Environmental Impact Assessment Report

NISA

North Irish Sea Array

Volume 9: Appendices (Offshore)

Appendix 19.1
Airspace Analysis and Radar Modelling

Statkraft

CIP Copenhagen Infrastructure Partners

GoBe APEM Group

ARUP

Airspace Analysis and Radar Modelling

North Irish Sea Array Offshore Wind Farm

29 April 2024

CL-5721-RPT-002 V3.0

www.cyrrus.co.uk

info@cyrrus.co.uk

Document Information

Document title	Airspace Analysis and Radar Modelling
Author	S McPherson
Reviewed by	P Foulsham
Produced by	Cyrrus Limited Cyrrus House Concept Business Court Allendale Road Thirsk North Yorkshire YO7 3NY T: +44 (0) 1845 522 585 F: +44 (0) 8707 622 325 E: info@cyrrus.co.uk W: www.cyrrus.co.uk
Document reference and Version	CL-5721-RPT-002 V3.0
Date of release	29 April 2024

Change History Record

Issue	Change Reference	Date	Details
1.0		06 February 2023	Initial issue.
2.0		23 March 2023	Re-issued with updated NISA offshore design parameters.
3.0		29 April 2024	Re-issued with final design parameters.

Abbreviations

amsl	above mean sea level
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATCSMAC	Air Traffic Control Surveillance Minimum Altitude Chart
ATS	Air Traffic Service
BRA	Building Restricted Area
CAA	Civil Aviation Authority
CTA	Control Area
CTR	Control Zone
DA	Danger Area
DME	Distance Measuring Equipment
DTM	Digital Terrain Model
ECC	Export Cable Corridor
EIAR	Environmental Impact Assessment Report
EUMETNET	European Meteorological Services Network
FIR	Flight Information Region
FL	Flight Level
ft	feet
GA	General Aviation
GIS	Geographic Information System
IAA	Irish Aviation Authority
IAC	Irish Air Corps
IAIP	Integrated Aeronautical Information Package
IAF	Initial Approach Fix
IAP	Instrument Approach Procedure
ICAO	International Civil Aviation Organisation
IF	Intermediate Approach Fix
IFP	Instrument Flight Procedure
IFR	Instrument Flight Rules
km	kilometre
LAT	Lowest Astronomical Tide
m	metre
MSA	Minimum Sector Altitude

NDB	Non-Directional Beacon
NISA	North Irish Sea Array
nm	nautical mile
OPERA	Operational Programme for the Exchange of Weather Radar Information
OSP	Offshore Substation Platform
PSR	Primary Surveillance Radar
RLoS	Radar Line of Sight
SFC	Surface
SID	Standard Instrument Departure
SRTM	Shuttle Radar Topography Mission
SSR	Secondary Surveillance Radar
STAR	Standard (Instrument) Arrival
SUA	Special Use Airspace
UK	United Kingdom
VFR	Visual Flight Rules
WTG	Wind Turbine Generator

References

[1] Eurocontrol (September 2014), ‘Eurocontrol Guidelines for Assessing the Potential Impact of Wind Turbines on Surveillance Sensors, Edition 1.2

[2] ICAO (November 2015), ‘EUR DOC 015: European Guidance Material on Managing Building Restricted Areas’.

[3] OPERA (October 2010), ‘Impact Study of Radar Observations by Wind Turbines’.

[4] OPERA (February 2022), ‘On the Coexistence of Weather Radar and Wind Turbines’.

Contents

List of figures

List of tables

1. Introduction

1.1. Overview

1.1.1. This document is a technical appendix to Volume 3, Chapter 19: Aviation and Radar of the North Irish Sea Array Offshore Wind Farm (NISA) Environmental Impact Assessment Report (EIAR). It provides detailed airspace analysis and radar modelling and outlines potential mitigation options.

1.1.2. The array area is approximately 88.5 square kilometres (km^2) and ranges from 11.3km to 23.5km from shore.

1.2. Effects of Wind Turbine Generators on Aviation

1.2.1. In aviation, surveillance radar equipment is used to determine the positions of aircraft in range and azimuth. A Primary Surveillance Radar (PSR) transmits radio signals and detects the radio signals when they are reflected back from aircraft or other targets, while a Secondary Surveillance Radar (SSR) transmits interrogation pulses and receives transmitted responses from transponder equipped aircraft.

1.2.2. Wind Turbine Generators (WTGs) can be problematic for PSRs as the characteristics of a moving WTG blade are like an aircraft. The PSR is unable to differentiate between wanted aircraft targets and clutter targets introduced by the presence of WTGs.

1.2.3. SSRs are less affected by WTGs, but turbine towers can cause physical blanking and diffracting effects and reflections can result in the SSR outputting false targets. According to Eurocontrol Guidelines[1], when WTGs are further than 16km from an SSR the impact is considered to be tolerable. In the UK, NATS (formerly National Air Traffic Services) applies a 28km protection range for its SSR facilities. Beyond 28km NATS does not consider the impact of WTGs on SSR to be material or relevant.

1.2.4. Potential impacts on Irish Aviation Authority (IAA) radar sites were identified at the Scoping stage.

1.2.5. The significance of any radar impacts depends on the airspace usage and the nature of the Air Traffic Service (ATS) provided in that airspace. The classification of the airspace in the vicinity of the array area and the uses of that airspace (civil and military) are set out in this appendix.

1.2.6. Radar impacts may be mitigated by either operational or technical solutions or a combination of both. In either case, the efficacy and acceptability of any operational and/or technical mitigation options available can only be determined through consultation with the radar operators and ATS providers.

[1] Eurocontrol Guidelines for Assessing the Potential Impact of Wind Turbines on Surveillance Sensors, Edition 1.2, September 2014

1.3. Technical Data

1.3.1. Radar Data

1.3.1.1. All radar parameters used in the assessment are taken from data held on file by Cyrrus.

1.3.2. Assessment Area

1.3.2.1. Boundaries for the array area and offshore export cable corridor (ECC) were supplied as geo-referenced Shapefiles:

- NISA_0154_Infrastructure_Boundary_Statkraft_20230310_WGS84_UTM30N.shp; and
- NISA_0154_Offshore_Cable_Corridor_Statkraft_20230901_WGS84_UTM30N.shp.

1.3.2.2. Together, these boundaries constitute the offshore development area and this is the assessment area used within this report.

1.3.3. WTGs

1.3.3.1. Two WTG models and up to 49 WTGs within the array area are being considered. The design parameters for these WTGs are shown in Table 1. Project Option 2 includes an aviation restricted zone where a number of WTGs have a lower blade tip height to avoid infringing minimum required obstacle clearance. This requirement is explained in Section 2.5 paragraphs 2.5.15 to 2.5.20.

Table 1: WTG design parameters

Parameter	Project Option 1	Project Option 2	
Maximum blade tip height above LAT	290m	311m Within the aviation restricted zone	316m Outside of the aviation restricted zone
Maximum rotor diameter	250m	276m	276m
Maximum hub height above LAT	165m	173m	178m
Total number of turbines	49	13	22

1.3.3.2. Note that blade tip heights are above Lowest Astronomical Tide (LAT). Radar assessments are based on tip heights above mean sea level (amsl), which is 2.85 metres (m) above LAT. Therefore amsl calculations incorporate an additional height buffer.

1.3.3.3. Proposed WTG layouts for Project Option 1 and Project Option 2 are shown in Figure 1 and Figure 2. Also shown are the proposed locations for an Offshore Substation Platform (OSP) for each project option. The OSP will have a total height above LAT of 67m (including substructure, topside and ancillary elements) and will not have a significant impact on aviation in terms of airspace or radar.

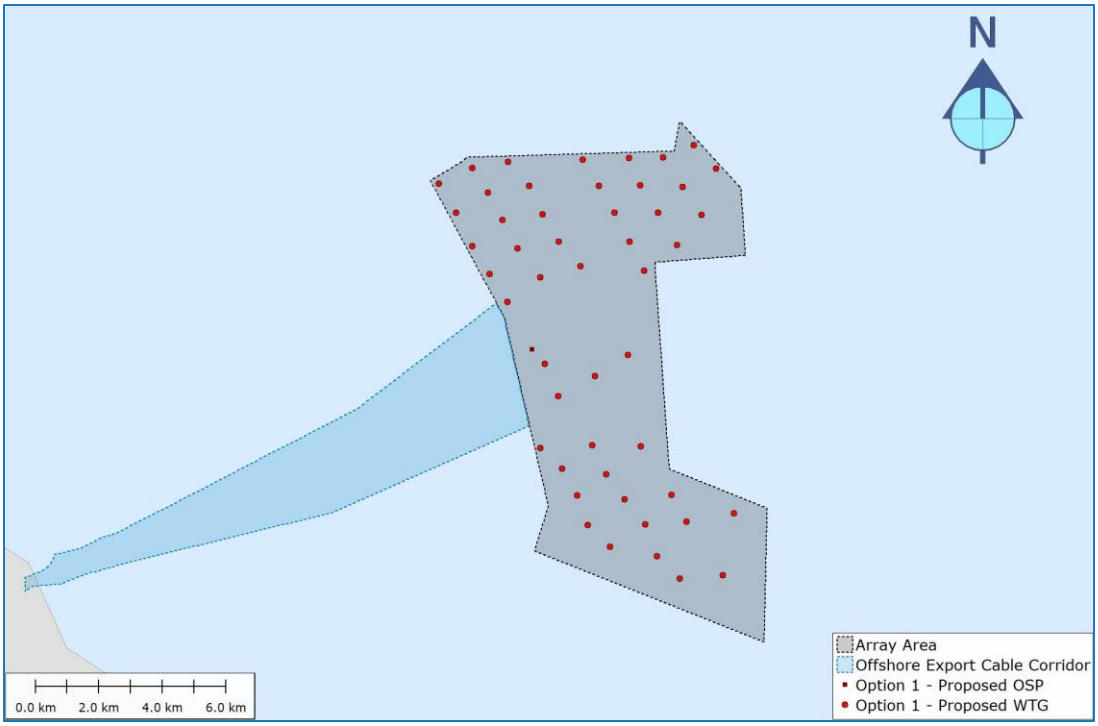

Figure 1: Project Option 1 proposed WTG layout

Figure 2: Project Option 2 proposed WTG layout

1.3.4. Terrain Data

1.3.4.1. Radar Line of Sight (RLoS) modelling is undertaken using Shuttle Radar Topography Mission (SRTM) 1-arc second (30m) resolution digital terrain elevation data.

1.3.5. Analysis Tools

- ATDI HTZ communications V2023.3 release 1488 radio planning tool; and
- Blue Marble Global Mapper V21.1.1 Geographic Information System (GIS).

1.3.6. Mapping Datum

1.3.6.1. Irish Transverse Mercator (IRENET95 datum) is used as a common working datum for all mapping and geodetic references.

1.3.6.2. Where necessary, mapping datum transformations are made using Global Mapper or Grid Inquest II Coordinate Transformation Program.

1.3.6.3. All heights stated in this document are amsl (Newlyn datum) unless otherwise stated.

2. Airspace Analysis

2.1. Introduction

2.1.1. This assessment is a review of potential impacts on aviation within the array area. For the purposes of this assessment a maximum tip height of 1,050 feet (ft) amsl for the WTGs has been assumed, the equivalent of 316m rounded up to the nearest 50ft.

2.1.2. All information has been referenced from the Ireland Integrated Aeronautical Information Package (IAIP), available online from source, and is therefore the latest information available. Additional information has been sourced from IAA and United Kingdom (UK) Civil Aviation Authority (CAA) publications, as appropriate.

2.1.3. The assessment does not draw any conclusions but merely identifies areas of potential impact.

2.2. Scope

2.2.1. The scope of the assessment includes the array area and the surrounding airspace relating to aviation, its use and potential impact. The types of airspace and limitations on its use are identified.

2.3. Airspace Classification

2.3.1. In general, airspace can be characterised as either controlled or uncontrolled airspace. Aircraft in controlled airspace are being positively managed by Air Traffic Control (ATC) the entire time they are within that designated area. This type of airspace is generally used by airlines and corporate aviation. Aircraft in uncontrolled airspace are operating within a framework of rules but are not being controlled by ATC, although many pilots flying in this environment may choose to report their position, altitude, and intentions to ATC to benefit from the enhanced situational awareness that brings. Users of this airspace tend to be small aircraft engaged in training or private (social) flying.

2.3.2. In addition, Special Use Airspace (SUA) is airspace designated for specific activities such that limitations on airspace access may be imposed on other non-participatory aircraft. An example of such airspace will be a Danger Area (DA) established for military flight training.

2.3.3. There are three classes of airspace utilised in Ireland, namely classes A, C and G. Classes A and C are types of controlled airspace, while class G is uncontrolled airspace. Class A is the most strictly regulated controlled airspace whereby aircraft are positively controlled by ATC, compliance with ATC clearance is mandatory, and aircraft are flown and navigated solely with reference to aircraft instruments. Certain onboard equipment is also a prerequisite. Flight in class G airspace is generally visual, meaning pilots fly and navigate with reference to the natural horizon and terrain features they see outside. Pilots are required to maintain minimum distances from notified obstacles, including WTGs, and may only fly within the minimum weather and visibility criteria.

2.4. Aircraft Vertical Reference

2.4.1. An aircraft's vertical reference above the ground or sea can either be an altitude amsl or, above a designated altitude, a Flight Level (FL). An aircraft's altitude, expressed in feet, is based on the last known verified local barometric pressure while a FL, expressed in 100ft increments, is based on a common international barometric pressure setting of 1013.2 hectopascals. With aircraft using a common vertical datum safe separation can be achieved by either ATC or between pilots of different aircraft.

2.4.2. The airspace where vertical reference changes from altitude to FL and vice versa is known as the Transition Layer and consists of a (lower) Transition Altitude and (higher) Transition Level. A Transition Altitude of 5,000ft amsl is specified for each aerodrome in Ireland at which an ATC service is provided.

2.4.3. The vertical limits of airspace are defined in terms of either altitudes or FLs, with airspace commonly having a lower limit expressed as an altitude and an upper limit expressed as a FL.

2.5. Current Civil Aviation Baseline

2.5.1. The array area lies within the Shannon Flight Information Region (FIR), airspace regulated by the IAA. Approximately 22km east of the array area is the boundary between the Shannon FIR and the London FIR, which is regulated by the UK CAA, and approximately 25km north of the array area is the boundary with the Scottish FIR, also regulated by the UK CAA.

2.5.2. The IAA provides en route civil ATS within the Shannon FIR and operates a network of radar facilities at nine sites across Ireland which provide en route information on airborne traffic for both civil and military ATC. There are three such radar facilities at Dublin Airport: Dublin Head 2 and Dublin Head 3 are combined PSR/SSRs while Forrest Little is an SSR only facility.

2.5.3. The Dublin and Shannon Control Areas (CTAs) are established within the Shannon FIR and are defined areas of class C controlled airspace. Dublin CTA airspace consists of a Control Zone (CTR) around the immediate vicinity of Dublin airport with vertical limits from the ground up to 5,000ft amsl. Directly above the CTR is the Dublin CTA which expands outwards with varying lower limits but a common upper limit of FL245 (approximately 24,500ft amsl).

2.5.4. Aircraft within the Dublin CTR will be operating under one of two flight rules: Visual Flight Rules (VFR) or Instrument Flight Rules (IFR). VFR flight is conducted with visual reference to the natural horizon while IFR flight requires reference solely to aircraft instrumentation. IFR traffic will predominate within the CTR, while VFR traffic will be low-level fixed-wing aircraft and helicopters. Under VFR flight the pilot is responsible for maintaining a safe distance from terrain, obstacles and other aircraft. The Dublin CTR and CTA allows flights departing or arriving at peripheral airfields to be accommodated within controlled airspace should they so wish.

2.5.5. Dublin CTA airspace is shown in Figure 3. It can be seen that the offshore development area is outside the Dublin CTR class C controlled airspace, which extends upwards from the surface (SFC). With a maximum tip height of 1,050ft amsl, turbines within the array area will be within class G uncontrolled airspace and below the Dublin CTA.

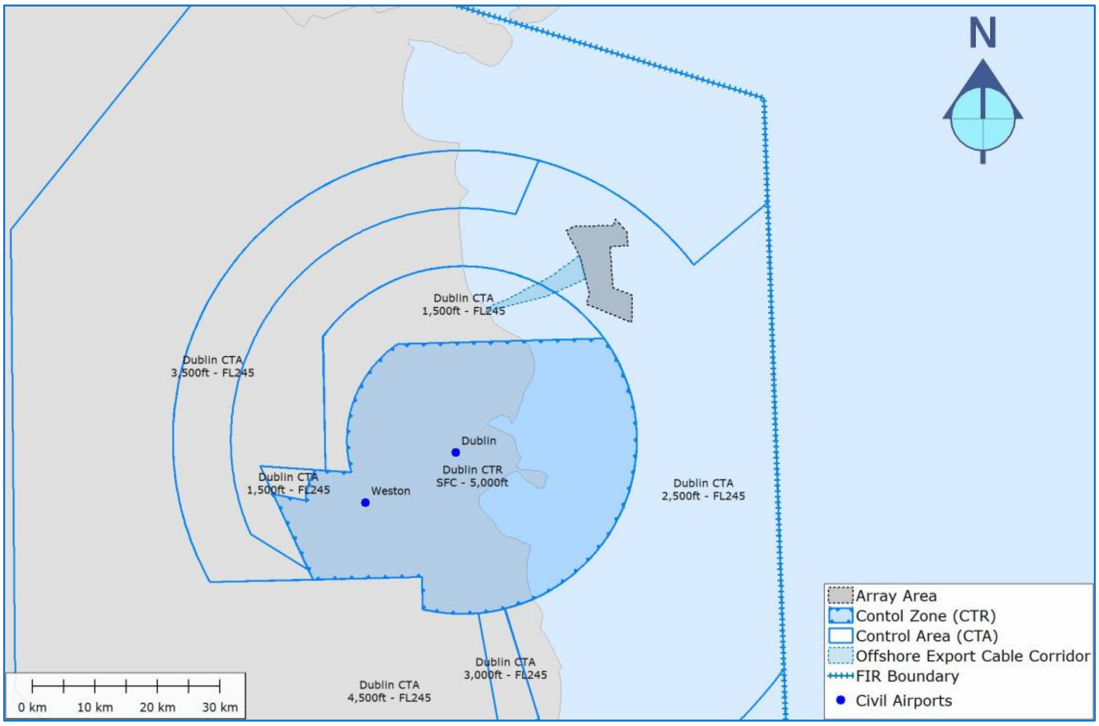

Figure 3: Dublin CTA airspace

2.5.6. Within the airspace associated with Dublin Airport there are multiple Instrument Flight Procedures (IFPs) serving aircraft departing, arriving, and landing at the airport. IFPs are procedures published in the IAIP used by aircraft flying under IFR which are designed to achieve and maintain an acceptable level of safety in operations and keep aircraft clear of all known obstacles. Types of IFPs include Instrument Approach Procedures (IAPs), Standard Instrument Departures (SIDs) and Standard (Instrument) Arrivals (STARs).

2.5.7. Dublin Airport is a busy international airport with parallel east-west runways and a third runway oriented north-south. The parallel runways are designated 10R/28L[2] and 10L/28R, and the third is designated 16/34. Most aircraft departing Dublin will follow SIDs, a series of pre-determined routes starting at the runway and via, for the most part, satellite derived waypoints, route to a 'termination point' outside of Dublin's airspace or on the boundary of the Shannon and London or Scottish FIRs. Most aircraft arriving at Dublin will follow STARs from a point on or near the FIR boundary and, via certain waypoints, route to a point where aircraft can integrate with, or be radar vectored to, an IAP which will allow it to land.

2.5.8. Several of these IFPs pass either directly over or in close proximity to the offshore development area. For example, Figure 4 depicts an extract of a SID chart for runway 28L.

[2] Aircraft landing on runway 28L will be approaching the left hand runway from the east on a heading of approximately 280°.

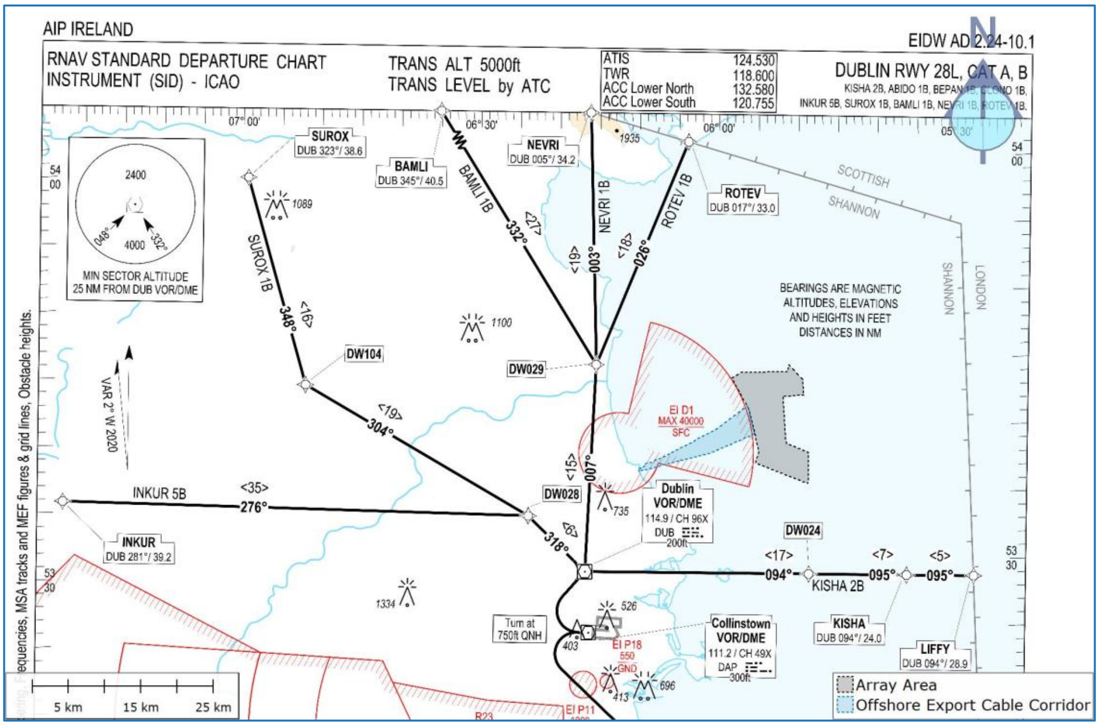

Figure 4: Dublin runway 28L SID chart extract

2.5.9. The SID chart shows that aircraft flying a KISHA 2B departure will pass within 12km south of the array area while climbing to an altitude of 4,000ft, the upper altitude limit at the termination waypoint labelled LIFFY.

2.5.10. The STARs published for Dublin Airport require aircraft to descend to a minimum altitude of 3,000ft for certain arrival routes. This is depicted in Figure 5 which is an extract of a STAR chart for runways 28L and 28R. Dublin Airport's STARs use a Point Merge method for sequencing arrival flows, where approaching aircraft enter Point Merge arcs from which they can turn and fly continuous descents to the runway.

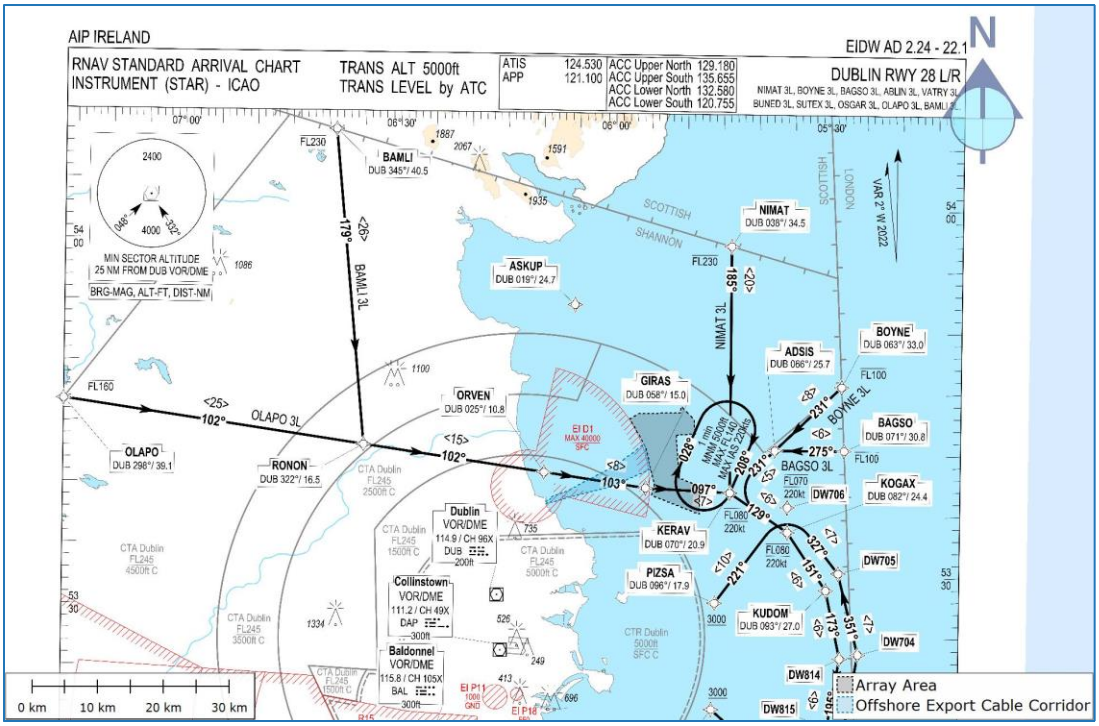

Figure 5: Dublin runway 28L/R STAR chart extract

2.5.11. The STAR chart shows that aircraft inbound from the west will overfly the offshore development area descending to FL80, approximately 8,000ft amsl. Holding procedures, shown as oval shaped routes based around a single waypoint, allow ATC to tactically delay inbound aircraft in order to assist with separating and sequencing aircraft. Figure 5 shows a holding pattern in the vicinity of the array area established around the waypoint KERAV. Aircraft flying this holding pattern are at a minimum altitude of 5,000ft.

2.5.12. An extract from an IAP for runway 28L is depicted in Figure 6. The missed approach path passes within approximately 13km south of the array area. Aircraft following this path will be at an altitude of 3,000ft.

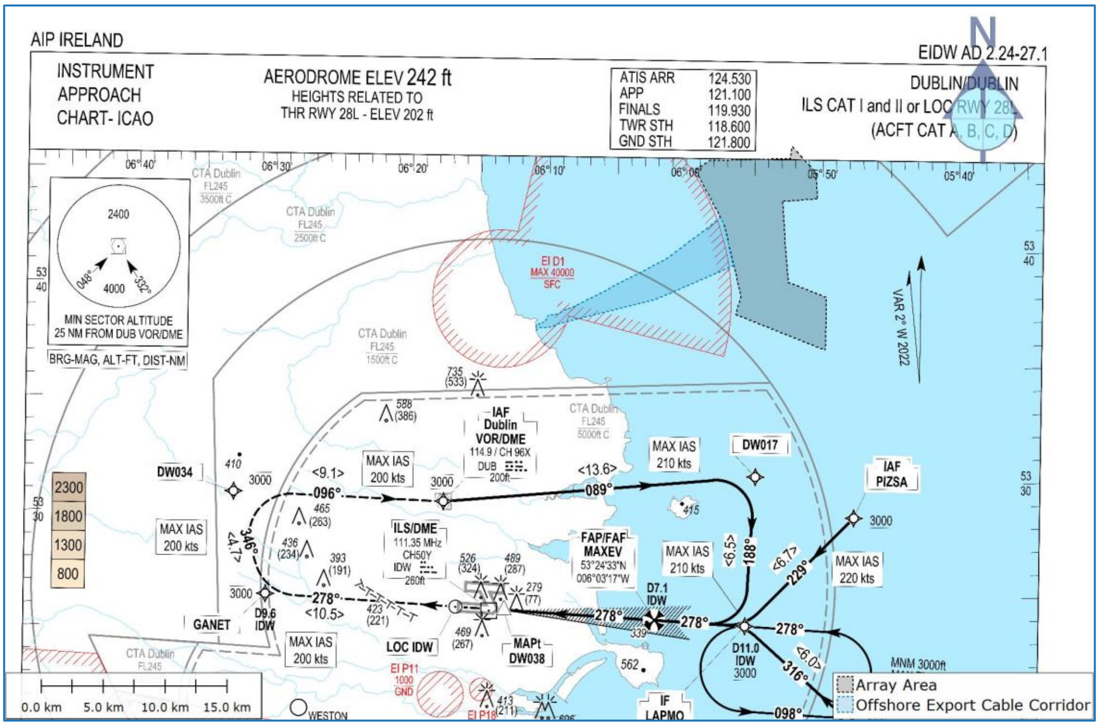

Figure 6: Dublin runway 28L IAP chart extract

2.5.13. All the Dublin IFPs have associated Minimum Sector Altitudes (MSAs) shown in the top left-hand corner of the charts. An MSA defines the minimum safe altitude an aircraft can descend to within a sector of radius 25 nautical miles (nm), approximately 46km. These sectors provide vertical clearance protection from obstacles such as high terrain or tall masts and towers of at least 300m (approximately 1,000ft) to aircraft within that area. This allows pilots of aircraft flying under IFR the reassurance of properly designated obstacle and terrain clearance protection whilst making an approach and landing at an airport in poor weather.

2.5.14. The offshore development area is within a sector where the MSA is 2,400ft amsl. WTGs with a maximum tip height of 1,050ft amsl will be at least 1,350ft below aircraft flying at the published minimum safe altitude.

2.5.15. Also published for Dublin Airport in the IAIP is an ATC Surveillance Minimum Altitude Chart (ATCSMAC), an extract of which is shown in Figure 7. The Dublin ATCSMAC is divided into 14 sectors, each of which has an associated minimum radar vectoring altitude. Vectoring altitudes are the lowest altitude to which a radar controller may issue aircraft altitude clearances during vectoring/direct routing except if authorised for radar approaches, departures and missed approaches. The minimum vectoring altitude in each sector provides 300m (approximately 1,000ft) clearance above the highest known obstacle, similarly to an MSA.

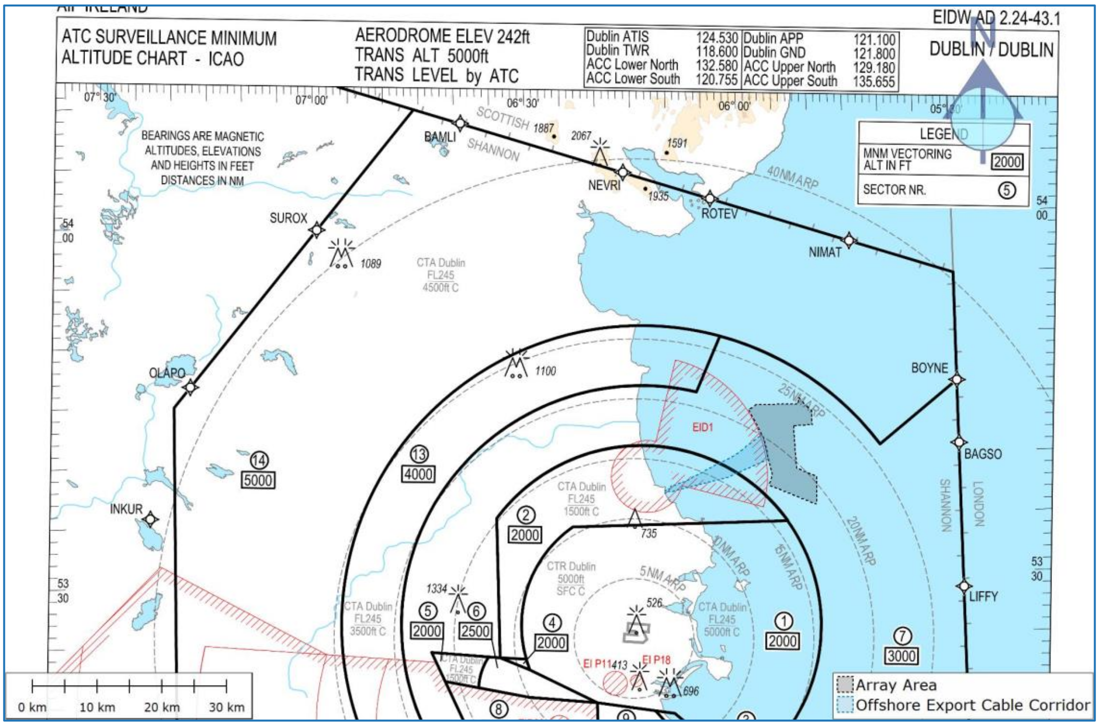

Figure 7: Dublin ATCSMAC

2.5.16. Figure 7 shows that the ECC is within sectors 2 and 7, and the array area is within sector 7. Sectors 2 and 7 have minimum vectoring altitudes of 2,000ft (610m) and 3,000ft (915m) respectively. WTGs with a tip height of 316m amsl will not infringe the required 300m obstacle clearance in sector 7.

2.5.17. When validating minimum altitudes against the highest known obstacles, a buffer of either 3nm (5.6km) or 5nm (9.3km) is applied beyond each sector boundary. Standard approach radar control separation between aircraft is 5nm, but a reduction in separation to 3nm is permitted within airspace at busy airports to increase airport efficiency and capacity. This reduction in separation is applied in the airspace in the vicinity of Dublin Airport, so it is assumed that a 3nm buffer is applied to the ATCSMAC sectors.

2.5.18. Figure 8 shows the ATCSMAC sectors with 3nm buffers around sectors 1 and 2 which both have minimum vectoring altitudes of 2,000ft (610m). The array area is within the 3nm buffers around sectors 1 and 2, therefore WTGs with a tip height of 316m amsl will infringe the required 300m obstacle clearance in these buffer areas.

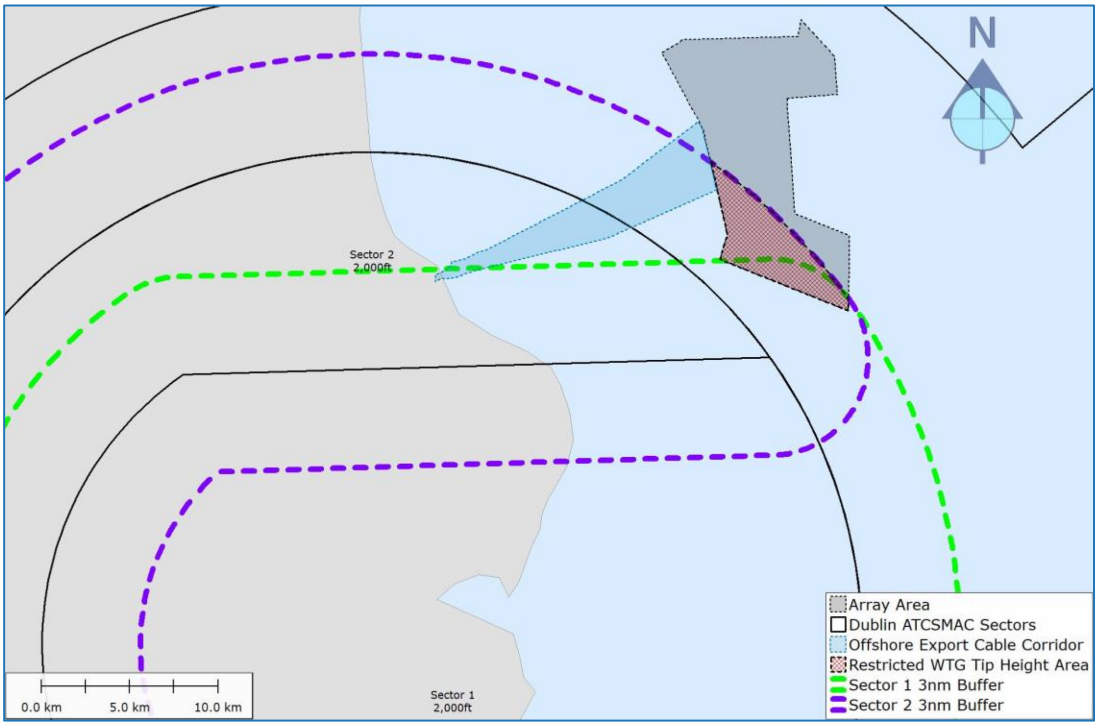

Figure 8: ATCSMAC sectors 1 and 2 with 3nm buffers

2.5.19. The total area where WTGs with a tip height of 316m amsl will infringe the minimum required obstacle clearance is shown as a red cross-hatched area in Figure 8.

2.5.20. Figure 9 shows that 10 WTGs are within the aviation restricted area and 3 are on the border (the Limit of Deviation of 500m overlaps). Therefore potentially 13 WTGs within the Project Option 2 proposed WTG layout will be within the restricted tip height area. As part of the proposed development design, WTGs within this area will have a lowered tip height of 311m above LAT, or 308.15m amsl, so that the minimum required obstacle clearance for sectors 1 and 2 is not infringed.

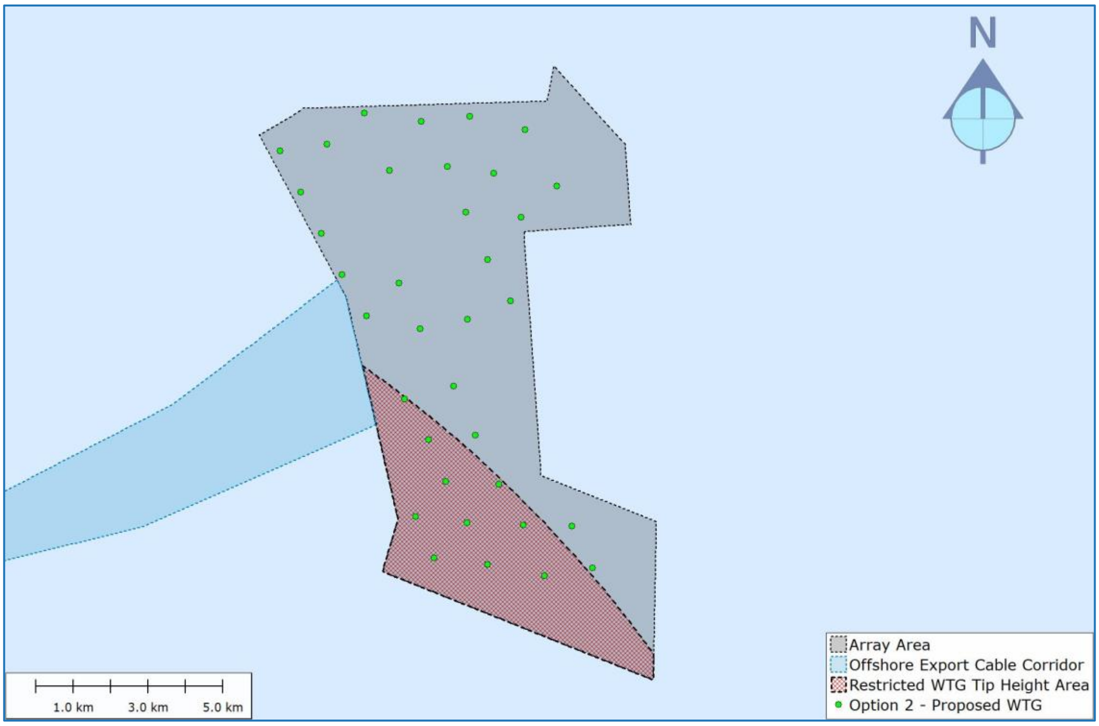

Figure 9: Project Option 2 proposed WTG layout

2.5.21. There are several airfields around the Dublin area serving General Aviation (GA). This is a wide-ranging field of aviation varying from private pleasure flights to commercial charter and corporate aviation. Low altitude helicopter operations also cater for a variety of roles from charter and aerial work to emergency medical service flights.

2.5.22. GA airfields identified in County Meath and Fingal include:

- Ballyboughal Airfield, approximately 24km from the array area;
- Weston Airport, approximately 47km from the array area;
- Trim Aerodrome, approximately 53km from the array area; and
- Athboy Aerodrome, approximately 60km from the array area.

2.5.23. None of these airfields have associated IFPs or radar facilities.

2.5.24. Other large or busy airports catering to commercial air traffic are:

- Belfast City Airport, approximately 97km from the array area;
- Belfast Aldergrove Airport, approximately 103km from the array area; and
- Isle of Man Airport, approximately 89km from the array area.

2.5.25. The nearest busy commercial airport on the UK mainland is Liverpool Airport, approximately 200km to the east.

2.6. Current Military Aviation Baseline

2.6.1. SUA in the form of the Gormanston Danger Area EID1 lies over the western extent of the offshore development area, as depicted in Figure 10.

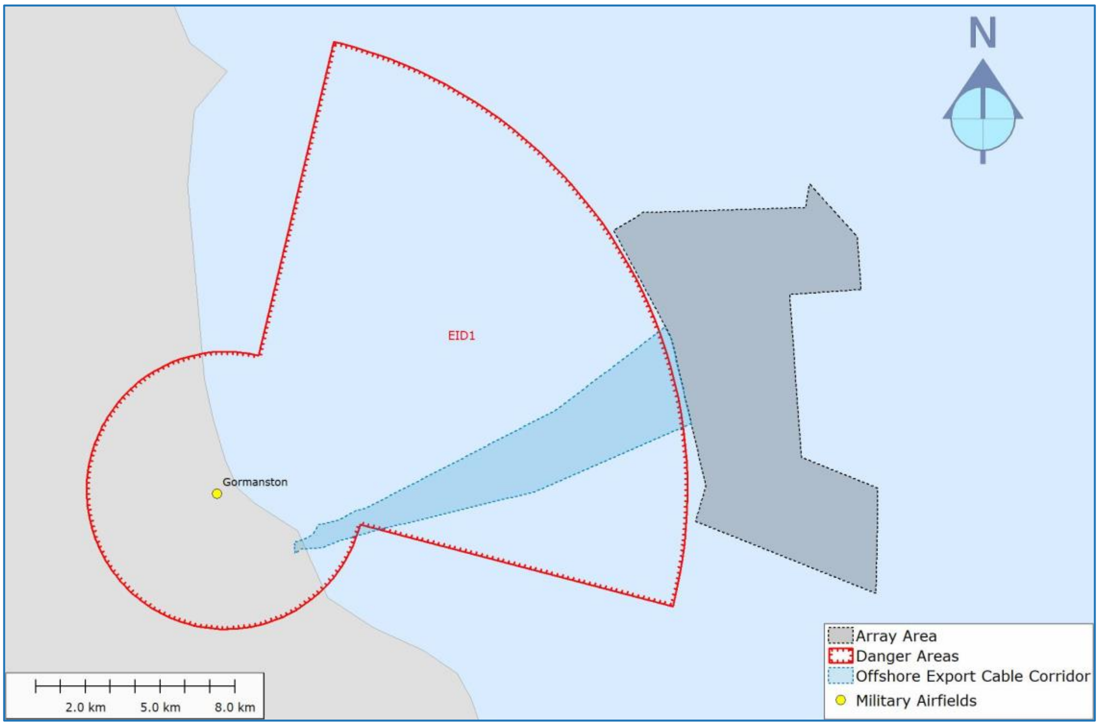

Figure 10: Gormanston Danger Area EID1

2.6.2. The airspace, which extends vertically from the surface up to 40,000ft amsl, is used by the Irish Air Corps (IAC) as a firing range at times and dates notified by the Department of Defence. Firing range activities include air-to-air and air-to-ground firing, using rockets and heavy machine guns.

2.6.3. Pilots and Air Traffic Service Units will be informed by NOTAM[3] about the operational status of the airspace at the time of their flight in the vicinity.

2.6.4. The lateral extent of EID1 is infringed by most of the ECC, but the array area is beyond EID1 to the east. WTGs sited close to the western boundary of the array area may affect the ability of military aircraft to establish on required profiles or flight paths to training targets at the military base at Gormanston.

2.6.5. Although officially closed from 2002, Gormanston Aerodrome is in continuous use by the IAC for air operations and live firing. There are two operational radio navigation aids installed at the airfield, a Non-Directional Beacon (NDB) and a Distance Measuring Equipment (DME) facility.

2.6.6. An NDB is a radio transmitter that enables suitably equipped aircraft to establish their relative bearing to and from the beacon.

2.6.7. A DME provides the pilot of an aircraft with a direct and continuous visual indication of the distance between the DME antenna and the aircraft.

[3] A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

2.6.8. In order to protect navigation aid signals, safeguarded areas are established around the facility sites. The purpose of the safeguarded area is to identify obstacles with the potential for causing unacceptable interference to the signals. Structures that infringe the safeguarded area must undergo technical assessments to determine the degree of potential interference, if any, and whether the interference will be acceptable to the Air Navigation Service Provider (ANSP).

2.6.9. In Ireland, the safeguarding process is based upon the application of the International Civil Aviation Organisation (ICAO) document EUR DOC 015 European Guidance Material on Managing Building Restricted Areas (ICAO, 2015). The document defines Building Restricted Area (BRA) shapes for both directional and omni-directional navigation aid facilities.

2.6.10. NDBs and DMEs are omni-directional facilities. The omni-directional BRA shape as depicted in EUR DOC 015 Figures 2.1 and 2.2 is reproduced in Figure 11.

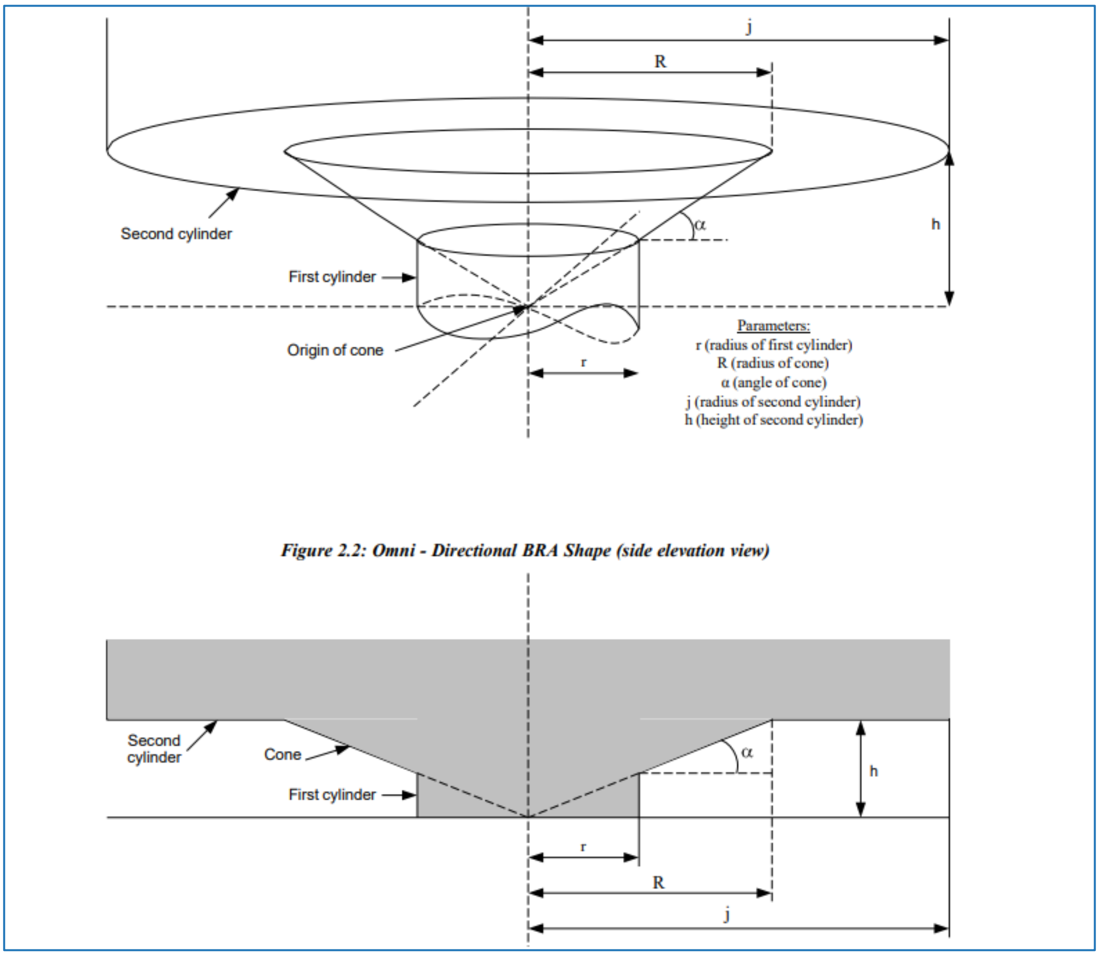

Figure 11: EUR DOC 015 Figures 2.1 and 2.2 – Omni-directional BRA shape

2.6.11. Applicable dimensions to be applied for various omni-directional navigation aids are reproduced in Figure 12.

*Type of **navigation** facilities*	*Radius (r – Cylinder) (m)*	*Alpha (a – cone) (°)*	*Radius (R- Cone) (m)*	*Radius (j – Cylinder) (m) Wind turbine(s) only*	*Height of cylinder j (h -height) (m) Wind turbine(s) only*	*Origin of cone and axis of cylinders*
DME N	300	1.0	3000	N/A	N/A	Base of antenna at ground level
CVOR	600	1.0	3000	15000	52	Centre of antenna system at ground level
DVOR	600	1.0	3000	10000	52	Centre of antenna system at ground level
Direction Finder (DF)	500	1.0	3000	10000	52	Base of antenna at ground level
Markers	50	20.0	200	N/A	N/A	Base of antenna at ground level
NDB	200	5.0	1000	N/A	N/A	Base of antenna at ground level

Figure 12: EUR DOC 015 Table 1 (extract) – Harmonised guidance figures for omni-directional facilities

2.6.12. Figure 13 shows the locations of the Gormanston NDB and DME with their respective BRA shapes.

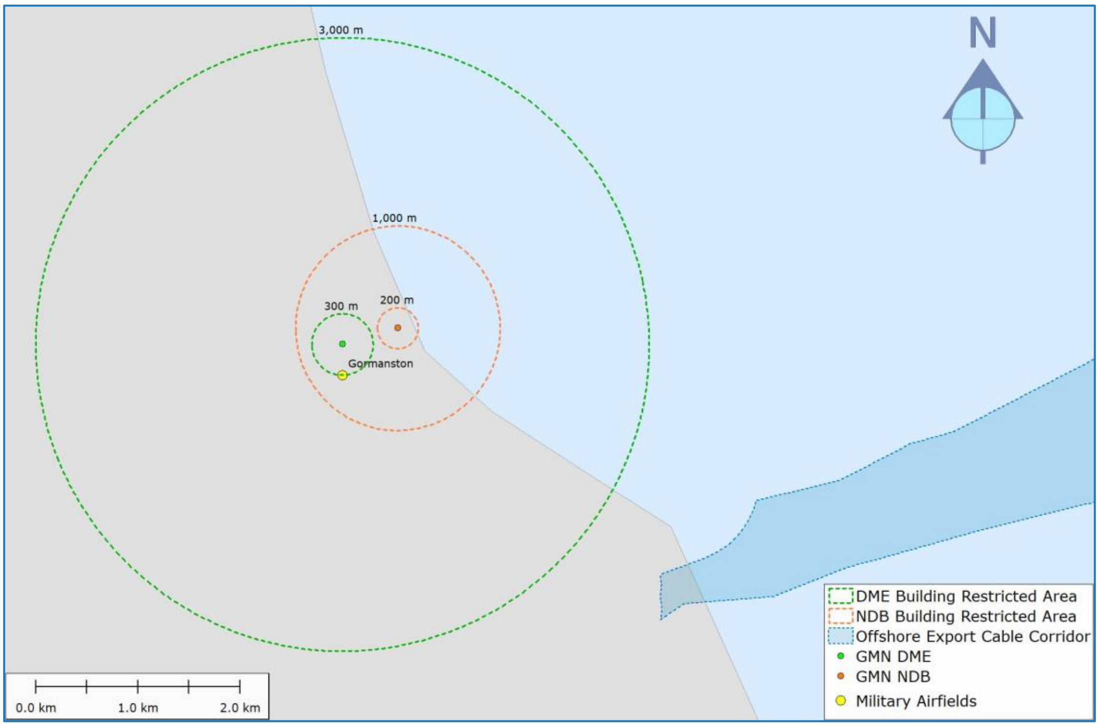

Figure 13: Gormanston NDB and DME safeguarded areas

2.6.13. The NDB and DME safeguarded areas are not infringed by the offshore development area.

2.6.14. Approximately 50km south-west of the array area is the military airbase known as Casement Aerodrome. It is the headquarters of the IAC. Aircraft based at Casement Aerodrome include various fixed-wing and rotary-wing types. These are used for training as well as in military and civil defence roles. The Garda Air Support Unit is also based at Casement.

2.6.15. Casement Aerodrome has specific airspace designated for any flight training required by the IAC or related services. These are named Military Operating Areas 3, 4 and 5 and are south-west of the aerodrome.

2.6.16. Casement Aerodrome has published IFPs for departures from and approaches to the aerodrome. An extract from the IAP for runway 22 is depicted in Figure 14.

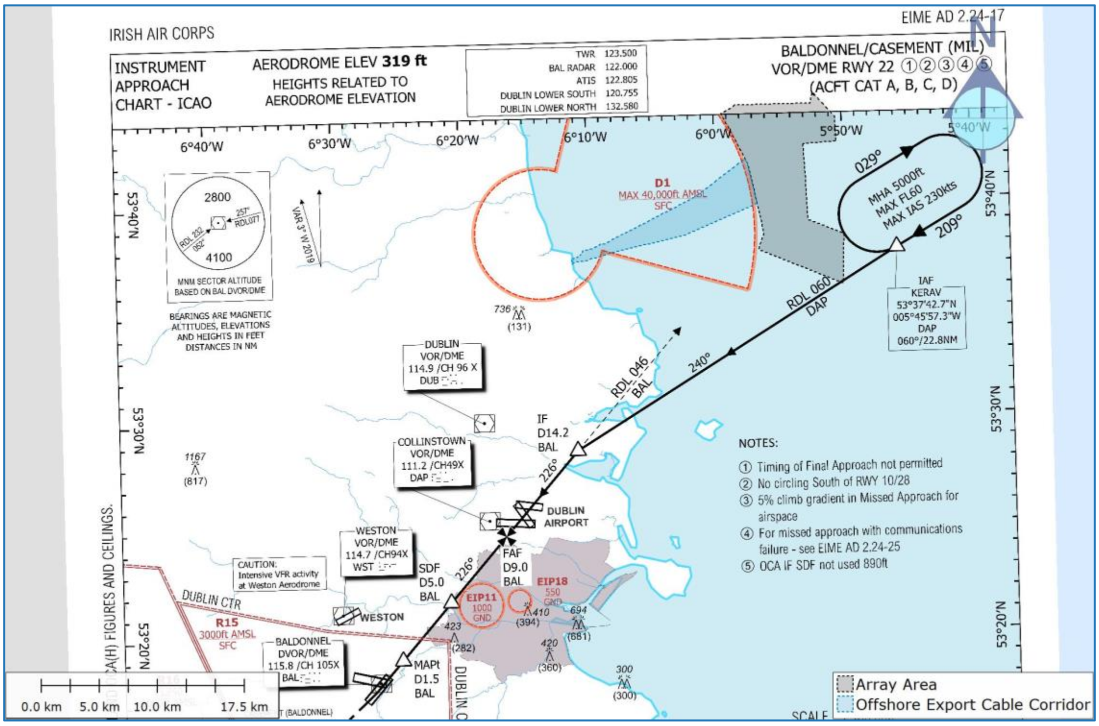

Figure 14: Casement runway 22 IAP chart extract

2.6.17. Figure 14 shows that aircraft flying from the Initial Approach Fix (IAF) at waypoint KERAV to the Intermediate Approach Fix (IF) will cross the south-eastern corner of the array area. Aircraft flying this leg of the IAP will be descending from an altitude of 5,000ft to achieve 3,000ft amsl at the IF.

3. Radar Line of Sight Assessment

3.1. Methodology

3.1.1. RLoS is determined by use of a radar propagation model (ATDI HTZ communications) using 3D Digital Terrain Model (DTM) data (SRTM) with 30m horizontal resolution. Radar data is entered into the model and RLoS to the WTGs from each radar is calculated.

3.1.2. Note that by using a DTM no account is taken of possible further shielding of the WTGs due to the presence of structures or vegetation that may lie between the radar and the WTGs. Thus, the RLoS assessment is a worst-case result.

3.1.3. For PSR the principal source of adverse wind farm effects are the WTG blades, so RLoS is calculated for the maximum blade tip height of the WTGs, i.e. 316m amsl.

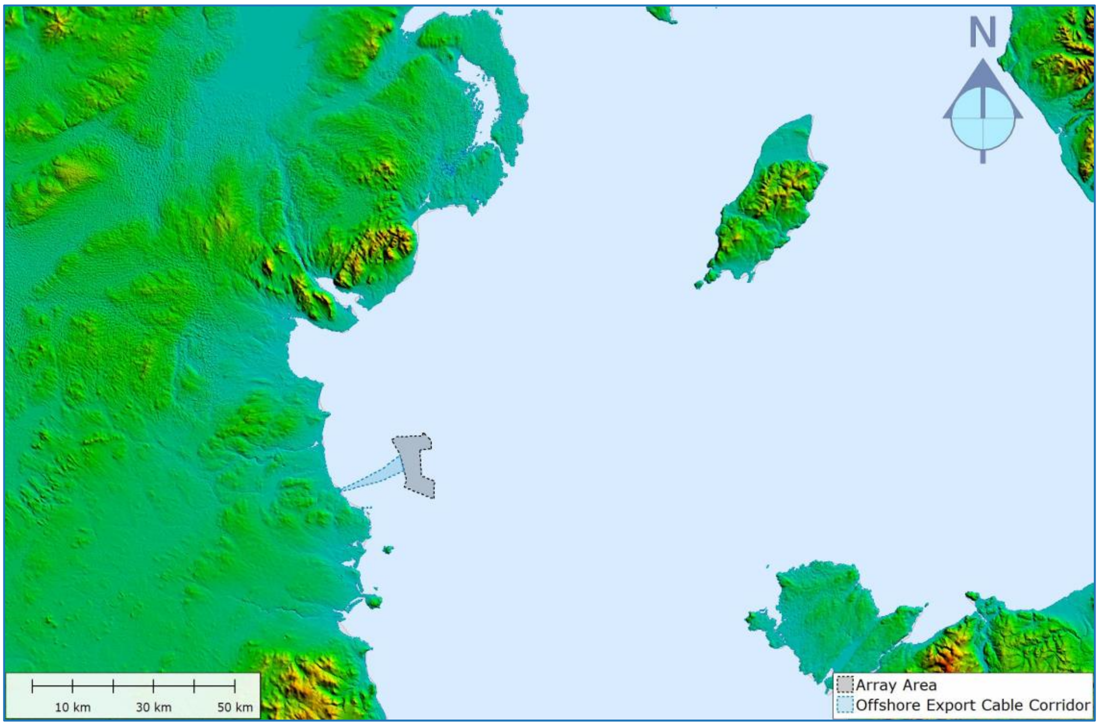

Figure 15: 30m DTM used for RLoS modelling

3.2. Licensed airfields with surveillance radar

3.2.1. The closest radar equipped airfield to the array area is Dublin Airport, 31.6km to the south-west. The next nearest such airfields are Isle of Man Airport, 89.2km to the north-east, Belfast City Airport, 96.6km north, and Be lfast Aldergrove Airport, 103.2km north of the array area.

3.2.2. Dublin

3.2.2.1. Dublin Airport has three radar sites: Dublin Head 2 and Dublin Head 3 are combined PSR/SSRs while Forrest Little is an SSR only facility.

3.2.2.2. Dublin Head 2 RLoS coverages for blade tip heights of 290m and 316m amsl are shown in Figure 16.

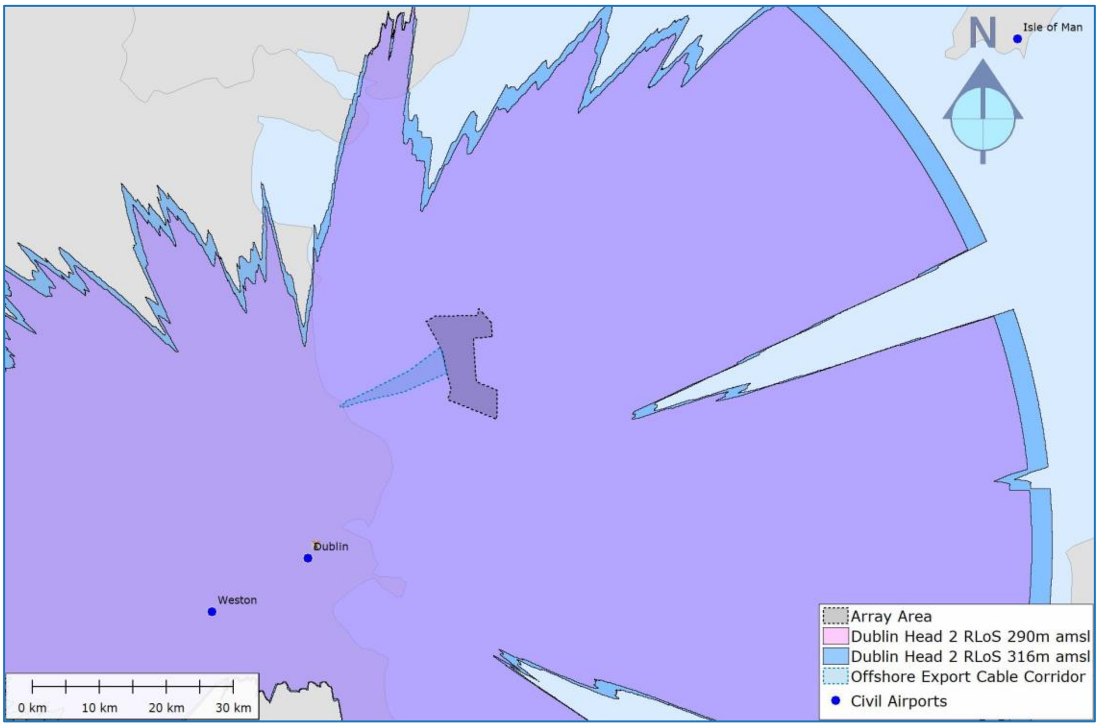

Figure 16: Dublin Head 2 RLoS coverages

3.2.2.3. All WTGs within the array area will be in RLoS of the Dublin Head 2 PSR/SSR and highly likely to be detected, irrespective of blade tip height. The Forrest Little SSR facility is sited in close proximity to Dublin Head 2 and will have similar coverage over the offshore development area.

3.2.2.4. Dublin Head 3 RLoS coverages for blade tip heights of 290m and 316m amsl are shown in Figure 17.

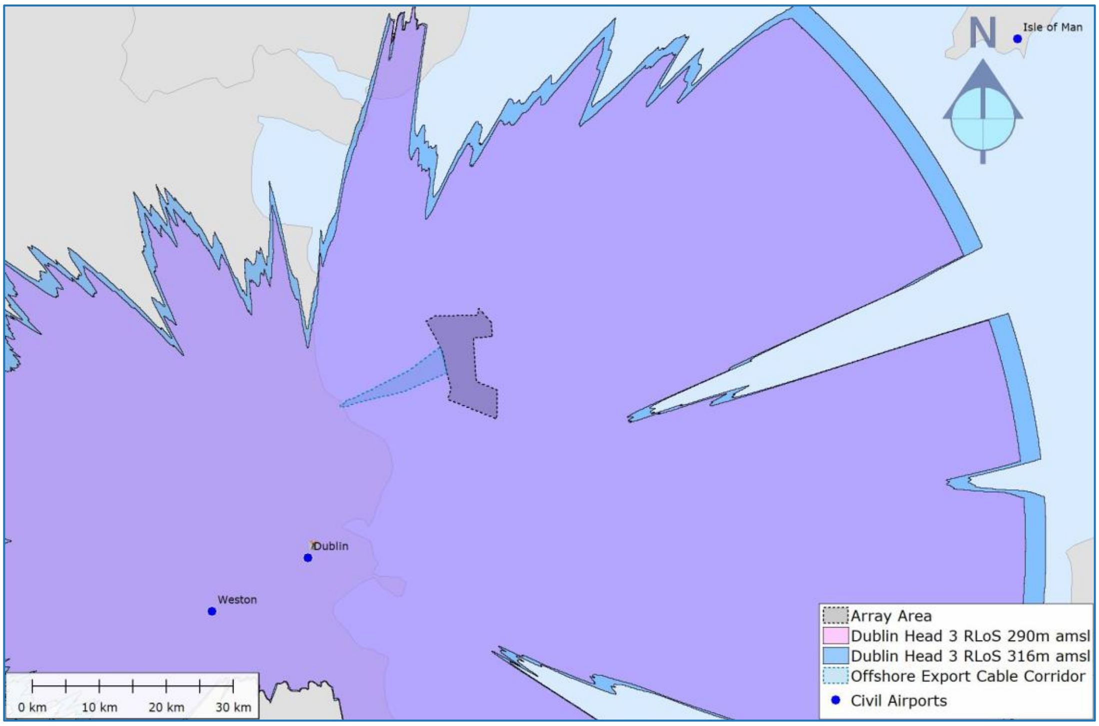

Figure 17: Dublin Head 3 RLoS coverages

3.2.2.5. All WTGs within the array area will be in RLoS of the Dublin Head 3 PSR/SSR and highly likely to be detected, irrespective of blade tip height.

3.2.3. Isle of Man

3.2.3.1. Isle of Man RLoS coverages for blade tip heights of 290m and 316m amsl are shown in Figure 18.

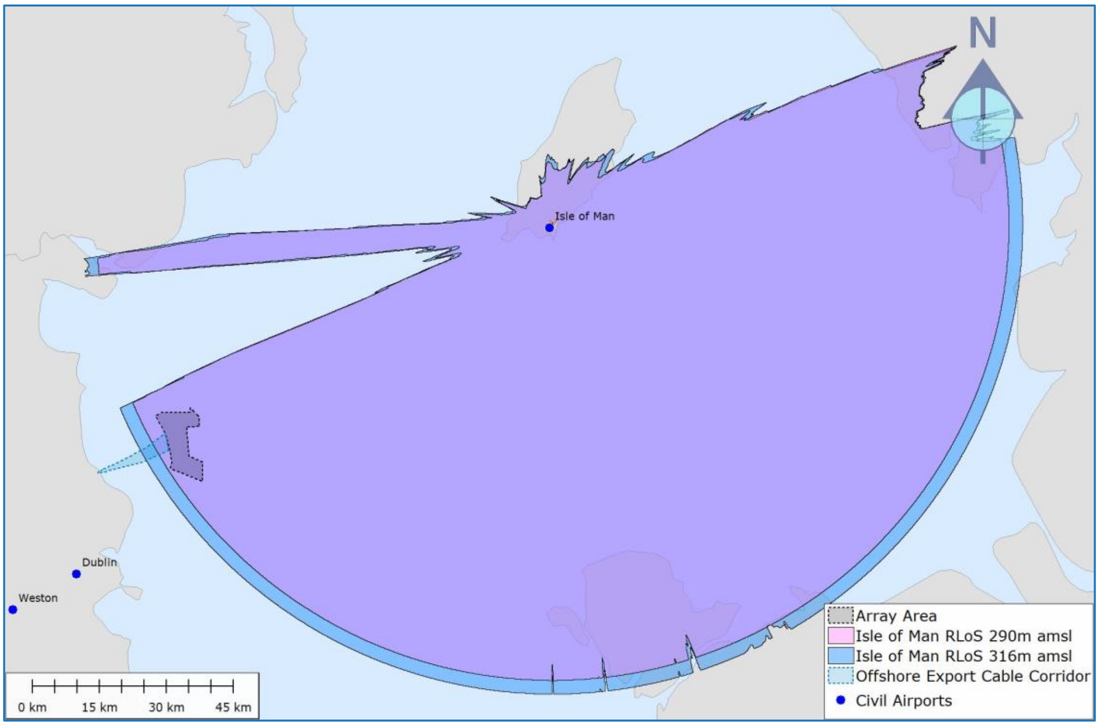

Figure 18: Isle of Man RLoS coverages

3.2.3.2. All WTGs within the array area will be in RLoS of the Isle of Man PSR and highly likely to be detected, irrespective of blade tip height.

3.2.3.3. It is understood that the PSR is only used operationally to a range of 30nm (55.6km), so it is considered unlikely that Isle of Man ATC will be providing a radar control service for aircraft in the vicinity of the offshore development area. The impact on Isle of Man PSR is therefore not considered to be operationally significant, and this has been confirmed through consultation with the stakeholder.

3.2.4. Belfast City

3.2.4.1. Belfast City RLoS coverage for a blade tip height of 316m amsl is shown in Figure 19.

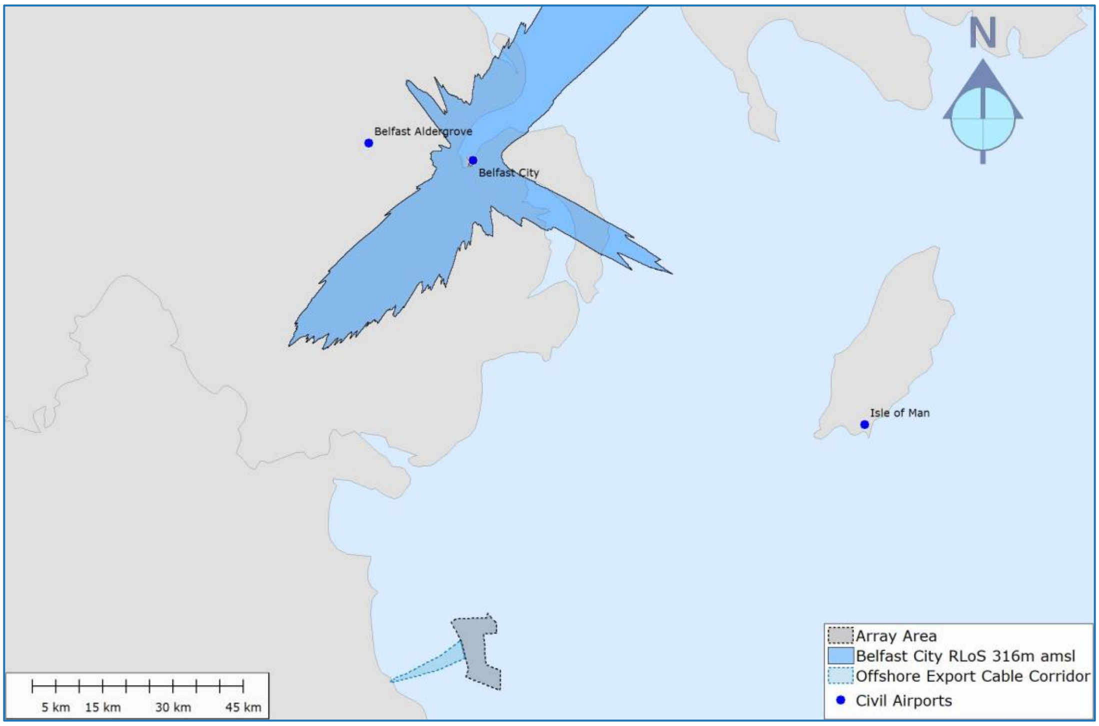

Figure 19: Belfast City RLoS coverage

3.2.4.2. No WTGs within the array area will be in RLoS of the Belfast City PSR, irrespective of blade tip height. It is highly unlikely that WTGs with a maximum blade tip height of 316m amsl will be detected by the Belfast City PSR.

3.2.5. Belfast Aldergrove

3.2.5.1. Belfast Aldergrove RLoS coverage for a blade tip height of 316m amsl is shown in Figure 20.

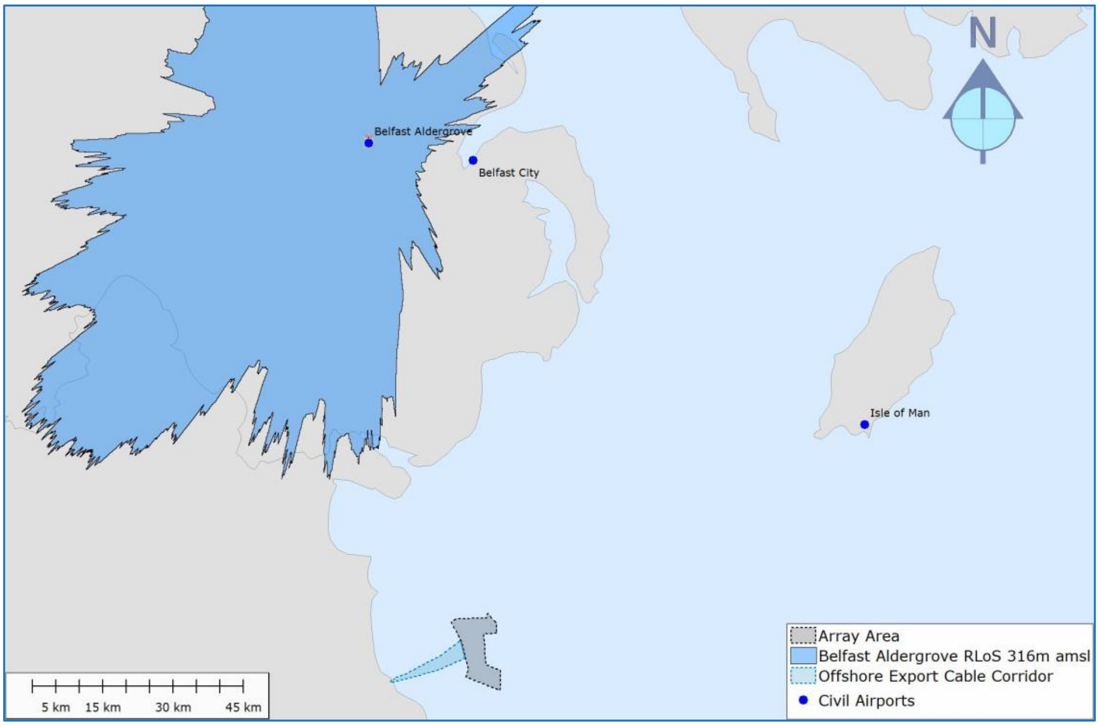

Figure 20: Belfast Aldergrove RLoS coverage

3.2.5.2. No WTGs within the array area will be in RLoS of the Belfast Aldergrove PSR, irrespective of blade tip height. It is highly unlikely that WTGs with a maximum blade tip height of 316m amsl will be detected by the Belfast Aldergrove PSR.

3.3. Military airfields with surveillance radar

3.3.1. The closest radar equipped military airfield to the array area is Casement Aerodrome, 49.7km to the south-west. The next nearest is Royal Air Force Valley on the UK mainland, 95.1km to the south-east.

3.3.2. Casement

3.3.2.1. Casement RLoS coverages for blade tip heights of 290m and 316m amsl are shown in Figure 21.

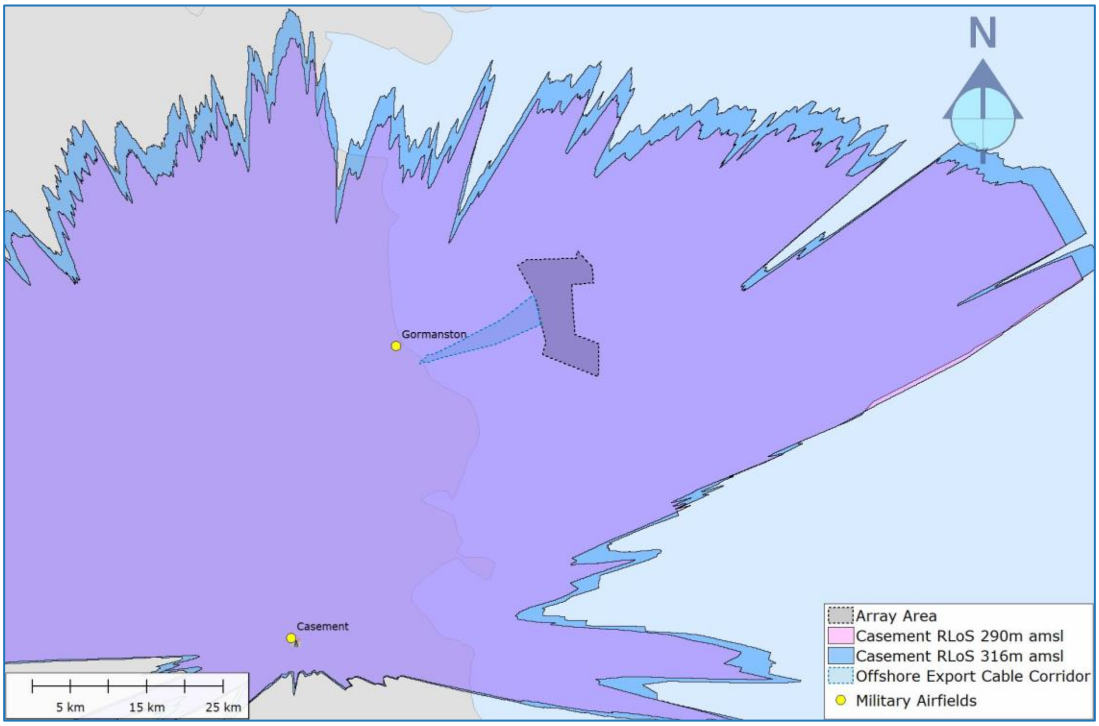

Figure 21: Casement RLoS coverages

3.3.2.2. All WTGs within the array area will be in RLoS of the Casement PSR and highly likely to be detected, irrespective of blade tip height.

3.3.2.3. Casement Aerodrome has published a radar vectoring chart, an extract of which is depicted in Figure 22.

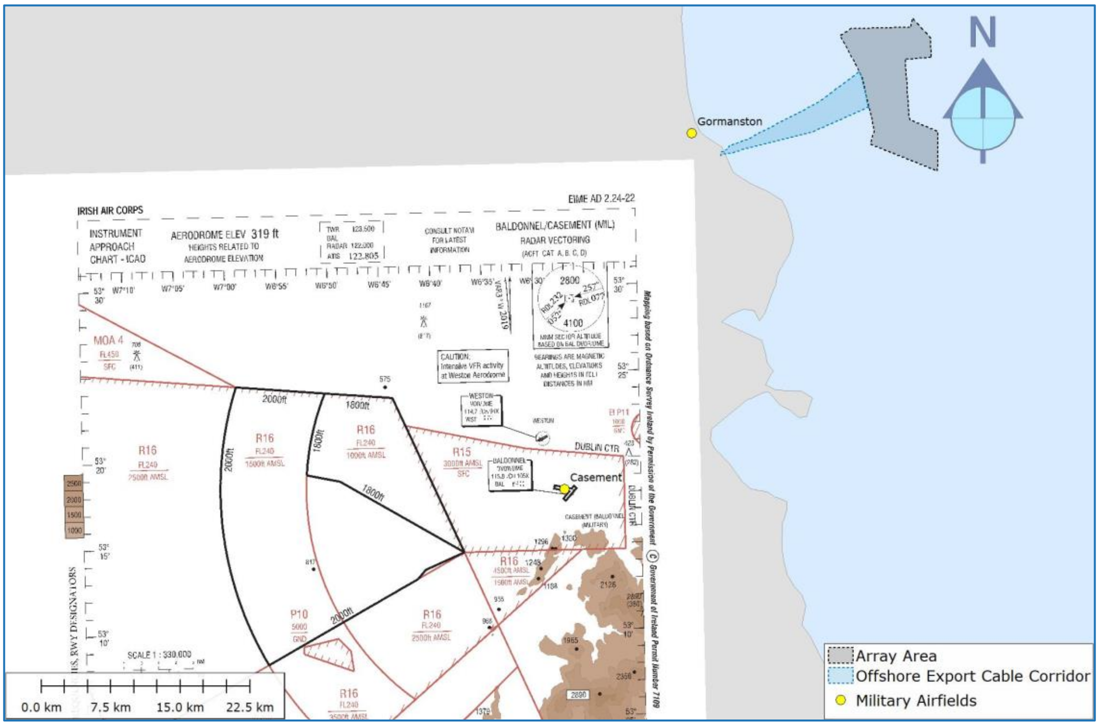

Figure 22: Casement radar vectoring chart extract

3.3.2.4. Figure 22 shows that radar vectoring is used predominantly to the south-west of Casement Aerodrome and not in the vicinity of the offshore development area. It appears that the offshore development area is not in an operationally significant location for Casement ATC, however this requires confirmation through stakeholder consultation.

3.3.3. Valley

3.3.3.1. Valley RLoS coverage for a blade tip height of 316m amsl is shown in Figure 23.

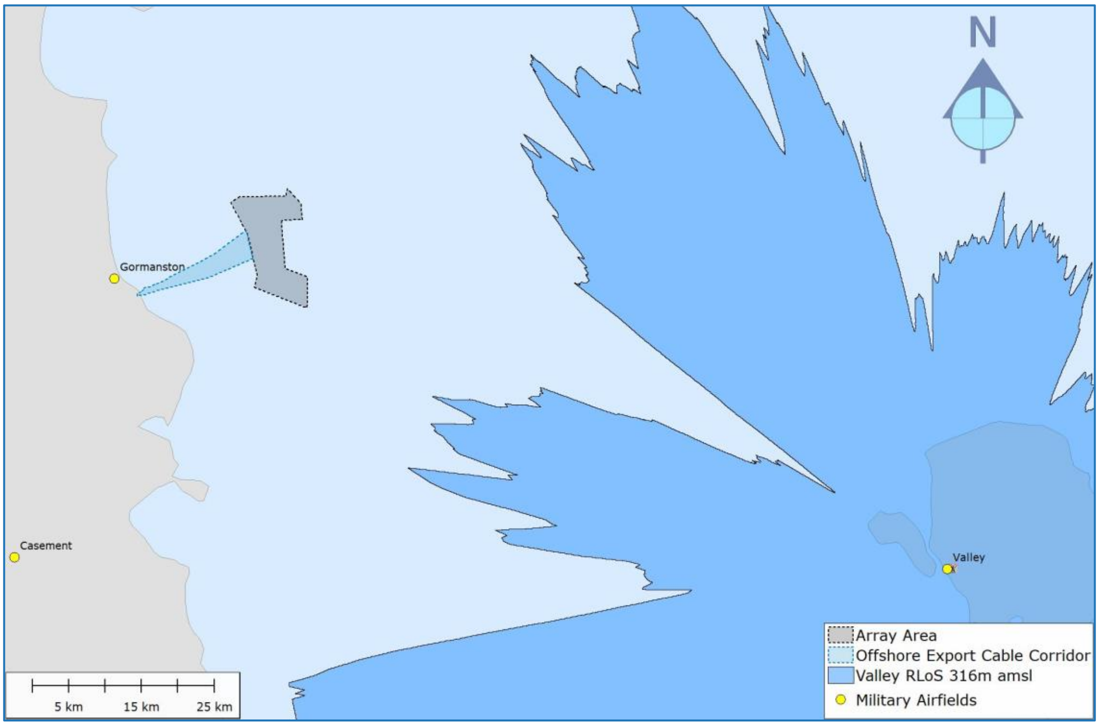

Figure 23: Valley RLoS coverage

3.3.3.2. No WTGs within the array area will be in RLoS of the Valley PSR, irrespective of blade tip height. It is highly unlikely that WTGs with a maximum blade tip height of 316m amsl will be detected by the Valley PSR.

3.4. Weather radar

3.4.1. WTGs can have an adverse impact on weather radars, as detailed in the OPERA[4] (Operational Programme for the Exchange of Weather Radar Information) document Impact Study of Radar Observations by Wind Turbines (OPERA, 2010). The three main impacts are beam blocking and reflections causing clutter and impact on Doppler data and wind fields measurements. The study recommends impact studies for wind farm projects that are within 20km of C-band weather radars.

[4] OPERA is the Radar Programme of EUMETNET (European Meteorological Services Network).

3.4.2. There are currently two C-band weather radars in Ireland, located at Dublin Airport and Shannon Airport. The Dublin weather radar is approximately 29.8km south-west of the NISA array area.

3.4.3. RLoS coverages for Dublin weather radar at blade tip heights of 290m and 316m amsl are shown in Figure 24.

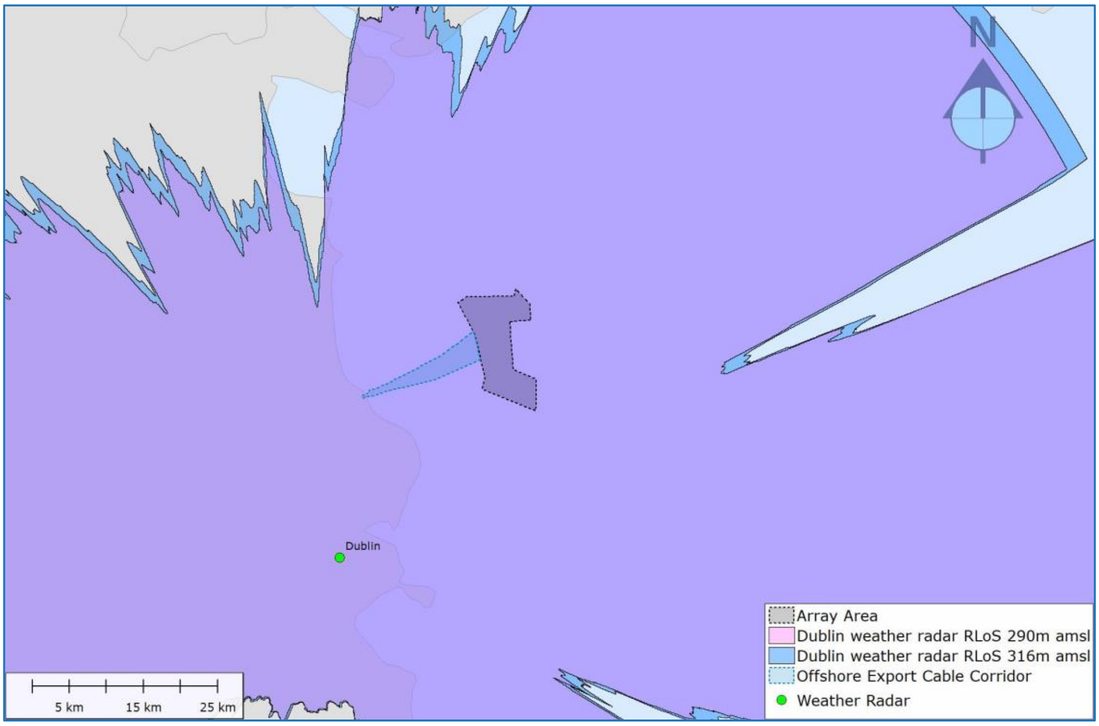

Figure 24: Dublin weather radar RLoS coverages

3.4.3.1. All WTGs within the array area will be in RLoS of the Dublin weather radar and highly likely to be detected, irrespective of blade tip height; however, as the array area is more than 20km from the radar and as such an impact study is not required.

3.4.4. A new OPERA report On the Coexistence of Weather Radars and Wind Turbines (OPERA, 2022) recommends continuing to follow the 2010 guidelines until new international guidelines are in place.

This Page Is Intentionally Blank