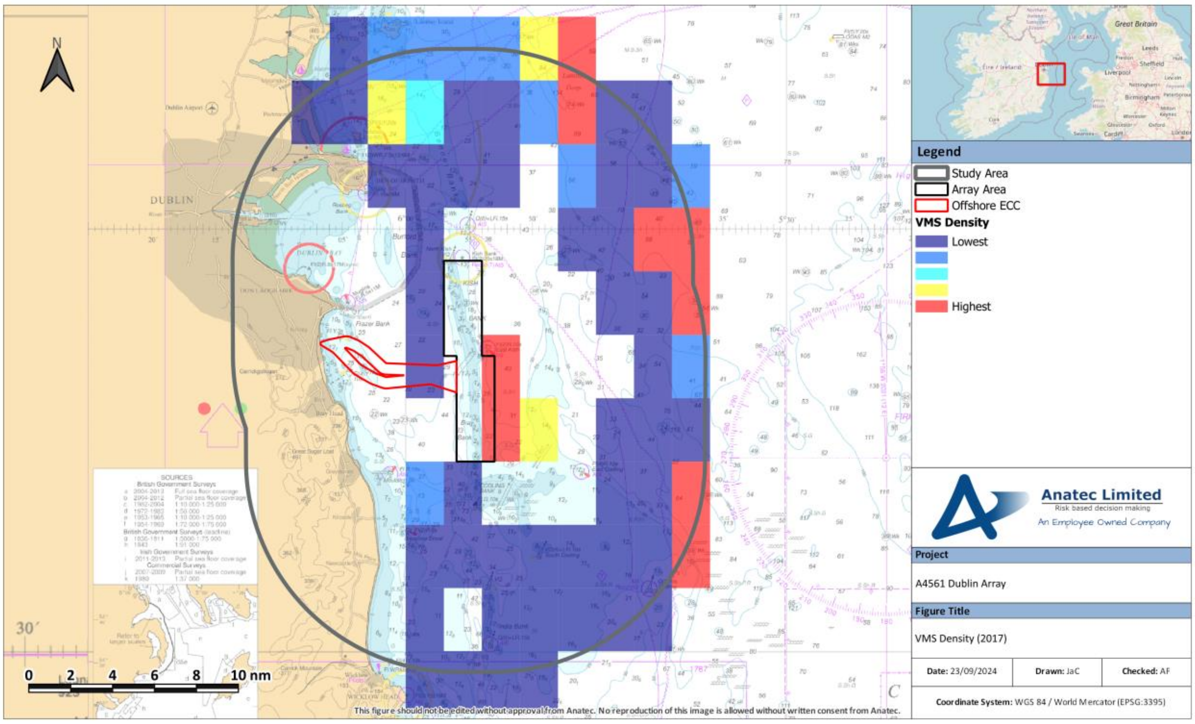

Figure 10-10: VMS Intensity - 2017

152. The individual fishing gear types recorded via VMS from the 2014-18 data are described as follows:

- Beam trawlers recorded in high numbers at the eastern perimeter of the study area;
- Demersal trawlers recorded to the southeast of the study area;
- Dredgers recorded in high numbers directly east of the array area; and
- Potters recorded directly west of the southern portion of the array area, as well as in the southeast of the study area.

153. All datasets studied broadly indicated that fishing tends to take place close to the edges of the shallow banks. Active fishing on the banks themselves was less common, however transits across the banks were recorded.

10.4.3 Recreational Vessels

154. Figure 10-11 presents the recreational vessels recorded during the survey periods within the study area.

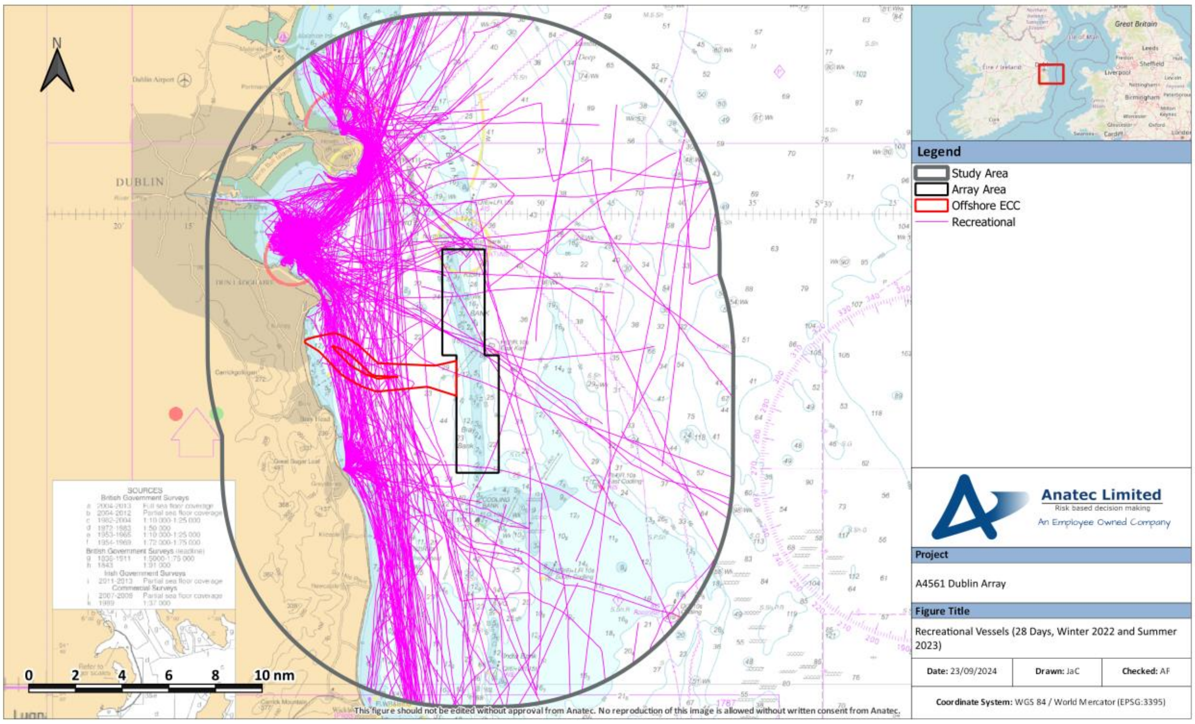

Figure 10-11: Recreational Vessels 28 Days Winter 2022 and Summer 2023

155. Recreational vessels were observed within coastal regions, especially transiting to / from various harbours on the coast. A high degree of seasonality was observed for recreational vessels with an average of approximately 29 recreational vessels recorded per day during the summer survey period compared to an average of approximately four to five recreational vessels per day during the winter survey period.

156. A number of wrecks are also located on the banks and the RMS Leinster is also located to the east of the site and is visited on a regular basis by dive vessels, as raised during consultation (see Section 4).

157. Figure 10-12 presents the number of recreational vessels during the summer survey period. It should be considered that the Study Area is utilised for recreational races, including by the Irish Sea Offshore Racing Association (ISORA), and that recreational activity is observed to increase on the days before and after a race which is likely due to the arrival and departure of crews.

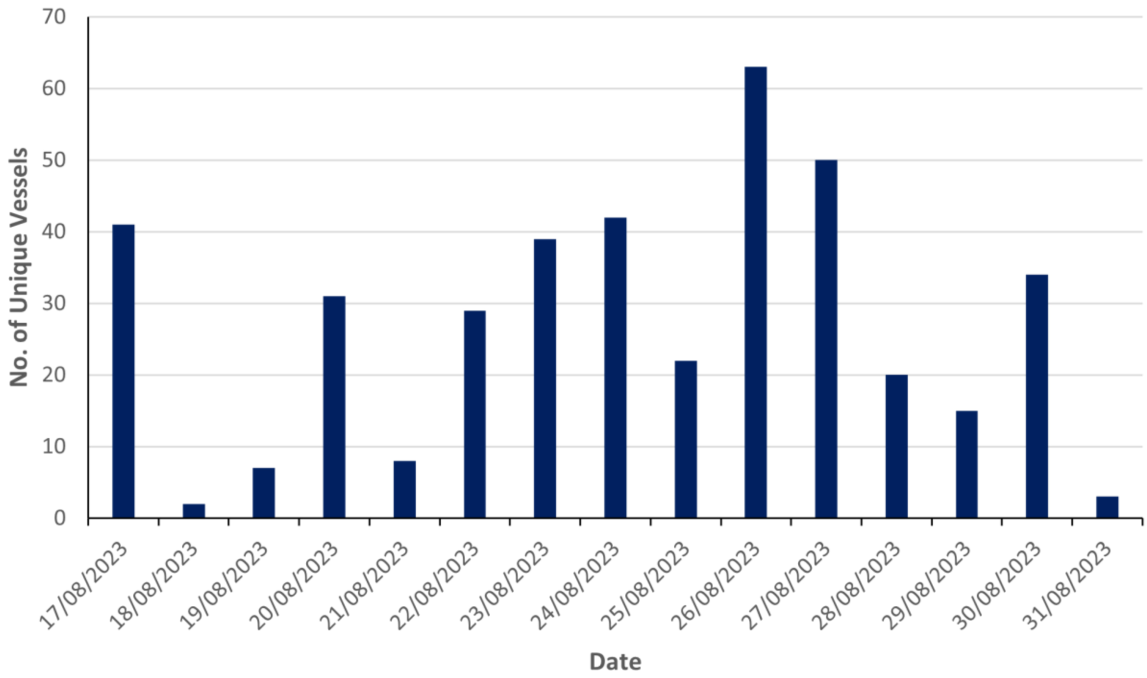

Figure 10-12: Number of Recreational Vessels per Day (Summer)

158. Table 10-3 presents the ISORA races during the 2023 season, and the number of vessels which completed each race. Races or race legs entirely in Welsh waters have not been shown.

159. It has been indicated within Table 10-3 whether any potential interaction between each race and the array area may occur including the approximate location of the interaction, based on historical race tracking data made available by ISORA (2023)[9].

Table 10-3: ISORA Races (ISORA, 2023)

ISORA Race Number	Course Name	Start Date	Number of Vessels in 2023 Race [10]	Potential Interaction with the array area	Rationale
1	Dún Laoghaire to Dún Laoghaire	15/04/2023	12	Yes	East Kish buoy is a waypoint.
3	Dún Laoghaire to Dún Laoghaire	22/04/2023	11	Yes	North Kish and East Kish buoys are waypoints.
5	Dún Laoghaire to Dún Laoghaire	29/04/2023	11	No	North Kish buoy is a waypoint.

[9] Note a number of races use virtual marks as waypoints whose positions have been approximated and for these races if the route passes close to Dublin Array it has been assumed that this race will have a potential interaction.
[10] Estimated based on info provided on the ISORA website (ISORA, 2023).

ISORA Race Number	Course Name	Start Date	Number of Vessels in 2023 Race [10]	Potential Interaction with the array area	Rationale
7	Dún Laoghaire to Pwllheli	06/05/2023	11	Unknown	n/a
8	Pwllheli to Dún Laoghaire	20/05/2023	8	Unknown	n/a
9	Dún Laoghaire to Dingle	07/06/2023	16	Unknown	n/a
10	Dún Laoghaire to Dún Laoghaire	24/06/2023	7	Unknown	n/a
13	Dún Laoghaire to Dún Laoghaire	22/07/2023	7	Unknown	n/a
16	Dún Laoghaire to Dún Laoghaire	18/08/2023	7	Unknown	n/a
19	Pwllheli to Kish Light to Dún Laoghaire	02/09/2023	8	Unknown	n/a

160. Potential impacts to races including those held by ISORA are assessed in Volume 3: Chapter 10: Shipping and Navigation.

10.4.4 Summary

161. Table 10-4 and Table 10-5 present the minimum, maximum and average vessels per day of each vessel type (excluding partial days) analysed in the previous Sections within the study area during the summer and winter study periods, respectively.

162. Passenger vessels showed a small degree of seasonality with a greater degree recorded during the summer survey period. Similarly, more fishing vessels were recorded during the summer survey period. A much greater number of recreational vessels were observed during summer which is likely partially due to the ISORA races that are hosted within the area (see Section 10.4.3). It is worth noting that for fishing and recreational vessels, the recorded numbers are likely to be lower than realistic as fishing vessels under 15m in length, as well as recreational vessels, are under no obligation to broadcast information via AIS.

Table 10-4: Summary of Vessel Counts (Winter 2022)

Vessel Type	Minimum Vessels per Day	Maximum Vessels per Day	Average Vessels per Day
Passenger	5	8	6
Cargo	12	28	19-20
Tanker	1	5	3

Vessel Type	Minimum Vessels per Day	Maximum Vessels per Day	Average Vessels per Day
Fishing	0	16	4-5
Recreational	0	15	4-5

Table 10-5: Summary of Vessel Counts (Summer 2023)

Vessel Type	Minimum Vessels per Day	Maximum Vessels per Day	Average Vessels per Day
Passenger	7	15	12
Cargo	14	24	19
Tanker	0	6	4
Fishing	4	15	8
Recreational	2	63	29

10.5 Vessel Sizes

10.5.1 Vessel Length

163. Figure 10-13 presents the vessels recorded during the study periods colour-coded by vessel length within the study area.

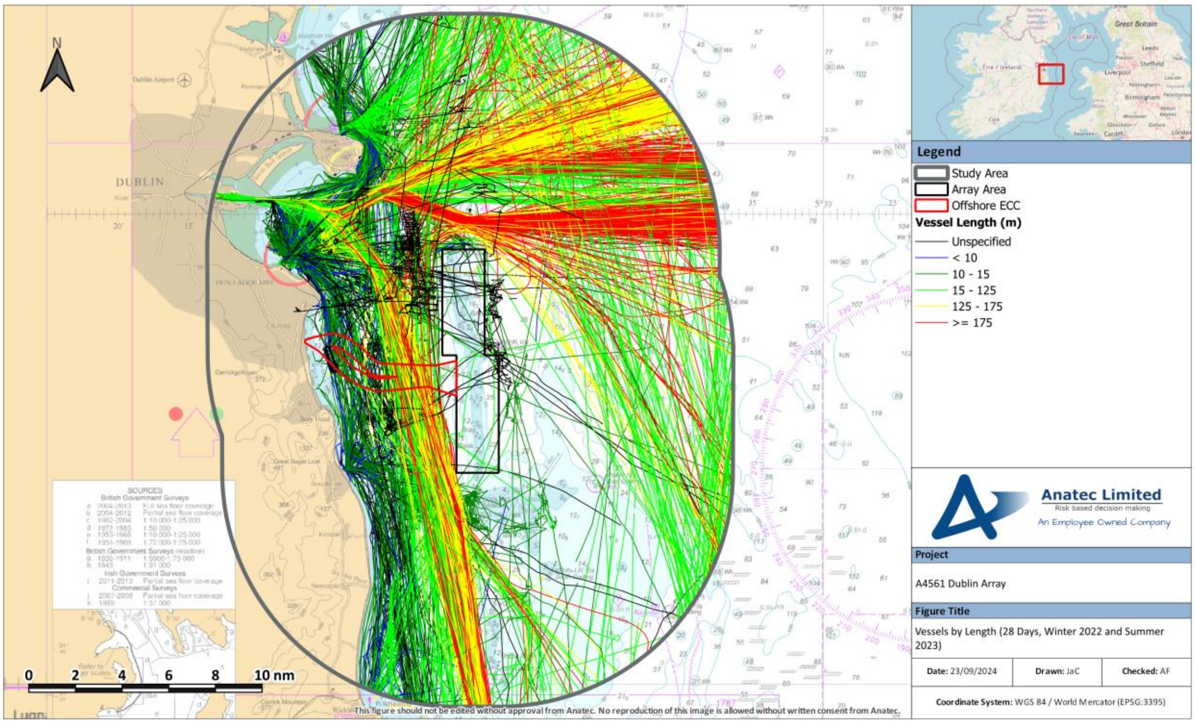

Figure 10-13: Vessels Recorded Colour-coded by Length

164. Vessel length was unspecified for 21% of vessels within the study area throughout the study period, excluding vessels with unspecified lengths the average vessel length throughout the study periods was 88 m. The longest vessel recorded transiting the study area was a 330 m cruise liner on the 27th August 2023, transiting north of the array area.

165. Vessels operating inshore, in proximity to the array area were typically smaller (< 20 m) vessels, while larger vessels typically transited further from the shore. The majority of vessels less than 20 m were either recreational or fishing vessels.

166. Figure 10-14 presents the distribution of vessel lengths recorded throughout the survey period excluding vessels with unspecified lengths.

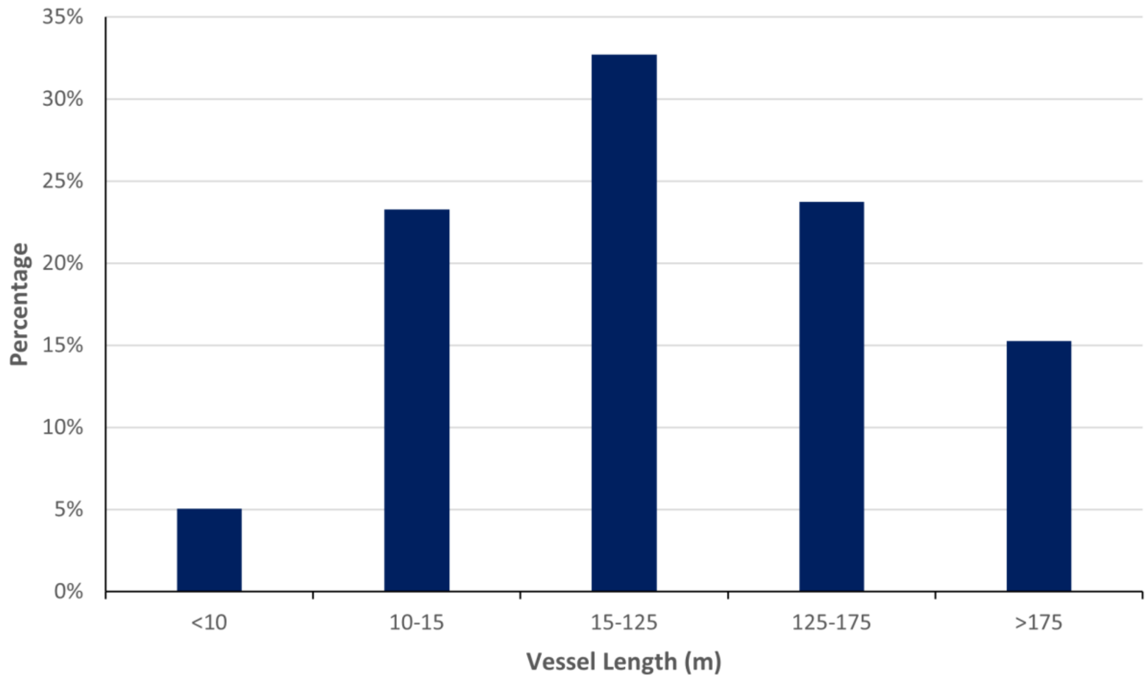

Figure 10-14: Distribution of Vessel Length within Study Area

10.5.2 Vessel Draught

167. Based on the information available from AIS an overview of vessel tracks within the study area, colour-coded by vessel draught, is presented in Figure 10-15. It should be noted that vessel draught information was not available for 42% of vessels recorded throughout the winter and summer survey periods. The vast majority of vessels with unspecified draught were recreational vessels (56% of all unspecified draughts) while approximately 17% of unspecified draughts were associated with fishing vessels.

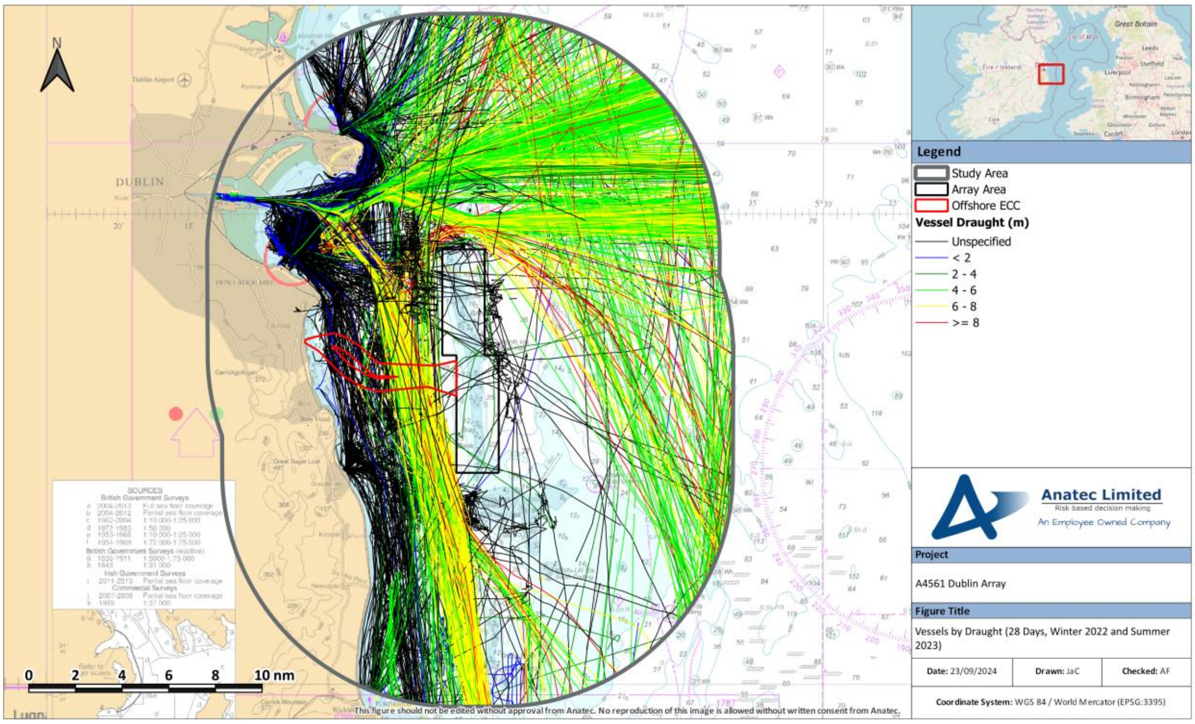

Figure 10-15: Vessels Recorded Colour-coded by Draught

168. The average draught of vessels within the study area was 5.5 m. The deepest vessel draught recorded was 9.3 m by a bulk carrier which was recorded while travelling between Belfast and Waterford.

169. Figure 10-16 presents the distribution of vessel draughts within the study area (excluding the vessels for which draught information was not attainable).

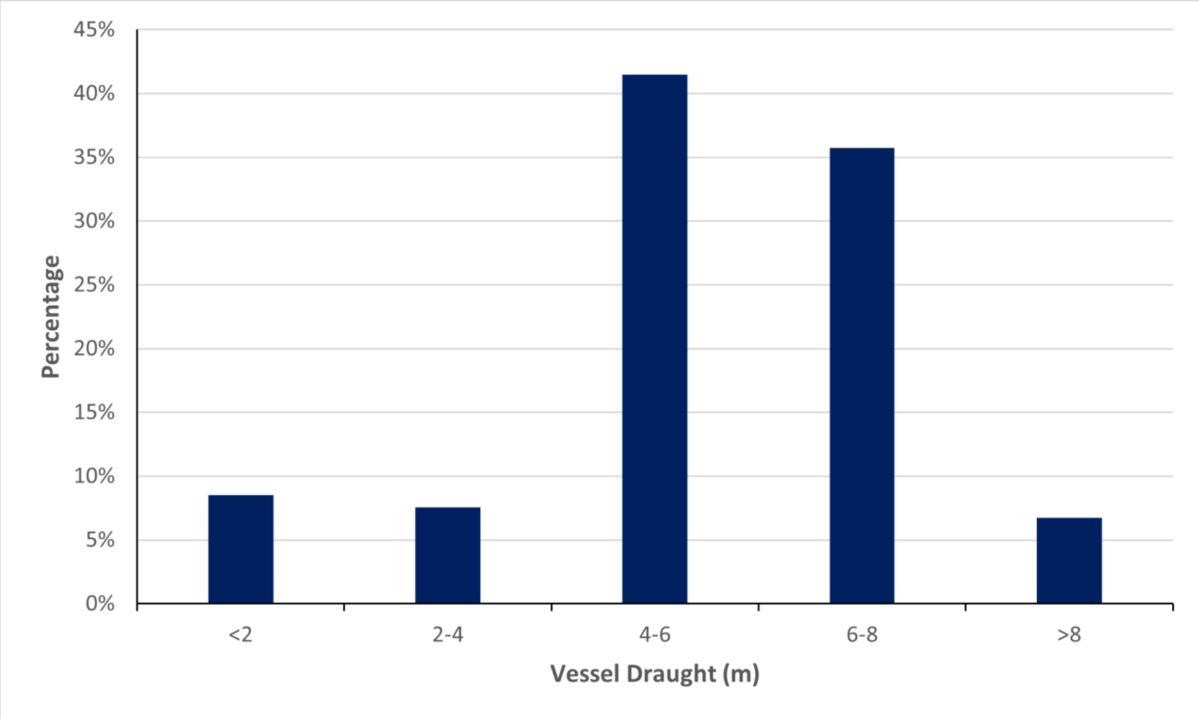

Figure 10-16: Distribution of Vessel Draught within Study Area

10.6 Anchored Vessels

170. Figure 10-17 presents the vessels identified as being at anchor, based on a speed assessment and the information transmitted via AIS. As can be seen, vessels were primarily identified as anchoring within the charted anchorage in Dublin Bay near the pilot boarding station.

171. It was noted during consultation (see Section 4) and recorded within the dataset, that due to the Dublin port anchorage currently often being at capacity, vessels have also started to anchor further to the south of the Dublin Bay charted anchorage, directly south of the offshore ECC.

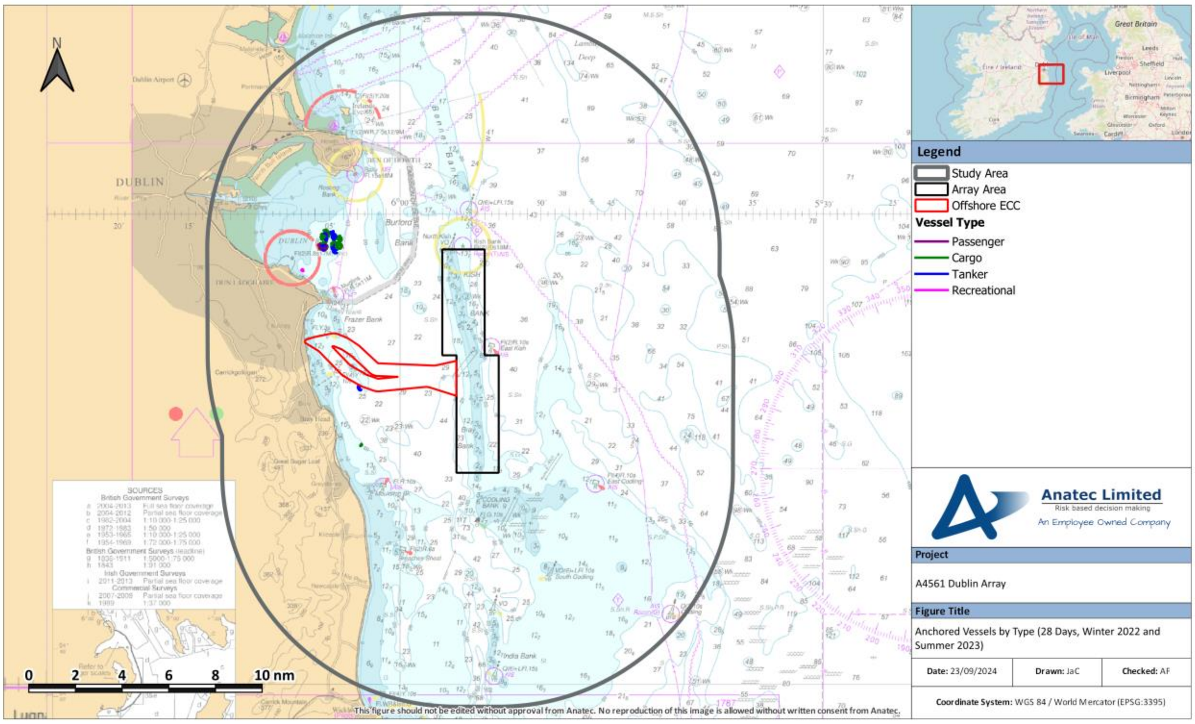

Figure 10-17: Anchored Vessels 28 Days Winter 2022 and Summer 2023

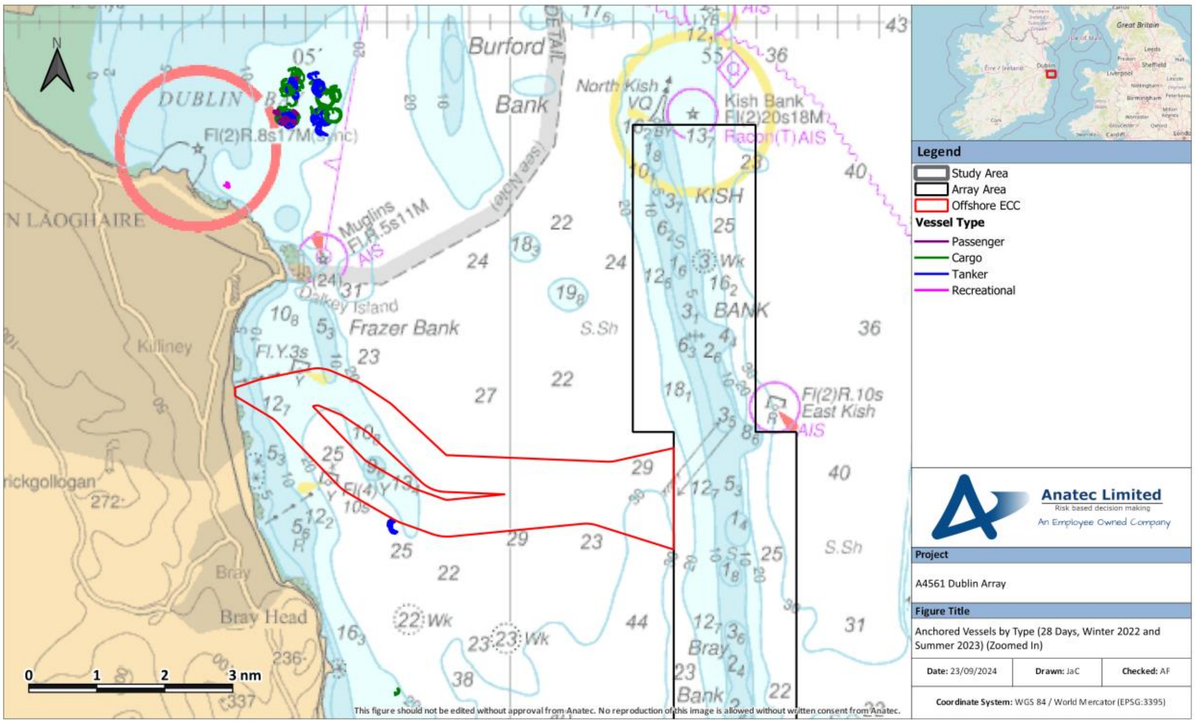

Figure 10-18: Anchored Vessels 28 Days Winter 2022 and Summer 2023 (Zoomed In)

11 Base Case Vessel Routeing

11.1 Definition of a Main Route

172. Main routes have been identified using the principles set out in MGN 654 (MCA, 2021). The vessel traffic data has been assessed to identify cases of vessels transiting at similar headings and to similar destinations, with any such cases classed as being a main route. To help identify main routes, vessel traffic data can also be interrogated to show vessels (by name / or operator) that frequently transit those routes identifying 'regular runner / operator routes'. The route width is then calculated using the 90th percentile rule from the median line of the potential shipping route as shown in Figure 11-1.

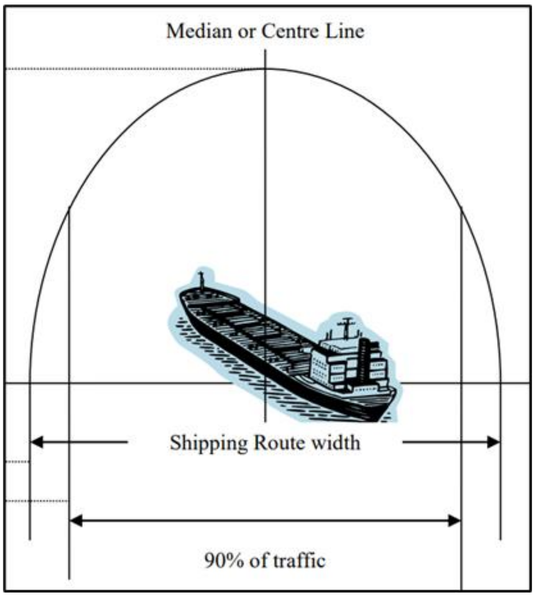

Figure 11-1: Illustration of Main Route Calculation (MCA, 2016)

11.2 Pre-Wind Farm Main Routes

173. A total of nine main routes were identified from the 28 days of AIS / AIS and radar data studied (see Section 10). These routes and corresponding 90th percentiles are shown relative to the array area in Figure 11-2. Following this, relevant details of each route are given in Table 11-1. This includes terminus ports, however it should be considered that these are based upon the most common destinations transmitted via AIS by vessels on those routes and therefore it should not be assumed that a transit through the study area on a given route will be to one of the destination listed.

174. For the purpose of the NRA, only routes with more than one vessel per day have been presented as Main Routes within this Section. However, lower use routes have still been identified and included within the allision and collision modelling (see Section 15).

Table 11-1: Main Routes

Route Number	Vessels Per Day	Description
1	14	**Liverpool (UK) - Dublin (Ireland)**. Used by cargo vessels (66%) and passenger vessels (30%). This included the Stena Line and Seatruck-operated RoRo routes between Dublin and Liverpool; and the P&O Ferries-operated RoPax route between Dublin and Liverpool.
2	10	**Holyhead (UK) - Dublin (Ireland)**. Used by passenger vessels (97%). This included the Stena Lines and Irish Ferries-operated RoPax routes between Dublin and Holyhead.
3	10	**Rotterdam (Netherlands) - Dublin (Ireland)**. Used by cargo vessels (71%) and tankers (14%). This included the CLdN-operated RoRo route between Dublin and Dutch/Belgian ports; and the Irish Ferries-operated RoPax route between Dublin and Cherbourg.
4	8	**Holyhead (UK) - Dublin (Ireland)**. Used by passenger vessels (95%). This included the Stena Lines and Irish Ferries-operated RoPax routes between Dublin and Holyhead.
5	3	**Warrenpoint (Northern Ireland) - Avonmouth (UK)**. Used by cargo vessels (88%).
6	1	**Belfast (Northern Ireland) - Dublin (Ireland)**. Used by cargo vessels (51%), tankers (30%), and passenger vessels (19%).
7	1	**Rotterdam (Netherlands) - Dublin (Ireland)**. Used by cargo vessels (51%) and tankers (29%).
8	1	**Drogheda (Ireland) – Howth (Ireland)**. Low use route, various vessel types.
9	1	**Rotterdam (Netherlands) - Dublin (Ireland)**. Used by tankers (38%), cargo vessels (34%), and passenger vessels (28%).

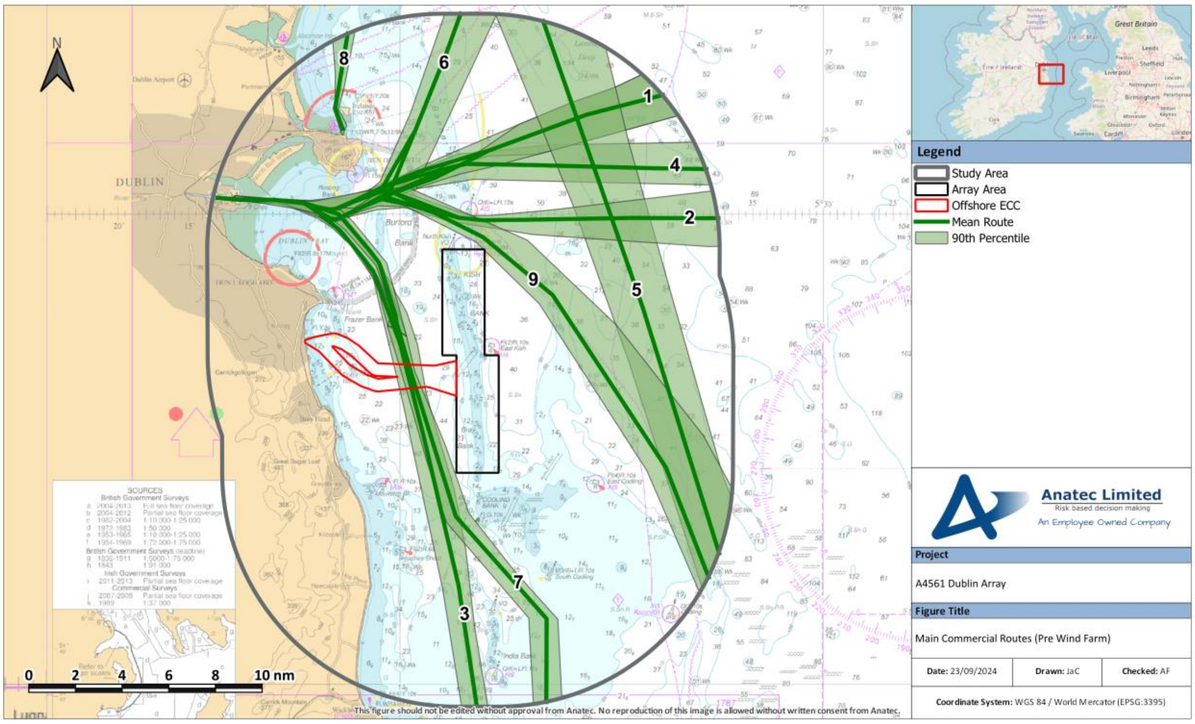

Figure 11-2: Pre-Wind Farm Main Routes

12 Navigation, Communication, and Position Fixing Equipment

175. This Section discusses the potential impacts upon communication and position fixing equipment of vessels that may arise due to the infrastructure associated with Dublin Array.

176. Note that due to the more advanced stage of offshore wind in the UK, the majority of the studies relating to communication and position fixing equipment have been performed within UK wind farms however this guidance and research is considered directly applicable to vessel operation in proximity to offshore wind farms in Irish waters.

12.1 Very High Frequency Communications (Including Digital Selective Calling)

177. 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 VHF transceivers (including Digital Selective Calling (DSC)) when operated close to WTGs.

178. The WTGs had no noticeable effect on voice communications within the wind farm 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.

179. During this trial, a number of telephone calls were made from ashore, within the wind farm, and on its seawards side. No effects were recorded using any system provider (MCA and QinetiQ, 2004).

180. 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 be on the seaward side of the wind farm and communications were reported to be very clear, with no apparent degradation of performance. Communications with the service vessel located within the wind farm were also fully satisfactory throughout the trial (MCA, 2005).

181. 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.dk, 2014).

182. 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, Dublin Array is anticipated to have no significant impact upon VHF communications.

12.2 Very High Frequency Direction Finding

183. 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 the WTGs (within approximately 50 m) this is deemed to be a relatively small-scale impact due to the limited use of VHF DF equipment and will not impact on operational or SAR activities (MCA, QinetiQ, 2004).

184. 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 target vessel within the wind farm, at a range of approximately 1 nm, the homer system operated as expected with no apparent degradation.

185. Since the trials detailed above, no significant issues with regards to VHF DF have been observed or reported, and therefore Dublin Array is anticipated to have no significant impact upon VHF DF equipment.

12.3 Automatic Identification System

186. No significant issues with interference to AIS transmission from operational offshore wind farms has been observed or reported to date. Such interference was also not evident in the trials carried out at the North Hoyle Offshore Wind Farm (MCA, QinetiQ, 2004)

187. In theory, there could be interference when there is a structure located between the transmitting and receiving antennas (i.e., blocking the line of site) 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 Dublin Array.

12.4 Navigational Telex System

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

189. 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 navigational 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 settings.

190. The 490 kHz national NAVTEX service may be transmitted in the local language. In UK and Irish waters 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.

191. 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 Dublin Array.

12.5 Global Positioning System

192. Global Positioning System (GPS) is a satellite based navigational system. GPS trials were also undertaken throughout the 2004 trails 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"*.

193. 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)

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

12.6 Electromagnetic Interference

195. 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 within a sextant to calculate latitude, and with a mariner chronometer to calculate longitude.

196. Like any magnetic device, compasses are affected by nearby ferrous materials as well as by strong electromagnetic forces, such as magnetic fields emitted by 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 should not be allowed to be affected to the extent that safe navigation is prohibited. The important factors with respect to cables that affect the resultant deviations are:

- Water depth;
- Burial depth;
- Current (Alternating Current (AC) or Direct Current (DC)) running through the cables;
- Spacing or separation of the two cables in a pair (balanced monopole or bipolar design); and/or
- Cable route alignment relative to the Earth's magnetic field.

197. Dublin Array export and array cables will be AC, with studies indicating that AC does not emit an Electromagnetic Field (EMF) significant enough to impact marine magnetic

compasses (Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), 2008).

198. No problems with respect to magnetic compasses have been reported to date in any of the trials caried out (inclusive of SAR helicopters) nor at any operational offshore wind farms. However, 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).

12.7 Marine Radar

199. This Section summarises 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 minimum spacing then was achievable at the time of the studies undertaken, which is beneficial in terms of Radar interference effects (and surface navigation in general) as detailed below.

12.7.1 Trials

200. During the early years in offshore renewables in 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.

201. In 2004 trials undertaken at the North Hoyle Offshore Wind Farm (MCA, 2004) identified areas of concerns 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 the time). This results in Radar responses strong enough to produce interfering side lobes and reflected echoes (often referred to as false targets or ghosts).

202. 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 12-1.

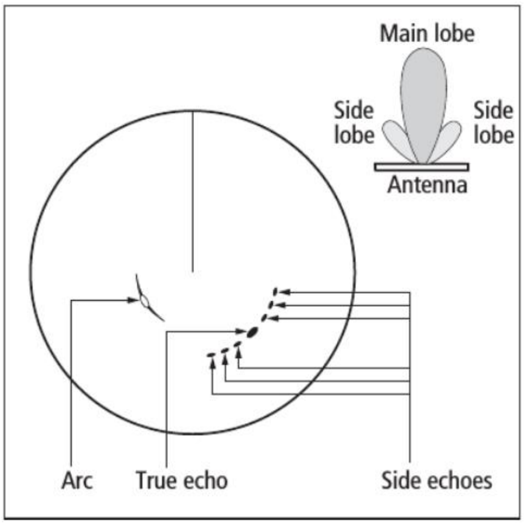

Figure 12-1: Illustration of Side Lobes on a Radar Screen

203. 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 or range, as illustrated in Figure 12-2.

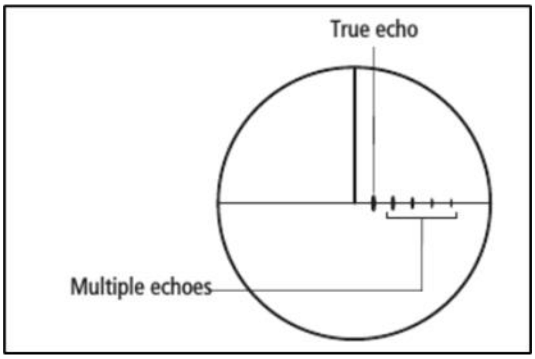

Figure 12-2: Illustration of Multiple Reflected Echoes on Radar Screen

204. Based upon 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.

205. 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 crafts, particularly yachts or Glass Reinforced Plastic (GRP) constructed craft; therefore due care should be taken in making such adjustment.

206. Theoretical modelling of the effect of the development of the proposed Atlantic Array Offshore Wind Farm, which was to be located off the south coast of Wales in the UK, on marine Radar systems was undertaken by the Atlantic Array project (Atlantic Array, 2002) and considered a wider spacing of WTGs than that considered within the early trials. 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 against the WTGs and safe navigation;
- Even in the worst case with Radar operator settings artificially set to poor, there is a significant clear space around each of the WTGs 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 mode, 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 (i.e., those without AIS which are usually fishing and recreational crafts). It is noted that this situation would arise with or without WTGs in place; and
- There is potential for the performance of a vessel’s ARPA to be affected when tracking targets in or near the array. Although greater vigilance is required, during the Kentish Flats trials it was shown that false targets were quickly identified as such by mariners and then by the equipment itself.

207. In summary, experience in UK waters has shown that mariners have become increasingly aware of 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 vessels or structures. Effects can be effectively mitigated by ‘careful adjustment of Radar controls’ but also distancing (0.5 nm>) where possible from the structures and therefore limiting exposure time.

208. The MCA has also produced guidance to mariners operating in proximity to OREIs in the UK, which is also applicable to OREIs in Irish waters, which highlights Radar issues amongst others to be taken into account when planning and undertaking voyages in

proximity to OREIs (MCA, 2008). The interference buffers presented in Table 12-1 are primarily based on MGN 654 (MCA, 2021), but also consider MGN 371 (MCA, 2008), MGN 543 (MCA, 2018), and MGN 372 (MCA, 2008).

Table 12-1: Distances at which Impacts on Marine Radar Occur

Distance at which Effects Occurs (nm)	Identified Effects (as per MGNs)
0.5	▪ Intolerable impacts can be experienced at under 0.5 nm. ▪ 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 0.5nm 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 produced strong Radar echoes giving early warning of their presence. ▪ Target size of the WTG echo increase close to the WTG with a consequent degradation on both X and S-band Radars.

12.7.2 Experience from Operational Developments

209. The evidence from mariners operating in proximity to existing offshore wind farms is that they quickly learn to adapt to any effects. Figure 12-3 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 12-3 are as per Table 12-1.

210. As indicated by Figure 12-3, vessels utilising these TSS lanes will experience some Radar interference based on the available guidance. Both developments are operational, and each of the lanes is used by a minimum of five vessels per day on average. However, to date, there have been no incidents recorded (including any related to Radar use) or concerns raised by the users.

211. 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). It is noted approximately 38% of the vessel traffic recorded within the array area was under 15 m LOA, reflecting the close distance to shore and the high proportion of recreational vessels. 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.

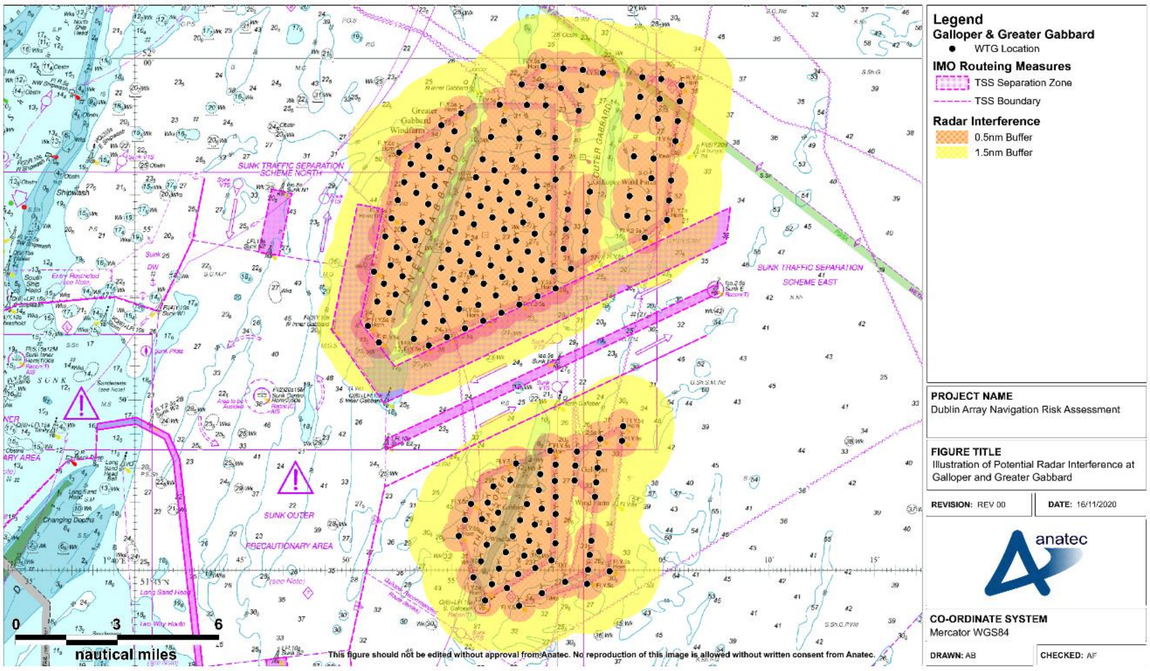

Figure 12-3: Illustration of Potential Radar Interference at Galloper and Greater Gabbard

12.7.3 Increased Target Returns

212. 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.

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

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

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

215. It is noted that there are multiple operational wind farms including Galloper that successfully operate fixed Radar antenna from locations on the periphery of the array.

These antennas are able to provide accurate and useful information to onshore coordination centres.

12.7.5 Application to Dublin Array

216. Upon development of Dublin Array, some commercial vessels may pass within 1.5 nm of the wind farm infrastructure (in particular at the south west corner), and therefore may be subject to a minor level of Radar interference. Trials, modelling, and experience from existing developments note that this impact can be mitigated by the adjustment of Radar controls.

217. Figure 12-4 presents an illustration of potential Radar interference due to Dublin Array relative to the post wind farm routeing illustrated in Section 14.6. The Radar effects have been applied to Layout A introduced in Section 6.2.1.1 which includes the greatest number of structures. It has been assumed for the purpose of Figure 12-4 that the OSP will produce the same magnitude of Radar interference as the WTGs, however there is no indication that this structure would have notable effect in reality.

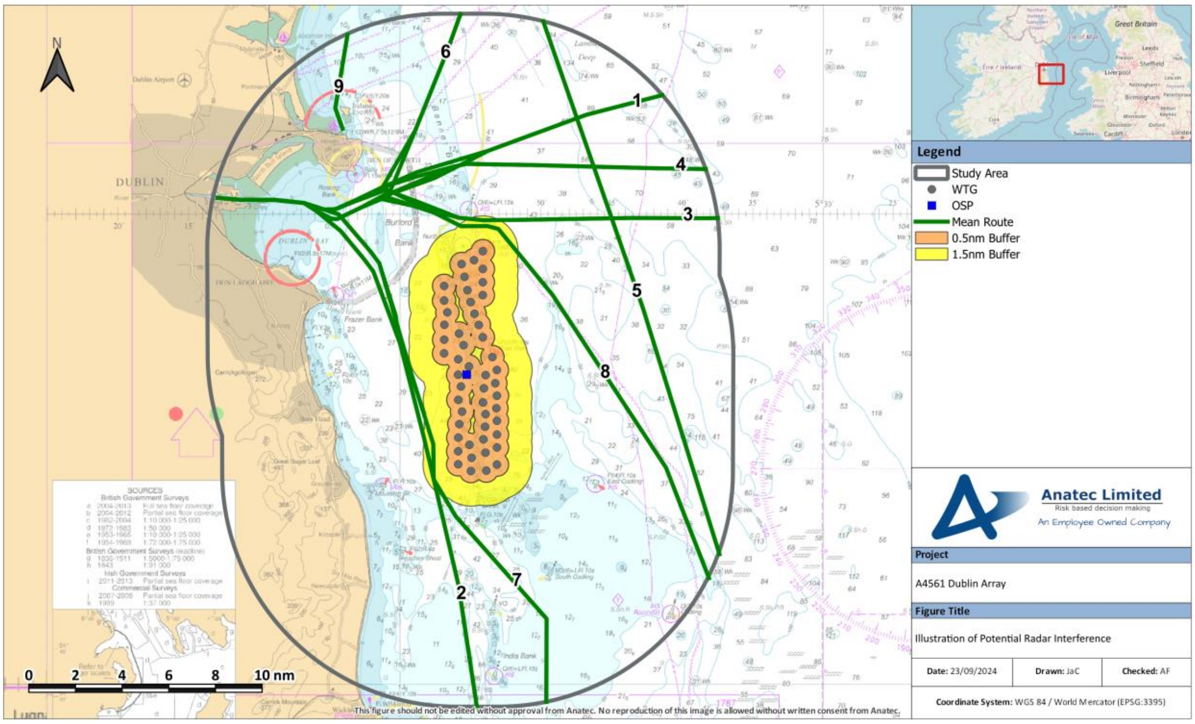

Figure 12-4: Illustration of Potential Radar Interference

218. Vessels passing within the array area will be subject to a greater level of interference with impacts becoming more substantial in close proximity to the WTGs. This will require additional mitigation by any vessels including consideration of the navigational conditions (i.e., visibility) when passage planning and compliance with (COLREGs) will be essential. Again, looking at existing experience within UK offshore wind farms, vessels do navigate safely within arrays including those with spacing significantly less than at Dublin Array. It should be considered that, based on consultation, the shallow

depths associated with the Kish and Bray Banks may mean vessel transits through the array area itself are lower than at other operational wind farms with greater navigable depths.

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

12.8 Sound Navigation Ranging Systems

220. No evidence has been found to date with regard to existing offshore wind farms to suggest that they produce any kind of Sound Navigation Ranging (SONAR) systems[11] interference which is detrimental to the fishing industry, or to military systems. No impact is therefore anticipated in relation to Dublin Array.

12.9 Noise

12.9.1 Surface Noise

221. The sound level from WTGs at a distance of 350m has been predicted to be in the range of 35 decibels (dB) and 45 dB (Scottish Government, 2002). Furthermore, modelling undertaken during the consenting process for the Atlantic Array Offshore Wind Farm showed that the highest predicted level due to operational WTG noise (for a 125 m tall 8 Megawatt (MW) WTG) is around 60 dB (Atlantic Array, 2012).

222. A vessel's whistle for a vessel of 75 m length should generate in the order of 138 dB and be audible at a range of 1.5 m (IMO, 1972/77); hence this should be heard above the background noise of the WTGs. Similarly, fog horns will also be audible over the background noise of the WTGs.

223. There are therefore no indications that the sound level of Dublin Array will have a significant influence on marine safety.

12.9.2 Underwater Noise

224. In 2005, the underwater noise produced by operational WTGs of 110 m height and with 2MW 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).

225. During the operation and maintenance phase of Dublin Array, the subsea noise levels generated by WTGs will likely be greater than that produced at Horns Rev Offshore Wind Farm (in Danish waters) given the larger WTGs size, but nevertheless is not anticipated to have any significant impact as they are designed to work in pre-existing

[11] Systems that utilise sound waves to determine the distance objects are away from the source, generally, for the purposes of navigation.

noisy environments (please see the Underwater Noise Modelling Report for consideration of operational noise - Appendix 4.3.5-7).

12.10 Existing Aids to Navigation

226. There are no existing AtoN within the array area. However, there are three AtoN on the peripheries of array area marking the Kish and Bray Banks, specifically, the East Kish buoy 0.3 nm east of the site, North Kish buoy 0.1 nm north of the site, and the Kish Bank buoy 0.1 nm north of the site (see Section 7.8).

227. Consultation will be undertaken post consent with Irish Lights to determine the locations and types of buoyage required, or any potential need to alter the existing AtoNs. Initial consultation has already been undertaken (see Section 4.3). It is also noted that the array itself will form an additional AtoN given its lighting and marking, which will increase awareness of the shallow banks, and may result in vessels passing further from the shallow depths.

12.11 Assessment Summary

228. Table 12-2 summarises the anticipated impacts and the screening in or out of impacts from Dublin Array on communication and position fixing equipment based on the assessment undertaken within Sections 12.1 - 12.9.

Table 12-2: Assessment Summary

Topic		Sensitivity	Screen In/Out (Isolation)	Screen In/Out (Cumulative)
Type	Specific			
Communication	VHF	No anticipated impacts.	Screened out	Screened out
	VHF DF	No notable degradation and therefore no anticipated impacts.	Screened out	Screened out
	AIS	No anticipated impacts.	Screened out	Screened out
	NAVTEX	No anticipated impacts.	Screened out	Screened out
	GPS	No anticipated impacts.	Screened out	Screened out
EMFs	Subsea cables	No anticipated impacts.	Screened out	Screened out
	WTGs	No anticipated impacts.	Screened out	Screened out
Marine Radar	Use of marine Radar	Trials, modelling, and experience from existing developments note that this impact can be mitigated by the careful adjustment of Radar controls but also by the closest point of approach exceeding 0.5nm where possible or limiting exposure.	Screened out	Screened out
SONAR	SONAR Systems	No anticipated impacts.	Screened out	Screened out

Topic		Sensitivity	Screen In/Out (Isolation)	Screen In/Out (Cumulative)
Type	Specific			
Noise	WTG generated noise	No anticipated impacts.	Screened out	Screened out
	SONAR	No anticipated impacts.	Screened out	Screened out

13 Cumulative Overview

229. Cumulative effects have been considered for activities in combination and cumulatively with Dublin Array. This Section provides an overview of the baseline used to inform the CEA including vessel routeing, and projects and developments screened into the CEA based upon the criteria outlined in Section 3.4.

13.1 Screened in Developments

13.1.1 Other Offshore Wind Farms

230. In addition to Dublin Array, there are other offshore wind farm developments within the Irish Sea at various stages of development. Table 13-1 includes details of the offshore wind farm developments, including the project status[12]. Further details of cumulative screening are provided in Volume 3, Chapter 10: Shipping and Navigation.

Table 13-1: Cumulative Offshore Wind Farms

Development	Distance to Site (nm)	Status	Data Confidence	Screened In
Codling Bank Wind Park	1.6	Phase 1	Medium	Yes
Codling Bank Wind Park Extension	7.9	Phase 1	Medium	Yes
North Irish Sea Array (NISA)	11.5	Phase 1	Medium	Yes
Arklow Bank Phase 2	13.9	Phase 1	Medium	Yes
Oriel	34.9	Phase 1	Medium	Yes

13.1.2 Oil and Gas Infrastructure

231. There is no surface oil and gas infrastructure within the cumulative study area, and hence no oil and gas assets have been screened into the cumulative assessment.

13.1.3 Ports

232. No known port expansions that could have cumulative effect have been identified. It is noted that consultation has been undertaken with Dublin Port to agree suitable future case scenarios (see Section 4). On this basis, potential increases associated with changes in capacity of existing ports are considered as being accounted for within the future case traffic scenarios assessed.

[12] Project statuses correct at time of writing 14/11/2023.

13.2 Effects on Routeing

13.2.1 Construction

233. The key impact on vessel routeing during cumulative construction phases is likely to be from the cable installation processes for Dublin Array and Codling Wind Park, as cable routes for each project use the area inshore of the array area used by north/sound bound vessels to or from Dublin Port.

234. Any associated impact would be temporary in nature, limited only to the period when one or both projects were installing cable. Dublin Array have included a Vessel Management Plan (VMP)to support their EIAR (Volume 7: 7.6) which includes measures by which navigational safety impacts from cable installation will be managed. Further, Codling Wind have included a Navigational Safety Plan (Anatec, 2024) within their planning application.

13.2.2 Operation and Maintenance

235. Noting the proximity of Codling Bank Wind Park and Arklow Bank Phase 2, there may be some cumulative deviation effects on routeing. However, given the very limited effects of Dublin Array on deviations when the project is considered in isolation (see Section 14.6), and noting the location of these 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 (which is limited).

236. The NISA project is located 11.5 nm to the north of the site, with Oriel being located 34.9 nm to the north. These projects may interact with routes that also pass offshore of the site, however similarly to consideration of the Codling Bank Wind Park and Arklow Bank Phase 2, any deviations associated with Dublin Array will be minimal and as such will not be a large contributor to the any cumulative deviations.

237. 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 Bank in particular. These impacts are assessed qualitatively on a cumulative basis in Volume 3, Chapter 10: Shipping and Navigation.

14 Future Case Vessel Traffic

238. This Section presents the future case level of activity within and in proximity to the array area and the anticipated shift in the mean route positions of the main commercial routes post wind farm.

239. The future case activity and routeing has been input into the collision and allision risk modelling and is considered throughout the impact assessment undertaken in Volume 3, Chapter 10: Shipping and Navigation of the EIAR, where future case refers to the assessment of risk based upon the predicted growth in future shipping densities and traffic types as well as any foreseeable changes in the marine environment, as discussed in the following subsections.

14.1 Increases in Commercial Vessel Activity

240. As with any NRA process there is uncertainty associated with long-term predictions of vessel traffic growth particularly in relation to the potential for any other new developments in Ireland or transboundary ports and the long-term effects of Brexit.

241. Noting that port developments (which may be associated with commercial vessels) are discussed separately in Section 14.2, two independent scenarios of potential growth in commercial vessel movements of 10% and 20% have been estimated throughout the lifetime of Dublin Array.

14.2 Increases in Traffic Associated with Ports

242. Due to the proximity of the array area to Dublin port (considered a major port), increases to port traffic may impact on the general traffic levels in proximity to the array area. A 10% increase in traffic has therefore been assessed to account for potential increases for ports in proximity to the array area.

243. It is noted that Dublin Port Company has published a 2012-2040 Master Plan with a goal to increase traffic volumes, but as the 2018 Review (Dublin Port, 2018) indicates this is not guaranteed, and is considered aspirational and subject to change. Discussions were therefore held with the Dublin Port Authority and it was agreed that an additional scenario of a 25% future case increase of traffic would be included in the NRA.

14.3 Increases in Commercial Fishing Vessel Activity

244. Given fishing trends will depend on a variety of factors, an indicative 10% increase in fishing vessel activity (transits and engaged in fishing) is considered conservative, and has therefore been applied.

14.4 Increases in Recreational Traffic

245. It was raised during consultation (Section 4) that the proximity of the array area to the coast may result in an increase in recreational vessels (sightseers) visiting the structures.

Noting any changes will be dependent on a variety of factors, a conservative 10% increase in traffic is considered appropriate.

14.5 Increases in Traffic Associated with Dublin Array Operations

246. During the construction phase there will be traffic associated with Dublin Array transiting through the study area from base port(s) to the array area. During the operations and maintenance phase there will also be traffic associated with Dublin Array transiting through the study area, although likely less frequently than during the construction phase. Although this traffic is not considered within the collision risk modelling (as mean route positions will not be defined), associated increases will be assessed within Volume 3, Chapter 10: Shipping and Navigation.

14.6 Routeing

14.6.1 Methodology

247. It is not possible to consider all possible alternative routeing options for commercial traffic and therefore worst-case alternatives have been considered where possible taking into account points raised by commercial operators during consultation. Assumptions for re-routeing include:

- All alternative routes maintain a minimum mean distance of 1 nm from offshore installations to ensure a realistic worst case is modelled; and
- All mean routes take into account the shallow banks and known routeing preferences.

248. MGN 654 provides guidance to offshore renewable energy developers on both the assessment process and design elements associated with the development of an offshore wind farm. Annex 2 of MGN 654 defines a methodology for assessing passing distances between offshore wind farm boundaries but states that it is *"not a prescriptive tool but needs intelligent application"*.

249. To date, internal and external studies undertaken by Anatec on behalf of the UK Government and individual clients (including those constructing wind farms in Ireland) show that vessels do pass consistently and safely within 1 nm of established wind farms and these distances vary depending on searoom available as well as prevailing conditions. This evidence also demonstrates that the Mariner defines their own safe passing distance based upon the conditions and nature of the traffic at the time, but they are shown to frequently pass 1 nm off established developments. Evidence also demonstrates that commercial vessels do not transit through wind farm arrays, noting that this correlated with the consultation findings (Section 4).

250. The NRA also aims to estimate maximum possible risk based on navigational safety parameters, and when considering this the most conservative realistic scenario for vessel routeing is considered when main routes pass 1 nm off developments. Evidence

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

14.6.2 Main Route Deviations

251. Figure 14-1 presents the post wind farm main routes. Of the nine main routes identified, two are anticipated to require deviation as a result of the array area (Routes 7 and 9). The deviations are summarised in Table 14-1, which shows the length of the routes within the study pre and post wind farm, and the change on distance that this represents.

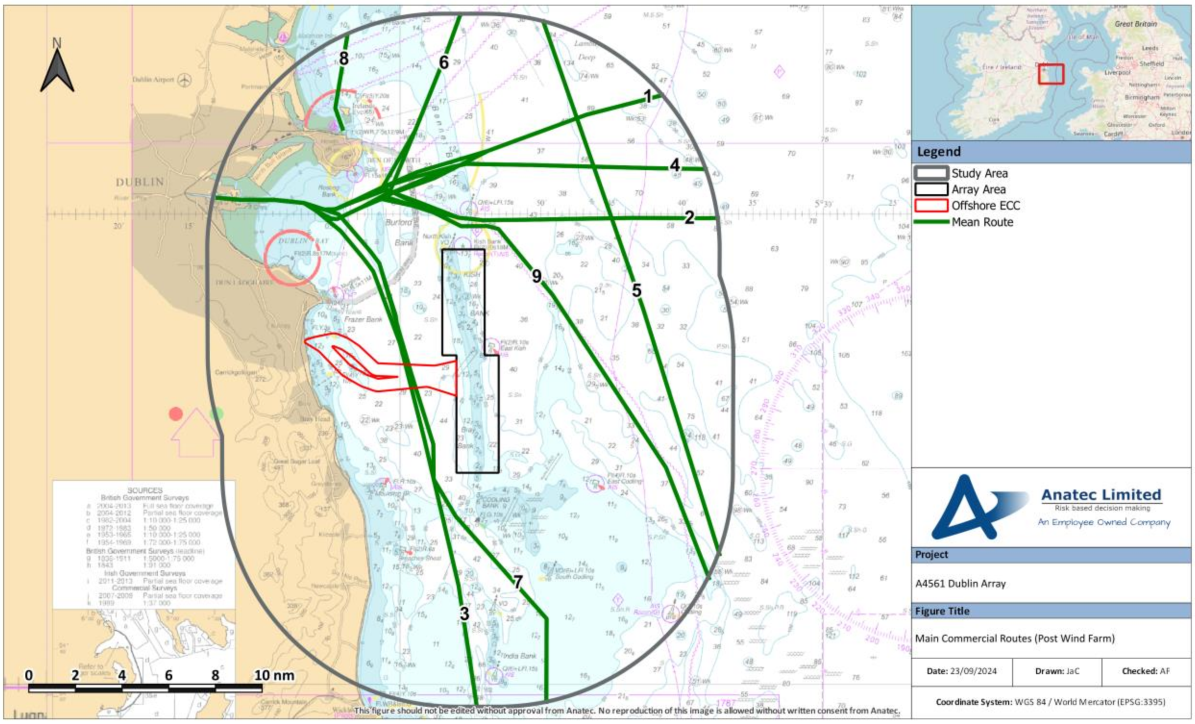

Figure 14-1: Post Wind Farm Main Routes

Table 14-1: Deviation Summary

Route	Distance within Study Area (nm)		Change	
	Pre-Wind Farm	Post Wind Farm	Distance(nm)	%
7	28.2	28.4	0.2	< 1
9	29.6	30.0	0.3	1.3

252. Route 7 is anticipated to shift to the west to avoid the south west corner of the array area, which corresponds to an increase in distance of 0.2 nm overall, representing an increase of less than 1%. Vessels on Route 9 are anticipated to make a minor deviation to the north to avoid the northern extent of the array area, which corresponds to an

increase in distance of 0.3 nm overall, representing an increase of approximately 1.3%. It should be considered that while these deviations are minor, they will have an effect on collision risk given both are being displaced closer to existing routeing. This is assessed within Section 15.3.1.

14.6.3 Available Searoom

253. It is noted that the south west corner was raised with regards to the post wind farm scenario in terms of the potential for a “squeeze” of traffic within this area. As illustrated in Figure 14-2, there is a gap of 3.2 nm between the array area and the Moulditch Buoy, with the 90th percentiles of the relevant traffic seen to be distancing approximately 0.7 nm from the Bray Bank. It is noted that the spacing may increase depending on the location of WTGs.

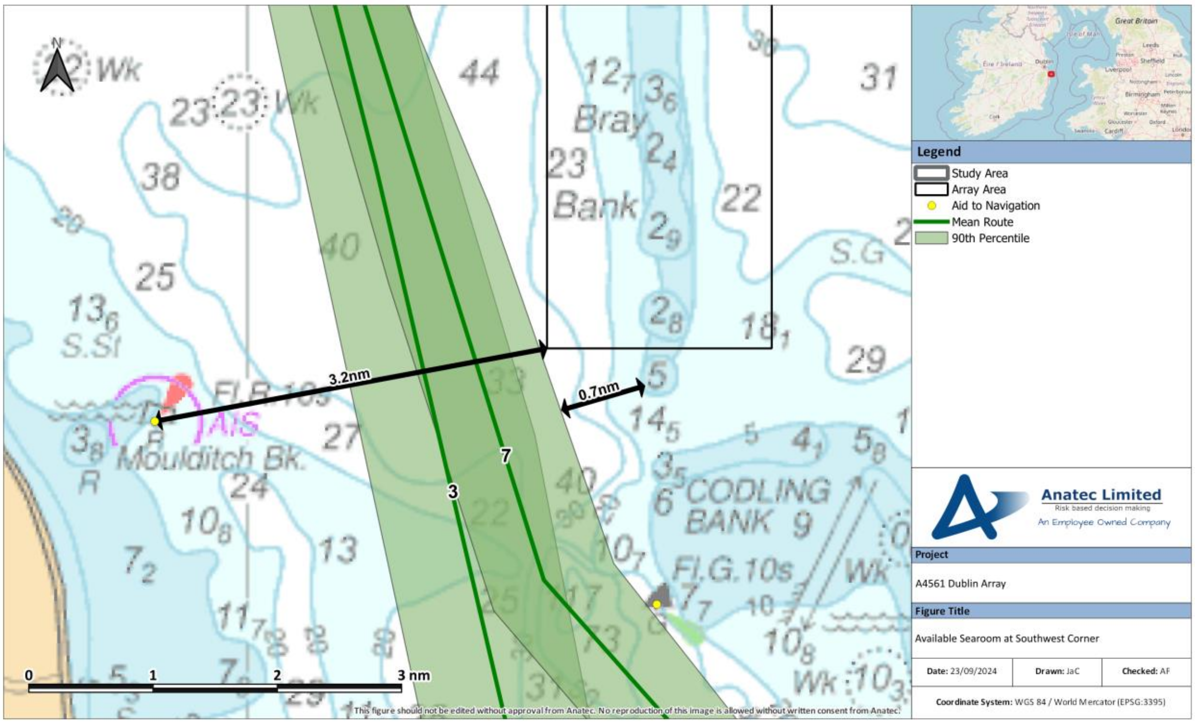

Figure 14-2: Available Searoom – Southwest Corner

254. To assess the baseline traffic levels within this gap, the number of concurrent vessels per hour recorded in the vicinity of the area between the southwest corner of the array area and the Mouldtich buoy was estimated based on the vessel traffic survey data (see Section 10). The assessment showed that the average number of concurrent vessels of the busiest hour of each day over the 28 day encounter period studied (Section 15.2.1) was approximately two vessels.

255. The busiest hour identified over the period (Section 15.2.1) was between 4:00 and 5:00 on the 12th November 2019, when four vessels were recorded concurrently (within the same hour) in the area. No other instances of more than three vessels were identified. The four vessels were all cargo vessels of lengths 89, 141, 151, and 89 m. Figure 14-3

shows a snapshot of the positions of these vessels at 04:43 am, the only point at which any of these vessels came in close proximity in the area of interest. The tracks are shown in their entirety, with the position of each at 04:43 am made clear. As shown, the *FRI Brevik* and *Wega* passed safely at a distance of approximately 0.3nm from each other, however the *Luhnau* and *Mirror* were already through the gap at this point on their respective courses.

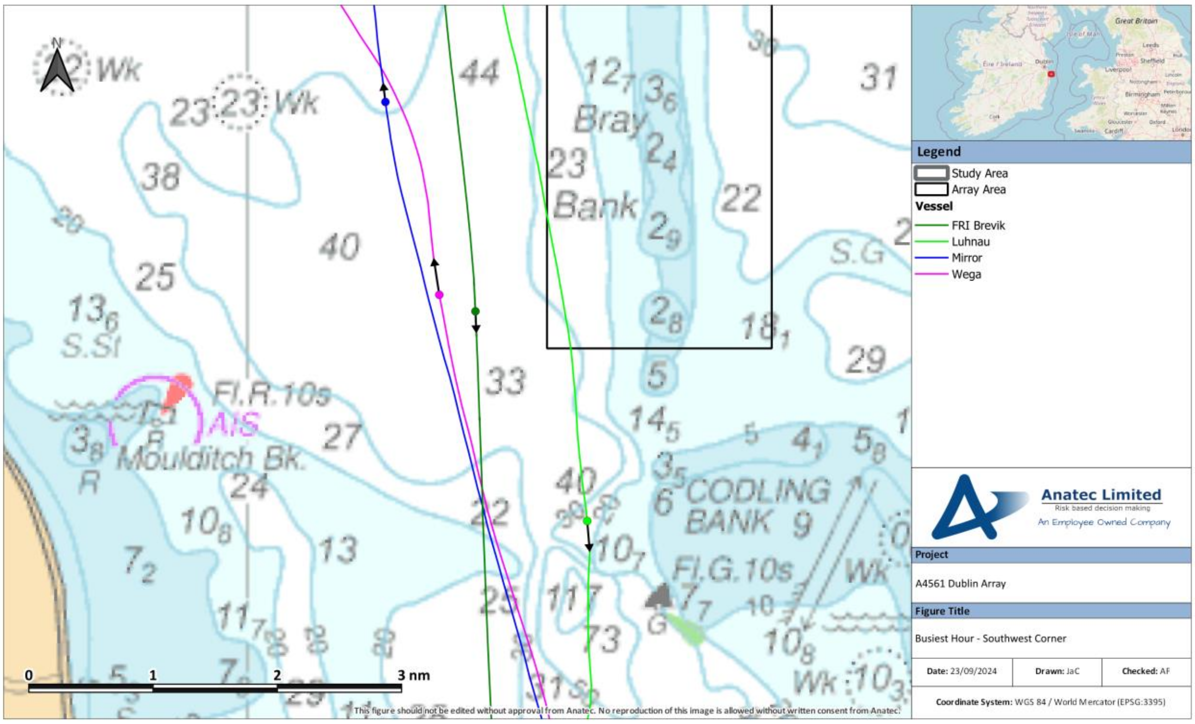

Figure 14-3: Busiest Hour – Southwest Corner at 04:43am 12th November 2019

256. Guidance within MGN 654 (MCA, 2021) does not specify at what distance vessels should pass offshore structures (nor does MGN 372 which provides advice to mariners) instead stating 'These notes do not provide guidance on a safe distance at which to pass an OREI, as this depends upon individual vessels and conditions.' MGN 654 includes a shipping template which provides guidance on the siting of WTGs relative to traffic lanes, and notes that within 0.5 nm intolerable effects (mainly related to effects on marine Radar) may be experienced but over 0.5 nm impacts are within tolerable parameters if ALARP.

257. It is also noted that, in line with COLREGS Rule 9, vessels will be on alert when transiting the area both in a pre and post wind farm environment, and that the "squeeze" point is limited spatially (i.e., only when in the proximity of the southwest corner of the array area). Taking this into account in combination with the typical number of vessels that will be in the area concurrently (one to two), there is considered to be sufficient searoom for vessels to navigate. This will be assessed in Volume 3, Chapter 10: Shipping and Navigation.

15 Modelling

15.1 Overview

258. To inform the impact assessment, a quantitative assessment of the major hazards associated with Dublin Array has been undertaken. The following subsections outline the inputs and methodology used for the collision and allision risk modelling.

259. The modelling process utilises Anatec COLLRISK[13] modelling suite, which has been used for similar NRA purposes for various UK and other international projects.

15.1.1 Scenarios under Consideration

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

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

15.1.2 Hazards under Consideration

261. Hazards under consideration 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.

262. The pre wind farm assessment has used the vessel traffic survey data (see Section 10), in combination with the outputs of consultation (see Section 4), and other baseline data sources (such as Anatec's ShipRoutes database and previous NRAs undertaken within Irish waters) to determine baseline traffic patterns. Conservative assumptions have then been made with regard to route deviations and future shipping growth over the life of Dublin Array (see Section 14).

[13] Anatec's COLLRISK software conforms to the MCA Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations including tuning of parameters, consistency checks, behavioural reasonableness, sensitivity analysis; and comparison with the real world. COLLRISK is recognized as industry-leading software in the specialist field of collision risk assessment.

15.2 Pre-Wind Farm

15.2.1 Vessel to Vessel Encounters

263. An assessment of current vessel to vessel encounters in proximity to the array area has been undertaken by replaying at high speed the data collected as part of the 2022 and 2023 vessel traffic surveys (see Section 5.1).

264. 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 congestion and therefore also increase the risk of encounters and collisions. No account has been given as to whether the encounters are head on or stern to head, just close proximity. It should also be considered that planned operations involving vessels in proximity (e.g., pair trawling or towing) may also be captured within the encounters analysis.

265. It is noted that significant levels of encounters were recorded within Dublin Port limits. Therefore, to ensure the focus of the assessment is on traffic passing the site (i.e., vessels which may deviate as a result of Dublin Array), the area within Dublin Port limits has been excluded, noting that the TSS lanes on approach to Dublin Bay have been retained.

266. During the summer study period, there was an average of approximately 88 encounters per day. This fell to an average of 24 encounters per day during the winter period. It should be considered that 49% of encounters were observed to involve at least one recreational vessel.

267. The average number of encounters not involving a recreational vessel were 34 per day during summer, and 23 in winter.

268. To illustrate the areas within which encounter levels are highest, a heat map based upon the geographical distribution of vessel encounter tracks is presented in Figure 15-1. Following this, for the purposes of clarity around commercial vessel encounters (noting the significant levels of recreational encounters as above), Figure 15-2 shows an equivalent map with non-recreational encounters presented.

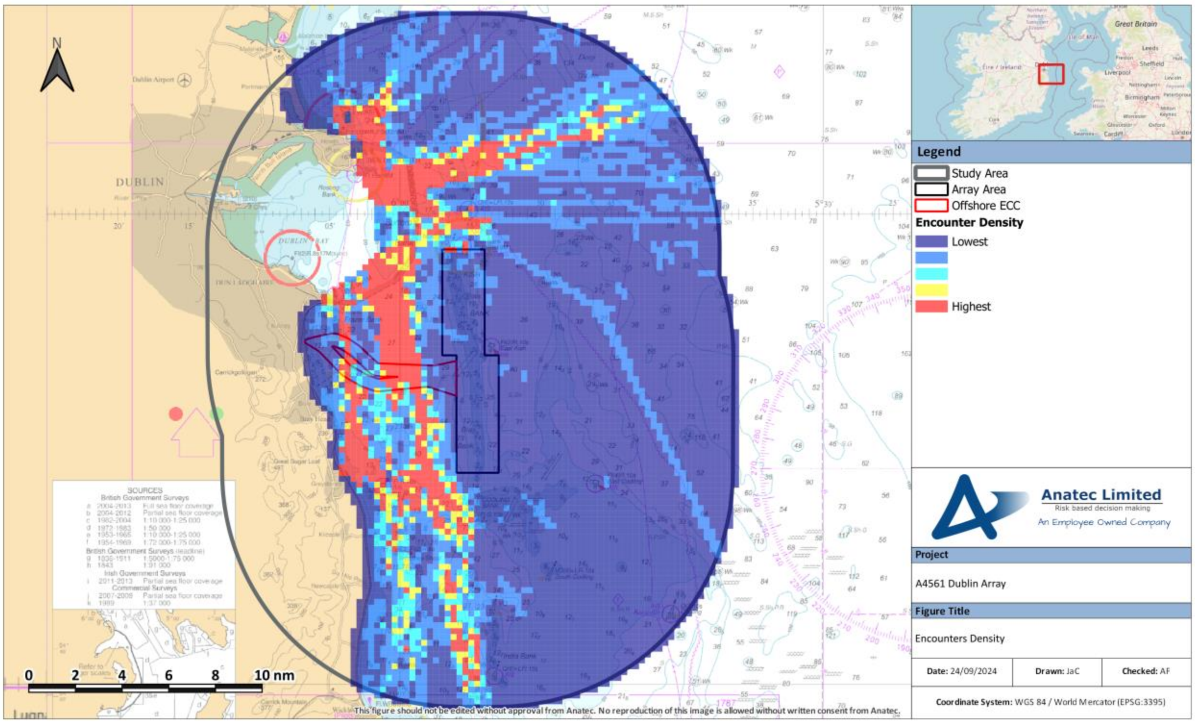

Figure 15-1: Vessel Encounters Heat Map within the Study Area (0.25 x 0.25nm Grid)

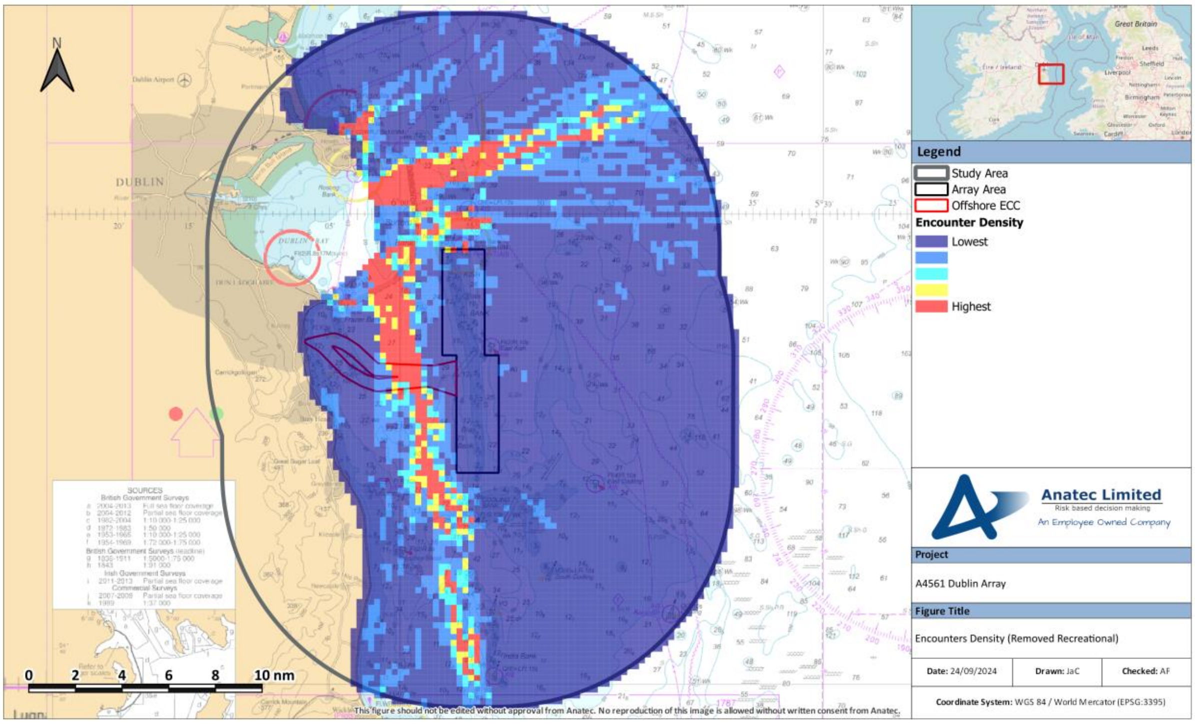

Figure 15-2: Vessel Encounters Heat Map (Non-Recreational Only) within the Study Area (0.25 x 0.25nm) Grid

269. As can be seen in both Figure 15-1 and Figure 15-2, the highest vessel density was associated with the approach to Dublin Port, resultant of a high number of vessels converging on the same location (see Figure 11-2).

15.2.1.1 Available Searoom

270. Of relevance to baseline encounters is the southwest corner of the array area, which as per Section 4 was raised during consultation with regards to a potential "squeeze" of traffic leading to potential for increased encounters / collisions.

271. Study of the output of the encounters assessment shows that encounter density is lower within the vicinity of the southwest corner of the array area than the areas north and south, despite there being reduced searoom,. This is illustrated in Figure 15-3, which shows a detailed view of encounter density between the array area and the Moulditch buoy. A potential contributing factor to this observation is increased awareness / caution of vessels when in the area due to the presence of the shallows, and a favouring of searoom further from the southern area of the Bray Bank leading to a reduced width of high density area.

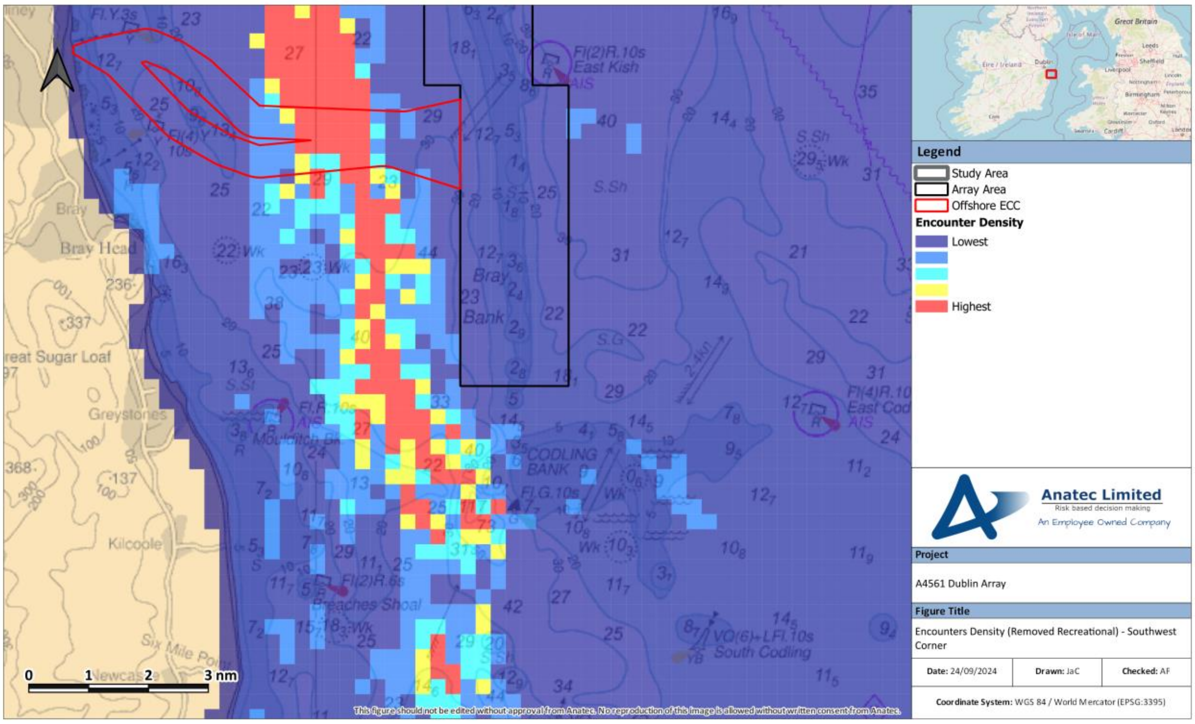

Figure 15-3: Encounter Density (Non-Recreational Only) – Southwest Corner

15.2.2 Vessel to Vessel Collisions

272. Using the pre wind farm routeing (see Section 11) as input, Anatec's COLLRISK model has been run to estimate the existing vessel to vessel collision risk in proximity to the array area. The route positions and widths are based upon the vessel traffic survey data.

273. A heat map based upon the geographical distribution of collision risk with a 0.25 nm x 0.25 nm grid for the base case is presented in Figure 15-4.

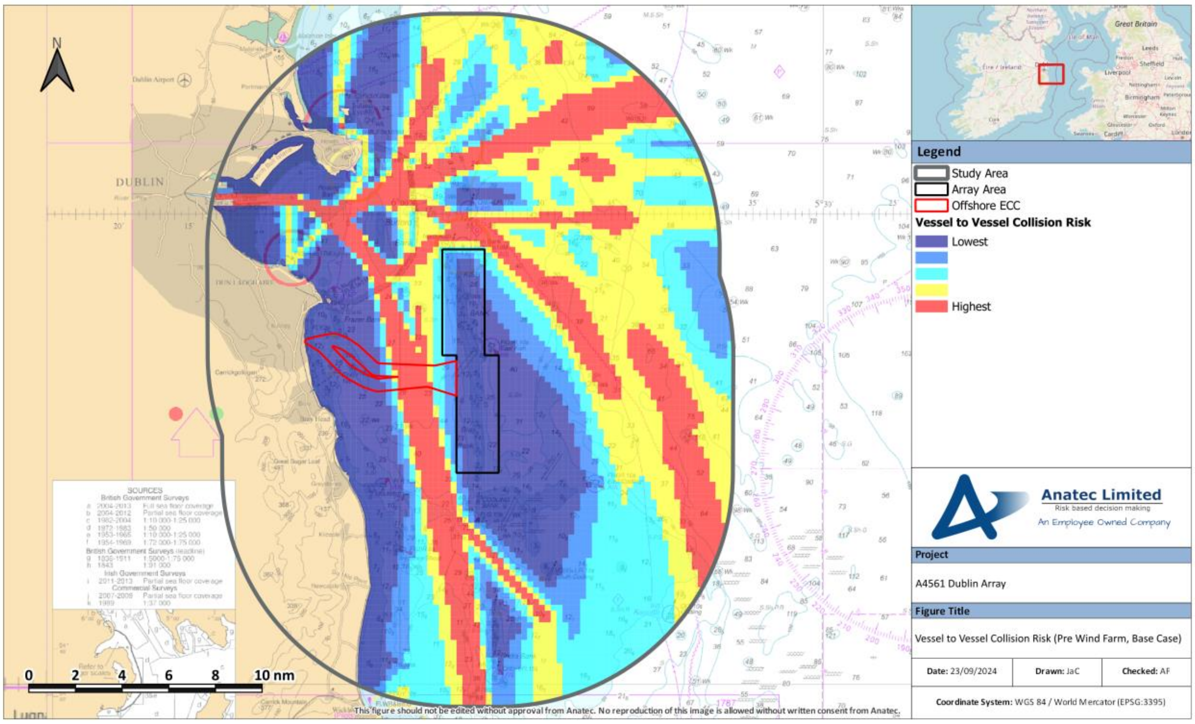

Figure 15-4: Pre-Wind Farm Base Case Collision Risk

274. Assuming base case vessel traffic levels, the annual collision frequency pre-wind farm was estimated to be 3.21 x 10^{-2}, corresponding to a collision return period of approximately one in 32.0 years. Note approximately 65% of the collision risk is associated with cells within the port limit (on the approach to Dublin Port), an area within which vessels will be on alert, and existing mitigations (Vessel Traffic Scheme, TSS lanes, and pilotage) reduce the risk of collision.

275. It is noted that the model is calibrated 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 reported minor incidents, is presented in Section 9.7.

15.3 Post Wind Farm

15.3.1 Vessel to Vessel Collisions

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

277. A heat map based upon the geographical distribution of collision risk within a 0.25 nm x 0.25 nm grid for the base case is presented in Figure 15-5. Note the ranges used in Figure 15-5 are the same as those used in Figure 15-4, allowing for a direct comparison.

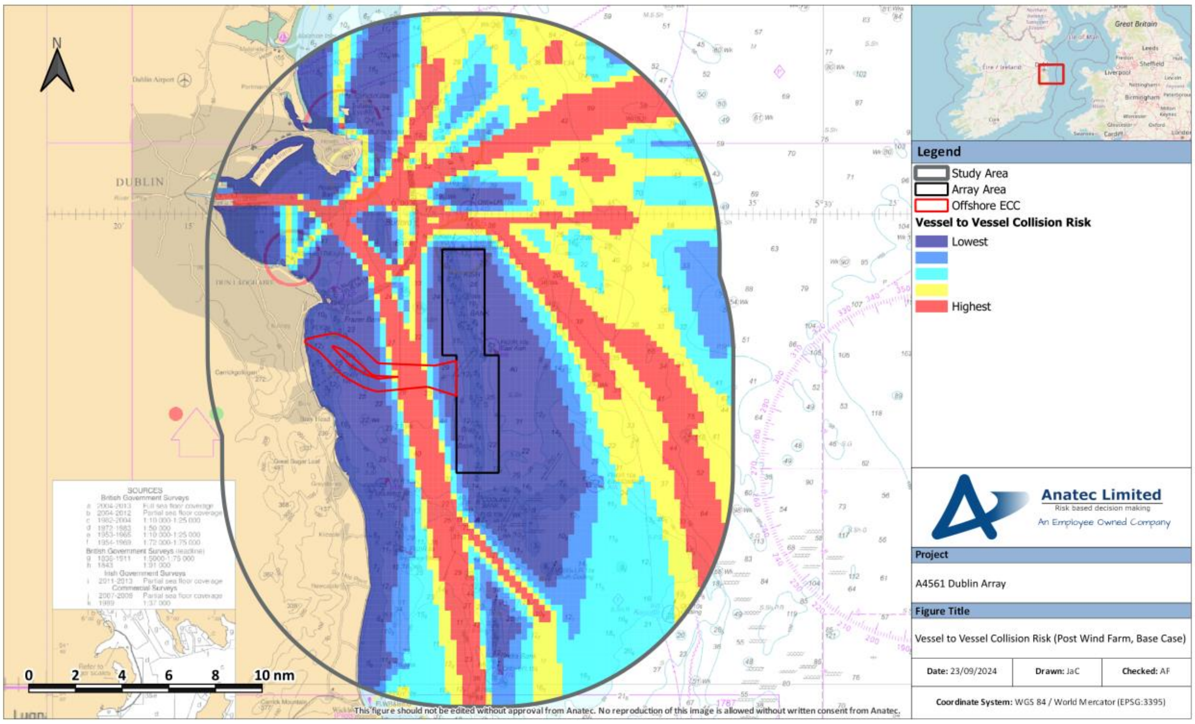

Figure 15-5: Post Wind Farm Base Case Collision Risk

278. Assuming the base case traffic levels, the annual collision frequency post wind farm was estimated to be 3.16 x 10^{-2}, corresponding to a collision return period of approximately one in 31.6 years. This represents a minimal increase in collision risk frequency within the study area when compared to the base case pre-wind farm results (1.3%).

279. Results for the future case traffic levels (pre and post wind farm) are presented in Table 15-1. A key area in terms of changing collision risk was observed to be the region in the vicinity of the south west corner of the array area, noting that busy main routes pass inshore of the structures here, and there is anticipated to be a “squeezing” of traffic at this point. The south west corner was raised in regards to potential changes in collision risk, and potential “squeeze” of vessels. The modelling results show that while there is an increase in the collision risk, this is considered to be within acceptable levels.

280. This also considers current levels of traffic and the available searoom as per Section 14.6.3. Further, assessment of this area in Section 15.2.1.1 showed a reduction in encounter levels in the vicinity of the southwest corner, likely due to alert levels of traffic given the nearby shallows.

281. Impacts associated with collision are assessed in Volume 3, Chapter 10: Shipping and Navigation, including that posed by vessels associated with Dublin Array (which are not included within this quantitative assessment).

15.3.2 Powered Vessel to Structure Allision

282. Based upon the vessel routeing identified in the region, the anticipated change in routeing due to Dublin Array, and assumptions that commitments included as part of Dublin Array are in place, the frequency of an errant vessel under power deviating from its route to the extent that it comes into proximity with the array area is considered to be low. It is noted that no account has been made for the potential for vessels to ground prior to alliding with a WTG.

283. A plot of the annual powered allision frequency is presented in Figure 15-7.

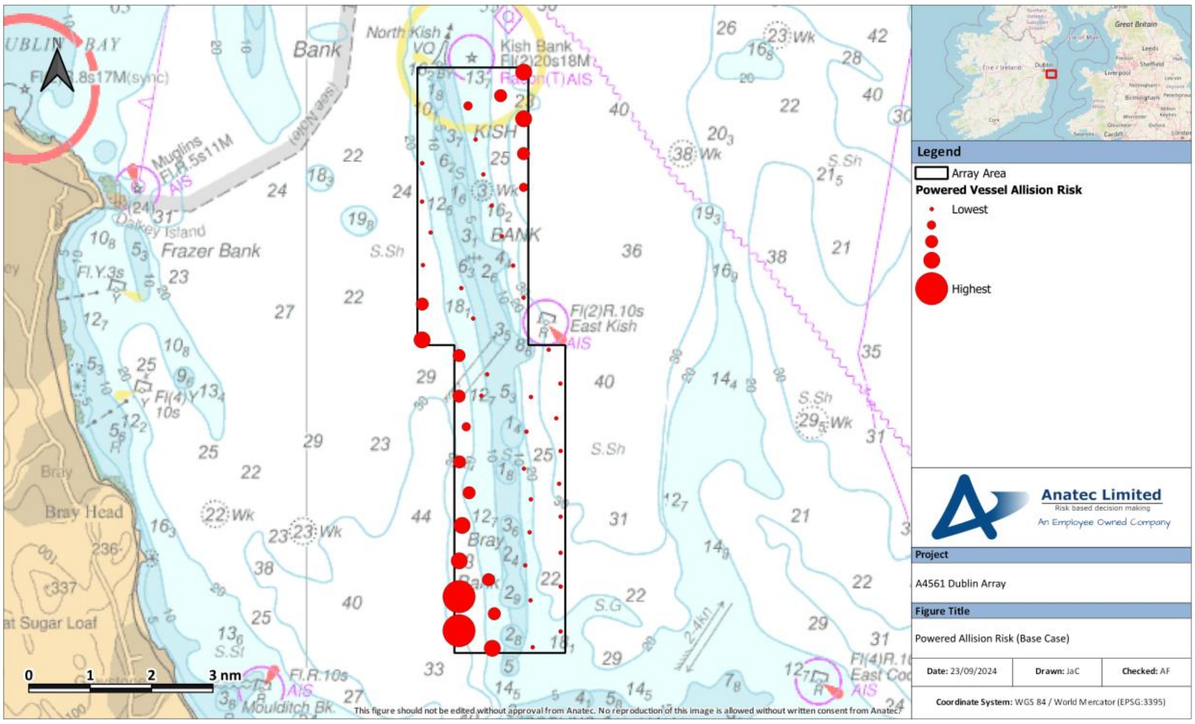

Figure 15-6: Powered Allision Risk (Base Case)

284. Assuming base case traffic levels, the annual powered drifting allision frequency post wind farm was 2.00 x 10^{-6}, corresponding to an allision return period of approximately one in 500,967 years.

285. Results for the future case traffic levels are provided in Table 15-1.

286. It is noted that the structure at highest risk was observed to be the south west corner, accounted for 92% of the total powered allision risk, which is indicative of its location relative to busy main routes passing within limited sea room inshore of the site. The highest risk structure was the structure located on the south west corner that has an allision frequency of 1.83 x 10^{-6}, corresponding to an allision return period of approximately 547,235 years.

287. The south west corner of the array area was raised a concern during the consultation phase in relation to squeeze of traffic. However, from an allision perspective embedded

mitigations of lighting and marking will ensure that the corner WTG is marked a significant peripheral structure as required by Irish Lights to ensure it is and remains visible to passing traffic.

15.3.3 Drifting Vessel to Structure Allision

288. Using the post wind farm routeing as an input, alongside the array layout, and local MetOcean data, Anatec's COLLRISK model was run to estimate the likelihood of a drifting commercial vessel alliding with one of the wind farm structures within the array area. The model is based on the premise that propulsion on a vessel must fail before drifting will occur. The model takes account of the type and size of the vessel, the number of engines, and the average time required to repair, but does not consider navigational errors caused by human actions.

289. 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). These have been estimated based upon the vessel traffic levels, speeds, and revised routeing. The exposure is divided by vessel type and size to ensure that associated likelihood factors, which based upon analysis of historical incident data have shown to influence incident rates, are taken into account.

290. Using this information, the overall rate of mechanical failure within proximity to the array area 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 incident. Therefore, three drift scenarios were modelled, each using the MetOcean data provided in Section 8.

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

291. 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, noting that due to the shallow banks there is also a possibility of vessels grounding prior to alliding but this is not accounted for in order to model a maximum risk.

292. After modelling the three drift scenarios, it was established that the flood dominated scenario produced the worst-case results. A plot of the annual drifting allision frequency per structure for the base case is presented in Figure 15-7.

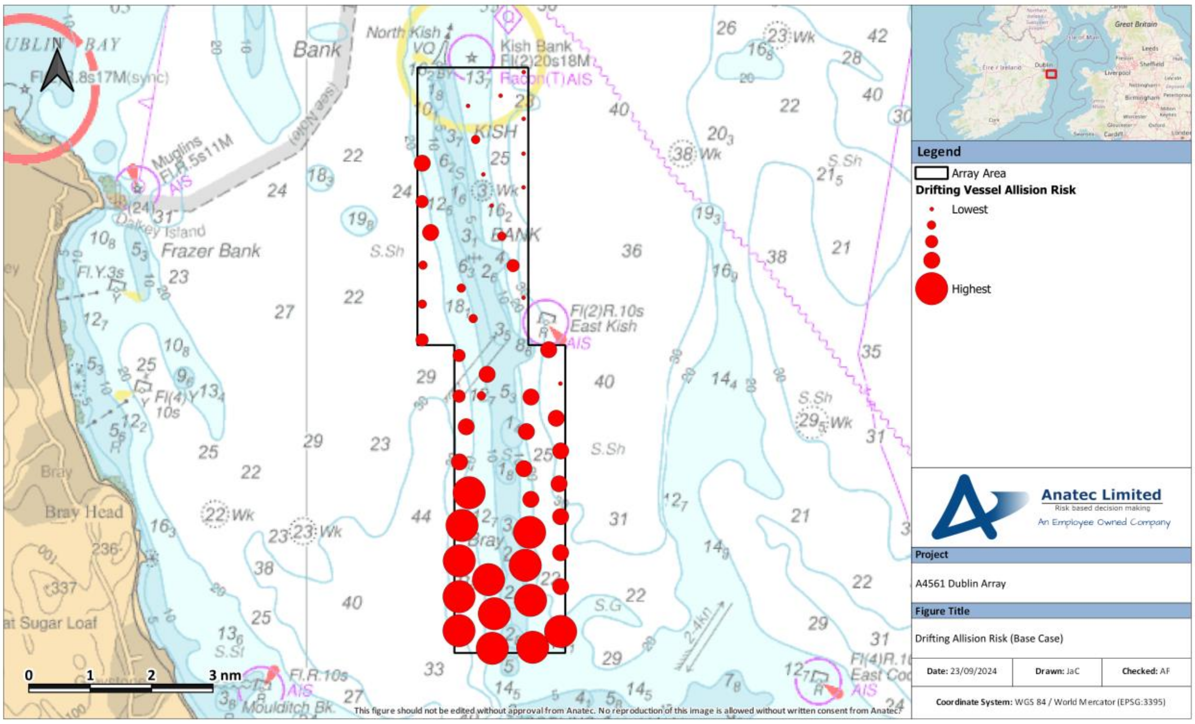

Figure 15-7: Drifting Allision Risk (Base Case)

293. Assuming base case vessel traffic levels, the annual drifting allision frequency post wind farm was 3.97 x 10^{-3}, corresponding to an allision return period of approximately one in 252 years.

294. Results for the future case traffic levels are included in Table 15-1.

295. Structures located on the south west corner were the highest risk structures for a drifting allision. This is reflective of the main routes passing in proximity and the dominant flood direction.

15.3.4 Fishing Vessel to Structure Allision

296. Using the 28-days of survey data from 2022 and 2023 (see Section 5.2) as an input to the fishing allision function of Anatec's COLLRISK modelling software suite, the potential fishing vessel to structure allision risk following installation of Dublin Array has been assessed.

297. A fishing vessel allision is classified separately from other allisions since, unlike in the case of the commercial traffic characterised via the main routes, fishing vessels may be either in transit or actively fishing within the area (the allision modelling has included both fishing vessels in transit and actively engaged in fishing). Moreover, fishing vessels could be observed internally within the array area in addition to externally.

298. The COLLRISK fishing allision model uses vessel numbers, sizes (length and beam), array layout, and structure dimensions, and the likelihood of a major allision incident has been calibrated against historical maritime incident data.

299. Following the running of the model, Figure 15-8 presents the fishing vessel to structure allision risk for each of individual offshore wind structure.

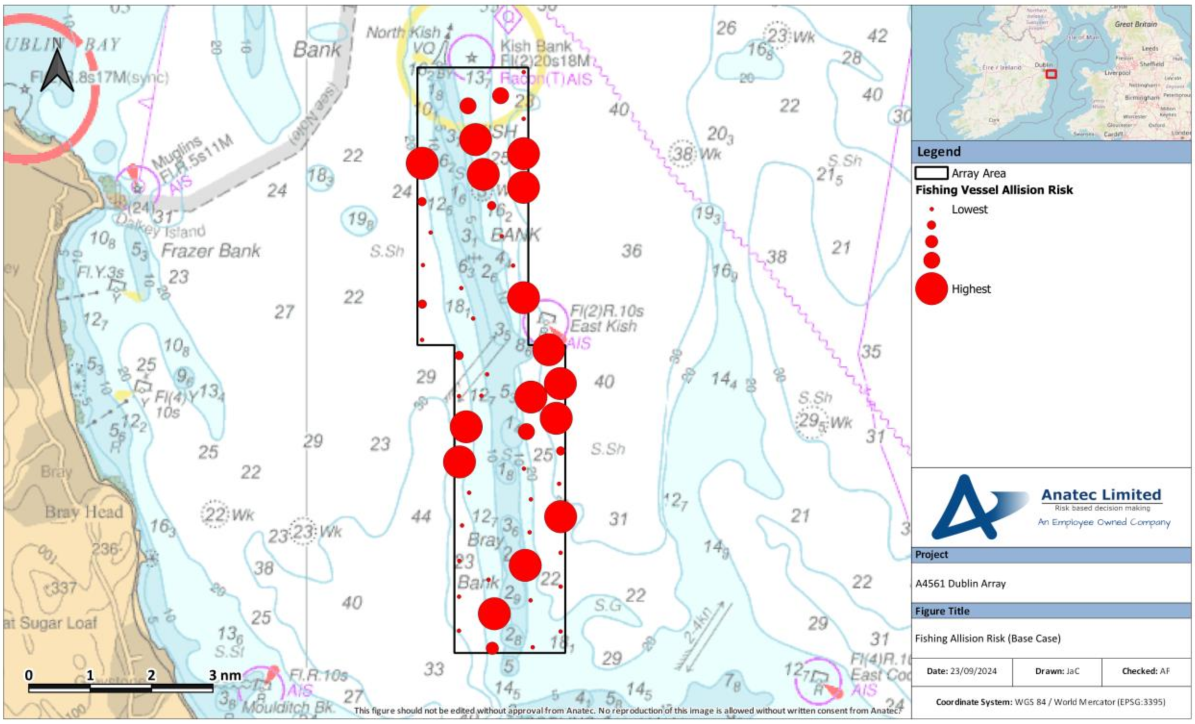

Figure 15-8: Fishing Allision Risk (Base Case)

300. Assuming base case vessel traffic levels, the annual fishing drifting allision frequency post wind farm was 5.85 x 10^{-2}, corresponding to an allision return period of approximately one in 17.1 years.

301. The highest risk was associated with eastern periphery WTGs. It is noted that as per both the modelling results and consultation input, there is the potential for allisions with internal structures given known transits through the site from smaller fishing vessels. As for the periphery WTGs this was primarily observed within the southern Section of the array area, reflective of the fishing vessel transits over the Bray Bank recorded within the marine traffic data (see Section 10.4.2).

302. Results for the future case traffic levels are included in Table 15-1.

15.4 Risk Results Summary

303. The previous Sections modelled two scenarios, namely pre wind farm and post wind farm with base case and future case traffic levels (to account for traffic growth, see Section 14). Table 15-1 summarises the results of the four scenarios.

Table 15-1: Summary of Annual Collision and Allision Frequencies

Collision / Allision Scenario	Base Case			Future Case		
	Pre-Wind Farm	Post Wind Farm	Change	Pre-Wind Farm	Post Wind Farm	Change
Vessel to Vessel Collision	3.12×10^{-2} (1 in 32.0 years)	3.16×10^{-2} (1 in 31.6 years)	4.07×10^{-4} (1 in 2,459 years)	3.82×10^{-2} (1 in 26.2 years)	3.87×10^{-2} (1 in 25.8 years)	5.03×10^{-4} (1 in 1,986 years)
Powered Vessel to Structure Allision	N/A	2.00×10^{-6} (1 in 500,967 years)	2.00×10^{-6} (1 in 500,967 years)	N/A	2.20×10^{-6} (1 in 454,095 years)	2.20×10^{-6} (1 in 454,095 years)
Drifting Vessel to Structure Allision	N/A	3.97×10^{-3} (1 in 252 years)	3.97×10^{-3} (1 in 252 years)	N/A	4.39×10^{-3} (1 in 228 years)	4.39×10^{-3} (1 in 228 years)
Fishing Vessel to Structure Allision	N/A	5.85×10^{-2} (1 in 17.1 years)	5.85×10^{-2} (1 in 17.1 years)	N/A	6.43×10^{-2} (1 in 15.6 years)	6.43×10^{-2} (1 in 15.6 years)
Total	**3.12×10^{-2} (1 in 32.0 years)**	**9.41×10^{-2} (1 in 10.6 years)**	**6.28×10^{-2} (1 in 15.9 years)**	**3.82×10^{-2} (1 in 26.2 years)**	**1.07×10^{-1} (1 in 9.3 years)**	**6.92×10^{-2} (1 in 14.5 years)**

304. Overall, the collision and allision frequency is estimated to increase by approximately 6.28×10^{-2} (one incident per 15.9 years) for the base case scenario and 6.92×10^{-2} (one incident in 14.5 years) for the future case scenario.

305. One key finding of the allision and collision modelling was that the highest risk area was around the south west corner of the array area, both in terms of change in collision risk, and powered / drifting allision. It is noted that this aligns with consultation findings, in that the south west corner was queried over a potential reduction in searoom associated with any structures placed in this area.

15.5 Future Case Sensitivity

306. As per Section 4, based on feedback from Dublin Port Authority, an additional sensitivity modelling analysis assuming a 25% increase in commercial traffic has also been undertaken. This includes both the allision and collision models (see Section 15.1.2). All

inputs other than the traffic volumes remain as per the base case and 10% future case scenarios.

307. This updated modelling has been undertaken to ensure potential traffic increases predicted under the Dublin Port Master Plan (Dublin Port, 2018) are captured within the future cases assessed within the modelling process.

308. As per Section 15.3.4, both active fishing and fishing vessels in transit have been captured.

309. The results of the sensitivity modelling are presented in Table 15-2.

Table 15-2: Future Case Sensitivity Analysis – 25% Traffic Increase

Collision / Allision Scenario	Base Case			Future Case – 25%		
	Pre-Wind Farm	Post Wind Farm	Change	Pre-Wind Farm	Post Wind Farm	Change
Vessel to Vessel Collision	3.12×10^{-2} (1 in 32.0 years)	3.16×10^{-2} (1 in 31.6 years)	4.07×10^{-4} (1 in 2,459 years)	4.92×10^{-2} (1 in 20.3 years)	4.98×10^{-2} (1 in 20.1 years)	6.46×10^{-4} (1 in 1,547 years)
Powered Vessel to Structure Allision	N/A	2.00×10^{-6} (1 in 500,967 years)	2.00×10^{-6} (1 in 500,967 years)	N/A	2.50×10^{-6} (1 in 399,926 years)	2.50×10^{-6} (1 in 399,926 years)
Drifting Vessel to Structure Allision	N/A	3.97×10^{-3} (1 in 252 years)	3.97×10^{-3} (1 in 252 years)	N/A	4.98×10^{-3} (1 in 201 years)	4.98×10^{-3} (1 in 201 years)
Fishing Vessel to Structure Allision	N/A	5.85×10^{-2} (1 in 17.1 years)	5.85×10^{-2} (1 in 17.1 years)	N/A	7.31×10^{-2} (1 in 13.7 years)	7.31×10^{-2} (1 in 13.7 years)
Total	**3.12×10^{-2} (1 in 32.0 years)**	**9.41×10^{-2} (1 in 10.6 years)**	**6.28×10^{-2} (1 in 15.9 years)**	**4.92×10^{-2} (1 in 20.3 years)**	**1.28×10^{-1} (1 in 7.8 years)**	**7.87×10^{-2} (1 in 12.7 years)**

310. Assuming a 25% increase in traffic, the total allision and collision frequency was estimated to increase by 7.87×10^{-2} (one in 12.7 years). This compares to an increase of 6.28×10^{-2} (one incident per 15.9 years) for the base case scenario and 6.92×10^{-2} (one incident in 14.5 years) for the 10% future case scenario.

15.6 Consequences

311. The most likely consequences for the majority of hazards associated with shipping and navigation are anticipated to be minor (such as collision/allision resulting in no hull breaches, foundering or injury to personnel). While the COLREGS Rule Five requires that "every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision"; in the worst case scenario, the consequences of a collision may be severe, including events resulting in Potential Loss of Life (PLL).

312. A quantitative assessment of the potential consequences of a collision or allision incident is provided in full in Annex A. This assessment applies the risk results presented in this Section to historical data regarding collision and allision incidents, and oil pollution. Full details are provided in Annex A, but in summary, the overall annual increase in PLL estimated due to the impact of Dublin Array on passing vessels is approximately one fatality per 2,499 years, assuming no increase in traffic (i.e., base case). In terms of individual risk to people, the incremental increase estimated due to the impact of Dublin Array for the base case (and future cases) is negligible. Given these very low results the fatality risk resulting from Dublin Array is not considered to be significant.

313. It was estimated that should Dublin Array be built, the overall increase in oil spilled from passing vessels would be approximately 0.3 tonnes per year, assuming no increase in traffic. This represents a minimal change (0.002%) when compared against the historical average pollution quantities from marine accidents in UK waters[14].

[14] UK data has been used due to the extensive availability (particularly MAIB data) noting that, given the proximity of UK and Irish waters and international nature of shipping, analysis based on MAIB data is considered applicable to the proposed development.

16 Impact Identification

314. This Section outlines the shipping and navigation impacts which have been identified based upon the baseline data and consultation undertaken. These impacts have been fed into the FSA undertaken within Volume 3, Chapter 10: Shipping and Navigation. It is noted that impacts associated with vessels engaged in fishing are considered in Volume 3, Chapter 9: Commercial Fisheries.

315. Based on the findings of the NRA, including the baseline assessment, quantitative modelling, consultation, and Hazard Log, the following impacts will be carried forward and assessed within Volume 3, Chapter 10: Shipping and Navigation of the EAIR:

Construction and Decommissioning Phases

- Displacement leading to increased encounters, vessel squeeze and collision risk;
- Temporary displacement of historic recreational races;
- Increased collision risk from project vessels;
- Allision from vessel under power;
- Allision from vessel Not Under Command;
- Port access restrictions; and
- Impact on emergency response capabilities.

Operation and Maintenance Phase

- Displacement leading to increased encounters, vessel squeeze and collision risk;
- Permanent or temporary displacement of historic recreational races;
- Increased collision risk from project vessels;
- Allision from vessel under power;
- Allision from vessel Not Under Command;
- Increased grounding / underkeel risk;
- Increased anchor snagging risk; and
- Impact on emergency response capabilities.

316. The impact assessment within the EIAR assesses the significance of each impact for the relevant receptors and identifies the need for any additional mitigation to ensure the risks are ALARP.

17 Mitigation

17.1 Project design features and other avoidance and preventative measures

317. As part of the iterative design process for Dublin Array, various measures have been adopted to reduce the risk of hazards identified, including those relevant to shipping and navigation. These measures typically include those identified as good or standard practice and include actions that will be undertaken to meeting legislation requirements. As there is a commitment to implementing these measures, and also to various standard sectoral practices and procedures, they are considered inherently part of the design of Dublin Array.

318. The project design features relevant to shipping and navigation are outlined in Table 17-1.

Table 17-1 Project Design Features Relevant to Shipping and Navigation

Measure	Description
Advisory Safe Passing Distances outlined in the VMP	Application, promulgation and use of advisory safe passing distances surrounding vessels that are undertaking sensitive construction, installation, or maintenance works. These vessels are likely to display Restricted in Ability to Manoeuvre (RAM) status.
Provision of search and rescue (SAR) lanes	Observe SAR lanes between discrete rows of wind farm structures of a minimum of 500 m width on a consistent line of orientation
Agreement with MSO on vessel requirements pre-construction	All vessels engaged in the construction, O&M and decommissioning of the Dublin Array project will comply with IMO conventions, Health and Safety Authority (HSA) requirements, and have suitable vessel certification in line with MSO requirements.
Charting measures outlined in the VMP	Charting of all structures associated with the project on relevant nautical and electronic charts.
Project design in line with MGN 654 Compliance	Compliance with MGN 654 with respect to WTG design and construction. Includes the need to consult with MSO and Irish Lights where water depths are reduced by more than 5% as a result of cable protection or other infrastructure.

Measure	Description
Agreement of Emergency Response Plans with relevant parties (IRCG).	Creation and implementation of emergency response plans in consultation with IRCG prior to commencement of construction. This will take the form of an Emergency Response Cooperation Plan in IRCG template which will be made available for inspection.
Buoyed Construction / Decommissioning Area as outlined in the LMP	Implementation of a buoyed construction / decommissioning area around the site during the appropriate phases, in consultation with Irish Lights. The buoyed areas will not exclude vessels, but will alert traffic to the ongoing works.
Lighting and Marking design options as outlined in the LMP	Lighting and marking in accordance with IALA G-1162 (IALA, 2021) and Irish lights requirements. In particular, the use of marine lighting to mark selected peripheral structures.
Marine pollution contingency planning.	Agreement of a pollution management plan in IRCG template with relevant parties (IRCG) prior to commencement of construction which will be made available for inspection.
Project design with a minimum WTG blade clearance	Minimum WTG blade clearance of 28m above MHWS (exceeds minimum requirement of 22m in line with MGN 654 (MCA, 2021) and the draft DOT Irish Guidance).
Dropped objects plan included as part of the PEMP	A Dropped Objects Plan will be developed for reporting and recovery of dropped objects where they pose a potential hazard to other marine users.
Cable burial measures detailed within Volume 2: Chapter 2.6, Project Description	Chapter 2.6 sets out the principles of the Cable Installation Plan (CIP), process for agreement of a final plan, and primary commitments that will be adopted. The Cable Burial Risk Assessment will provide the required information to support the development of the CIP Measures to include a cable burial risk assessment undertaken pre-construction including consideration of under keel clearance and appropriate cable protection applied based upon the outcomes. To include consideration of requirements for monitoring of the protection.

Measure	Description
Guard vessels	Use of temporary guard vessel(s) where identified by risk assessment, e.g., to protect unlit structures and/or unprotected cable prior to burial.
Promulgation of Information	Circulation of information via Notice to Mariners and other appropriate media including Fisheries Liaison Officer (FLO). Includes circulation relevant Leisure Almanac.
Provision of self-help capability	Agreement of Emergency Response Plans with relevant parties (IRCG) including the self help provisions available. Will form part of the ERCoP which will be agreed with IRCG prior to commencement of construction and which will be made available for inspection.
Traffic Monitoring	Commitment to undertake vessel traffic monitoring by AIS during the construction phase.
Guard Vessels	Use of temporary guard vessel where identified by risk assessment, e.g., to protect unlit structures and/or unprotected cable prior to burial
Project design: Decommissioning	Prior to decommissioning, assessment to identify any potential hazards that may occur during the removal of infrastructure including under keel risks from partially removed infrastructure, with suitable mitigation then identified. Any changes relative to chart datum of more than 5% will be confirmed and agreed with MSO and Irish Lights prior to decommissioning.

17.2 Additional Mitigation

319. Volume 3, Chapter 10: Shipping and Navigation will assess impacts (assuming the embedded mitigations in Section 17.1 are in place), and subsequently identify any necessary additional mitigation to ensure all risks are ALARP.

320. It is noted that certain additional mitigation measures were identified as part of the Hazard Log process (see Section 38 and Annex D). These are as follows:

- Entry/exit points to the array area for vessels associated with Dublin Array;
- Designated routes to/from array area for vessels associated with Dublin Array which avoid crossing main routes at south west corner of the site;
- Mandatory carriage of AIS for all vessels associated with Dublin Array;

- Procedures for management of Aids to Navigation to be discussed with Irish Lights;
- Consideration given to consultation with fishing users on CBRA;
- Consultation direct with recreational race operators to ensure minimal displacement;
- Close liaison with Dublin Port via a Communications Plan including in relation to commercial vessels routeing west of Dublin Array into Dublin Port; and
- Continued consultation with Irish Coastguard and RNLI to ensure array design considers emergency response access.

18 Summary

321. Using a baseline assessment, quantitative assessment, and consultation with relevant stakeholders, impacts relating to shipping and navigation have been identified and assessed for Dublin Array for all phases of development (construction, operations and maintenance, and decommissioning).

322. The following subsections summarise the key elements of the NRA.

18.1 Consultation

323. Consultation has been undertaken throughout the planning stage of Dublin Array with various statutory, commercial, and recreational stakeholders (see Section 4). This includes direct stakeholder meetings, a regular operator and recreational user outreach, Hazard Workshops, and responses received to the Dublin Array EIA Scoping Report (RWE, 2020). Concerns raised during consultation have been summarised in Section 4 together with the Section of this NRA or Volume 3, Chapter 10: Shipping and Navigation that addresses the concerns.

18.2 Navigational Features

324. The existing navigational features in proximity to the array area have been presented in Section 7.

325. The Kish and Bray Banks on which the array area is to be sited are marked by AtoN, namely the North Kish buoy, East Kish buoy, and the Kish Light. The majority of other AtoN in the area are associated with marking the approach to Dublin.

326. The key port in the vicinity of the array area in terms of commercial traffic volumes is considered as being Dublin, located 9.2 nm to the west. There are two TSS associated with Dublin Bay (the North Burford TSS and South Burford TSS), which are utilised by the majority of commercial traffic seeking access to Dublin.

327. Numerous wrecks are located within the study area including nine charted wrecks within the array area itself, noting that the RMS Leinster is located to the east.

328. Numerous cables are present within the study area. Two piped outfalls terminate in proximity to the offshore ECC.

329. The only operational wind farm of relevance to Dublin Array is Arklow Phase 1, which is located approximately 20 nm to the south of the site and consists of seven WTGs located on the Arklow Bank.

18.3 Maritime Incidents

330. Maritime incidents reported to MCIB and RNLI which have occurred in proximity to the array area have been presented in Section 9.

18.3.1 MCIB

331. A total of six incidents of relevance with reports released by the MCIB were identified between 1992 and 2023, comprising three groundings and three collisions.

18.3.2 RNLI

332. Incidents reported to the RNLI for the 10-year period between 2013 and 2022 have been analysed in Section 9.3. Approximately 84 unique incidents occurred per year with the majority of these incidents occurring within coastal regions with a limited number occurring further offshore. The most common incident type was 'machinery failure (41%), 'person in danger (29%), and 'other' (11%). The most frequent casualty type was powered recreational vessels (57%), personal craft (19%), fishing vessels (8%), and recreational sailing vessels (8%). The majority of RNLI lifeboat launches were from three stations – Dún Laoghaire (54%), Howth (37%), and Wicklow (9%). Two launches were from the Skerries station, with one launch each from Lough Swilly and Rosslare Harbour.

18.4 Vessel Traffic

333. A total of 28 days of marine traffic survey data was assessed as part of the NRA process. This comprised of two distinct 14 day periods to account for seasonal variation. An average of 58 unique vessels per day were recorded within 10 nm of the array area during the 14 day winter period, and an average of 81 per day during the summer period. This reduction during winter was observed to be primarily resultant of lower levels of recreational activity, noting that the most common vessel type recorded during the summer period was recreation, which accounted for approximately 36% of the total traffic. Anchoring activity was observed to be primarily within the Dublin Bay anchorage, with vessels also anchoring to the south.

18.5 Vessel Routeing

334. A total of nine main routes were identified based on assessment of the marine traffic data. The majority of these routes (seven of the nine) were observed to be associated with Dublin. Given the majority of traffic already avoids the Kish and Bray Banks, deviations were observed to be limited, however the Mean Route Positions of two routes are anticipated to shift to account for the presence of Dublin Array. These deviations are considered minor, representing at most a 1.3% increase of the portions of route length within the Study Area.

18.6 Navigation, Communication, and Position Fixing Equipment

335. Based on assessment undertaken within this NRA (see Section 12), no significant impacts that cannot be mitigated to navigation, communication, and position fixing equipment are anticipated.

18.7 Collision and Allision Risk Modelling

336. Collision and allision risk modelling has been performed on the following four scenarios in Section 13.

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

337. Table 18-1 presents a summary of the collision and allision modelling results. In summary, following installation of the wind farm a collision or allision was estimated to occur approximately once per 10.6 years assuming base case traffic levels, compared to once in 32 years pre wind farm.

Table 18-1: Summary of Annual Collision and Allision Frequencies

Collision / Allision Scenario	Base Case			Future Case		
	Pre-Wind Farm	Post Wind Farm	Change	Pre-Wind Farm	Post Wind Farm	Change
Vessel to Vessel Collision	3.12×10^{-2} (1 in 32.0 years)	3.16×10^{-2} (1 in 31.6 years)	4.07×10^{-4} (1 in 2,459 years)	3.82×10^{-2} (1 in 26.2 years)	3.87×10^{-2} (1 in 25.8 years)	5.03×10^{-4} (1 in 1,986 years)
Powered Vessel to Structure Allision	N/A	2.00×10^{-6} (1 in 500,967 years)	2.00×10^{-6} (1 in 500,967 years)	N/A	2.20×10^{-6} (1 in 454,095 years)	2.20×10^{-6} (1 in 454,095 years)
Drifting Vessel to Structure Allision	N/A	3.97×10^{-3} (1 in 252 years)	3.97×10^{-3} (1 in 252 years)	N/A	4.39×10^{-3} (1 in 228 years)	4.39×10^{-3} (1 in 228 years)
Fishing Vessel to Structure Allision	N/A	5.85×10^{-2} (1 in 17.1 years)	5.85×10^{-2} (1 in 17.1 years)	N/A	6.43×10^{-2} (1 in 15.6 years)	6.43×10^{-2} (1 in 15.6 years)
Total	**3.12×10^{-2} (1 in 32.0 years)**	**9.41×10^{-2} (1 in 10.6 years)**	**6.28×10^{-2} (1 in 15.9 years)**	**3.82×10^{-2} (1 in 26.2 years)**	**1.07×10^{-1} (1 in 9.3 years)**	**6.92×10^{-2} (1 in 14.5 years)**

338. Based on feedback from Dublin Port, an additional future case scenario assuming a 25% increase in traffic has also been undertaken. Assuming a 25% increase in traffic, the total allision and collision frequency was estimated to increase by 7.87×10^{-2} (one in 12.7 years). This compares to an increase of 6.28×10^{-2} (one incident per 15.9 years) for the base case scenario and 6.92×10^{-2} (one incident in 14.5 years) for the 10% future case scenario.

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Annex A Consequences

339. This appendix presents an assessment of the consequences of collision and allision incidents, in terms of people and the environment, due to the presence of Dublin Array.

340. The significance of the impact due to the presence of Dublin Array is also assessed based on risk evaluation criteria and comparison with historical incident data in UK waters[15]. UK data has been used due to the extensive availability (particularly MAIB data) noting that, given the proximity of UK and Irish waters and international nature of shipping, analysis based on MAIB data is considered applicable to the proposed development.

A.1 Risk Evaluation Criteria

A.1.1 Risk to People

341. Regarding the assessment of risk to people two measures are considered, namely:

- Individual risk; and
- Societal risk.

A.1.1.1 Individual Risk

342. Individual risk considers whether the risk from an incident to a particular individual changes significantly due to the presence of Dublin Array. 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.

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

344. Annual risk levels to crew (the annual risk to an average crew member) for different vessel types are presented in Figure A.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.

[15] 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.

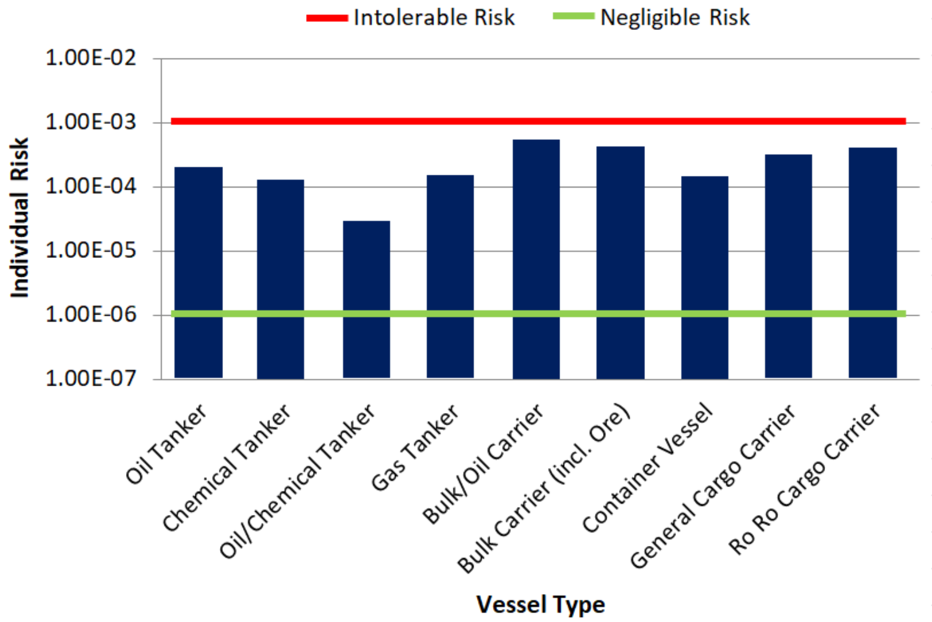

Figure A.1 Individual Risk Levels and Acceptance Criteria per Vessel Type

345. The typical bounds defining the ALARP regions for decision making within shipping are presented in Table A.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 A.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 in column reduced by one order of magnitude

346. 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 A.3, noting that in the period since HSE may have improved (rendering this a conservative review).

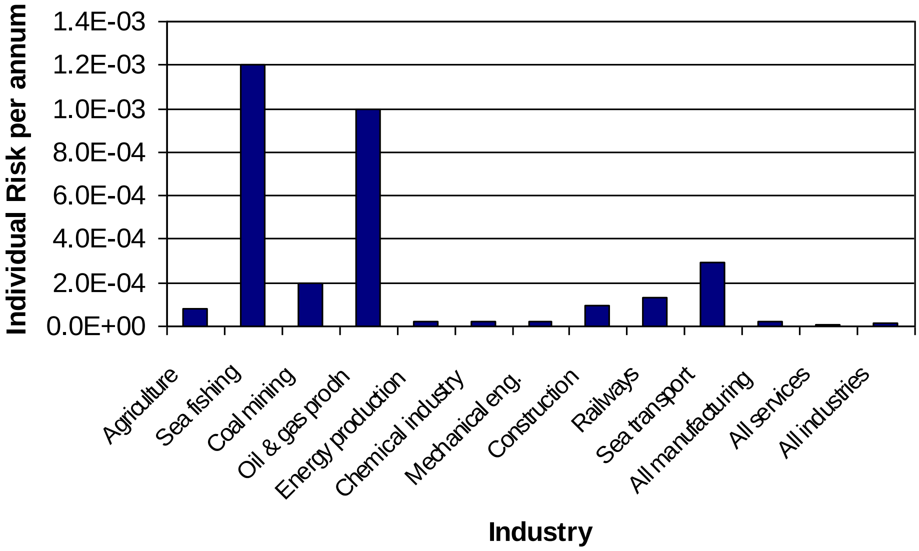

Figure A.2 Individual Risk per Year for Various UK Industries

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

A.1.1.2 Societal Risk

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

349. Within this assessment, societal (navigation based) risk can be assessed for Dublin Array, 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 (also known as Potential Loss of Life (PLL)); and
- F-N diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

350. When assessing societal risk this study focuses on PLL, which accounts for the number of people likely to be involved in an incident (which varies by vessel type) and assesses the significance of the change in risk compared to the UK background risk levels.

A.1.2 Risk to Environment

351. For risk to the environment the key criteria considered in terms of the risk due to Dublin Array is the potential quantity of oil spilled from a vessel involved in an incident.

352. 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 Dublin Array compared to UK background pollution risk levels.

A.2 Marine Accident Investigation Branch Incident Analysis

A.2.1 All Incidents in UK Waters

353. 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.

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

355. 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 Dublin Array.

356. 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).

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

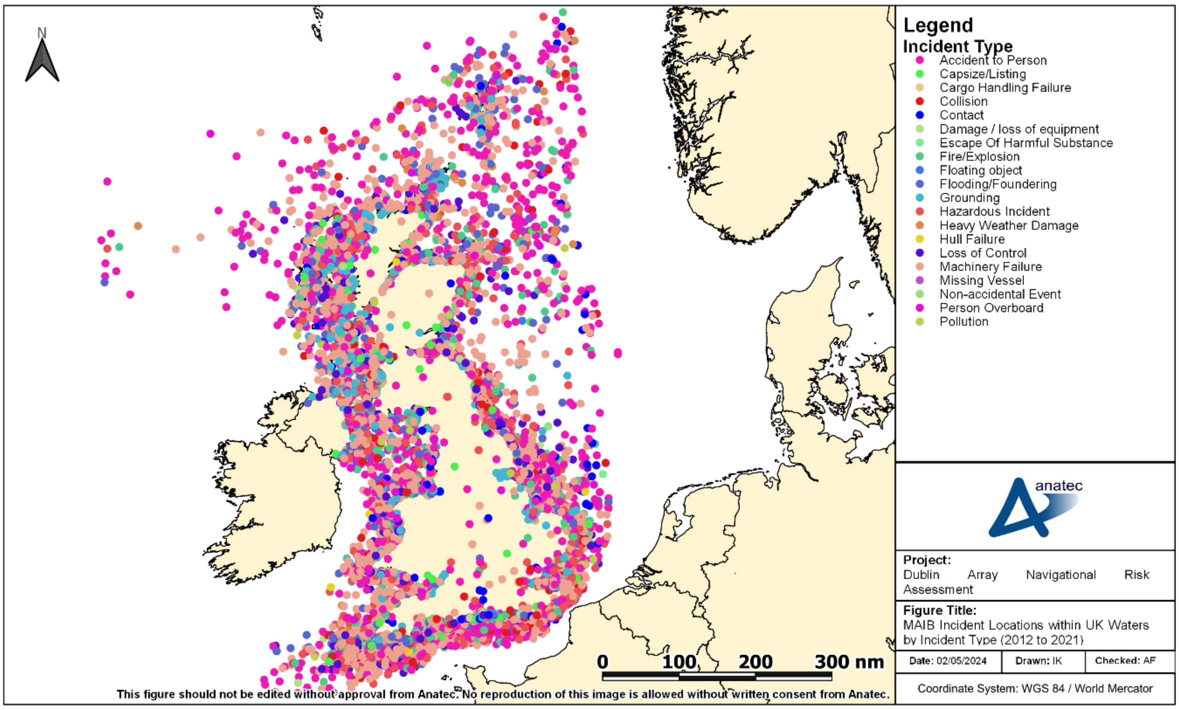

Figure A.3 MAIB Incident Locations by Incident Type within UK Waters (2002 to 2021)

358. The distribution of incidents by year in UK waters is presented in Figure A.4.

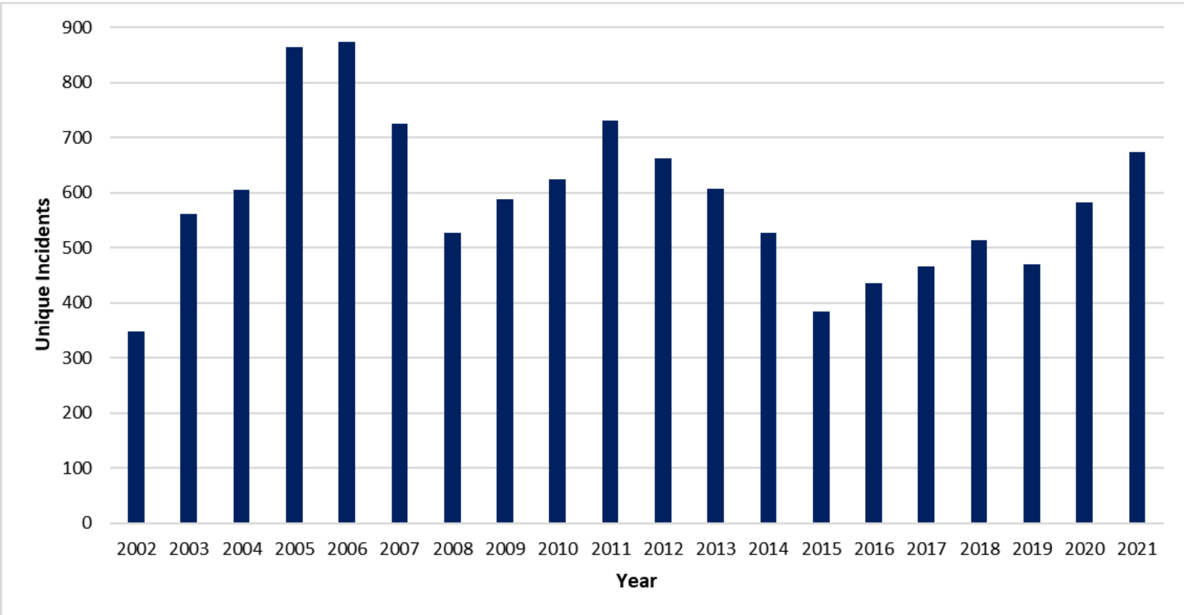

Figure A.4 MAIB Unique Incidents per Year within UK Waters (2002 to 2021)

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

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

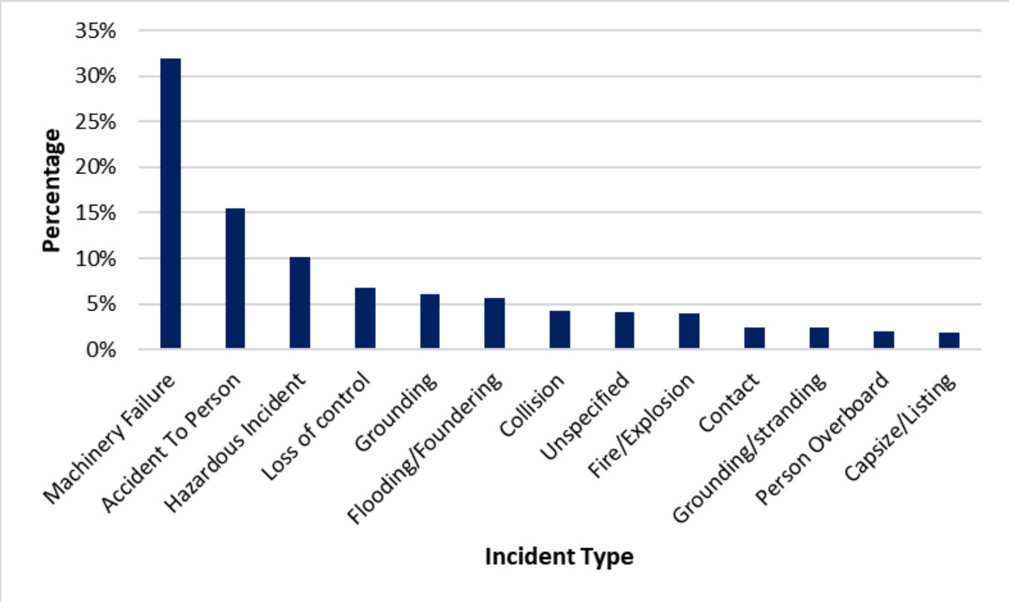

Figure A.5 MAIB Incident Type Breakdown within UK Waters (2002 to 2021)

361. 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.

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

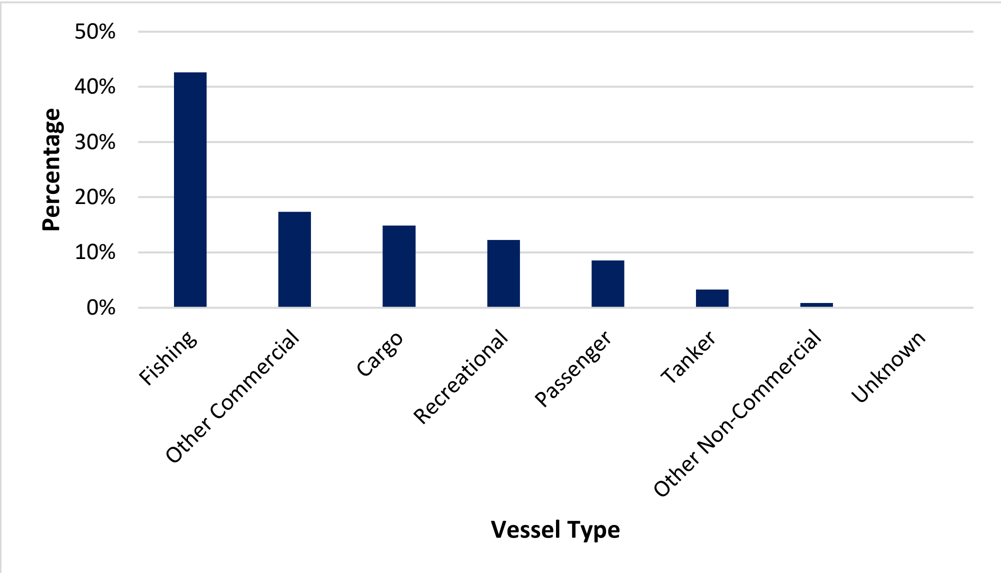

Figure A.6 MAIB Vessel Type Breakdown within UK Waters (2002 to 2021)

363. 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%).

364. 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.

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

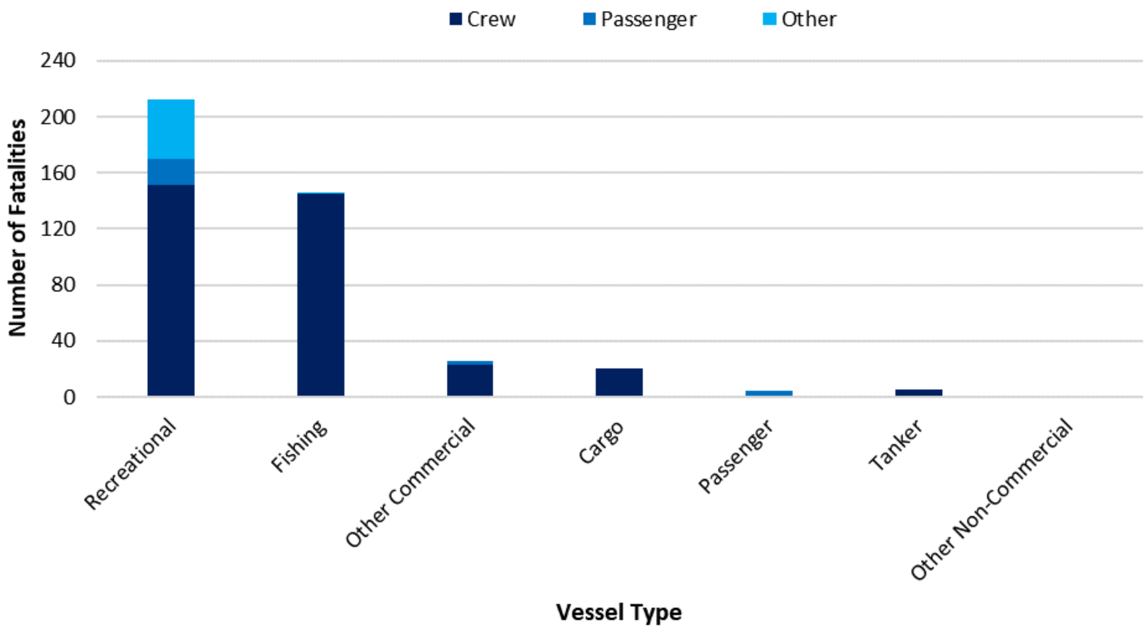

Figure A.7 MAIB Fatalities by Vessel Type within UK Waters (2002 to 2021)

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

A.2.2 Collision Incidents

367. 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).

368. 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).

369. The locations of collision incidents reported in proximity to the UK are presented in Figure A.8.

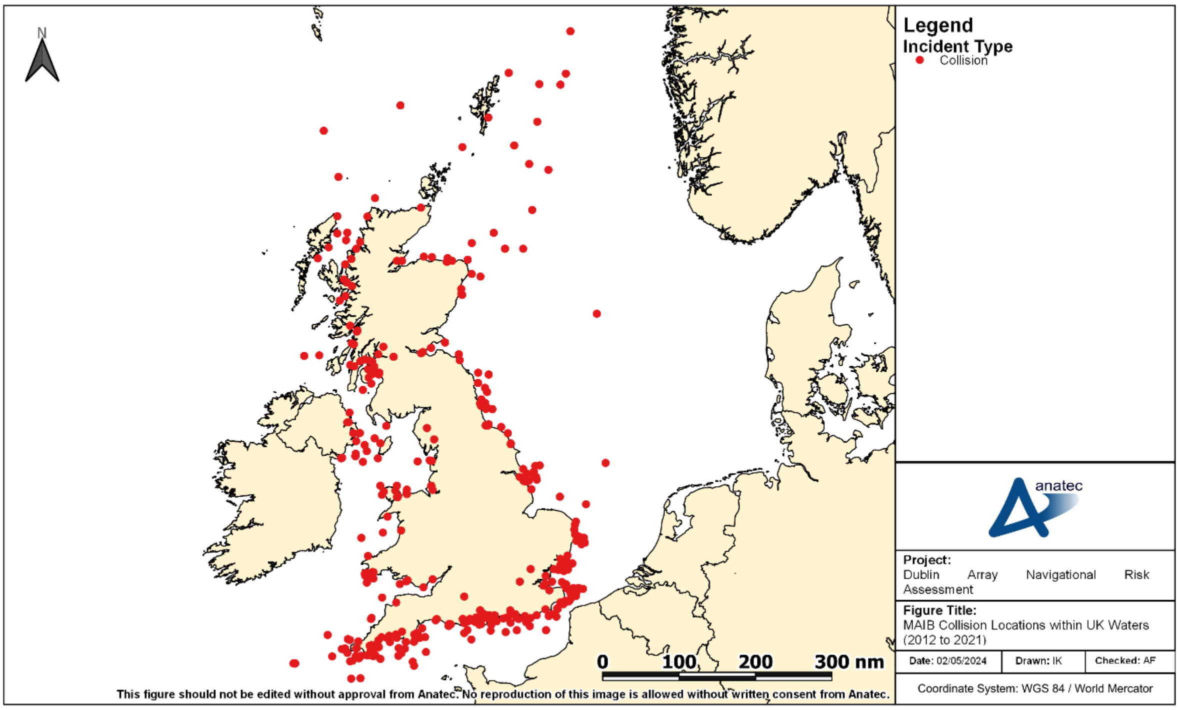

Figure A.8 MAIB Collision Incident Locations within UK Waters (2002 to 2021)

370. The distribution of collision incidents per year is presented in Figure A.9.

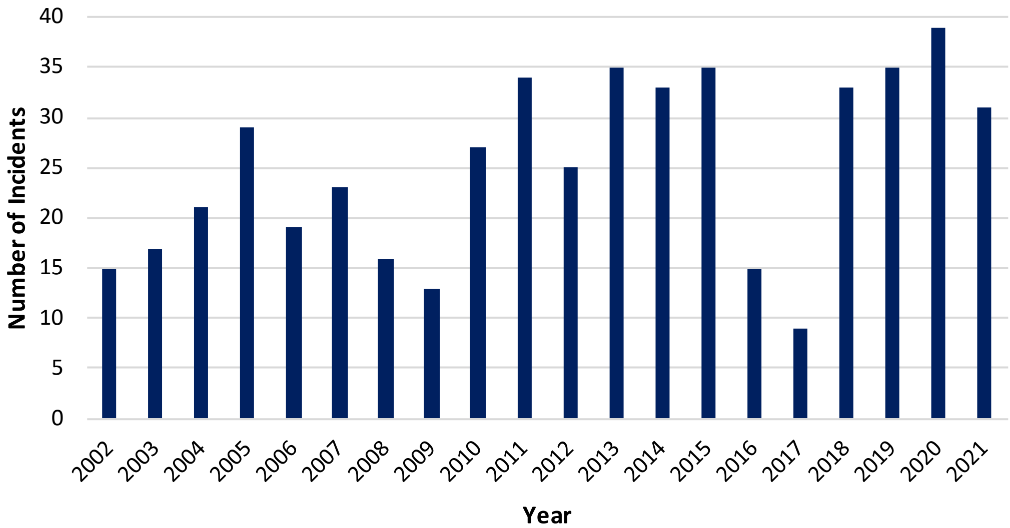

Figure A.9 MAIB Annual Collision Incidents within UK Waters (2002 to 2021)

371. 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.

372. The distribution of vessel types involved in collision incidents is presented in Figure A.10.

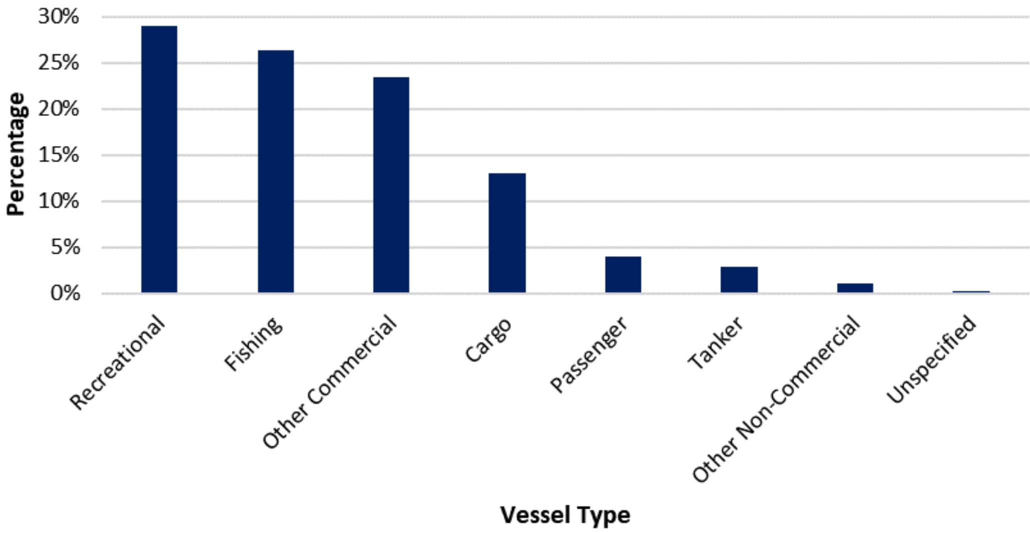

Figure A.10 MAIB Collision Fatalities by Vessel Type within UK Waters (2002 to 2021)

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

374. 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 A.2.

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

Date	Description	Fatalities
July 2005	Collision between two powerboats at night. Both vessels were unlit and both helmsmen had consumed alcohol. One of the helmsmen died.	1
October 2007	Collision between fishing vessel and coastal general cargo vessel following failure to keep an effective lookout. Fishing vessel sank with three of the four crew members abandoning ship into a life raft, but the fourth crew member was not recovered.	1
August 2010	Collision between passenger ferry and fishing vessel. Fishing vessel sank with one of the two crew members recovered from the sea but the other member was not recovered despite an extensive search.	1
June 2015	Collision between 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

A.2.3 Allision Incidents

375. 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.

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

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

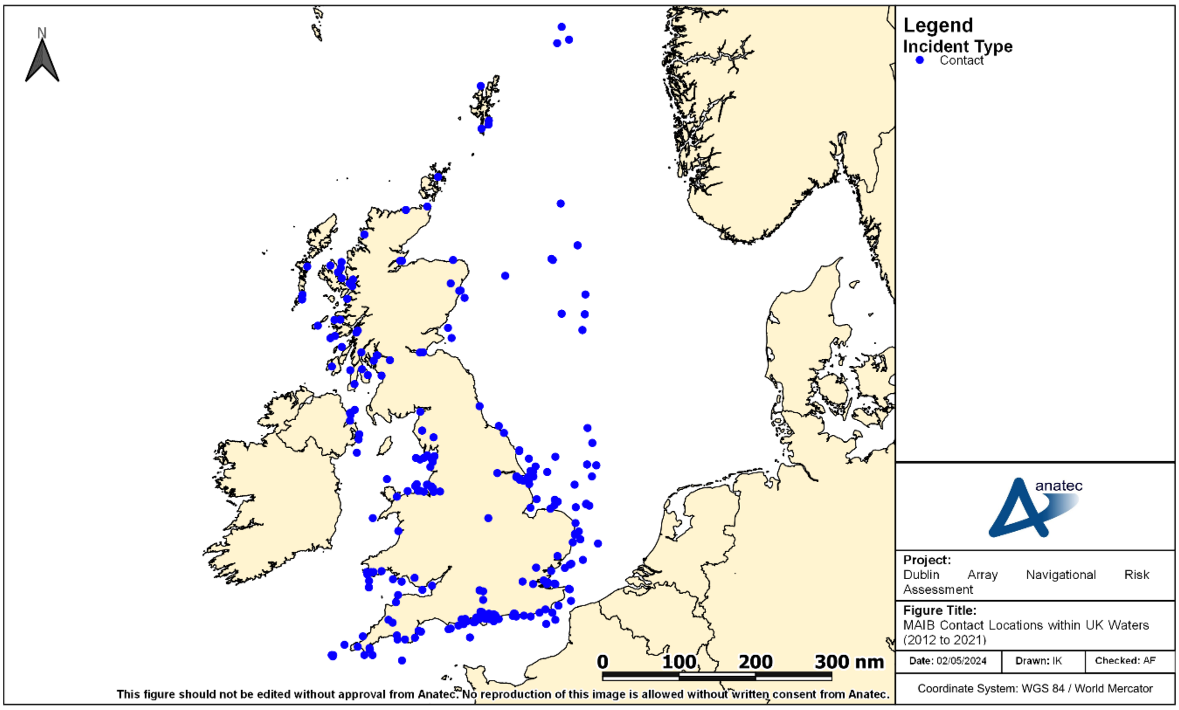

Figure A.11 MAIB Allision Incident Locations within UK Waters (2002 to 2021)

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

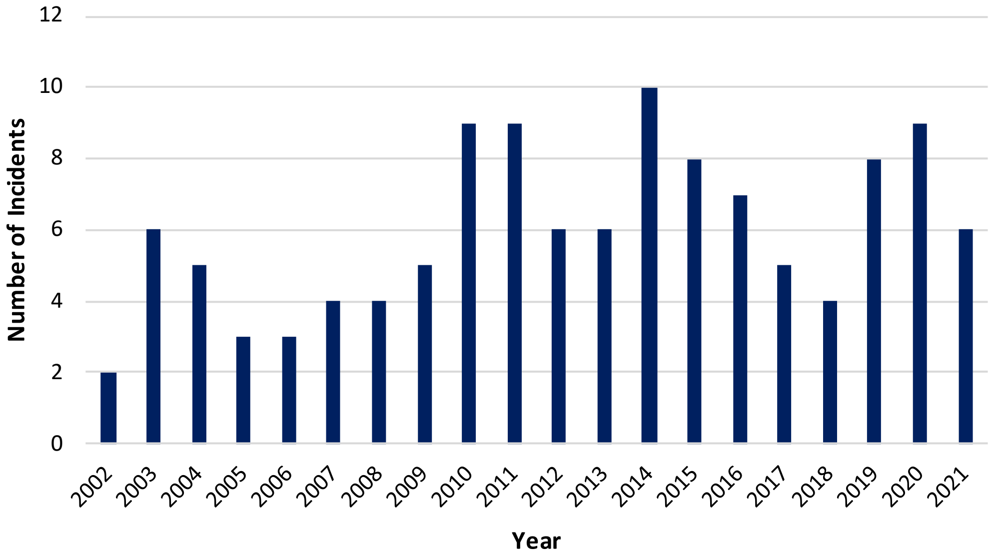

Figure A.12 MAIB Allision Incidents per Year within UK Waters (2002 to 2021)

379. 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.

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

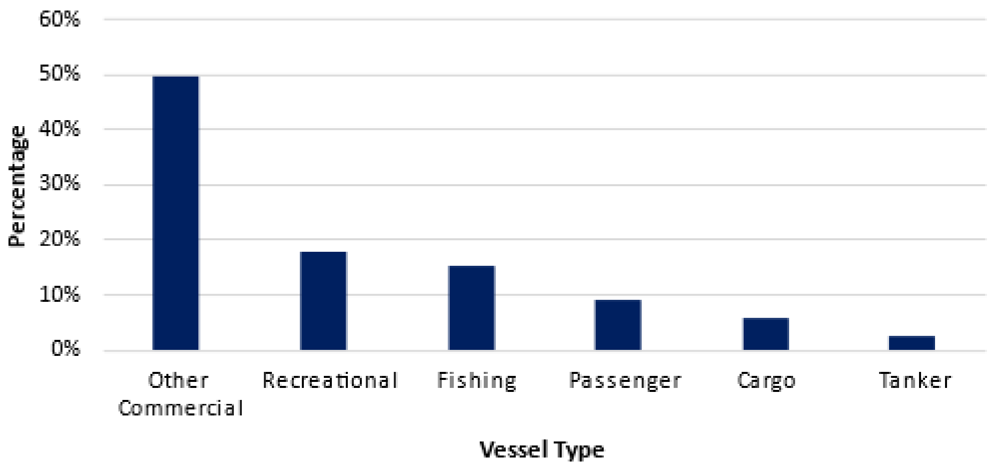

Figure A.13 MAIB Allision Incidents by Vessel Type within UK Waters (2002 to 2021)

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

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

A.3 Fatality Risk

A.3.1 Incident Data

383. 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 Dublin Array.

384. Dublin Array 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.

385. Of these incident types, only vessel to vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in Section A.2 is considered directly applicable to these types of incidents.

386. 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 A.2.3). Additionally, none of the allision incidents reported by the MAIB between 2002 and 2021 resulted in a fatality.

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

A.3.2 Fatality Probability

388. 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.

389. 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 A.3 presents the average number of POB estimated for each category of vessel navigating in proximity to Dublin Array. 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 A.3 Estimated Average POB by Vessel Category

Vessel Category	Subcategories	Source of Estimated Average POB	Estimated Average POB
Cargo/freight	Dry cargo, other commercial, service ship, etc.	MAIB incident data	15
Tanker	Tanker/combination carrier	MAIB incident data	23
Passenger	RoRo passenger, cruise liner, etc.	Vessel traffic survey data / online information	988
Fishing	Trawler, potter, dredger, etc.	MAIB incident data	3.3
Recreational	Yacht, small commercial motor yacht, etc.	MAIB incident data	3.3

390. 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 appropriate 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.

391. Using the average POB, along with the vessel type information involved in collision incidents reported by the MAIB (see Section A.2.2), there was an estimated 46,233 POB the vessels involved in the collision incidents.

392. Based upon five fatalities during the period 2002 to 2021, the overall fatality probability in a collision for any individual onboard is approximately 1.08×10^{-4} per collision.

393. 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 A.4. In addition, due to zero fatalities resulting from commercial vessel collisions between 2002 and 2021, the time period used to assess the fatality probability for commercial vessels has been extended by five years to ensure a meaningful probability is captured.

Table A.4 Collision Incident Fatality Probability by Vessel Category

Vessel Category	Subcategories	Fatalities	People Involved	Fatality Probability	Time Period
Commercial	Dry cargo, passenger, tanker, etc.	1	72,408	1.4×10^{-5}	1997 to 2021 (25 years)
Fishing	Trawler, potter, dredger, etc.	2	927	2.2×10^{-3}	2002 to 2021 (20 years)
Recreational	Yacht, small commercial motor yacht, etc.	3	1,023	2.9×10^{-3}	2002 to 2021 (20 years)

A.3.3 Fatality Risk due to Dublin Array

394. The base case and future case annual collision frequency levels pre and post wind farm for Dublin Array are summarised in Table 15-1.

395. 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 Dublin Array for the base case and future case are presented in Figure A.14. The same distribution but excluding fishing vessels is presented in Figure A.15.

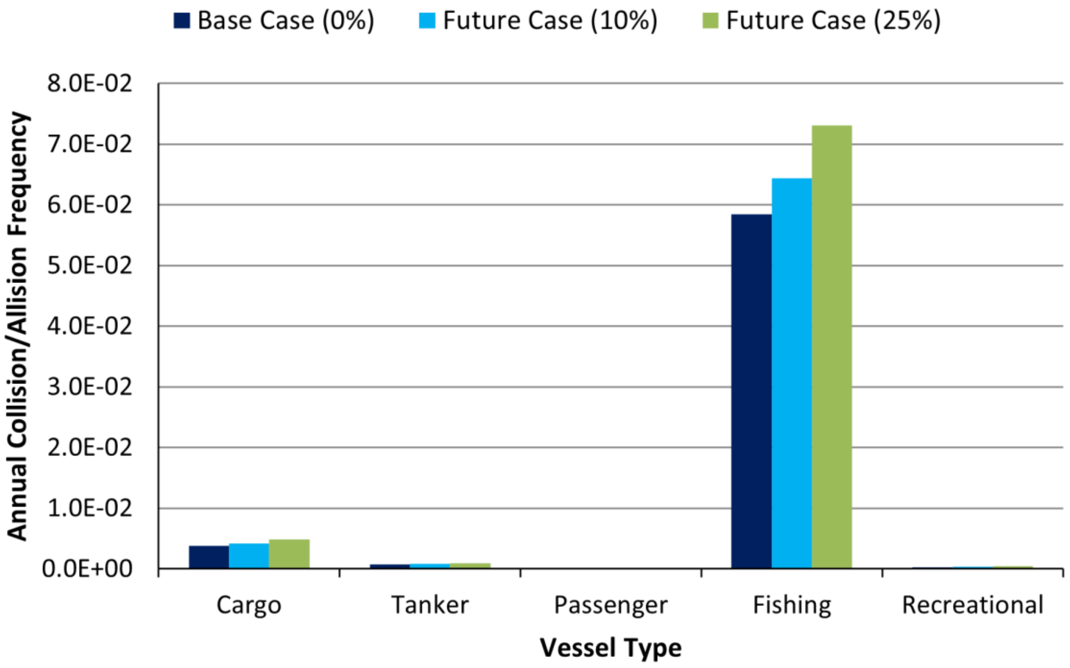

Figure A.14 Estimated Change in Annual Collision and Allision Frequency by Vessel Type

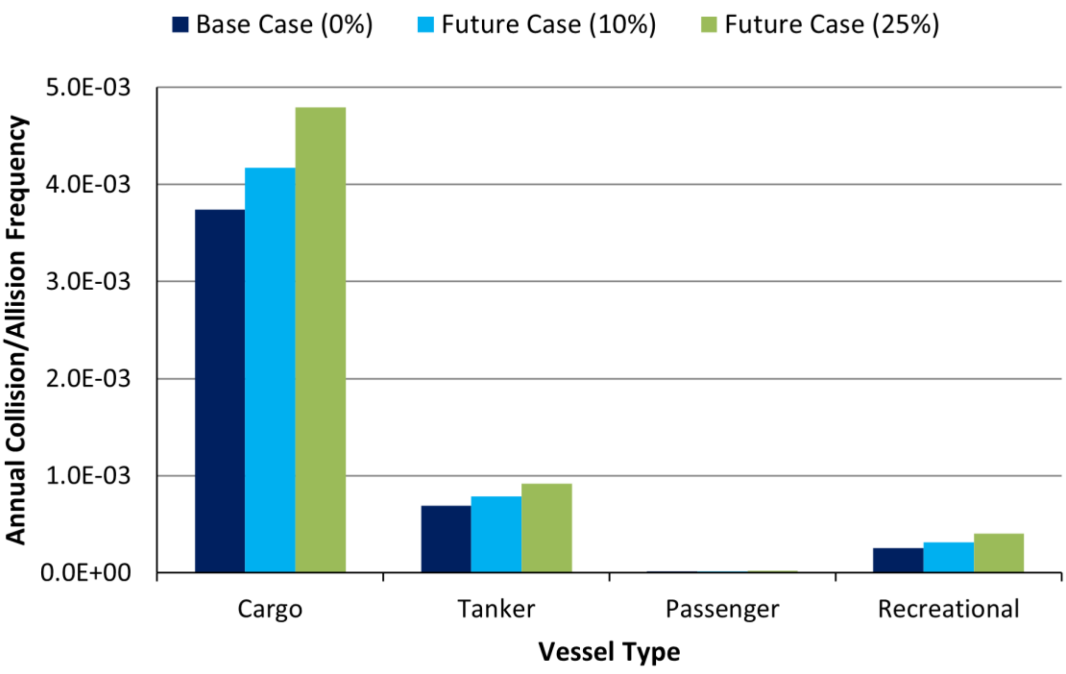

Figure A.15 Estimated Change in Annual Collision and Allision Frequency by Vessel Type (Excluding Fishing Vessels)

396. The change in collision and allision frequency is dominated by fishing vessels due to their active presence within and in proximity to the array area and the highly conservative nature of Anatec's COLLRISK model for fishing vessel allisions.

397. The second greatest collision and allision frequency change was associated with cargo vessels but was significantly lower than fishing vessels.

398. Combining the annual collision and allision frequency (see Table 15-1), estimated number of POB for each vessel type (see Table A.3) and the estimated fatality probability for each vessel type category (see Table A.4), the annual increase in PLL due to the presence of Dublin Array for the base case is estimated to be 4.00×10^{-4}, equating to one additional fatality every 2,499 years.

399. The estimated incremental increases in PLL due to Dublin Array, distributed by vessel type and for the base case and future case, are presented in Figure A.16. The same distribution but excluding fishing vessels is presented in Figure A.17.

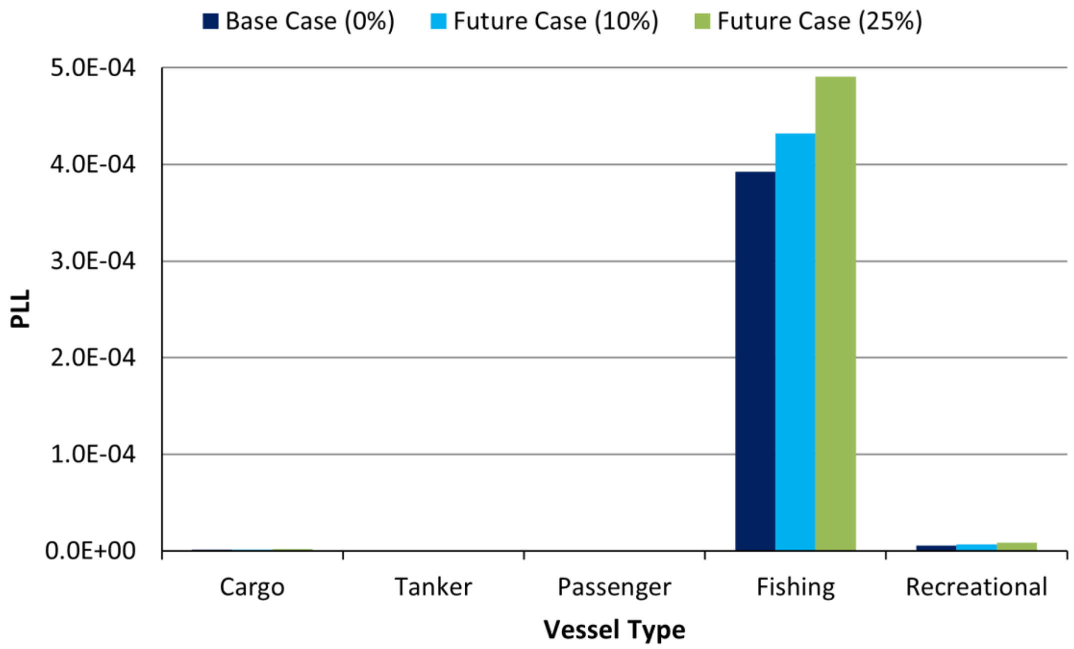

Figure A.16 Estimated Change in Annual PLL by Vessel Type

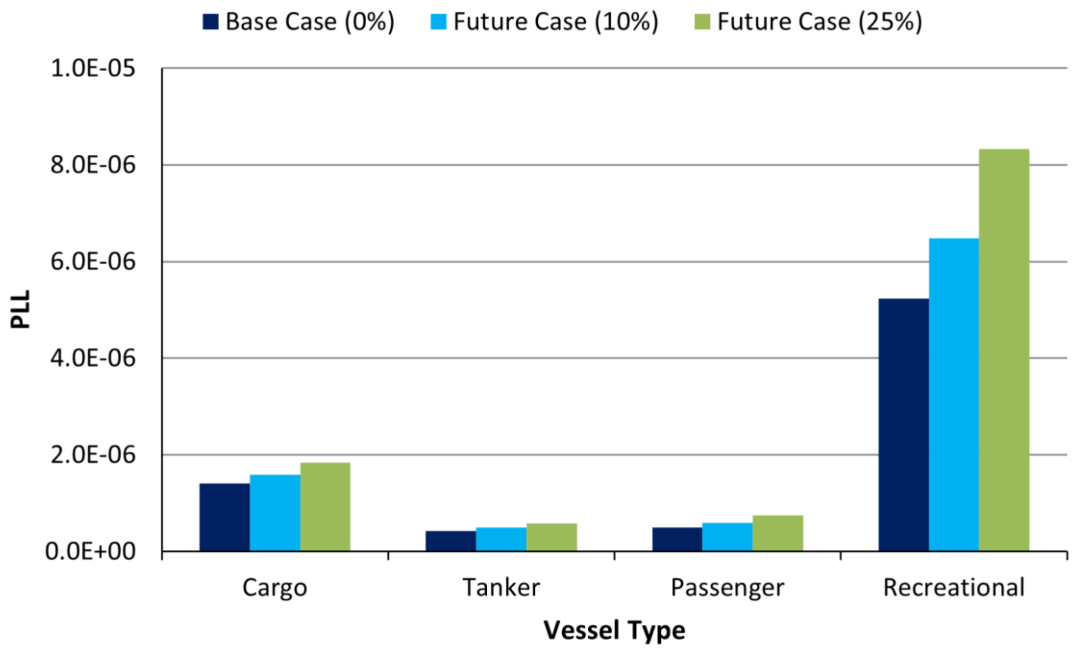

Figure A.17 Estimated Change in Annual PLL by Vessel Type (Excluding Fishing Vessels)

400. As with the change in collision and allision frequency, the change in annual PLL is dominated by fishing vessels which historically have a higher fatality probability than commercial vessels.

401. The second greatest annual PLL change was associated with recreational vessels. Converting the PLL to individual risk based upon the average number of people exposed by vessel type, the results are presented in Figure A.18. The same results but excluding fishing vessels is presented in Figure A.19.

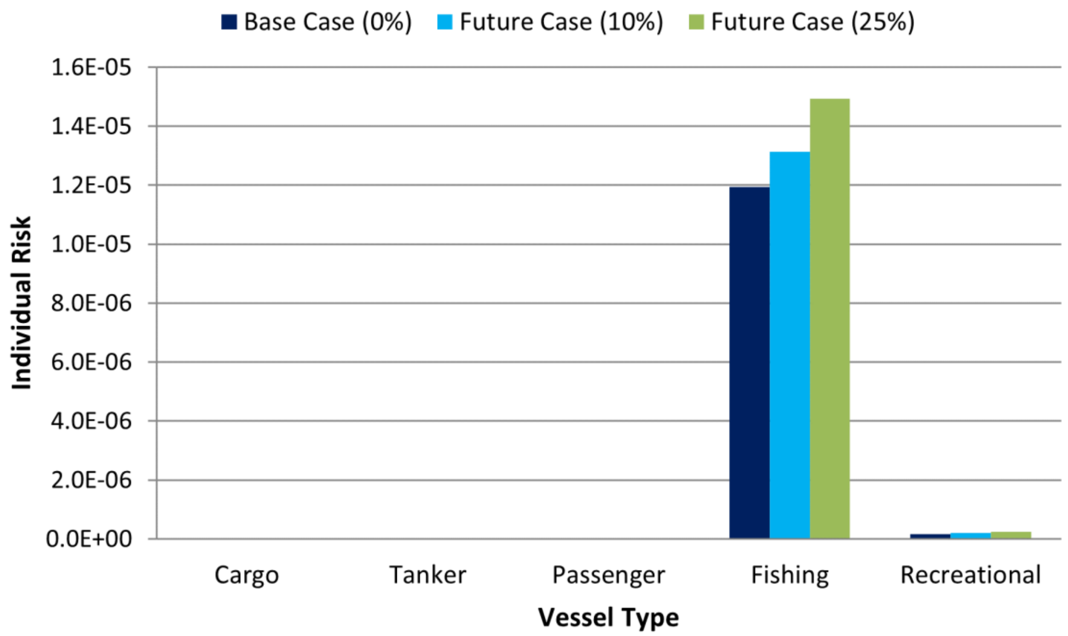

Figure A.18 Estimated Change in Individual Risk by Vessel Type

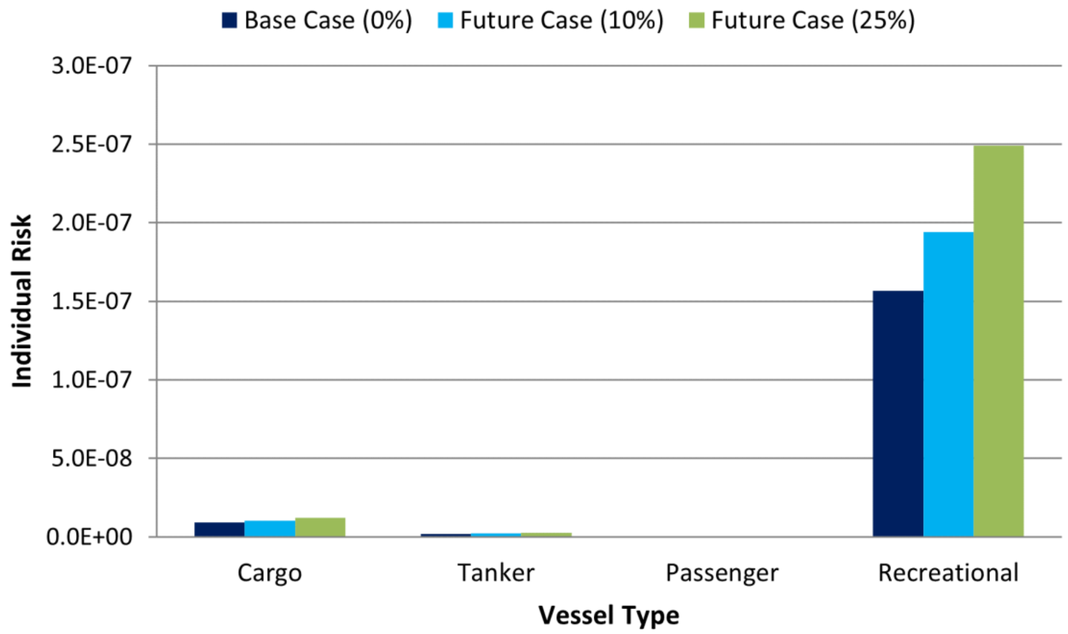

Figure A.19 Estimated Change in Individual Risk by Vessel Type (Excluding Fishing Vessels)

402. The change in individual risk to people is dominated by fishing vessels, again reflecting the higher probability of a fatality occurring in the event of an incident involving a fishing vessel compared to other vessel types.

403. The second greatest individual risk change was associated with recreational vessels, followed by cargo vessels.

A.3.4 Significance of Increase in Fatality Risk

404. 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 per 2,499 years represents a small change.

405. In terms of individual risk to people, the change for commercial vessels attributed to Dublin Array (approximately 1.11×10^{-8} 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.

406. For fishing vessels, the change in individual risk attributed to Dublin Array (approximately 1.19×10^{-5} for the base case) is low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

A.4 Pollution Risk

A.4.1 Historical Analysis

407. 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).

408. Two types of oil spill are considered in this assessment:

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

409. The research undertaken as part of the UK DfT's MEHRAs project (UK 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 A.20.

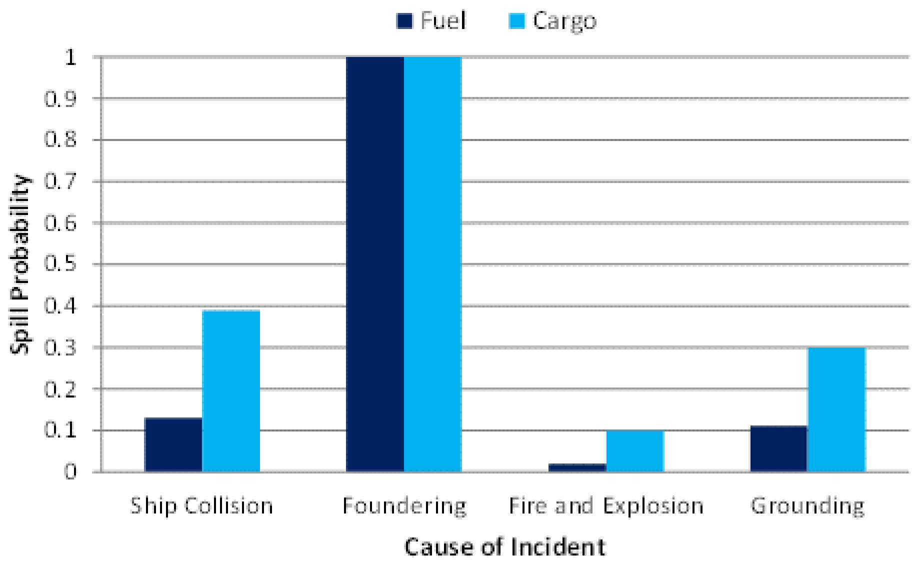

Figure A.20 Probability of an Oil Spill Resulting from an Accident

410. 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.

411. 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.

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

413. For cargo spills from laden tankers, the spill size can vary significantly. The ITOPF reported the following spill size distribution for tanker collisions between 1974 and 2004:

- 31% of spills below seven tonnes;
- 52% of spills between seven and 700 tonnes; and
- 17% of spills greater than 700 tonnes.

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

415. 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.

A.4.2 Pollution Risk due to Dublin Array

416. Applying the above probabilities to the annual collision and allision frequency by vessel type presented in Figure A.20 and the average spill size per vessel, the average amount of oil spilled per year due to the impact of Dublin Array is estimated to be 0.30 tonnes per year for the base case, rising to 0.39 tonnes for the 20% future case.

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

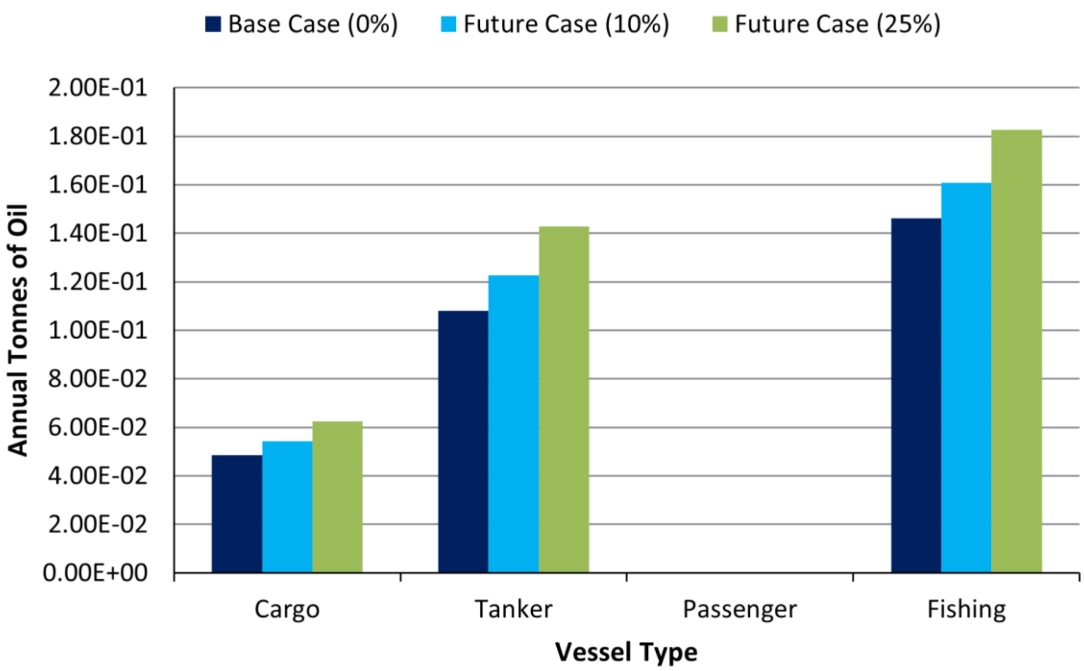

Figure A.21 Estimated Change in Pollution by Vessel Type

418. The annual oil spill results are dominated by fishing vessels due to their high associated annual collision and allision frequency. The second greatest contributor was tankers, reflecting the greater oil spill volume per incident associated with tankers.

A.4.3 Significance of Increase in Pollution Risk

419. To assess the significance of the increased pollution risk from vessels caused by Dublin Array, historical oil spill data for the UK has been used as a benchmark.

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

421. The overall increase in pollution estimated due to Dublin Array of 0.30 tonnes for the base case represents a 0.002% increase compared to the historical average pollution quantities from maritime incidents in UK waters. This may also be conservative given the potential for future changes towards less polluting vessel fuels.

A.5 Conclusion

422. This appendix has quantitively assessed the fatality and pollution risk associated with Dublin Array in the event of a collision or allision incident occurring. The assessment indicates that the fatality and pollution risk associated with fishing vessels is greatest.

423. Overall, the impact of Dublin Array 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 in Irish Sea.

424. Discussion of relevant mitigation measures and monitoring is provided in Section 17 of the NRA.

Annex B Regular Operators

28th August 2020 – Dublin Array Offshore Wind Farm Consultation

Stakeholder Consultation on Impacts relating to Shipping and Navigation for the Dublin Array Offshore Wind Farm

Dear Stakeholder,

RWE (formerly innogy Renewables Ireland) has partnered with Irish company Saorgus Energy to continue the development of the Dublin Array Offshore Wind Farm (OWF) Project, a major offshore development project, located in the Irish Sea off the coast of Dublin. The project is in the development phase and RWE is leading on the development of the project on behalf of the partnership. RWE plan to submit an updated development consent application ("a planning application") in 2021 to achieve an operational date that helps Ireland meet its 2030 renewable energy targets.

Further information can be found on the project website - www.dublinarray.com.

The proposed Dublin Array OWF is located approximately 5 nautical miles (nm) east of Bray Head on the Kish and Bray sandbanks. It will cover a maximum area of approximately 17 nautical miles squared (nm^2), 59 kilometres squared (km^2) figure 1 presents the area within which the wind turbine generators and associated structures including offshore substation platforms would be located. This area is referred to as the "array area".

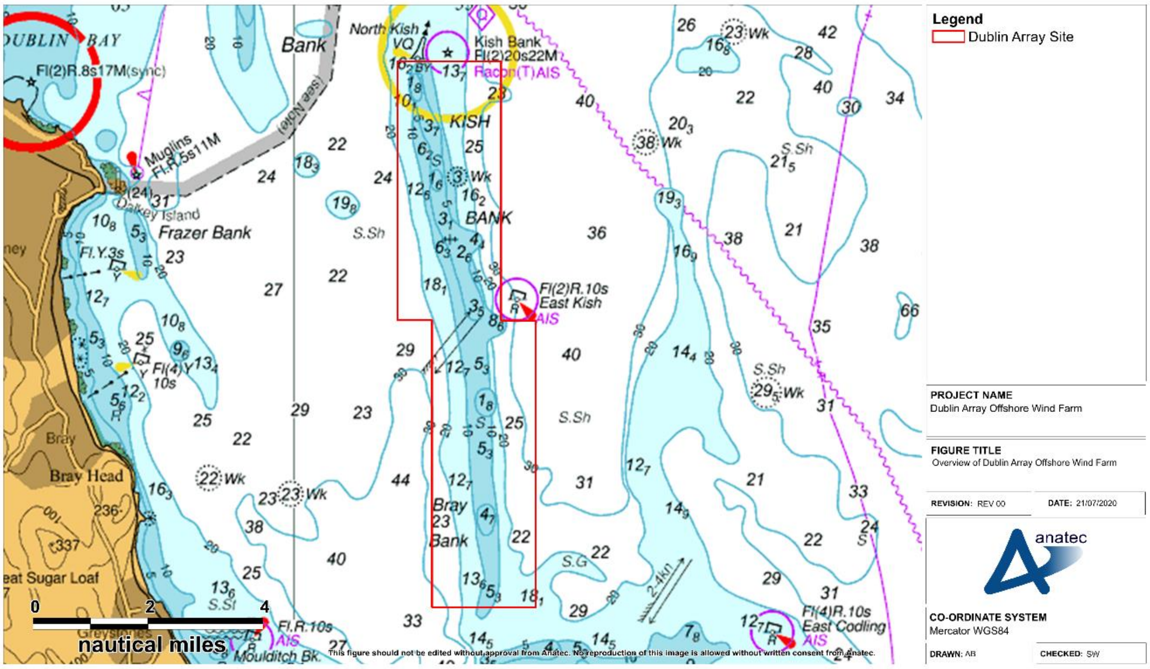

Figure 1: Overview of Dublin Array OWF

The offshore element of the wind farm could include:

- Between 45 and 61 turbines
- Individual turbine capacities of between 8 megawatts (MW) and 15 megawatts (MW)
- Total project capacity of between 600 MW and 900 MW
- Individual turbine tip heights of between 220 metres and 308 metres

Anatec Ltd (a specialist navigation risk consultancy) are providing technical support on shipping and navigation during the consent process and are coordinating consultation with stakeholders. Anatec will undertake a navigation assessment which will be presented in the Environmental Impact Assessment Report (EIAR) of the planning application. Therefore, we are writing to you, on the behalf of the Dublin Array OWF project, to kindly request feedback which will help inform the navigation assessment of the proposed offshore wind farm.

According to the assessment of AIS data, your company's vessel(s) has regularly navigated within, and/or in the vicinity of, the Dublin Array OWF and consequently your company has been identified as a potential Marine Stakeholder for the Dublin Array OWF. We therefore invite your feedback on the potential development including any impact it may have upon the navigation of vessels.

It is noted that the consultation process will include a hazard workshop/s for the Dublin Array OWF, during which stakeholders will be given the opportunity to discuss the project, and its potential impacts on shipping and navigation users (which includes regular operators of the area). The output of these discussions will be considered with various other inputs when assessing impacts within the EIAR.

We would be grateful if you could provide us with any comments or feedback that you may have by the 18th September 2020. This will allow us to assess your feedback and use it to inform the Navigational Risk Assessment (NRA) which is currently being undertaken. We would also be grateful if you could provide us with the relevant contact details of any vessel operators/owners you feel may be interested in commenting so they can be contacted.

In particular, we are keen to receive comments on the following:

1. Whether the proposal to construct Dublin Array OWF is likely to impact the routeing of any specific vessels, including the nature of any changes in regular transits;
2. Whether any aspect of Dublin Array OWF poses any safety concerns to your vessels, including any adverse weather routeing;
3. Whether you would choose to make passage internally within the array area;
4. Whether you wish to be retained on our list of Marine Stakeholders and consulted throughout the NRA process; and
5. Whether you wish to attend a Hazard Workshop, either online or at a venue that will be confirmed at a later date, at which impacts relating to shipping and navigation will be discussed.

Responses should be sent via email to [redacted]. Should you require any further information to support your review, please do not hesitate to contact us.

Yours Sincerely,

[redacted]

Anatec Ltd

cc. [redacted]

Annex C Recreational Users

Date: 30th September 2020

Recreational Stakeholder Consultation on Impacts relating to Shipping and Navigation for the Dublin Array Offshore Wind Farm

Dear Sir or Madam,

RWE (formerly innogy Renewables Ireland) has partnered with Irish company Saorgus Energy to continue the development of the Dublin Array Offshore Wind Farm (OWF) Project, a major offshore development project, located in the Irish Sea off the coast of Dublin. The project is in the development phase and RWE is leading on the development of the project on behalf of the partnership. RWE plan to submit an updated development consent application ("a planning application") in 2021 to achieve an operational date that helps Ireland meet its 2030 renewable energy targets.

Further information can be found on the project website - www.dublinarray.com.

The proposed Dublin Array OWF is located approximately 5 nautical miles (nm) east of Bray Head on the Kish and Bray sandbanks. It will cover a maximum area of approximately 17 nautical miles squared (nm^2), 59 kilometres squared (km^2). Figure 1 presents the area within which the wind turbine generators and associated structures including offshore substation platforms would be located. This area is referred to as the "array area" as shown in the figure overleaf.

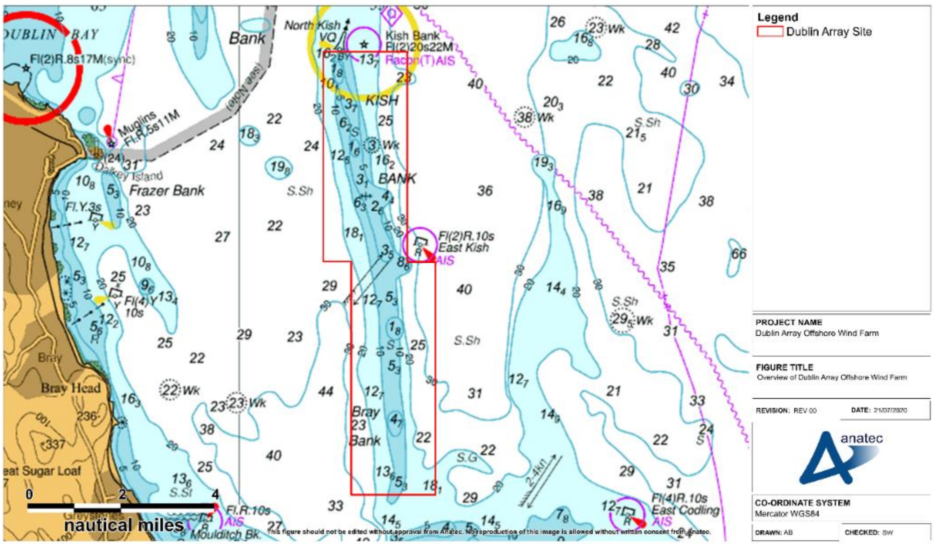

Figure 1: Overview of Dublin Array OWF

The offshore element of the wind farm could include:

- Between 45 and 61 turbines
- Individual turbine capacities of between 8 megawatts (MW) and 15 megawatts (MW)
- Total project capacity of between 600 MW and 900 MW

- Individual turbine tip heights of between 220 metres and 308 metres

Anatec Ltd (a specialist navigation risk consultancy) are providing technical support on shipping and navigation during the consent process and are coordinating consultation with stakeholders. Anatec will be undertaking a navigation assessment which will be presented in the Environmental Impact Assessment Report (EIAR) of the planning application.

We are writing to you to kindly request feedback which will help inform the navigation assessment of the proposed offshore wind farm.

Recreational activity in the area will be identified by consultation, on-site surveys, and desk-based studies. Using the data acquired by these methods, the potential impacts that the Dublin Array OWF may have upon shipping and navigation (including recreational users) will be identified and assessed. If the Dublin Array OWF is constructed and commissioned, vessels will be able to transit through the array. There of course will be some restrictions during the construction phase.

It is noted that the consultation process will include a hazard workshop/s for the Dublin Array OWF, during which stakeholders will be given the opportunity to discuss the project, and its potential impacts on shipping and navigation users (including recreational users). The output of these discussions will be considered with various other inputs when assessing impacts within the EIAR.

We would be grateful if you could provide any comments or feedback that you may have by the 21 September 2020. This will allow Anatec to assess your feedback and use it to inform the Navigational Risk Assessment (NRA) which is currently being undertaken. We would also be grateful if you could provide the relevant contact details of any other recreational club / organisation that you feel may be interested in commenting so they can be contacted.

In particular, we are interested to receive comments on the following:

- How you currently use the array area, and the area in the vicinity of the array area;
- How might the Dublin Array OWF change the way you navigate in the area i.e. whether you would choose to make passage through the array area;
- Whether you wish to be retained on our list of Marine Stakeholders and consulted throughout the NRA process; and
- Whether you wish to attend a Hazard Workshop, online or in-person at a location that will be confirmed at a later date, where the impacts relating to shipping and navigation will be discussed.

Responses should be sent via email to [redacted]. Should you have any queries or require additional information to support your review, please do not hesitate to contact us.

In addition to the hazard workshop/s specific to marine navigation, the Dublin Array Offshore Wind Farm project will also be undertaking general public consultation through a digital consultation platform later in the Autumn. The digital consultation will contain information about technical elements of the projects, visualisations, feedback options and also offers visitors the ability to undertake a survey related to the project. We will contact you again shortly with detail of when the digital consultation will be live.

Yours faithfully,

[redacted]

RWE Renewables Ireland Ltd

cc. [redacted]

Annex D Hazard Log

Table E.1 Hazard Log[16]

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
Commercial Vessels																						
Displacement	Temporary displacement from historical routes.	C/D	Promulgation of information; Appropriate marking on nautical charts; and Compliance with MGN 543 (in line with regulator preference).	Buoyed construction / area / decommissioning area or advisory safe passing distances causing displacement; Human error or navigational error; Mechanical or technical failure; and Adverse Weather.	Increased encounters but does not impact on compliance with COLREGs; and Increased journey time/distance but does not impact on schedules.	4	1	1	1	2	1.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs potentially leading to increased journey time, impacts on schedules and increased collisions.	1	4	3	4	4	3.8	**Broadly Acceptable**		

[16] Note agreed version of Hazard Log references MGN 543 as relevant guidance at time of the Workshops. As per Section **Error! Reference source not found.**, this was superseded by MGN 654 in April 2021.

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
Collision	Increased collision risk due to wind farm construction vessels.	C/D	Promulgation of information; Project vessels to abide by SOLAS and COLREGS; Creation and implementation of emergency response plans; Implementation of a buoyed construction/ decommissioning area during appropriate phases; and Advisory safe passing distances.	Increased vessel movements within the area due to project construction/ decommissioning; Third party users not aware vessels are engaged in operations; Human error or navigational error; Mechanical or technical failure (vessel); and Adverse Weather Collision with vessels installing cables.	Increased encounters that do not impact on compliance with COLREGS.	5	1	1	1	1	1.0	**Tolerable**	Increased encounters that do impact on compliance with COLREGS and result in increased collisions.	3	4	3	4	4	3.8	**Tolerable**	Entry/exit points to the array area; Designated routes to/from the array area; and Monitoring of site (via Marine Coordination).	Regular operators noted they would like to see project vessels avoiding crossing areas where commercial traffic passes in narrow area i.e., south west areas; and Port of Dublin raised concerns about the potential for closure of the southern TSS to allow for installation of the cable.

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences					Risk		Frequency	Consequences					Risk		
							People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence			
Allision	New allision risk due to pre commissioned structures.	C/D	Lighting and marking of wind farm in line with Irish Lights guidance and IALA O-139; Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); Creation and implementation of emergency response cooperation plans; Implementation of a buoyed construction/ decommissioning area during appropriate phases; and Advisory safe passing distances.	Presence of pre commissioned structures; Human error or navigational error Mechanical or technical failure (vessel); Adverse weather; Unfamiliarity with project; and Failure of AtoN.	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed.	4	1	1	1	1	1.0	**Broadly Acceptable**	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution.	2	5	4	4	5	4.5	**Tolerable**	Management of AtoN to be discussed with Irish Lights.	

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences					Risk		Frequency	Consequences					Risk		
							People	Environment	Property	Business	Average Consequence				People	Environment	Property	Business	Average Consequence			
Displacement	Displacement from historical routes.	O	Promulgation of information; Compliance with MGN 543 (in line with regulator preference); Project vessels to abide by SOLAS and COLREGS; Creation and implementation of emergency response cooperation plans; and Advisory safe passing distances.	Presence of structures; Human error or navigational error; Mechanical or technical failure; and Adverse Weather.	Increased encounters but does not impact on compliance with COLREGs; and Increased journey time/distance but does not impact on schedules.	5	1	1	1	1	1.0	**Tolerable**	Increased encounters but does impact on compliance with COLREGs and increased collisions; and Increased journey time/distance but does impact on schedule.	2	4	3	4	4	3.8	**Broadly Acceptable**		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
Collision	Increased collision risk due to wind farm operation and maintenance vessels.	O	Promulgation of information; Compliance with MGN 543 (in line with regulator preference); Project vessels to abide by SOLAS and COLREGS; Creation and implementation of emergency response cooperation plans; and Advisory safe passing distances.	Increased vessel movements within the area due to project maintenance; Third party users not aware vessels are engaged in operations; Human error or navigational error; Mechanical or technical failure (vessel); and Adverse Weather.	Increased encounters that do not impact on compliance with COLREGS.	4	1	1	1	1	1.0	**Broadly Acceptable**	Increased encounters that do impact on compliance with COLREGS and result in increased collisions.	2	4	3	4	4	3.8	**Broadly Acceptable**		Regular operators noted they would like to see project vessels avoiding crossing areas where commercial traffic passes in narrow area i.e., south west areas.

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
Allision	New allision risk due to commissioned structures.	O	Lighting and marking of wind farm in line with Irish Lights guidance and IALA O-139; Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); Creation and implementation of emergency response cooperation plans; and Advisory safe passing distances.	Presence of structures; Human error or navigational error; Mechanical or technical failure resulting in a vessel drifting; and Adverse Weather.	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed.	4	1	1	1	1	1.0	**Broadly Acceptable**	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution.	2	5	4	4	5	4.5	**Tolerable**	Management of AtoN to be discussed with Irish Lights.	

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
Grounding	Increased risk of grounding due to cable protection or scour protection.	O	Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); and Cable Burial Risk Assessment pre-construction.	Presence of cable protection reduces underkeel clearance; Human error or navigational error; Mechanical or technical failure; Adverse Weather; Navigational error; and Unfamiliarity with operational cable location.	Vessel transits over an area of reduced clearance causing vibration etc. but does not make contact.	2	1	1	1	1	1.0	**Broadly Acceptable**	Vessel makes contact with cable protection/ infrastructure resulting in damage to the vessel and potentially pollution.	1	2	3	4	3	3.0	**Broadly Acceptable**		
Anchoring Snagging	Increased anchor snagging risk due to cables, cable protection and sub surface structures.	O	Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); and Cable Burial Risk Assessment pre-construction.	Presence of cables, cable protection or other subsea infrastructure; Human error or navigational error; Mechanical or technical failure; and Adverse Weather.	Commercial vessel anchors on or drags anchor over an installed cable/protection or other subsea infrastructure but no interaction occurs.	3	1	1	1	1	1.0	**Broadly Acceptable**	Commercial vessel anchors on or drags anchor over an installed cable, cable protection or other subsea infrastructure resulting in damage to the cable/protection and/or anchor.	2	2	2	3	2	2.3	**Broadly Acceptable**		
Fishing Vessels																						

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
Displacement	Temporary displacement from historical transits to fishing grounds.	C/D	Promulgation of information; Appropriate marking on nautical charts; and Compliance with MGN 543 (in line with regulator preference).	Buoyed construction area/ decommissioning area or advisory safe passing distances causing displacement; Human error or navigational error; Mechanical or technical failure; and Adverse Weather.	Increased encounters but does not impact on compliance with COLREGs; and Increased journey time/distance but does not impact journey time.	3	1	1	1	2	1.3	Broadly Acceptable	Increased encounters and impacts on compliance with COLREGs potentially leading to increased journey time and increased collisions.	2	4	2	4	3	3.3	Broadly Acceptable		
Collision	Increased collision risk due to wind farm construction vessels.	C/D	Promulgation of information; Project vessels to abide by SOLAS and COLREGS; Creation and implementation of emergency response plans; Implementation of a buoyed construction/ decommissioning area during appropriate phases; and Advisory safe passing distances.	Increased vessel movements within the area due to project construction/ decommissioning; Third party users not aware vessels are engaged in operations; Human error or navigational error; Mechanical or technical failure (vessel); Adverse Weather; and Collision with vessels installing cables.	Increased encounters that do not impact on compliance with COLREGS.	4	1	1	1	1	1.0	Broadly Acceptable	Increased encounters that do impact on compliance with COLREGS and result in increased collisions.	3	4	2	4	3	3.3	Tolerable	Entry/exit points to the array area; Designated routes to/from the array area; and Monitoring of site (via Marine Coordination).	

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
Allision	New allision risk due to pre commissioned structures.	C/D	Lighting and marking of wind farm in line with Irish Lights guidance and IALA O-139; Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); Creation and implementation of emergency response cooperation plans; Implementation of a buoyed construction/ decommissioning area during appropriate phases; and Advisory safe passing distances.	Presence of pre commissioned structures; Human error or navigational error; Mechanical or technical failure (vessel); Adverse weather; Failure of AtoN; and Failure to take note of advisory safe passing distance.	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed; and Vessel attempting to place/retrieve in close proximity to pre commissioned structure (due to fish aggregation) has to take urgent action to avoid contact.	4	1	1	1	1	1.0	**Broadly Acceptable**	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution; and Vessel attempting to place/retrieve pots in close proximity to pre commissioned structure (due to fish aggregation) allides with pre commissioned structure.	3	4	2	4	2	3.0	**Tolerable**	Management of AtoN to be discussed with Irish Lights.	Vessel having navigational safety impacts was discussed at the hazard workshop, after being attracted by fish aggregation.

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		
Displacement	Displacement from historical transits to fishing grounds.	O	Promulgation of information; Compliance with MGN 543 (in line with regulator preference); Project vessels to abide by SOLAS and COLREGS; Creation and implementation of emergency response cooperation plans; Advisory safe passing distances; and Minimum spacing.	Presence of structures; Human error or navigational error; Mechanical or technical failure; and Adverse Weather.	Increased encounters but does not impact on compliance with COLREGs increased journey time.	2	1	1	1	1	1.0	**Broadly Acceptable**	Increased encounters and does impact on compliance with COLREGs potentially causing increased collisions and increased journey time.	1	4	2	4	3	3.3	**Broadly Acceptable**		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
Collision	Increased collision risk due to wind farm operation and maintenance vessels.	O	Promulgation of information; Compliance with MGN 543 (in line with regulator preference); Project vessels to abide by SOLAS and COLREGS; Creation and implementation of emergency response cooperation plans; Cable Burial Risk Assessment pre-construction; and Advisory safe passing distances.	Increased vessel movements within the area due to project maintenance; Third party users not aware vessels are engaged in operations; Human error or navigational error; Mechanical or technical failure (vessel); and Adverse Weather.	Increased encounters that do not impact on compliance with COLREGS.	3	1	1	1	1	1.0	**Broadly Acceptable**	Increased encounters that do impact on compliance with COLREGS and result in increased collisions.	2	4	2	4	3	3.3	**Broadly Acceptable**		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		
Allision	New allision risk due to commissioned structures.	O	Lighting and marking of wind farm in line with Irish Lights guidance and IALA O-139; Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); Creation and implementation of emergency response cooperation plans; and Advisory safe passing distances.	Presence of structures; Human error or navigational error; Mechanical or technical failure resulting in a vessel drifting; and Adverse Weather.	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed; and Vessel attempting to place/retrieve pots in close proximity to structure (due to fish aggregation) has to make last minute adjustments to avoid contact.	4	1	1	1	1	1.0	**Broadly Acceptable**	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution; and Vessel attempting to place/retrieve pots in close proximity to structure (due to fish aggregation) allides with the structure.	3	4	2	4	2	3.0	**Tolerable**	Management of AtoN to be discussed with Irish Lights.	

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
Grounding	Increased risk of grounding due to cable protection or scour protection.	O	Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); and Cable Burial Risk Assessment pre-construction.	Presence of cable protection reduces underkeel clearance; Human error or navigational error; Mechanical or technical failure; Adverse Weather; and Navigational error.	Vessel transits over an area of reduced clearance causing vibration etc. but does not make contact.	3	1	1	1	1	1.0	**Broadly Acceptable**	Vessel makes contact with cable protection/ infrastructure resulting in damage to the vessel and potentially pollution.	2	2	2	3	2	2.3	**Broadly Acceptable**		
Anchoring Snagging *Note impacts associated with commercial fishing gear are outside of the scope of the NRA process, and will be therefore be assessed separately.	Increased anchor snagging risk due to cables, cable protection and sub surface structures.	O	Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); and Cable Burial Risk Assessment pre-construction.	Presence of cables, cable protection or other subsea infrastructure; Human error or navigational error; Mechanical or technical failure; Adverse Weather; and Navigational error.	Fishing vessel anchors on or drags anchor over an installed cable/protection or other subsea infrastructure but no interaction occurs. *It is noted that fishing vessels anchors are in general smaller than commercial vessel anchors.	3	1	1	1	1	1.0	**Broadly Acceptable**	Fishing vessel anchors on or drags anchor over an installed cable, cable protection or other subsea infrastructure resulting in damage to the cable/protection and/or anchor, risks to vessel stability.	2	4	3	5	4	4.0	**Tolerable**	Monitoring of the cable; and Consideration given to consultation with fishing users on cable burial risk assessment.	
Recreational Vessels (2.5 to 24 metres)																						

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Average Consequence	Risk		
Displacement	Temporary displacement from historical cruising routes.	C/D	Promulgation of information; Appropriate marking on nautical charts; and Compliance with MGN 543 (in line with regulator preference).	Buoyed construction area/ decommissioning area or advisory safe passing distances causing displacement; Human error or navigational error; Mechanical or technical failure; and Adverse Weather.	Increased encounters but does not impact on compliance with COLREGs increased journey time/distance but does not impact journey time.	2	1	1	1	2	1.3	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs potentially leading to increased journey time and increased collisions.	1	4	1	4	3	3.0	**Broadly Acceptable**		
Displacement	Temporary displacement from historical racing routes.	C/D	Promulgation of information; Appropriate marking on nautical charts; and Compliance with MGN 543 (in line with regulator preference).	Buoyed construction area/ decommissioning area or advisory safe passing distances causing displacement; Human error or navigational error; Mechanical or technical failure; and Adverse Weather.	Occasional racing route unable to continue on historical route, but no effect on encounters or compliance with COLREGS.	5	1	1	1	2	1.3	**Tolerable**	Occasional racing route unable to continue on historical route, limited effect on encounters and compliance with COLREGS, but does not result in collision.	5	1	1	1	2	1.3	**Tolerable**	Consultation direct with race operators to ensure minimal displacement.	

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
Collision	Increased collision risk due to wind farm construction vessels.	C/D	Promulgation of information; Project vessels to abide by SOLAS and COLREGS; Creation and implementation of emergency response plans; Implementation of a buoyed construction/ decommissioning area during appropriate phases; and Advisory safe passing distances.	Increased vessel movements within the area due to project construction/ decommissioning; Third party users not aware vessels are engaged in operations; Human error or navigational error; Mechanical or technical failure (vessel); Adverse Weather; and Collision with vessels installing cables.	Increased encounters that do not impact on compliance with COLREGS.	4	1	1	1	1	1.0	**Broadly Acceptable**	Increased encounters that do impact on compliance with COLREGS and result in increased collisions.	3	4	2	4	3	3.3	**Tolerable**	Entry/exit points to the array area; Designated routes to/from the array area; and Monitoring of site (via Marine Coordination).	Emergency responders noted the risk of novice operators that may not be familiar with the operation of their vessel, familiar with COLREGS and generally inexperienced.

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		
Allision	New allision risk due to pre commissioned structures.	C/D	Lighting and marking of wind farm in line with Irish Lights guidance and IALA O-139; Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); Creation and implementation of emergency response cooperation plans; Implementation of a buoyed construction/ decommissioning area during appropriate phases; and Advisory safe passing distances.	Presence of pre commissioned structures; Human error or navigational error; Mechanical or technical failure (vessel); Adverse weather; Failure of AtoN; and Failure to take note of advisory safe passing distance.	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed.	4	1	1	1	1	1.0	**Broadly Acceptable**	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution.	3	3	1	3	2	2.3	**Broadly Acceptable**		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
Displacement	Displacement from historical cruising routes.	O	Promulgation of information; Compliance with MGN 543 (in line with regulator preference); Project vessels to abide by SOLAS and COLREGS; Creation and implementation of emergency response cooperation plans; Advisory safe passing distances; and Minimum spacing.	Presence of structures; Human error or navigational error; Mechanical or technical failure; and Adverse Weather.	Increased encounters but does not impact on compliance with COLREGs increased journey time/distance but does not impact journey time.	1	1	1	1	1	1.0	**Broadly Acceptable**	Increased encounters and impacts on compliance with COLREGs potentially leading to increased journey time and increased collisions.	1	4	1	4	3	3.0	**Broadly Acceptable**		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
							Consequences								Consequences							
						Frequency	People	Environment	Property	Business	Average Consequence	Risk		Frequency	People	Environment	Property	Business	Average Consequence	Risk		
Displacement	Displacement from historical racing routes.	O	Promulgation of information; Compliance with MGN 543 (in line with regulator preference); Project vessels to abide by SOLAS and COLREGS; Creation and implementation of emergency response cooperation plans; Advisory safe passing distances; and Minimum spacing.	Presence of structures; Human error or navigational error; Mechanical or technical failure; and Adverse Weather.	Occasional racing route unable to continue on historical route, but no effect on encounters or compliance with COLREGS.	4	1	1	1	1	1.0	**Broadly Acceptable**	Occasional racing route unable to continue on historical route, limited effect on encounters and compliance with COLREGS, but does not result in collision.	4	1	1	1	2	1.3	**Broadly Acceptable**	Consultation and continued cooperation direct with race operators to ensure minimal displacement.	

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		
Collision	Increased collision risk due to wind farm operation and maintenance vessels.	O	Promulgation of information; Compliance with MGN 543 (in line with regulator preference); Project vessels to abide by SOLAS and COLREGS; Creation and implementation of emergency response cooperation plans; Advisory safe passing distances; and Minimum spacing.	Increased vessel movements within the area due to project maintenance; Third party users not aware vessels are engaged in operations; Human error or navigational error; Mechanical or technical failure (vessel); and Adverse Weather.	Increased encounters that do not impact on compliance with COLREGS.	3	1	1	1	1	1.0	**Broadly Acceptable**	Increased encounters that do impact on compliance with COLREGS and result in increased collisions.	2	4	2	4	3	3.3	**Broadly Acceptable**		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		Frequency	Consequences: People	Environment	Property	Business	Average Consequence	Risk		
Allision	New allision risk due to commissioned structures.	O	Lighting and marking of wind farm in line with Irish Lights guidance and IALA O-139; Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); Creation and implementation of emergency response cooperation plans; and Advisory safe passing distances.	Presence of structures; Human error or navigational error; Mechanical or technical failure resulting in a vessel drifting; and Adverse Weather.	Vessel passes structure at an unsafe distance and has to make last minute adjustment to course/speed.	4	1	1	1	1	1.0	**Broadly Acceptable**	Vessel allides with structure resulting in damage to vessel, injury and potentially pollution.	3	3	1	3	2	2.3	**Broadly Acceptable**		

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences							Worst-Case Consequences	Realistic Worst-Case Consequences							Further Mitigation	Additional Comments
						Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		Frequency	Consequences: People	Consequences: Environment	Consequences: Property	Consequences: Business	Consequences: Average Consequence	Risk		
Grounding	Increased risk of grounding due to cable protection or scour protection.	O	Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); and Cable Burial Risk Assessment pre-construction.	Presence of cable protection reduces underkeel clearance; Human error or navigational error; Mechanical or technical failure; Adverse Weather; and Navigational error.	Vessel transits over an area of reduced clearance causing vibration etc. but does not make contact.	3	1	1	1	1	1.0	**Broadly Acceptable**	Vessel makes contact with cable protection/ infrastructure resulting in damage to the vessel and potentially pollution.	2	2	2	3	2	2.3	**Broadly Acceptable**		
Anchoring Snagging	Increased anchor snagging risk due to cables, cable protection and sub surface structures.	O	Promulgation of information; Appropriate marking on nautical charts; Compliance with MGN 543 (in line with regulator preference); and Cable Burial Risk Assessment pre-construction.	Presence of cables, cable protection or other subsea infrastructure; Human error or navigational error; Mechanical or technical failure; Adverse Weather; and Navigational error.	Recreational vessel anchors on or drags anchor over an installed cable/protection or other subsea infrastructure but no interaction occurs. *It is noted that recreational vessels anchors are in general smaller than commercial vessel anchors.	3	1	1	1	1	1.0	**Broadly Acceptable**	Recreational vessel anchors on or drags anchor over an installed cable, cable protection or other subsea infrastructure resulting in damage to the cable/protection and/or anchor.	2	2	1	2	2	1.8	**Broadly Acceptable**		
Emergency Response																						

Hazard Type	Hazard Title	Phase (C/O/D)	Embedded Mitigations	Possible Causes	Most Likely Consequences	Realistic Most Likely Consequences								Worst-Case Consequences	Realistic Worst-Case Consequences								Further Mitigation	Additional Comments
						Frequency	Consequences					Average Consequence	Risk		Frequency	Consequences					Average Consequence	Risk		
							People	Environment	Property	Business						People	Environment	Property	Business					
Emergency response	Presence of the wind farm may restrict access/ response for existing emergency responders.	C/O/D	Promulgation of information; Compliance with MGN 543 (in line with regulator preference); Lighting and marking of wind farm in line with Irish Lights guidance and IALA O-139; and Creation and implementation of emergency response cooperation plans.	Wind farm array not designed to facilitate responder access.	Delay to response request.	4	1	1	1	1		1.0	**Broadly Acceptable**	Delay to response request leading to loss of life.	2	4	3	5	4		4.0	**Tolerable**	Continued consultation with Irish Coastguard and RNLI to ensure array design considers emergency response access.	
Emergency response	Presence of wind farm may attract tourists or recreational users to the area increasing number of emergency callouts.	C/O/D	Promulgation of information; Lighting and marking of wind farm in line with Irish Lights guidance and IALA O-139; and Creation and implementation of emergency response cooperation plans.	Novelty Inexperience with navigating within wind farm arrays, and the banks.	Increased callouts, but without effect on resource ability to respond.	5	1	1	1	1		1.0	**Tolerable**	Increased callouts affecting emergency responses resources.	2	4	2	4	3		3.3	**Broadly Acceptable**	Monitoring of site via marine coordination.	