RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Environmental Statement

Volume 7

Appendix 15-2 Airspace Analysis and Radar Modelling

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Environmental Statement Volume 7, Appendix 15-2 Airspace Analysis and Radar Modelling

Dogger Bank South Offshore Wind Farms

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V1.0	Initial Issue	21 November 2023	Initial Issue

Abbreviations

AARA	Air to Air Refuelling Area
AD	Air Defence
AD&OW	Air Defence and Offshore Wind
AIP	Aeronautical Information Publication
amsl	above mean sea level
ATC	Air Traffic Control
ATS	Air Traffic Service
BEIS	Department for Business, Energy and Industrial Strategy
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
DA	Danger Area
DASA	Defence and Security Accelerator
DBS	Dogger Bank South
DESNZ	Department for Energy Security and Net Zero
DOC	Designated Operational Coverage
DTM	Digital Terrain Model
EIA	Environmental Impact Assessment
FIR	Flight Information Region
FL	Flight Level
ft	feet
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
HMRI	Helicopter Main Routing Indicator
HTZ	Helicopter Traffic Zone
IFR	Instrument Flight Rules
km	kilometres
LARS	Lower Airspace Radar Service
m	metres
MDA	Managed Danger Area
MHWS	Mean High Water Springs
MOD	Ministry of Defence
NERL	NATS (En Route) plc

nm	nautical miles
PEIR	Preliminary Environmental Information Report
PSR	Primary Surveillance Radar
RAF	Royal Air Force
RLoS	Radar Line of Sight
RRH	Remote Radar Head
S&IP	Strategy and Implementation Plan
SAR	Search and Rescue
SUA	Special Use Airspace
TRA	Temporary Reserved Area
UK	United Kingdom
VFR	Visual Flight Rules

References

[1] Dogger Bank South Offshore Wind Farms Environmental Impact Assessment Scoping Report Revision 02 (RWE, 2022)

[2] CAP 032 UK Aeronautical Information Publication (CAA, 2023)

[3] CAP 764 Policy and Guidelines on Wind Turbines (CAA, 2016)

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1. Introduction

1.1. Overview

1.1.1. This document is an appendix to **Volume 7, Chapter 15 Aviation and Radar (application ref: 7.15.0)** of the Dogger Bank South (DBS) Offshore Wind Farms Environmental Statement (ES). It provides detailed airspace analysis and radar modelling and outlines potential mitigation options.

1.1.2. The Projects include two array areas separated by an inter-platform cabling area. The DBS East Array Area is approximately 349 square kilometres (km^2) and lies approximately 128km from the coast and the DBS West Array Area is approximately 355km^2 and lies approximately 106km from the coast.

1.2. Effects of Wind Turbines on Aviation

1.2.1. Wind turbines can be problematic for aviation Primary Surveillance Radars (PSRs) as the characteristics of a moving wind turbine blade are like an aircraft. The PSR is unable to differentiate between wanted aircraft targets and clutter targets introduced by the presence of wind turbines.

1.2.2. Potential impacts of the DBS development on the Ministry of Defence (MOD) Air Defence (AD) PSR at Staxton Wold were identified at the Scoping stage (see Scoping Report, section 2.11.3).

1.2.3. 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.

1.2.4. 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.

1.3. Technical Data

1.3.1. Radar Data

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

1.3.2. ES Offshore Development Area

1.3.2.1. The offshore development area boundary for the ES was supplied as a geo-referenced Shapefile:

- PC2340_RWE_OF_ZZ_M2_Z_0465_ES_Offshore_Development_Area.shp.

1.3.2.2. The offshore development area boundary incorporates the following:

- The DBS East and DBS West Array Areas;
- An inter-platform cabling area;
- A 1km temporary construction buffer zone around each array and inter-platform cabling area; and
- A 2km wide offshore export cable corridor, which includes a 500 metre (m) temporary construction buffer either side of the 1km central corridor within which cable burial is proposed to occur.

1.3.2.3. The offshore development area boundary and the boundaries of the DBS Array Areas are depicted in Figure 1.

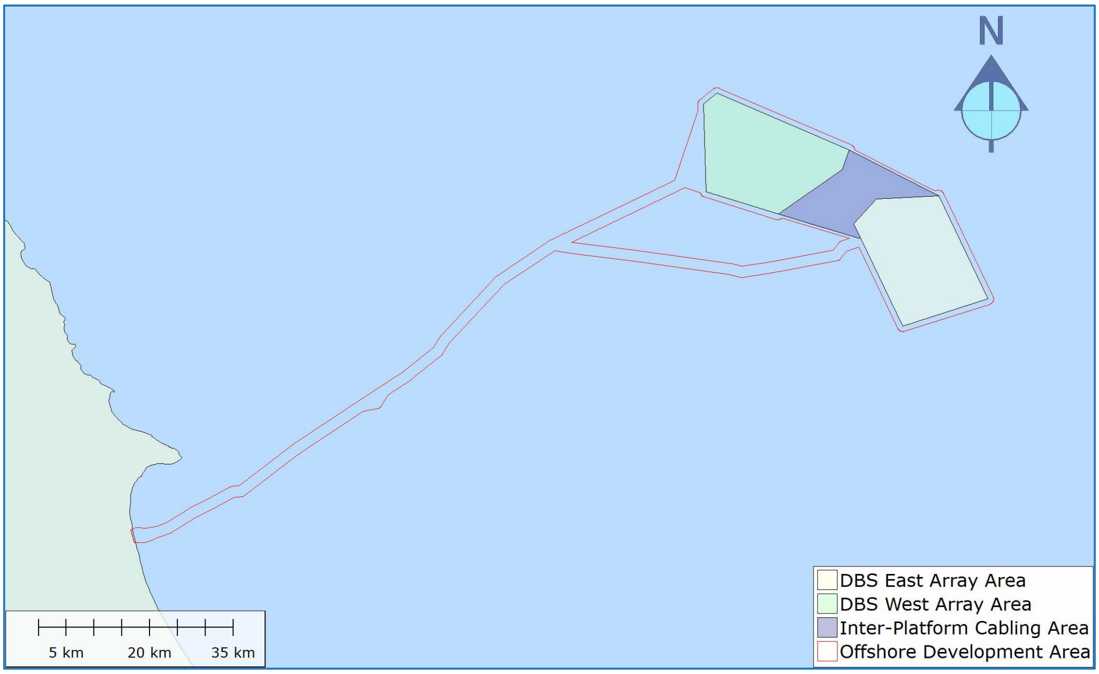

Figure 1: DBS Array Areas

1.3.2.4. As the analysis and modelling within this document is focused on the potential impact on aviation of infrastructure within the Array Areas, the inter-platform cabling area is not considered further.

1.3.3. Wind Turbines

1.3.3.1. Hypothetical scenarios of up to 200 wind turbines with maximum tip height of 308.87m or up to 113 wind turbines with maximum tip height of 394.08m above Mean High Water Springs (MHWS) are being considered as a worst case for the Environmental Impact Assessment (EIA). The design parameters for these wind turbines are shown in Table 1. Note that the final wind turbine parameters may lie somewhere between these figures.

Parameter	Smaller wind turbine	Larger wind turbine
Maximum blade tip height above MHWS	308.87m	394.08m
Indicative maximum rotor diameter	258.87m	344.08m
Maximum number of wind turbines	200	113

Table 1: Wind turbine design parameters

1.3.3.2. Note that blade tip heights are above MHWS whereas radar assessments are based on tip heights above mean sea level (amsl). Within the DBS Array Areas MHWS is approximately 1.3m amsl.

1.3.3.3. Worst-case blade tip heights of 311m amsl for smaller wind turbines and 396m amsl for larger wind turbines are used for the airspace and radar assessments which incorporate an additional buffer of 0.83m and 0.62m respectively and therefore represents a precautionary approach.

1.3.4. Terrain Data

- ATDI UK 25m Digital Terrain Model (DTM)

1.3.5. Analysis Tools

- ATDI HTZ communications V2023.10 release 1493 radio planning tool; and
- Blue Marble Global Mapper V21.1.1 Geographic Information System (GIS).

1.3.6. Mapping Datum

1.3.6.1. UTM31 (WGS84 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 DBS Array Areas. For the purposes of this assessment a maximum tip height of 1,300 feet (ft) for the wind turbines has been assumed, the equivalent to 396m rounded up to the nearest 100ft.

2.1.2. All airspace information has been referenced from the United Kingdom (UK) Aeronautical Information Publication (AIP) available online from source and is therefore the latest information available. Additional information regarding offshore infrastructure has been sourced from the North Sea Transition Authority (NSTA) Open Data website.

2.1.3. The assessment does not draw any conclusions but identifies areas of potential impact which are assessed fully in **Volume 7, Chapter 15 Aviation and Radar (application ref: 7.15.0)**.

2.2. Scope

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

2.2.2. An offshore platform may be located mid-way along the export cable corridor, but the height of this structure is not expected to be sufficient to have an aviation impact and so it is not considered further within the assessment.

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 would be a Danger Area (DA) established for military flight training.

2.3.3. There are five classes of airspace in the UK, namely classes A, C, D, E and G. Classes A to E 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 wind turbines, 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. In UK airspace the Transition Altitude is set at 3,000ft amsl except in certain specified airspace where it is higher.

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 Airspace Baseline

2.5.1. The DBS Array Areas lie within the London Flight Information Region (FIR), airspace regulated by the UK CAA. Approximately 30km north of the DBS West Array Area is the boundary between the London FIR and the Scottish FIR, also regulated by the UK CAA. The boundary between the London FIR and the adjacent Amsterdam FIR, regulated by the Netherlands Aviation Authority, is approximately 134km south-east of the DBS East Array Area at its closest point.

2.5.2. NATS (En Route) plc (NERL) provides en route civil ATS within the London and Scottish FIRs. NERL operates a network of radar facilities which provide en route information on airborne traffic for both civil and military ATC.

2.5.3. A portion of UK FIR airspace known as North Sea Area V is delegated to the Netherlands. Within this area the Netherlands provides ATS to all aircraft at FL55 (approximately 5,500ft amsl) and below. Procedures and communications within this area are as if the airspace was an integral part of the Amsterdam FIR. North Sea Area V is depicted in Figure 2, together with the FIR boundaries, and lies approximately 41km east of the DBS East Array Area at its closest point.

2.5.4. Also shown in Figure 2 is the Southern Managed Danger Area (MDA) EG D323 complex. This is discussed further in section 2.6.

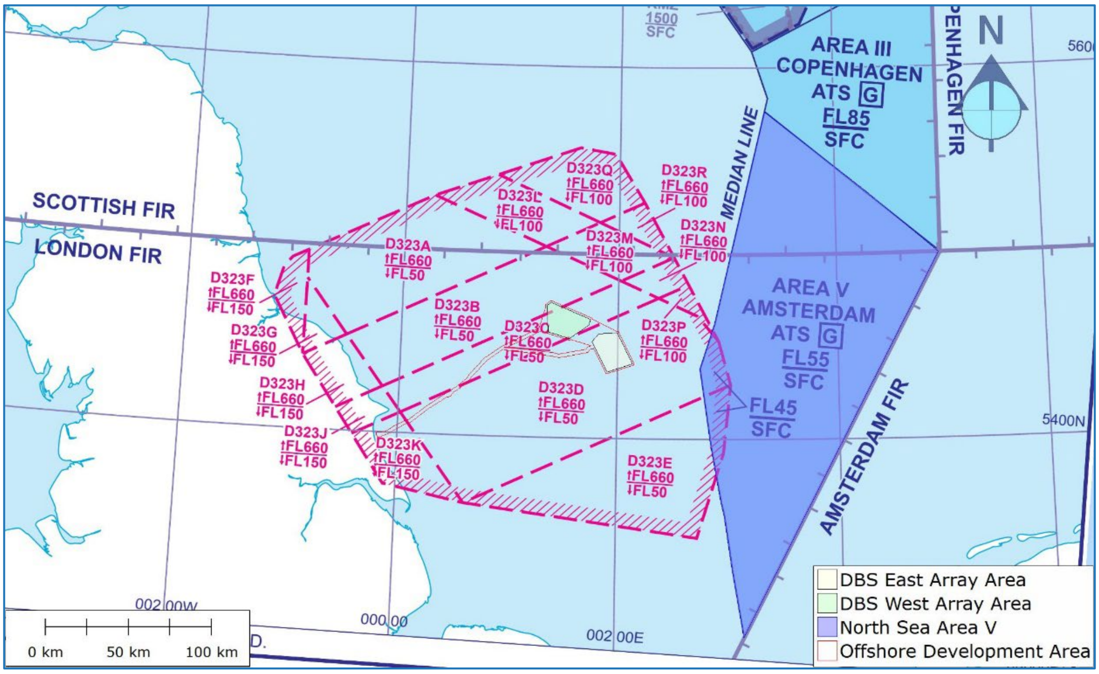

Figure 2: North Sea Area V

2.5.5. Immediately surrounding the DBS Array Areas is uncontrolled class G airspace, extending from sea level to FL195, approximately 19,500ft amsl.

2.5.6. This airspace is used by both civil and military aircraft, predominantly for low-level flight operations and generally by aircraft flying under Visual Flight Rules (VFR). Aircraft operate under one of two 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. Under VFR flight the pilot is responsible for maintaining a safe distance from terrain, obstacles, and other aircraft.

2.5.7. Above FL195 is class C controlled airspace in the form of a Temporary Reserved Area (TRA). This airspace, specifically TRA 006, has an upper vertical limit of FL245, approximately 24,500ft amsl, and is available for use by both military and civil aircraft, though its main use is to accommodate VFR military flying activity.

2.5.8. ATS routes are airways along which aircraft fly, navigating via ground-based electronic aids or, increasingly, Global Navigation Satellite System (GNSS) waypoints. ATS routes are used where high levels of traffic move between areas. They may be standalone sections or embedded, either wholly or in part, within a segment of airspace.

2.5.9. There are several ATS routes within the upper class C airspace above the DBS Array Areas. They are listed below together with their vertical limits:

- N96 FL245 to FL460;
- P5 FL245 to FL460;
- UL975 FL245 to FL460; and
- Y96 FL245 to FL460.

2.5.10. The ATS route structure in the vicinity of DBS is shown in Figure 3.

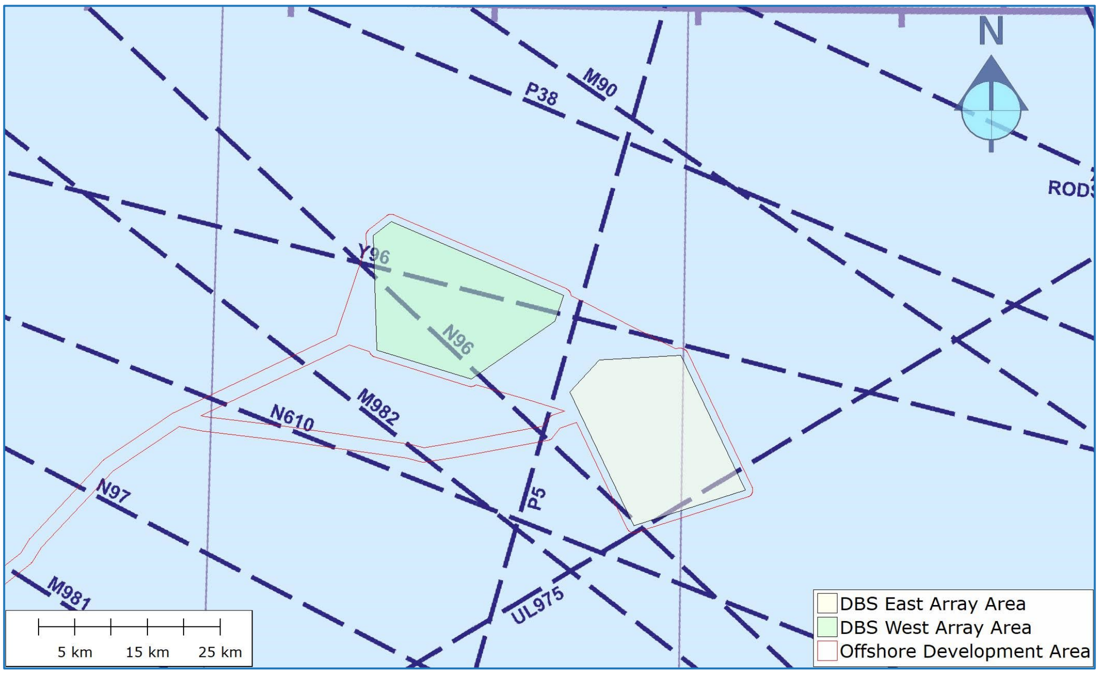

Figure 3: Upper ATS routes in the vicinity of DBS

2.5.11. Given the maximum blade tip height of 1,300ft amsl and the base of controlled airspace above, the wind turbine structures would not have an impact on aircraft operations within controlled airspace.

2.6. Special Use Airspace

2.6.1. The DBS Array Areas and export cable corridor lie beneath the Southern MDA, one of four MDA complexes in UK airspace that provide segregated airspace for military training. These areas of airspace are not permanently active, but rather are activated on request. Specifically, the DBS East Array Area is beneath Danger Area (DA) EG D323D, the DBS West Array Area is beneath DAs EG D323B and C, while the offshore export cable corridor is beneath DAs EG D323C, D and K.

2.6.2. When activated EG D323B to D have vertical limits from FL50 (approximately 5,000ft amsl) up to FL660 (approximately 66,000ft amsl). EG D323K has a lower limit of FL150 (approximately 15,000ft amsl). Activities within the Southern MDA include high energy manoeuvres, ordnance, munitions and explosives, and electrical/optical hazards.

2.6.3. The Southern MDA in the vicinity of DBS is shown in Figure 4. Also shown in Figure 4 is the Staxton DA (EG D412), approximately 24km north-west of the DBS West Array Area. When active, Staxton has vertical limits from the surface to 10,000ft amsl. Ordnance, and munitions and explosives activities take place within the Staxton DA.

2.6.4. Area 6 and Area 7, shown to the north-west and north-east of the DBS Array Areas in Figure 4, are Air-to-Air Refuelling Areas (AARAs) with vertical limits of FL100 (approximately

10,000ft amsl) to FL290 (approximately 29,000ft amsl). Within AARA airspace, fuel is transferred from tanker aircraft to receiver aircraft under a radar control service provided by military controllers based at Swanwick.

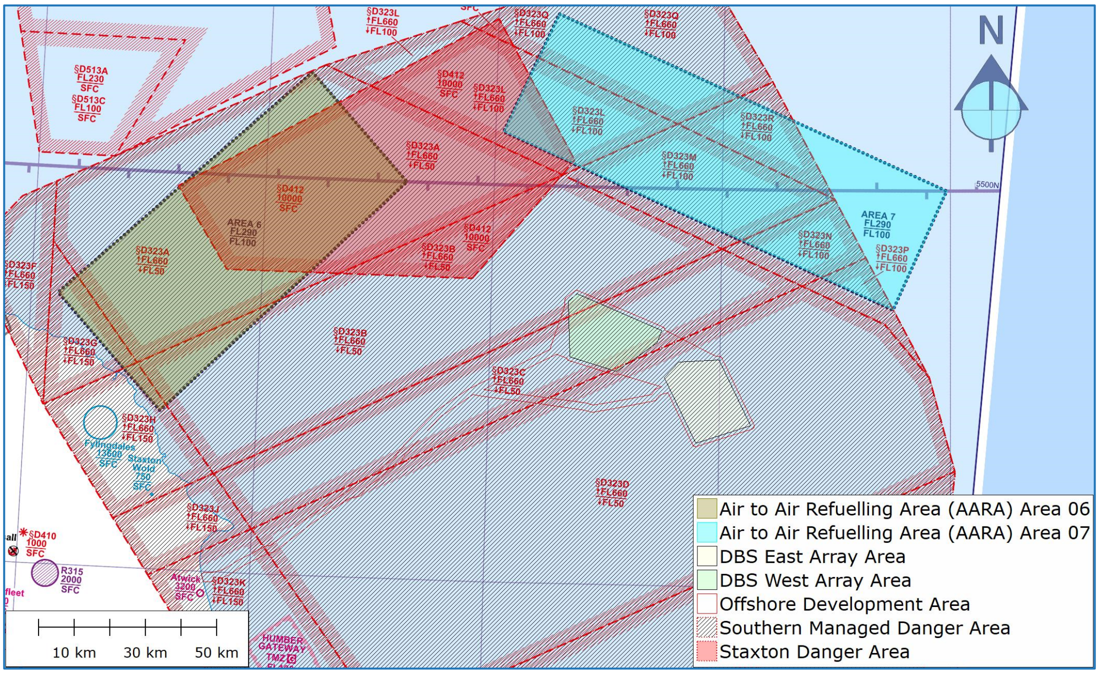

Chart reproduced with the permission of NATS (Services) Limited.

Figure 4: Special Use Airspace

2.7. Southern North Sea Offshore Operations

2.7.1. To enhance flight safety and expedite Search and Rescue (SAR) operations over the Southern North Sea, various Flight Information Services are provided by NATS Anglia Radar based at Aberdeen Airport. These services are available to helicopters operating in support of the offshore oil and gas and renewables industries and other civil and military aircraft transiting the airspace. The Anglia Radar Area of Responsibility in which these services are available is depicted in Figure 5 and extends from sea level to FL65 (approximately 6,500ft amsl).

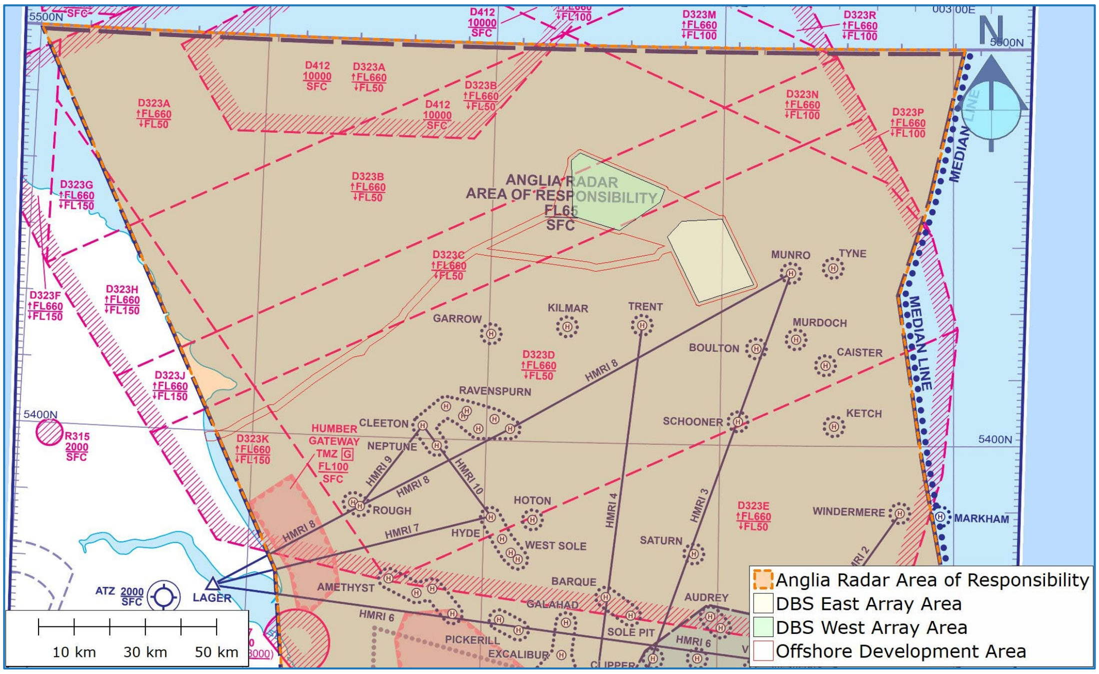

Figure 5: Anglia Radar Area of Responsibility

2.8. Helicopter Main Routing Indicators

2.8.1. A network of offshore routes over the Southern North Sea are flown by civilian helicopters in support of offshore oil and gas installations. The routes typically and routinely flown are published on charts as Helicopter Main Routing Indicators (HMRIs) to alert other airspace users of the potential for frequent low-level helicopter traffic.

2.8.2. These routes have no lateral dimensions and assume the background airspace classification within which they lie. HMRIs over the Southern North Sea generally extend vertically from 1,500ft amsl to FL60 (approximately 6,000ft amsl), although icing conditions or other flight safety considerations may require helicopters to operate below 1,500ft amsl.

2.8.3. The CAA publication Civil Aviation Publication (CAP) 764 Policy and Guidelines on Wind Turbines (CAA 2016) advises that planned obstacles within 2 nautical miles (nm) of an HMRI route centreline should be consulted upon with helicopter operators and the Air Navigation Service Provider (Anglia Radar).

2.8.4. 2nm buffers around the HMRIs in the vicinity of the Array Area are depicted in Figure 6, which shows that HMRI 8 passes within approximately 1.5nm of the DBS East Array Area. HMRI 8 routes from the coast, east of Humberside Airport to the Munro offshore platform.

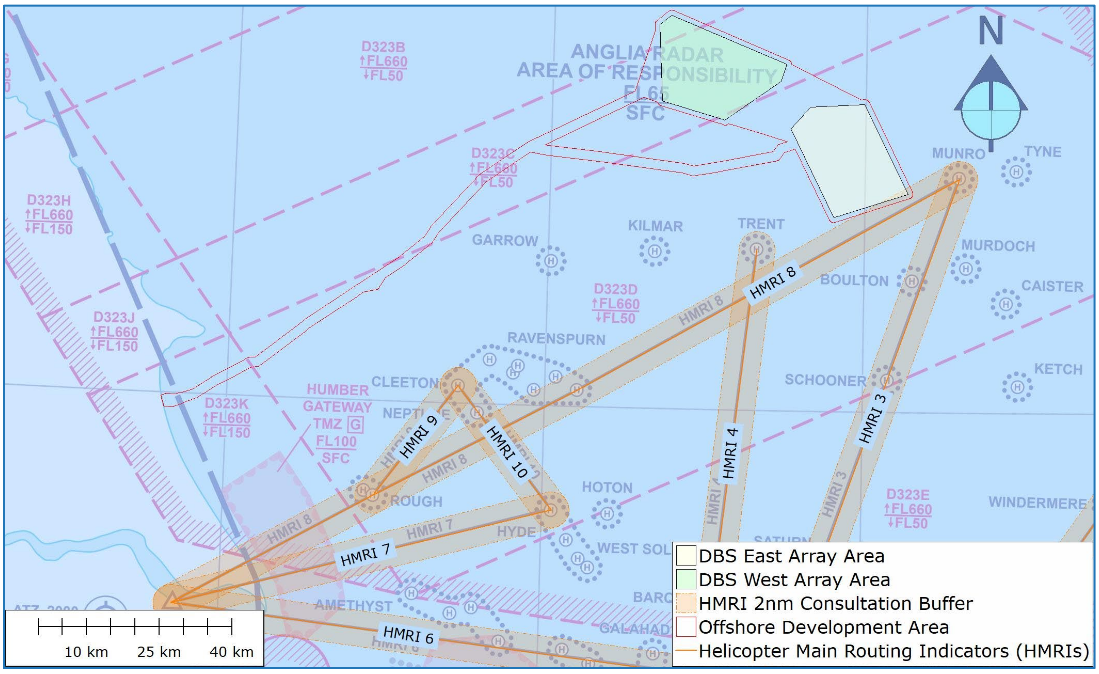

Figure 6: Helicopter Main Routing Indicators

2.8.5. Helicopters operating under IFR must maintain at least 1,000ft vertical clearance above the highest obstacles within 5nm, and would therefore need to transit the Array Area at a minimum of 2,500ft amsl for the maximum wind turbine tip height of 1,500ft amsl. Under VFR, helicopters must maintain a minimum of 500ft separation from obstacles.

2.8.6. The ability of a helicopter to fly higher over wind turbines depends on the icing level, and on days of low cloud base helicopters could be required to fly lower and extend their routings around wind turbine obstacles.

2.9. Offshore Helidecks

2.9.1. To help achieve a safe operating environment, a 9nm consultation zone for planned obstacles exists around offshore helicopter destinations. Within 9nm, obstacles such as wind turbines can potentially impact upon the feasibility of helicopters to safely fly low visibility or missed approach procedures at the associated helideck site. There are four offshore helidecks within 9nm of the DBS Array Areas, as depicted in Figure 7 and listed in Table 2. Of these platforms, it is understood that Cavendish is no longer in production and is subject to a decommissioning programme and a decommissioning programme for Munro MH was approved in July 2022.

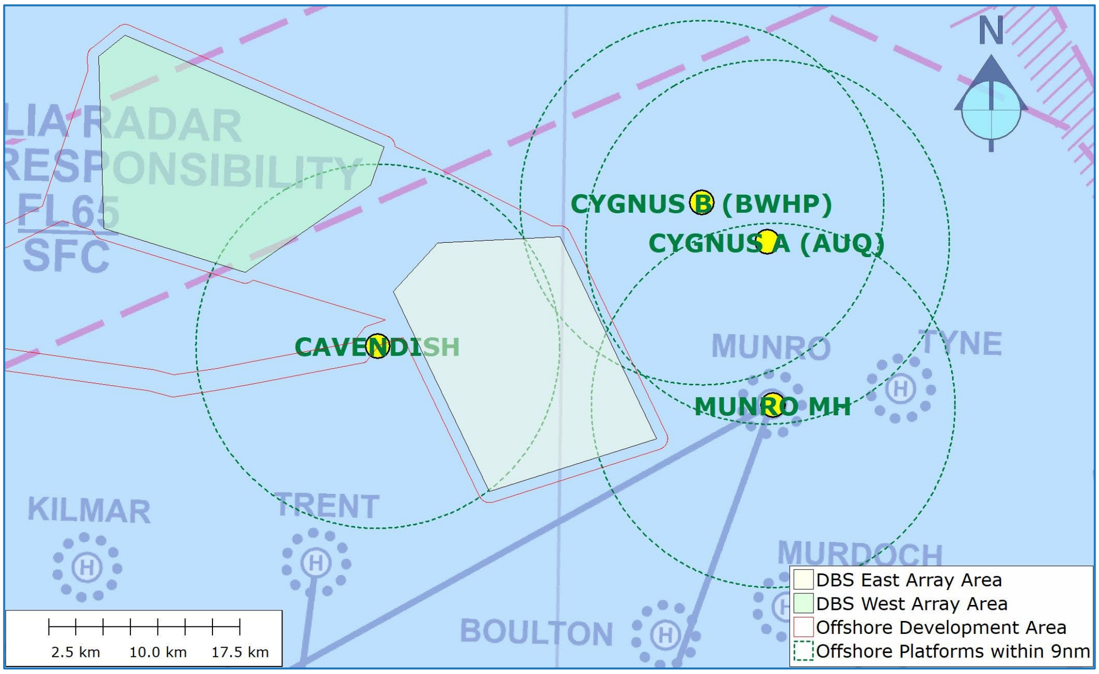

Figure 7: Offshore helidecks within 9nm of DBS Array Areas

Platform	Operator	Range from Array Areas (nm)
Cavendish	INEOS Industries	1.86
Cygnus A (AUQ)	Neptune E&P	9.15
Cygnus B (BWHP)	Neptune E&P	7.07
Munro MH	Harbour Energy	5.99

Table 2: Offshore helideck ranges from DBS Array Areas

2.9.2. CAP 764 states that the 9nm zone does not prohibit development but is a trigger for consultation with offshore helicopter operators, the operators of existing installations and exploration and development locations to determine a solution that maintains safe offshore helicopter operations alongside proposed developments. The CAA advises wind energy lease holders, oil and gas developers, and petroleum licence holders to discuss their development plans with each other to minimise the risks of unanticipated conflict. Consultation with offshore stakeholders is detailed in **Volume 7, Appendix 15-1 Aviation and Radar Consultation Responses (application ref: 7.15.15.1)**.

2.9.3. Helicopter Traffic Zones (HTZs) are established around individual and groups of offshore platforms to notify of helicopters engaged in platform approaches, departures and inter-platform transits. HTZ airspace extends vertically from sea level to 2,000ft amsl and laterally to 1.5nm from the platform helidecks.

2.9.4. Potential effects on offshore helicopter operations are assessed in more detail in **Volume 7, Appendix 15-3 Helicopter Access Report (application ref: 7.15.15.3)**.

2.10. Search and Rescue

2.10.1. SAR operations are a highly specialised undertaking involving not only aviation assets, but also small boats, ships, and shore-based personnel. SAR operations are generally carried out in extremely challenging conditions and at all times of the day and night. There are 10 helicopter SAR bases, incorporating 22 aircraft, around the UK with Bristow Helicopters providing helicopters and aircrew on behalf of the Maritime and Coastguard Agency.

2.10.2. The nearest SAR base is at Humberside Airport, approximately 156km south-west of the DBS West Array Area. Its helicopters provide rescue services for both offshore and land-based incidents up to approximately 460km from their base.

2.10.3. The random nature of people, watercraft or aircraft in distress makes it very difficult to determine the routes taken by SAR aircraft. Fixed wing SAR aircraft would tend to stay at higher altitudes in a command-and-control role during major incidents, whilst helicopters would be used in a low-level role, sometimes in support of small rescue boats.

3. Radar Line of Sight Assessment

3.1. Methodology

3.1.1. Radar Line of Sight (RLoS) is determined by use of a radar propagation model (ATDI HTZ communications) using 3D DTM data with 25m horizontal resolution. Radar data is entered into the model and RLoS to the wind turbines from the radar is calculated.

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

3.1.3. For PSR the principal source of adverse wind farm effects are the wind turbine blades, so RLoS is calculated for the maximum blade tip heights of the wind turbines.

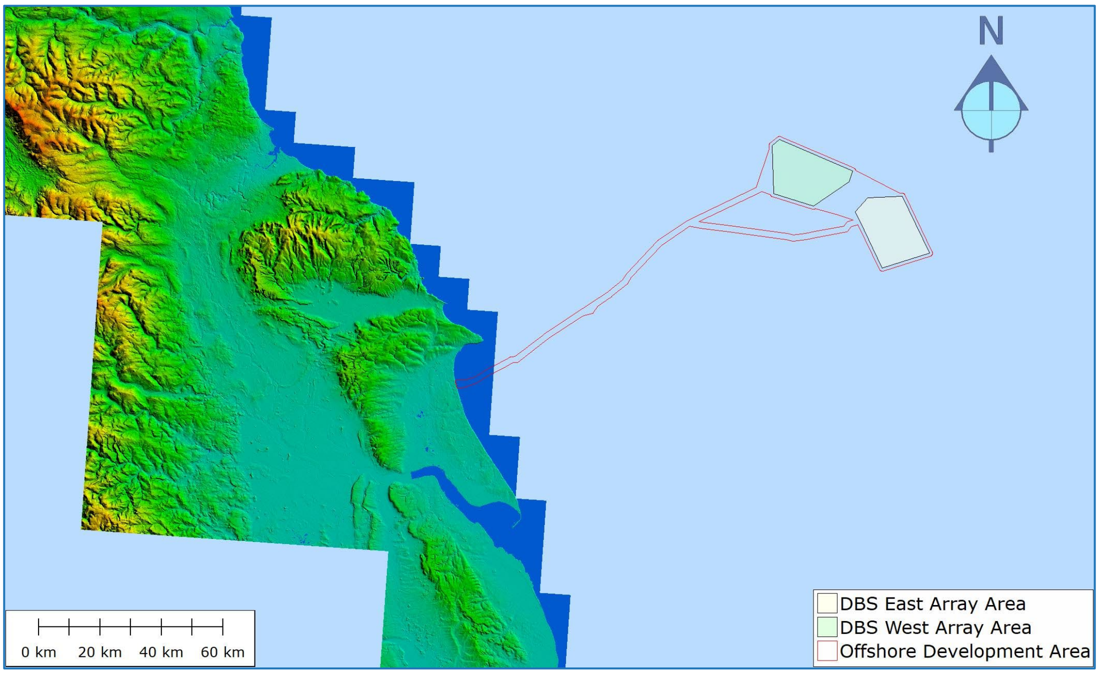

Figure 8: 25m resolution DTM used for RLoS modelling

3.2. Licensed Airfields with Surveillance Radar

3.2.1. Closest to Array Areas

3.2.1.1. The closest radar-equipped airfields to the DBS Array Areas are Humberside Airport, 156km to the south-west, and Teesside Airport, 181km west of the Array Areas. CAP 764 recommends consultation with any aerodromes with a surveillance radar facility that are within 30km of wind turbines, however this distance can be greater depending on the type and coverage of the radar and the particular operations at the aerodrome. Controllers at both these airports may provide a Lower Airspace Radar Service (LARS) to aircraft operating outside controlled airspace at a maximum range of 30nm (56km) from the Humberside facility and 40nm (74km) from the Teesside facility.

3.2.2. Humberside

3.2.2.1. Humberside RLoS coverage for the maximum blade tip height of 396m amsl is shown in Figure 9.

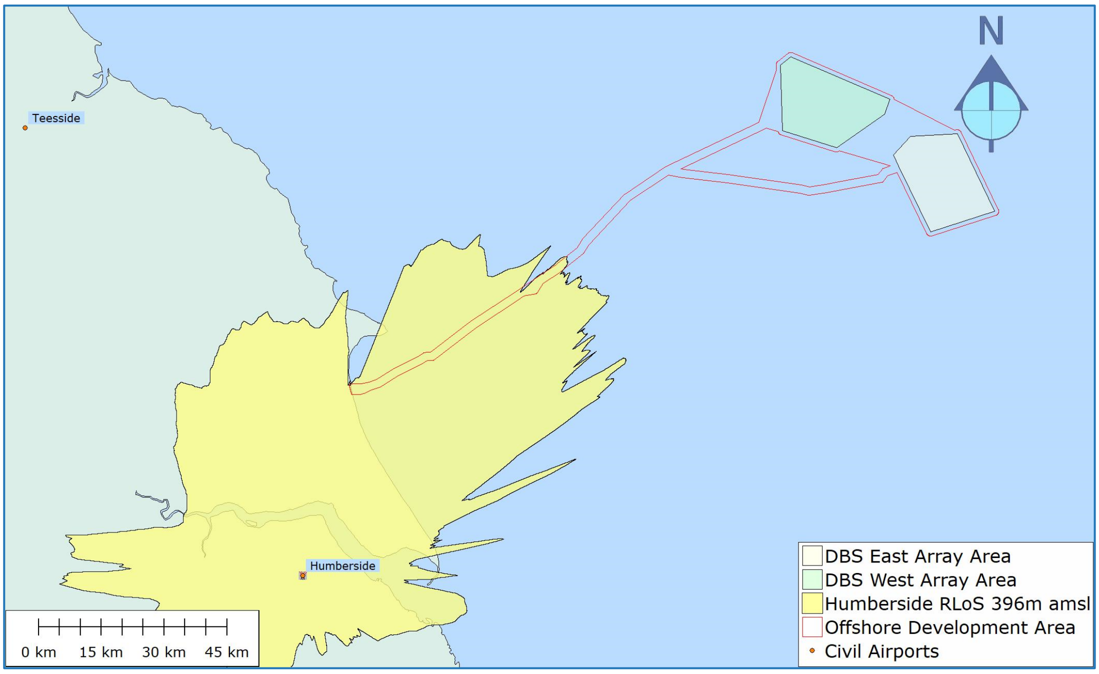

Figure 9: Humberside RLoS 396m amsl

3.2.2.2. At a maximum blade tip height of 396m amsl, none of the DBS wind turbines would be in RLoS of the Humberside Watchman PSR. No wind turbines installed within the Array Areas would be detected by Humberside PSR.

3.2.2.3. The Designated Operational Coverage (DOC) for Humberside's ATC radar service is 40nm (74km); so, at a minimum range of 156km, Humberside ATC would not be providing a radar control service for aircraft in the vicinity of the Array Areas.

3.2.3. Teesside

3.2.3.1. Teesside RLoS coverage for the maximum blade tip height of 396m amsl is shown in Figure 10.

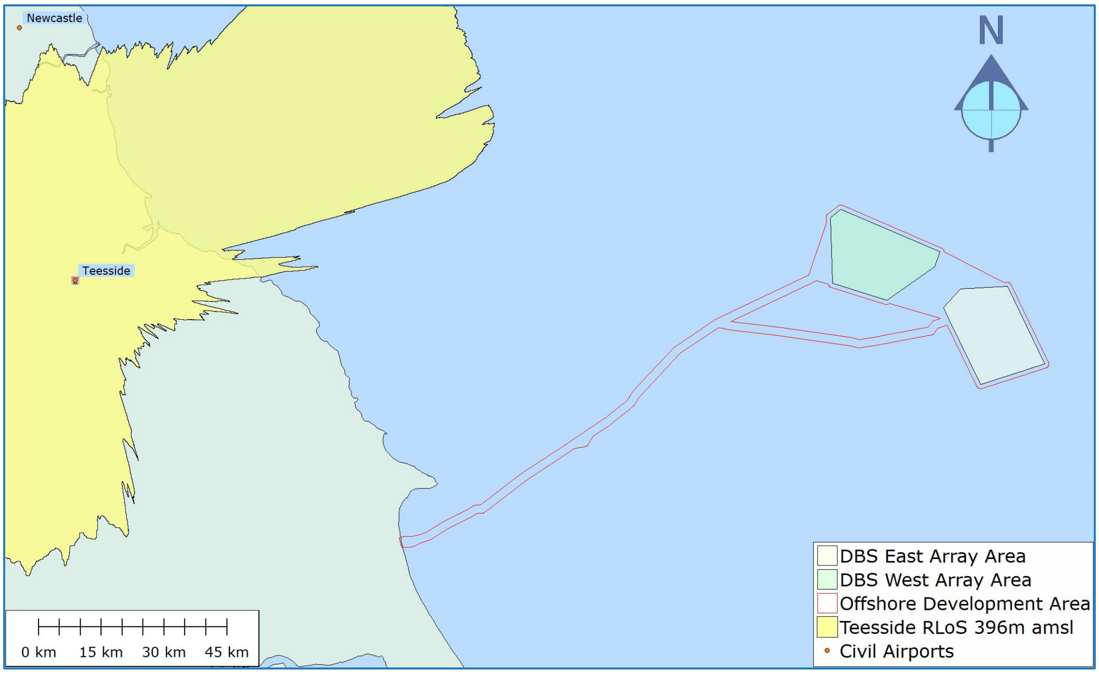

Figure 10: Teesside RLoS 396m amsl

3.2.3.2. At a maximum blade tip height of 396m amsl, none of the DBS wind turbines would be in RLoS of the Teesside Terma PSR. No wind turbines installed within the Array Areas would be detected by Teesside PSR.

3.2.3.3. The Designated Operational Coverage (DOC) for Teesside's ATC radar service is 40nm (74km); so, at a minimum range of 181km, Teesside ATC would not be providing a radar control service for aircraft in the vicinity of the Array Areas.

3.3. Military Airfields with Surveillance Radar

3.3.1. Closest to Array Areas

3.3.1.1. The closest radar-equipped military airfield to the Array Area is Royal Air Force (RAF) Leeming, 190km to the west. Controllers at this station offer a LARS to a range of 30nm (56km).

3.3.2. Leeming

3.3.2.1. Leeming RLoS coverage for the maximum blade tip height of 396m amsl is shown in Figure 11.

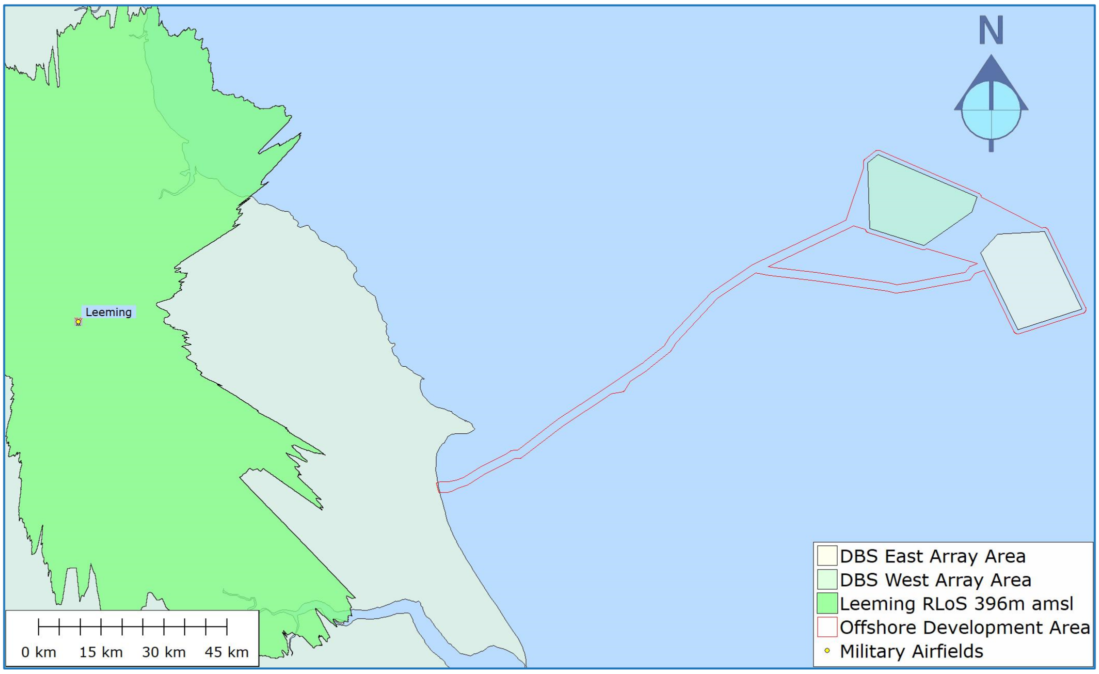

Figure 11: Leeming RLoS 396m amsl

3.3.2.2. No wind turbines within the Array Areas, irrespective of blade tip height, would be in RLoS of Leeming PSR. No wind turbines installed within the Array Areas would be detected by Leeming PSR.

3.4. NERL Radars

3.4.1. Closest to Array Areas

3.4.1.1. The closest NERL radars to the DBS Array Areas are at Claxby, 165km to the south-west, Cromer, 165km to the south, and Great Dun Fell, 244km to the west.

3.4.2. Claxby

3.4.2.1. Claxby RLoS coverage for the maximum blade tip height of 396m amsl is shown in Figure 12.

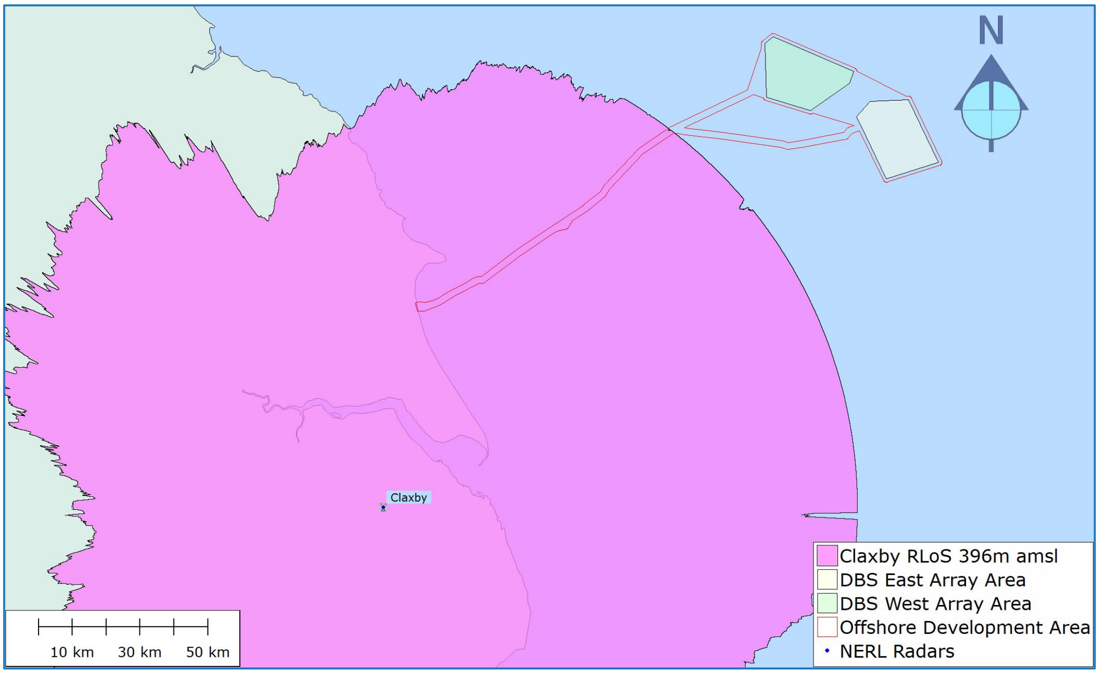

Figure 12: Claxby RLoS 396m amsl

3.4.2.2. At a maximum blade tip height of 396m amsl, none of the DBS wind turbines would be in RLoS of the Claxby ASR-23SS PSR. It is unlikely that any of the wind turbine categories proposed to be installed within the Array Areas would be detected by Claxby PSR.

3.4.3. Cromer

3.4.3.1. Cromer RLoS coverage for the maximum blade tip height of 396m amsl is shown in Figure 13.

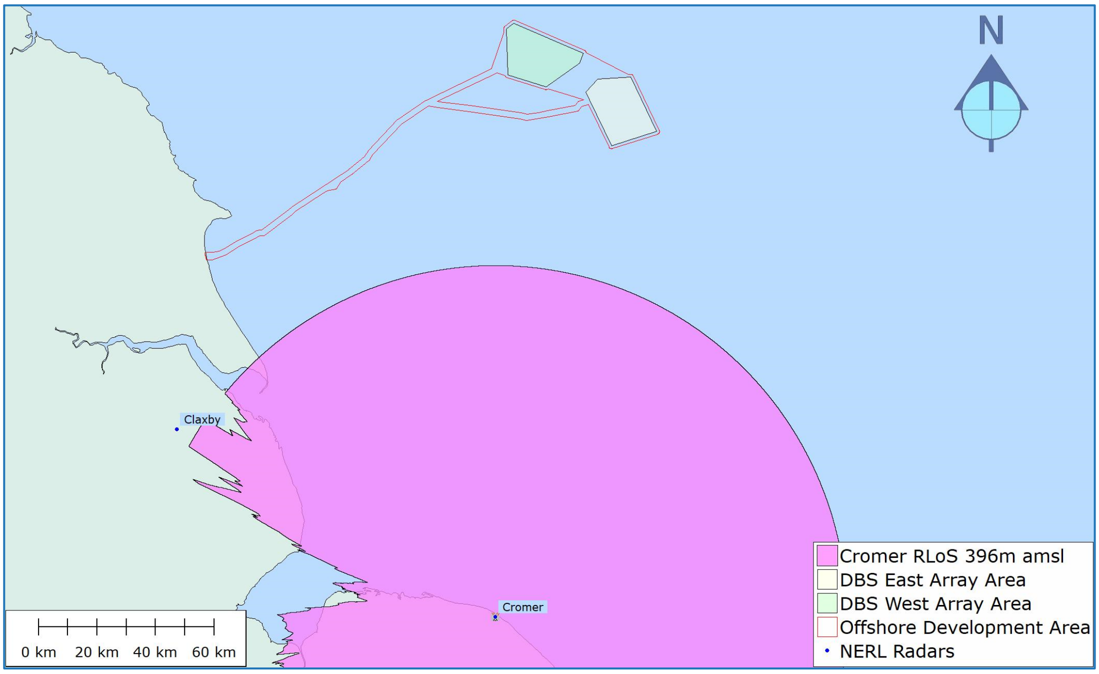

Figure 13: Cromer RLoS 396m amsl

3.4.3.2. At a maximum blade tip height of 396m amsl, none of the DBS wind turbines would be in RLoS of the Cromer ASR-10SS PSR. It is unlikely that any of the wind turbine categories proposed to be installed within the Array Areas would be detected by Cromer PSR.

3.4.4. Great Dun Fell

3.4.4.1. Great Dun Fell RLoS coverage for the maximum blade tip height of 396m amsl is shown in Figure 14.

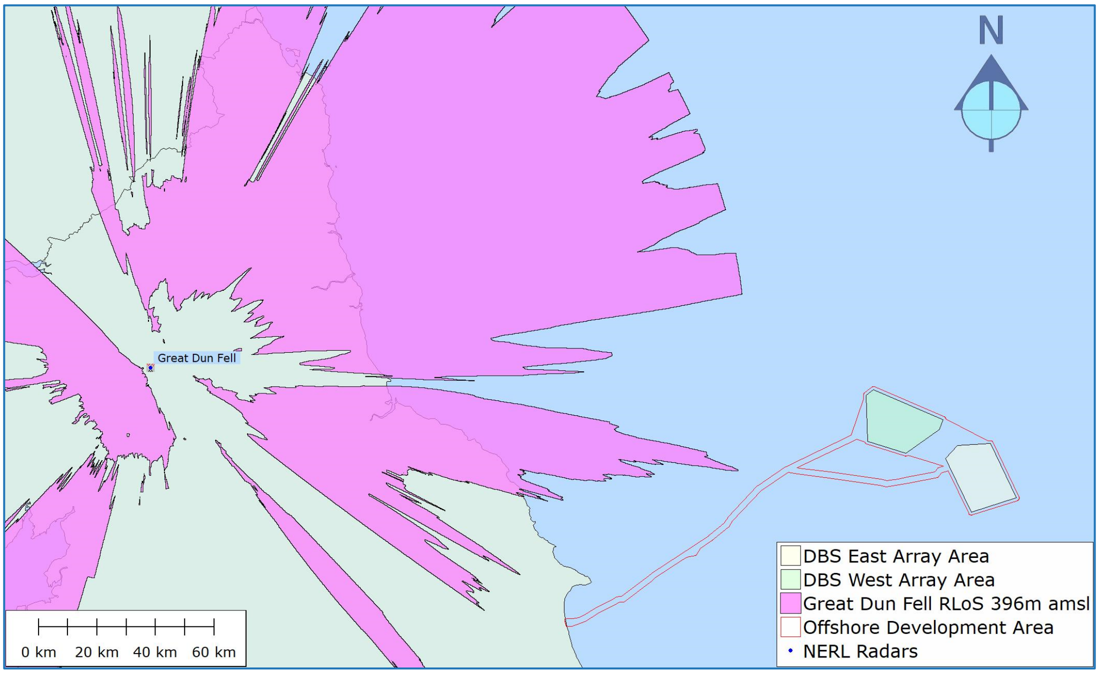

Figure 14: Great Dun Fell RLoS 396m amsl

3.4.4.2. At a maximum blade tip height of 396m amsl, none of the DBS wind turbines would be in RLoS of the Great Dun Fell ASR-23SS PSR. It is unlikely that any of the wind turbine categories proposed to be installed within the Array Areas would be detected by Great Dun Fell PSR.

3.5. MOD Air Defence Radars

3.5.1. Closest to Array Area

3.5.1.1. The closest AD radars to the DBS Array Areas are at Remote Radar Head (RRH) Staxton Wold, 123km to the west, RRH Neatishead, 185km to the south, and RRH Brizlee Wood, 213km to the north-west.

3.5.2. Staxton Wold

3.5.2.1. Staxton Wold RLoS coverage for the maximum blade tip height of 396m amsl is shown in Figure 15.

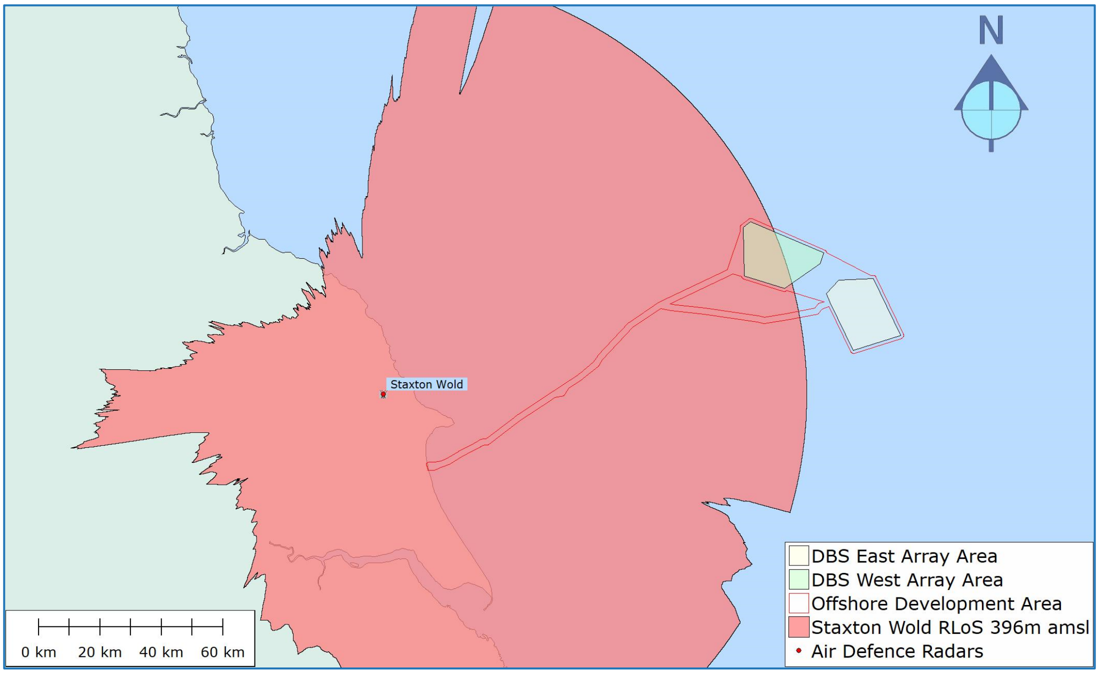

Figure 15: Staxton Wold RLoS 396m amsl

3.5.2.2. At a maximum blade tip height of 396m amsl, wind turbines within approximately 66% of the DBS West Array Area would be in RLoS of Staxton Wold PSR. 396m tip height wind turbines within the DBS East Array Area would not be in RLoS of Staxton Wold PSR.

3.5.2.3. Staxton Wold RLoS coverage for the smaller wind turbine maximum blade tip height of 311m amsl is shown in Figure 16.

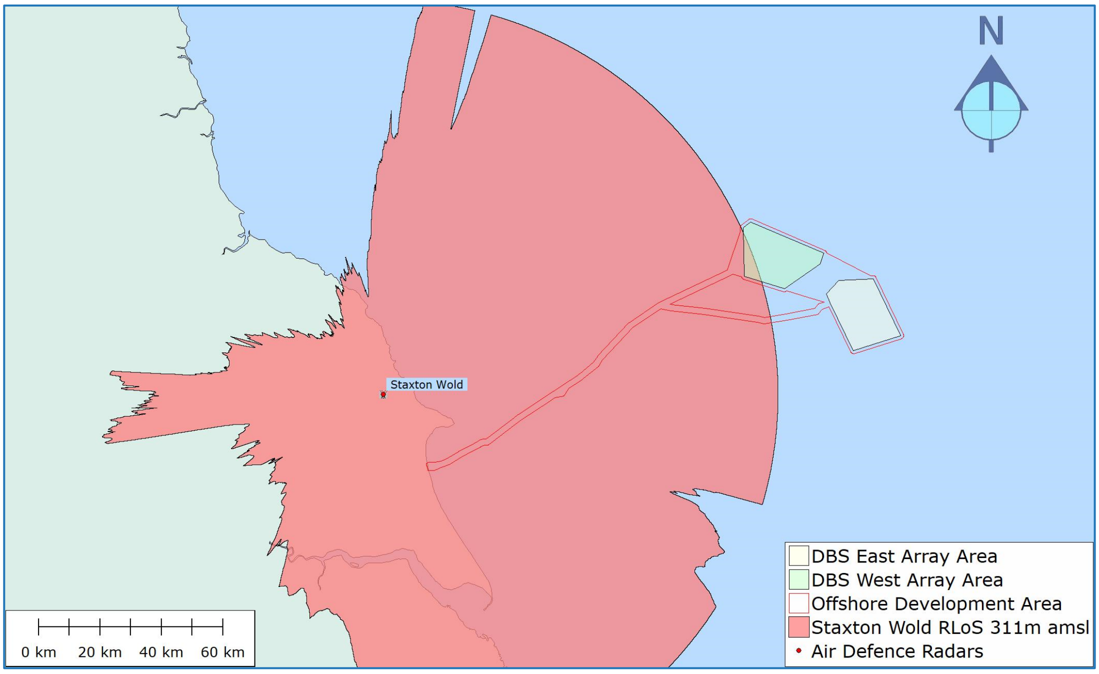

Figure 16: Staxton Wold RLoS 311m amsl

3.5.2.4. At a maximum blade tip height of 311m amsl, wind turbines within approximately 12% of the DBS West Array Area would be in RLoS of Staxton Wold PSR. No wind turbines within the DBS East Array Area would be in RLoS of Staxton Wold PSR.

3.5.2.5. Figure 17 shows Staxton Wold RLoS coverage for a wind turbine blade tip height of 271m amsl. This is the maximum tip height that would not be in RLoS of Staxton Wold PSR anywhere within the DBS East and West Array Areas.

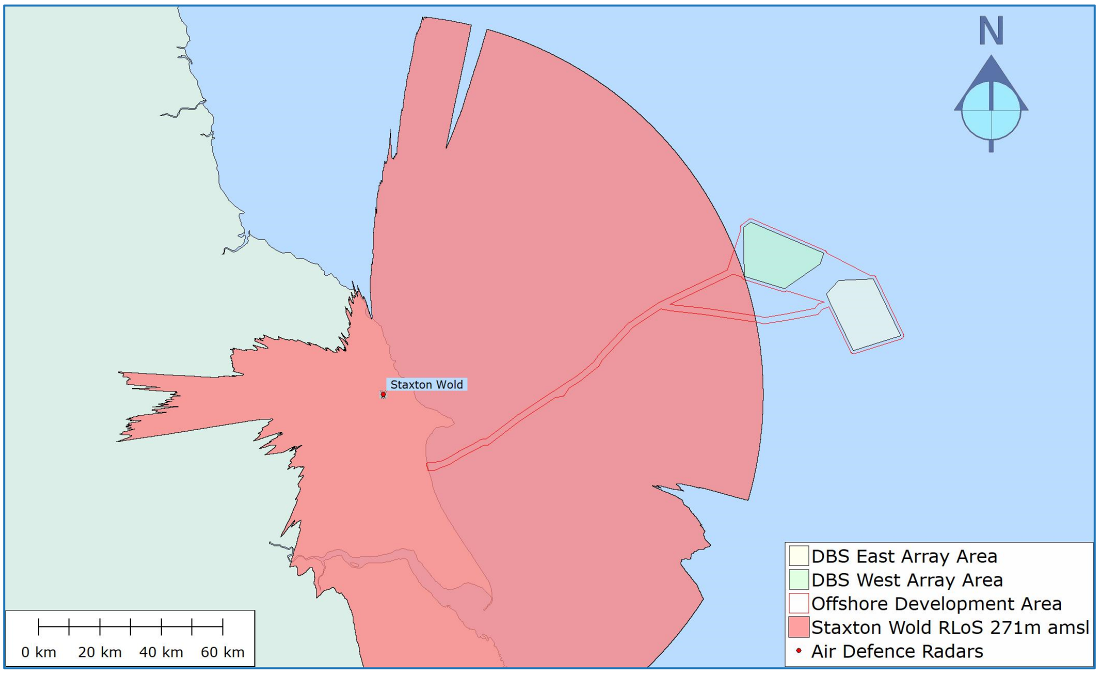

Figure 17: Staxton Wold RLoS 271m amsl

3.5.2.6. Staxton Wold RLoS coverage for a range of wind turbine tip heights between 271m amsl and 396m amsl is shown in Figure 18. The percentage of the DBS East and West Array Areas that would be in RLoS of Staxton Wold PSR for the various tip heights is shown in Table 3.

Wind turbine tip height amsl (m)	Percentage of area in RLoS of Staxton Wold PSR	
	DBS East	DBS West
271	-	-
300	-	6.7%
311	-	12.3%
350	-	37.9%
396	-	65.9%

Table 3: Percentage of DBS Array Areas in RLoS of Staxton Wold PSR

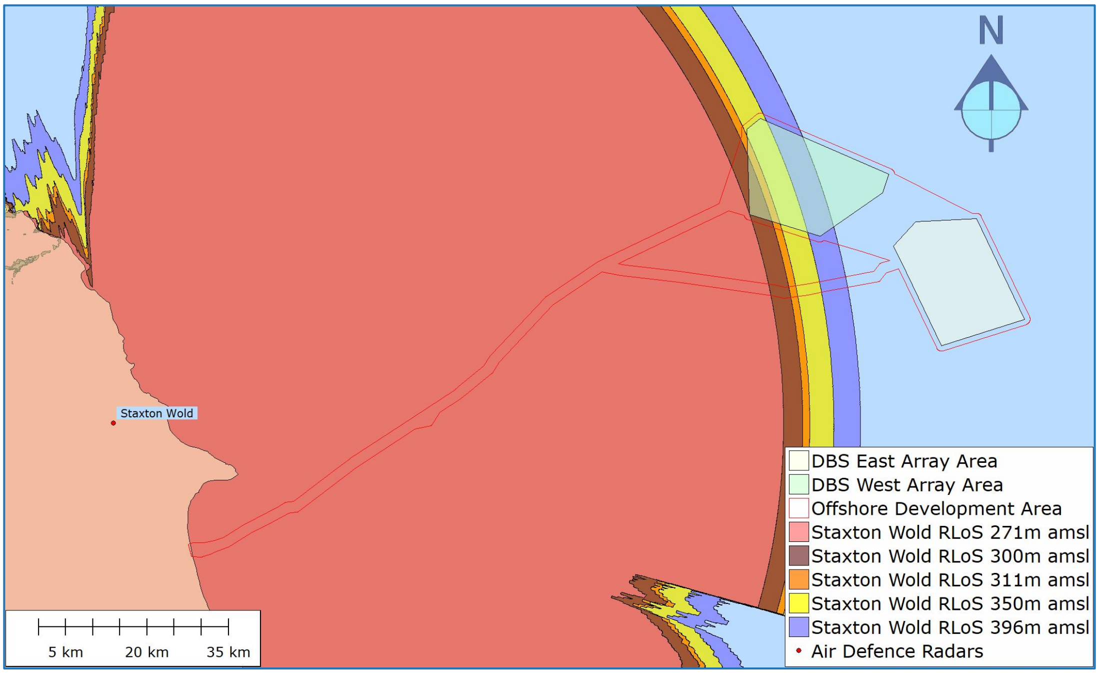

Figure 18: Staxton Wold RLoS coverages

3.5.2.7. The Staxton Wold PSR has recently been upgraded to an Indra Lanza Long-Range Tactical Radar (LTR-25) system. Detailed technical information for this system is not publicly available, however it can be stated that any wind turbines that are in RLoS of Staxton Wold PSR, between 271m and 396m in height within the ranges identified in Figure 18 for the DBS West array, would be detected by the radar. The LTR-25 is described by Indra as being "exceptionally effective in mitigating the effects of electronic warfare and wind farms", so there may be scope for configuring the radar to mitigate the effects of wind turbines within the DBS West Array Area.

3.5.3. Neatishead

3.5.3.1. The MOD recently completed the relocation of the Trimingham AD radar to a new inland site at RRH Neatishead.

3.5.3.2. Neatishead RLoS coverage for the maximum blade tip height of 396m amsl is shown in Figure 19.

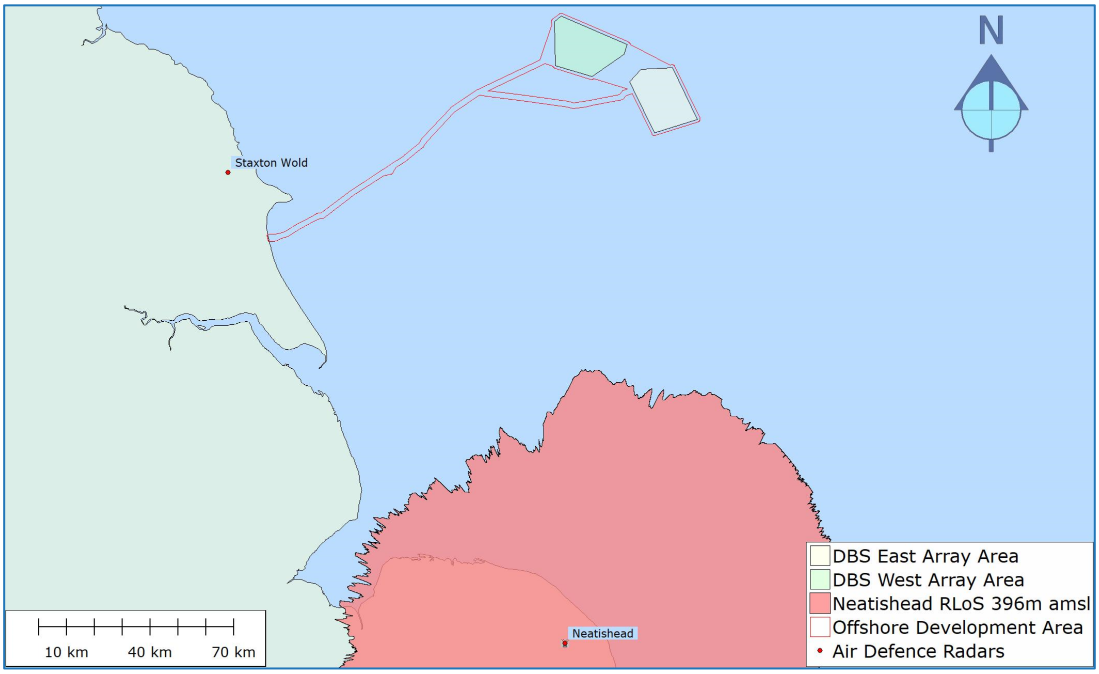

Figure 19: Neatishead RLoS 396m amsl

3.5.3.3. At a maximum blade tip height of 396m amsl, none of the DBS wind turbines would be in RLoS of the Neatishead TPS-77 PSR. It is unlikely that any of the wind turbine categories proposed to be installed within the Array Areas would be detected by Neatishead PSR.

3.5.4. Brizlee Wood

3.5.4.1. Brizlee Wood RLoS coverage for the maximum blade tip height of 396m amsl is shown in Figure 20.

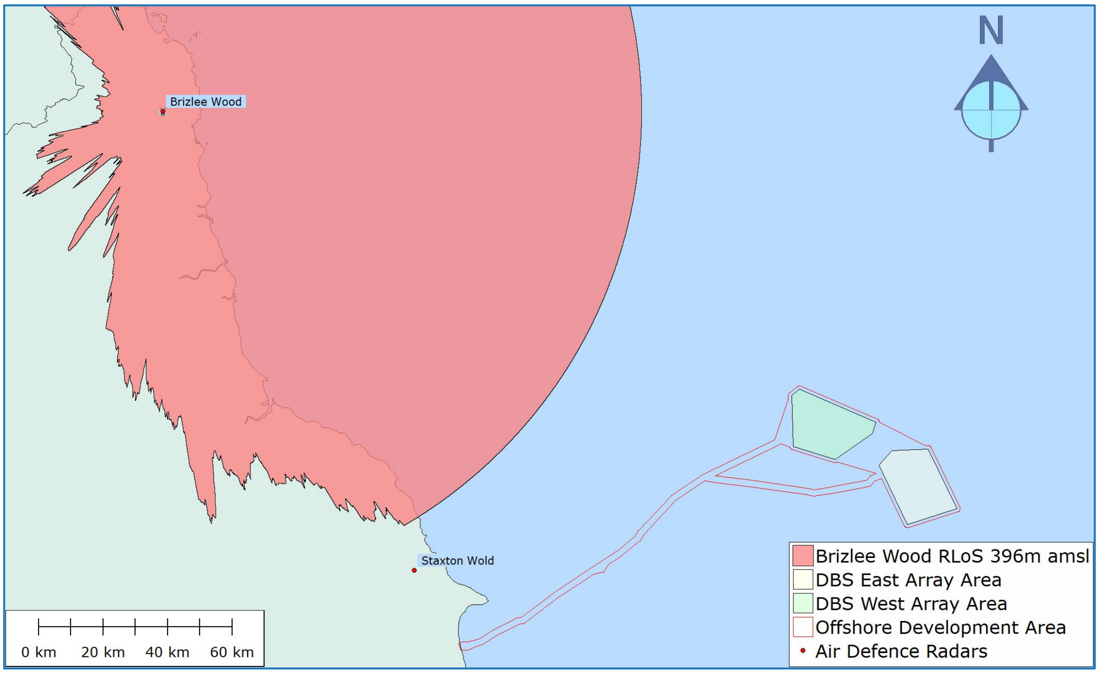

Figure 20: Brizlee Wood RLoS 396m amsl

3.5.4.2. At a maximum blade tip height of 396m amsl, none of the DBS wind turbines would be in RLoS of the Brizlee Wood TPS-77 PSR. It is unlikely that any of the wind turbine categories proposed to be installed within the Array Areas would be detected by Brizlee Wood PSR.

3.6. Radar Mitigation – MOD Air Defence Radars

3.6.1. An Air Defence and Offshore Wind (AD&OW) Windfarm Mitigation Task Force was formed as a collaborative initiative between the MOD, what was the Department for Business, Energy and Industrial Strategy (BEIS) now the Department for Energy Security and Net Zero (DESNZ), the Offshore Wind Industry Council and The Crown Estate in August 2019. The aim of the Task Force is to enable the co-existence of UK Air Defence and offshore wind by identifying potential mitigations and supporting processes, allowing offshore wind to contribute towards meeting the UK Government’s Net Zero target without degrading the nation’s AD surveillance capability.

3.6.2. The AD&OW Strategy and Implementation Plan (S&IP) sets the direction for this collaboration by identifying, assessing and deploying solutions that will enable the co-existence of AD&OW operations such that neither is unduly nor excessively compromised. The S&IP may lead to significant changes to current AD PSR characteristics and capabilities that in turn affect the potential impact that the Projects may have.

3.6.3. In support of the S&IP, in March 2020 the MOD Defence and Security Accelerator (DASA) and BEIS launched an Innovation Challenge to reduce and remove the impact of wind farms on the UK’s AD surveillance systems by seeking technological proposals in four areas:

- Alternatives to radar;
- Technologies applied to the wind turbine or installation;
- Technologies applied to the radar, its transmission or return; and

- Technological mitigations not covered by the above.

3.6.4. Phase 1 identified mitigations such as new radar signal processing methods or radar absorbing treatments applied to wind turbines and recommended a hybrid approach involving changes to both radar and wind turbine design to solve the problem in the long term.

3.6.5. Phase 2 of the competition was launched in April 2021 seeking proposals to address four main subject areas:

- Reduction of clutter or the impact of clutter;
- Ensuring efficient detection and tracking time;
- Technologies to mitigate against larger turbine blades and wider turbine spacing development; and
- Alternate methods of surveillance.

3.6.6. Of twenty submitted proposals, contracts for seven proposals were awarded in September 2021 and completed by March 2023.

3.6.7. DASA and DESNZ launched Stream 1 of Windfarm Mitigation for UK Air Defence: Phase 3 in February 2023, building upon Phases 1 and 2 to advance innovative technologies in radar signal processing, wind turbine materials and alternative tracking approaches.

3.6.8. In August 2023 funding was awarded for two projects: a project developing passive air defence sensors to address clutter from wind turbine blades, and another project developing stealth materials for next-generation wind turbine blades. At the same time, Phase 3 Stream 2 was launched to find solutions for the modelling and testing of different mitigation technologies.

3.6.9. The ultimate aim of the S&IP is to have mitigations in place to support offshore wind developments by Q2 2025, and therefore it is expected that such mitigation will be available before the construction of the Projects.

3.7. Consultation on mitigation

3.7.1. Potential mitigation measures will be consulted upon with stakeholders throughout the examination and post-consent periods and will also reflect appropriate measures that are being discussed at an industry level.

3.7.2. Given that the only potentially affected radar is the MOD facility at Staxton Wold, the MOD is the only consultee regarding radar mitigation.

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