Hornsea 4

Ørsted

Hornsea Project Four: Preliminary Environmental Information Report (PEIR)

Volume 5, Annex 9.1: Aviation and Radar Technical Report

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Glossary

Term	Definition
Airborne Radar Approach (ARA)	A procedure used by helicopters for low-visibility offshore approaches to offshore platforms which relies upon an aircraft's on-board weather radar for guidance and as a means of detecting obstacles in the approach path.
Commitment	A term used interchangeably with mitigation. Commitments are embedded mitigation measures. Commitments are either primary (design) or tertiary (Inherent) and embedded within the assessment at the relevant point in the Environmental Impact Assessment (EIA) (e.g. at Scoping or Preliminary Environmental Information Report (PEIR)). The purpose of Commitments are to reduce and/or eliminate Likely Significant Effects (LSEs), in EIA terms.
Controlled Airspace (CAS)	Airspace in which Air Traffic Control exercises authority. In the UK, Class A, C, D and E airspace is controlled.
Cumulative effects	The combined effect of Hornsea Four in combination with the effects from a number of different projects, on the same single receptor/resource.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
Flight Level	A standard nominal altitude of an aircraft, in hundreds of feet, based upon a standardized air pressure at sea-level.
Helicopter Main Route (HMR)	Routes which are established to facilitate safe helicopter flights in Instrument Flight Rules (IFR) conditions (i.e. when flight cannot be completed in visual conditions).
Hornsea Four	The proposed Hornsea Project Four offshore wind farm project; the term covers all elements within the DCO (i.e. both the offshore and onshore components).
Instrument Flight Rules (IFR)	The rules governing procedures for flights conducted with the crew making reference to aircraft cockpit instruments for situation awareness and navigation.
Instrument Meteorological Conditions (IMC)	Weather conditions which would preclude flight by the Visual Flight Rules, i.e. conditions where the aircraft is in or close to cloud or flying in visibility less than a specified minimum.
Minimum Sector Altitude (MSA)	Under aviation flight rules, the altitude below which it is unsafe to fly in IMC owing to presence of terrain or obstacles within a specified area.
Missed Approach Procedure (MAP)	The actions for the crew of an aircraft to take when an instrument approach procedure is not successful e.g. the crew are unable to see the runway, approach lights or helideck.

Term	Definition
Mitigation	A term used interchangeably with Commitment(s) by Hornsea Four. Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the EIA (e.g. at Scoping or PEIR).
Onshore cables	The cables which take the electricity from landfall to the onshore project substation.
Onshore infrastructure	The combined name for all onshore infrastructures associated with the project from landfall to grid connection.
Uncontrolled Airspace	Airspace in which Air Traffic Control does not exercise any executive authority, but may provide basic information services to aircraft in radio contact. In the UK, Class G airspace is uncontrolled.
Visual Flight Rules (VFR)	The rules governing flight conducted visually i.e. with the crew maintaining separation from obstacles, terrain and other aircraft visually.
Visual Meteorological Conditions (VMC)	A flight category which allows flight to be conducted under VFR defined by in flight visibility and clearance from cloud.

Acronyms

Acronym	Definition
ADR	Air Defence Radar
AfL	Agreement for Lease
agl	Above Ground Level
AIS	Aeronautical Information Service
amsl	Above mean sea level
AOC	Air Operators Certificate
ARA	Airborne Radar Approach
ASACS	Air Surveillance and Control System
ATC	Air Traffic Control
ATS	Air Traffic Service
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAS	Controlled Airspace
CAT	Commercial Air Traffic
DCO	Development Consent Order
DGC	Defence Geographic Centre
ERCoP	Emergency Response Co-operation Plan
FIR	Flight Information Region
FL	Flight Level
GAAC	General Aviation Awareness Council
GPS	Global Positioning System
HMR	Helicopter Main Route
IAIP	Integrated Aeronautical Information Package
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions

Acronym	Definition
LOS	Line of Sight
MAP	Missed Approach Procedure
MCA	Maritime Coastguard Agency
MDA	Managed Danger Areas
MDS	Maximum Design Scenario
MMO	Marine Management Organisation
MOD	Ministry of Defence
MRCC	Maritime Rescue Coordination Centre
MSA	Minimum Safe Altitude
NERL	NATS En Route Limited
NSIP	Nationally Significant Infrastructure Project
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Area
PSR	Primary Surveillance Radar
RAP	Recognised Air Picture
RCS	Radar Cross Section
RDP	Radar Data Processor
rpm	Revolutions per minute
SAR	Search And Rescue
TOPA	Technical and Operational Assessment
UKIAIP	United Kingdom Integrated Aeronautical Information Publication
UKLFS	United Kingdom Low Flying System
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

Units

Unit	Definition
m	metre
km	kilometre
Ms	Metres per second
nm	nautical mile

1 Introduction

1.1 Introduction

1.1.1 Project background

1.1.1.1 Ørsted Hornsea Project Four Limited (the Applicant) is proposing to develop Hornsea Project Four Wind Farm (hereafter Hornsea Four). Hornsea Four will be located approximately 65 km offshore from the East Riding of Yorkshire coast in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone (please see **Volume 1, Chapter 1: Introduction** for further details on the Hornsea Zone). Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network. The location of Hornsea Four is illustrated in **Figure 1**. The Preliminary Environmental Information Report (PEIR) boundary combines the search areas for the onshore and offshore infrastructure.

1.1.1.2 The Hornsea Four Agreement for Lease (AfL) area was 848 km^2 at the Scoping phase of project development. In the spirit of keeping with Hornsea Four's approach to Proportionate Environmental Impact Assessment (EIA), the project is currently giving due consideration to the size and location (within the existing AfL area) of the final project that will be taken forward to consent application (DCO). This consideration is captured internally as the "Developable Area Process", which includes Physical, Biological and Human constraints in refining the developable area, balancing consenting and commercial considerations with technical feasibility for construction. The combination of Hornsea Four's Proportionality in EIA and Developable Area process has resulted in a marked reduction in the AfL taken forward at the point of PEIR. (see **Figure 1**). The evolution of the AfL is detailed in the **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives** and **Volume 4, Annex 3.2: Selection and Refinement of the Offshore Infrastructure**. The final developable area taken forward to consent may differ from that presented in **Figure 1** due to the results of the EIA, technical considerations and stakeholder feedback.

1.1.1.3 Osprey Consulting Services Ltd (Osprey) was commissioned by the Applicant to undertake a characterisation of the aviation and radar baseline environment of the Hornsea Four array area and surrounding area to establish the aviation baseline and hence the potential for Hornsea Four to present an impact on aviation and radar interests within the proximity of the Hornsea Four array area.

1.1.1.4 The Hornsea Four aviation and radar study area shown in **Figure 1** encapsulates the Hornsea Four array area, the onshore and offshore cable corridors as well as the airspace between Hornsea Four array area and the UK mainland from Norwich Airport to the south (helicopter support to the offshore environment) and RAF Brizlee Wood (extent of potential of radar detectability) to the north. For the purposes of the assessment of cumulative effects, the study area also includes other offshore wind farms in the Southern North Sea that could have potential effects on identified military, aviation and radar stakeholders. Specifically, the aviation and radar study area cover:

- Aviation radar systems that could potentially detect 370 m high (blade tip) wind turbines within the Hornsea Four array area;
- Offshore helicopter operations including Helicopter Main Routes (HMRs) that are located within the proximity of the study area;
- Offshore oil and gas platforms that are located within a nine nautical mile (NM) 'consultation buffer' that overlaps the study area;
- Search and Rescue (SAR) flight operations; and
- Military low flying operations.

1.1.2 Background

1.1.2.1 The effects of wind turbines on aviation interests have been widely publicised but the primary concern is the maintenance of safe aviation operations. There are innumerable subtleties in the actual effects but there are two dominant scenarios that can lead to objection from aviation stakeholders:

- Physical: Wind turbines can present a physical obstruction to aircraft in transit at low altitudes; and
- Radar/Air Traffic Services (ATS): Wind turbine derived clutter appearing on radar displays can affect the safe provision of an ATS as it can mask unidentified aircraft from the air traffic controller and/or prevent the controller from accurately identifying aircraft under control. In some cases, radar reflections from the wind turbines can affect the performance of the radar system itself.

1.1.3 Aims and objectives

1.1.3.1 The purpose of this document is to establish which aviation stakeholders and receptors have the potential to be affected by the operation of Hornsea Four through the establishment of the baseline aviation and radar environment. Having established the baseline, further analysis has been completed on the potential of aviation radar systems to detect wind turbines together with an analysis of baseline aviation operations conducted at, in, and near the aviation and radar study area as presented in **Figure 1**.

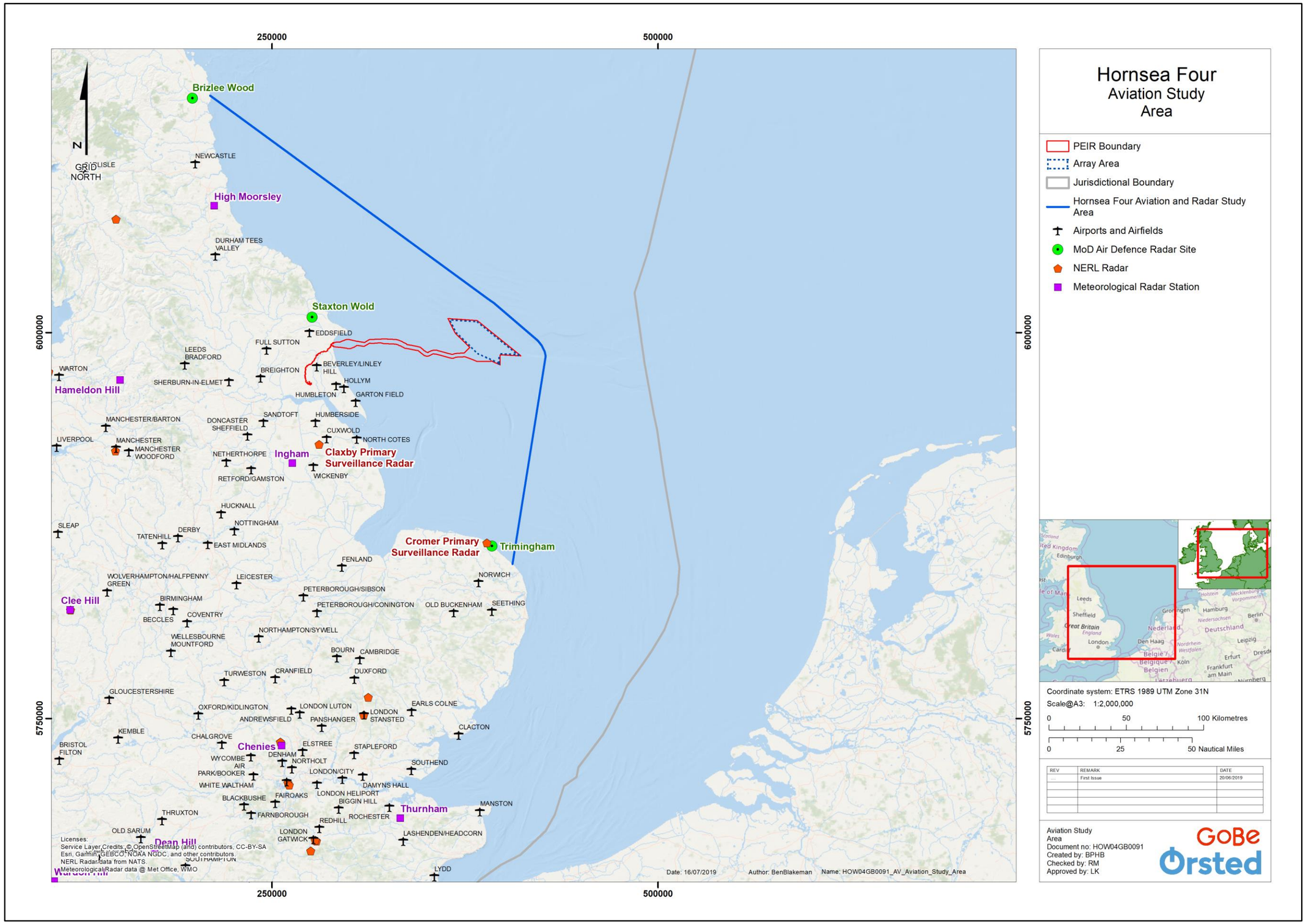


Figure 1: Location of Hornsea Four within the Hornsea Four aviation and radar study area (not to scale).

2 Methodology

2.1 Establishment of the Baseline

2.1.1.1 The methodology for the establishment of the baseline has been completed within the following phases:

- Stakeholder Identification: Osprey has identified a list of potential aviation stakeholders in accordance with Civil Aviation Publication (CAP) 764: *Policy and Guidelines on Wind Turbines* (CAA, 2016) and has considered the en-route and other aviation radar systems within operational range of the study area. The identification stage has also considered military areas of operation, tactical training and Practice and Exercise Areas (PEXA), Meteorological Radar systems, offshore helicopter operations in support of the Oil and Gas industries and airborne SAR operations; and
- Stakeholder Impact: for each identified stakeholder the impact (including impact to aviation radar systems) has been considered and subsequently the operational impact to aviation activities, including the effects of wind turbine detectability can create to radar systems, has been described.

2.2 Assessment Methodology

2.2.1.1 The operational baseline assessment has considered, but not been limited to, consideration of: the orientation of approach and departure flight paths; physical safeguarding of flight; types of aircraft flying near to the aviation and radar study area; and airspace characteristics and flight procedures as published in the United Kingdom Integrated Aeronautical Information Package (UKIAIP) (NATS 2019) (for civilian aviation activities) and the Military Aeronautical Information Package (MOD 2019) (Mil AIP).

2.3 Radar LOS analysis

2.3.1 Notes on Radar Operation

2.3.1.1 Radar operates by alternately transmitting a stream of high-power radio frequency pulses and 'listening' to echoes received back from targets within its line of sight (LOS). Generally, air surveillance radar employs a rotating antenna that provides 360° coverage in azimuth; the typical scan rate is 15 revolutions per minute (rpm) thus illuminating a given target every four seconds.

2.3.1.2 Primary Surveillance Radar (PSR) operates in two dimensions: the target range is measured based on the time for the transmitted signal to arrive back at the receiver, and the direction of the beam provides the position of the target in azimuth. A PSR such as the type in use at aerodromes across the UK have no height finding capability and as such the Air Traffic Control (ATC) Officer relies on Secondary Surveillance Radar (SSR) for this purpose. SSR is a collaborative radar system which means that the radar will 'interrogate' a transponder on the aircraft for useful information such as altitude and heading, which is then passed to the ATC display console. All military aircraft carry transponders which respond to SSR interrogation.

2.3.1.3 A PSR can distinguish between moving and static targets; for targets that are moving towards or away from the radar, the frequency of the reflected signal from a moving target

changes between each pulse (transmit and receive) which is known as the Doppler shift. This can be most practically explained by considering the change in frequency of the engine sound heard by a pedestrian when a car passes by on the road – the sound as the car approaches is higher than the sound heard by the pedestrian as it travels away. The Doppler shift has the effect of making the sound waves appear to bunch up in front of the vehicle (giving a higher frequency) and spread out behind it (lower frequency). The true frequency of the engine is only heard when the car is immediately next to the pedestrian. The radar receiver is 'listening' to the radio waves reflected from the moving object and working out whether the returned signal is of a higher/lower frequency (moving object) or if the returned frequency is the same as the transmitted signal (a stationary object).

2.3.1.4 Dependent on radar detectability, wind turbines are potentially a cause of PSR false plots, or clutter, as the rotating blades can trigger the Doppler threshold (minimum shift in signal frequency) of the Radar Data Processor (RDP) and therefore may be interpreted as legitimate target echo (aircraft) movement. Significant effects have been observed on radar sensitivity caused by the substantial Radar Cross Section (RCS) of the wind turbine structural components (blades, tower and nacelle) which can exceed that of a large aircraft; the effect 'blinds' the radar (or the operator) to wanted targets in the immediate vicinity of the wind turbine. False plots and reduced radar sensitivity may impair the effectiveness of radar to an unacceptable level and compromise the provision of a safe radar service to participating aircraft.

2.3.1.5 It is mainly for the above reasons that airport operators and other Air Navigation Service Providers (ANSP) object to wind farm developments that are within radar LOS to their radar system. However, it is worth noting that detectability of wind turbines does not automatically constitute a valid reason for objection. There are several relevant examples where the impact of offshore wind farms is managed on an operational basis without the need for technical mitigation.

2.3.2 Method

2.3.2.1 Osprey used the ATDI ICS LT (Version 4.3.3) tool to model the terrain elevation profile between the identified radar systems and the Hornsea Four study area. This is otherwise known as a point-to-point LOS analysis. The result is a graphical representation of the intervening terrain and the direct signal LOS (considering earth curvature and radar signal properties).

2.3.2.2 The analysis undertaken gives an indication of the likelihood of wind turbines being detected such that the operational significance of the turbine relative to nearby aviation radar assets can be assessed.

2.3.2.3 It is important to note that the analysis of radar detectability of wind turbines is a limited and theoretical desk-based study; in reality there are unpredictable levels of signal diffraction and attenuation within a given radar environment (ambient air pressure, density and humidity) that can each influence the probability of a turbine being detected however, radar line of sight analysis provides an indication of the potential of radar detectability to assess impact on aviation surveillance equipment.

2.3.2.4 The qualitative definitions used in the LOS assessment are defined in **Table 1**.

Table 1: Radar LOS Qualitative Definitions.

Result	Definition
Yes	The turbine is highly likely to be detected by the radar: Direct LOS exists between the radar and the turbine.
Likely	The turbine is likely to be detected by the radar at least intermittently.
Unlikely	The turbine is unlikely to be detected by the radar but cannot rule out occasional detection.
No	The turbine is unlikely to be detected by the radar as significant intervening terrain exists.

3 Aviation Baseline Environment

3.1.1.1 The study area is situated in an area of Class G uncontrolled airspace, which is established from the surface up to Flight Level[1] (FL) 195 (approximately 19,500 ft). Several established airways are located above FL 195 in Class C controlled airspace (CAS) which are illustrated within **Figure 2**.

3.1.1.2 Under these classifications of airspace, the following applies:

- Class G uncontrolled airspace: any aircraft can operate in this area of uncontrolled airspace without any mandatory requirement to be in communication with an ATC unit. Pilots of aircraft operating under Visual Flight Rules (VFR) in Class G airspace are ultimately responsible for seeing and avoiding other aircraft and obstructions; and
- Class C CAS: all aircraft operating in this airspace must be in receipt of an ATS.

3.1.1.3 Overhead and surrounding the study area, uncontrolled airspace below FL 195 is sub-divided into areas with the following aviation stakeholder responsibility.

- NATS: provide an ATS at some airports in the UK and provide air traffic services to traffic en-route (overflying or flying between airports) in UK airspace. NATS operate a number of long-range PSRs and SSRs positioned to provide maximum coverage of UK airspace.
- Anglia Radar: based at Aberdeen Airport and employing NATS PSRs and SSRs, has its area of responsibility established for the provision of ATS to commercial air traffic (CAT) helicopter operations that support the offshore Oil & Gas Industry, from the surface up to FL 65 (approximately 6,500 ft);
- Military En-route Area Control: Military air traffic controllers sitting alongside their civilian colleagues at Area Control Centres (ACC) utilise NATS radar for the provision of ATS to aircraft flying outside of CAS above FL 100 within radar/radio coverage. NATS have a contracted responsibility to provide appropriate PSR coverage to support this task; and
- Ministry of Defence (MOD) Air Surveillance and Control System (ASACS): uses its Air Defence Radar (ADR) resources in support of operational flights within UK airspace and for training exercises.

[1] Flight Level – used to ensure safe vertical separation between aircraft which are operating above the transition altitude. Above the transition attitude the aircraft altimeter pressure setting is normally set to a standard pressure setting and altitudes expressed as a Flight Level.

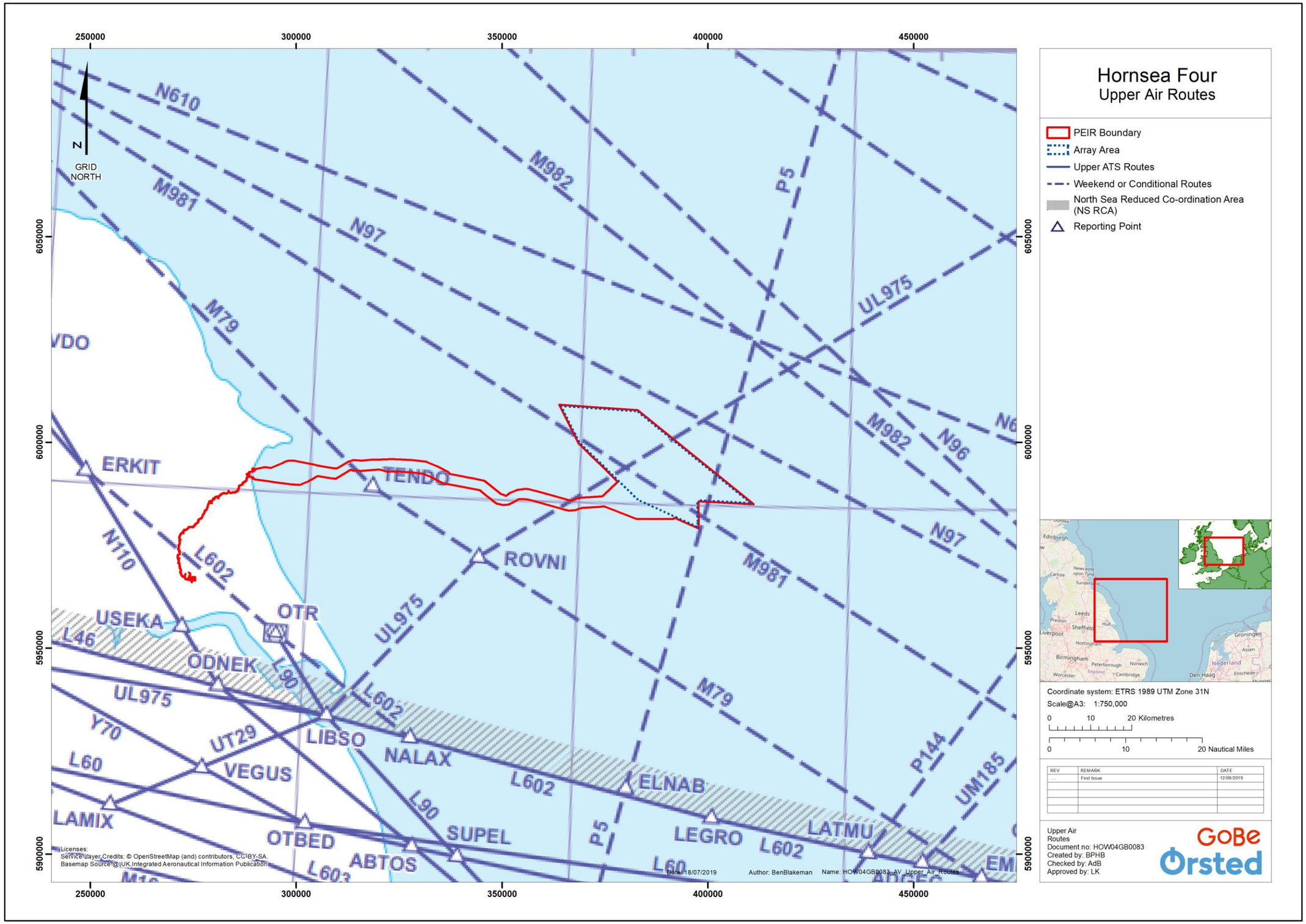


Figure 2: Upper Air routes above the study area (not to scale). Extract reproduced from CAA digital map data. © Crown copyright 2019 UK IAIP ENR.

3.1.2 NATS

3.1.2.1 The CAA, through CAP 764 (CAA, 2016), advises that a range of 24 km between a wind farm and a SSR system should be used as the trigger point for further discussions with the appropriate service provider who can make a more detailed, accurate assessment of the likely effect of the wind farm project on their SSR. It is important to note that the Hornsea Four array area is in excess of 110 km from any SSR facility at its nearest point, therefore no impact is expected on SSR systems.

3.1.2.2 NATS En Route Ltd (NERL) use PSRs based in North Lincolnshire (Claxby) and Norfolk (Cromer) to support their provision of ATS to aircraft operating between the UK and mainland Europe, and to those overflying the UK Flight Information Region (FIR) near the study area. Cromer has been included within the assessment to establish if the potential for radar detectability of the Hornsea Four wind turbines is theoretically possible.

3.1.2.3 The layout of wind turbines for Hornsea Four has not yet been finalised. Therefore, to facilitate the radar LOS analysis between radar systems, an evenly spread grid placement of the 370 metres (m) blade tip wind turbines with in the Hornsea Four array area has been assumed. Figure 3 provides the theoretical results of the radar LOS analysis from the Claxby PSR to wind turbines of a blade tip of 370 m placed within the Hornsea Four array area.

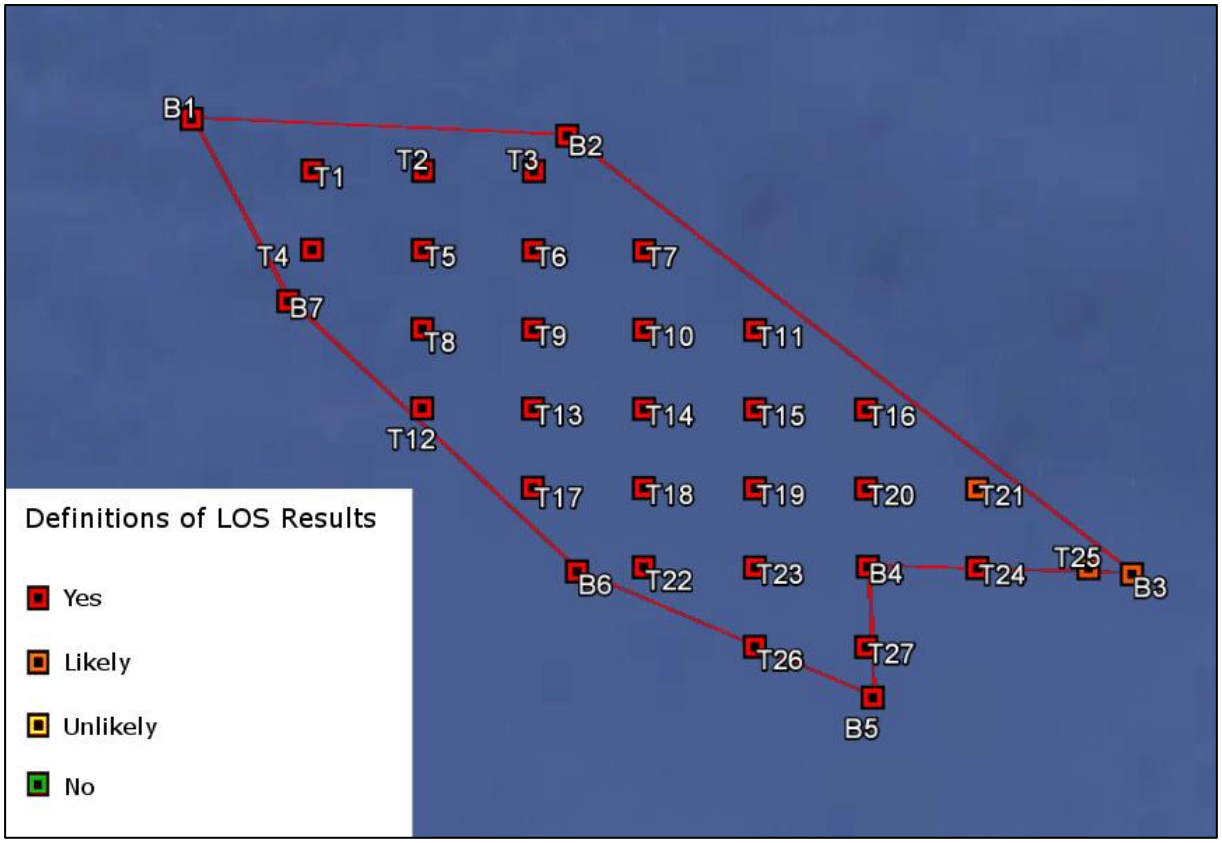


Figure 3: LOS results Claxby PSR at a turbine height of 370m.

3.1.2.4 The results of the LOS analysis indicate that wind turbines of 370 m within Hornsea Four array area are, theoretically, highly likely (definition as stated in Table 1) to be detectable

by the Claxby PSR system which therefore presents the potential to create unacceptable radar clutter on NATS (and other users) radar screen displays.

3.1.2.5 NATS have completed a Technical and Operation Assessment (TOPA) (NATS 2018), the results of which agree with the Osprey analysis provided in **Figure 3**. The NATS TOPA also provided results of a radar LOS analysis at 370 m blade tip wind turbines from the Cromer PSR to the study area which indicates that there will be no detection of 370 m blade tip wind turbines contained within the study area from this radar system.

3.1.3 MOD Radar systems

3.1.3.1 The MOD, through the ASACS Force, is responsible for compiling a Recognised Air Picture (RAP) to monitor the airspace in and around the UK in order to launch a response to any potential airborne threat. This is achieved through the utilisation of a network of long-range ADR, some of which are located along the east coast of the UK. Any effect of wind turbines on the ASACS radars that serve the airspace above the Hornsea Four array area has the potential to reduce the capability of the ASACS Force.

3.1.3.2 ASACS radar resources are also used in support of training and exercises on an almost daily basis. A network of Managed Danger Areas (MDAs) are established over the North Sea; within the lateral and vertical confines of the MDAs, air combat training, high energy manoeuvres and supersonic flight can be expected. **Figure 4** provides an illustration of the study area within the lateral boundary of D323D.

3.1.3.3 It is important to note that when the MDAs are not required for specific military training or exercise use, the airspace is then available for use for Civil and Military En-route operations.

3.1.3.4 The Southern MDA is located above the North Sea; EG D323D (an element of the Southern MDA) is located directly above the Hornsea Four array area, and when active, operates from FL 50 up to FL 660.

3.1.3.5 The MOD currently has the capability of utilising two ADR systems in the region of the study area; the Trimingham ADR, situated in North Norfolk and the Brizlee Wood ADR located in Northumberland, both of which have an operational range of 400 km. Previously an additional ADR system was located at Staxton Wold. The presence of and functionality of this radar is unconfirmed. Should further information pertaining to Staxton Wold be made available from the MOD, the LOS analysis and assessments will be updated accordingly.

3.1.3.6 A radar LOS analysis has been completed for these three ADR positions for the Maximum Design Scenario (MDS) of wind turbines located in the Hornsea Four array area (**Figure 5**). Further details of the MDS for aviation impacts is presented in **Volume 2, Chapter 9: Aviation and Radar**. The results indicate that, theoretically, the Brizlee Wood ADR would not detect the maximum 370 m blade tip wind turbines.

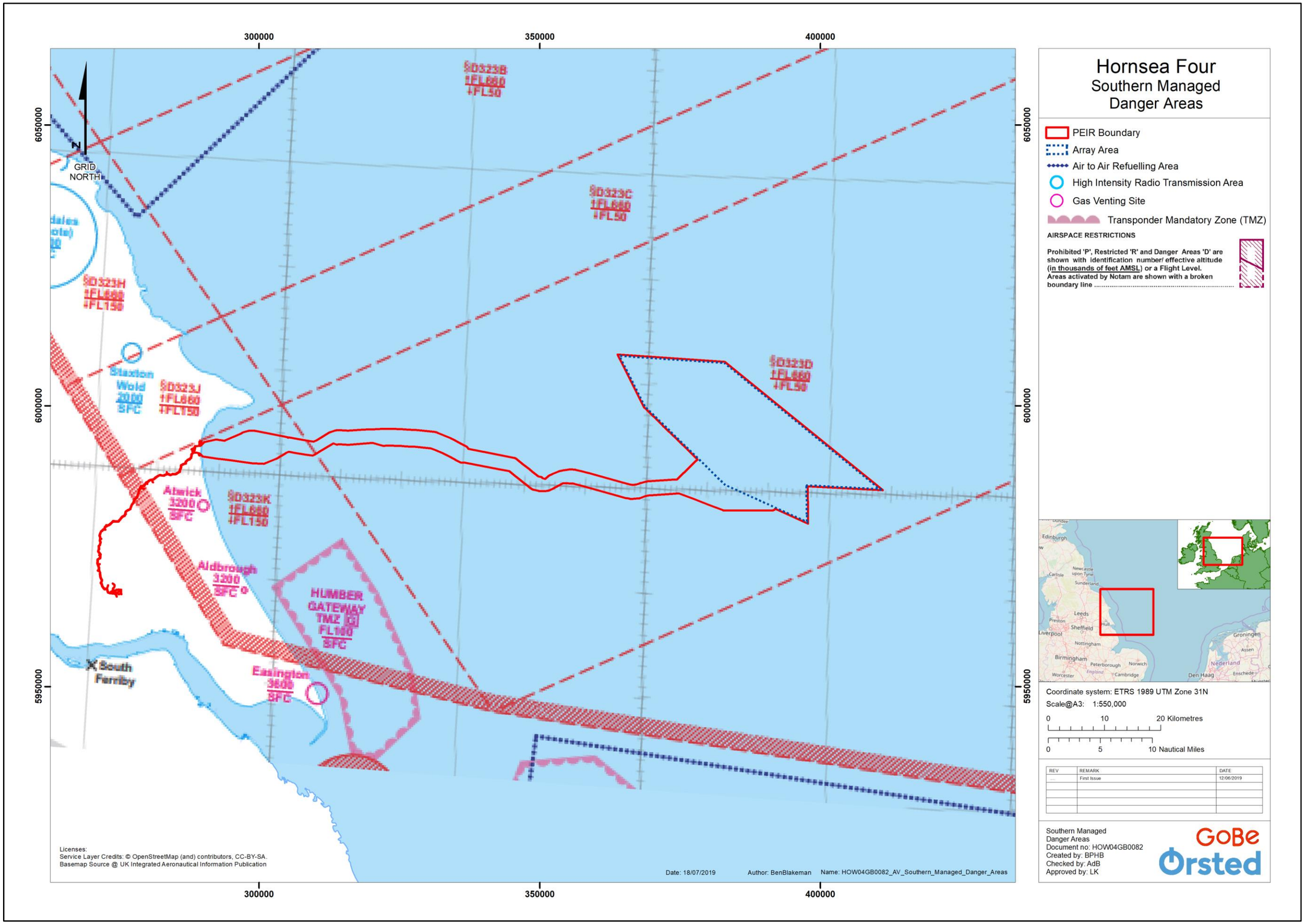


Figure 4: Southern Managed Danger Areas (not to scale). Extract Reproduced from CAA digital map data © Crown copyright 2019 UK IAIP ENR.

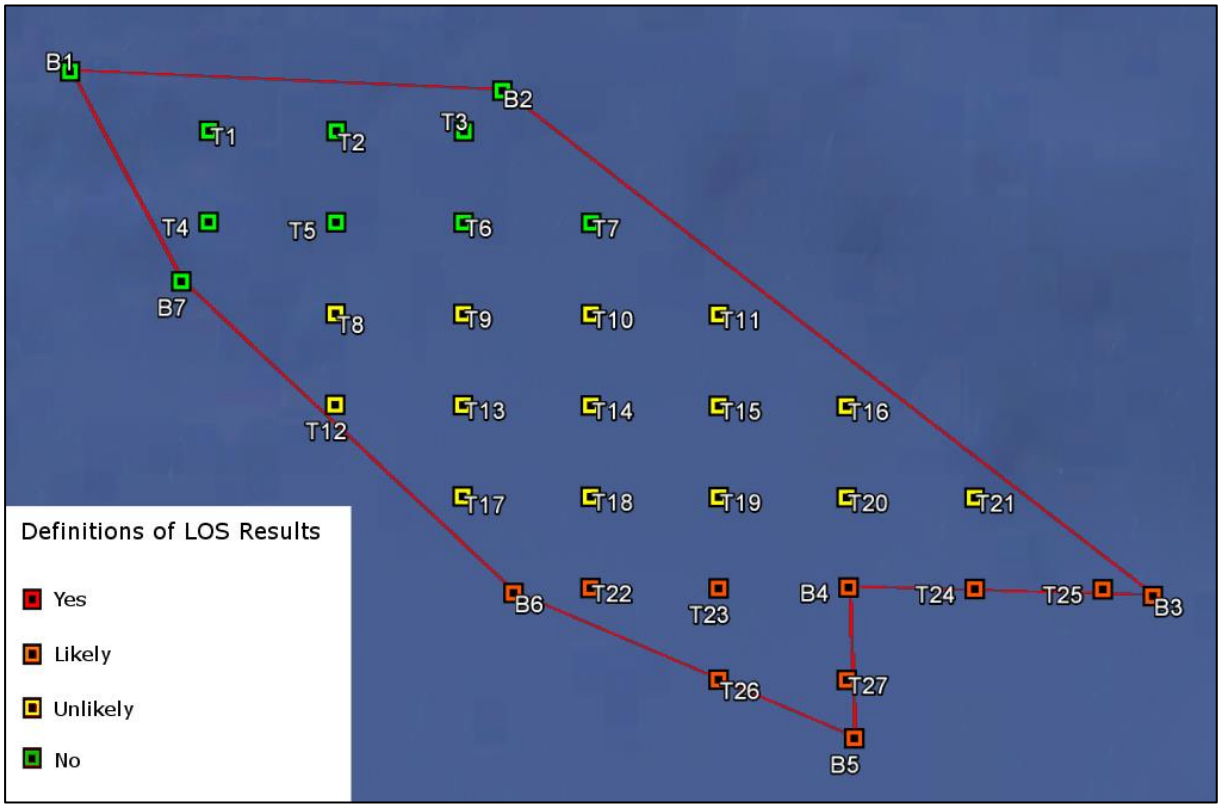


Figure 5: LOS Results Trimingham ADR at a blade tip of 370 m.

3.1.3.7 The results of the LOS analysis for the Trimingham ADR are mixed and are provided at Figure 5. This indicates that wind turbines with a blade tip height of 370 m located within the southern part of the Hornsea Four array area (T22-T27 inclusive, as indicated in Figure 5) will be, theoretically, detectable by the Trimingham ADR leading to potential interference to the radar system whilst areas further north within the array will be unlikely to or will not be detectable.

3.1.3.8 During June 2016, the MOD provided an update on MOD Air Defence Radar Mitigation (MOD 2019a) which stated that *"the MOD has continued to work with wind farm developers where it has been able to mitigate the risk of wind farms impacting on the MOD's ability to meet operational requirements"*. The MOD has also conducted 2 trials regarding the impact of specific wind farms on specific ADR systems that have provided further evidence on which the MOD base their understanding of the current issue. The MOD are working with industry to resolve the current issues and supporting the Government to mitigate all risks to military air surveillance capabilities.

3.1.4 Offshore Helicopter Operations

Helicopter Main Routes (HMRs)

3.1.4.1 A network of HMRs are established near the aviation and radar study area to support the transport of personnel and material to offshore oil and gas installations. Figure 6 provides the location of the study area and adjacent HMRs.

3.1.4.2 HMR 4 routes from the North Norfolk coast, clipping the study area to the east towards to/from the Trent platform; whilst HMR 8 which routes from the Lincolnshire coast to the Munro Platform, bisects the study area.

3.1.4.3 When operating under Instrument Flight Rules (IFR), helicopters require a Minimum Safe Altitude (MSA) of 300 m (984 ft) height clearance from obstacles within 1 NM of the aircraft, which would indicate that whilst operating above the physical obstruction of the wind turbines, offshore helicopters would be required to fly at 2,300 ft amsl (1,213 ft (370 m) plus 1000 ft rounded up to nearest 100 ft). When operating under VFR and visual Meteorological Conditions (VMC), helicopters will route direct to their destination point and require a minimum of 500 ft separation from obstacles.

3.1.4.4 Many wind turbines beneath an HMR could result in helicopters flying higher in order to maintain a safe vertical separation from those wind turbines beneath the route. However, this option is not available on days of low cloud base when the icing level is below 2,000 ft due to the risk of ice aggregation on the aircraft. The proliferation of wind turbines, whether close to an HMR or not (as some offshore installations are located away from the HMR system), could restrict the pilot's freedom to manoeuvre when conditions are not ideal.

3.1.4.5 An HMR is not a mandatory routing for helicopter operators offshore. Where ATC coverage is less comprehensive (as in the Northern North Sea, northeast of Aberdeen), flights are more likely to be conducted along HMRs. The region covered by the current study area is, however, served by radar coverage and provision of ATC services by Anglia Radar to aircraft operating offshore; where this is the case helicopter flights are likely to be provided a direct routing to their offshore destination.

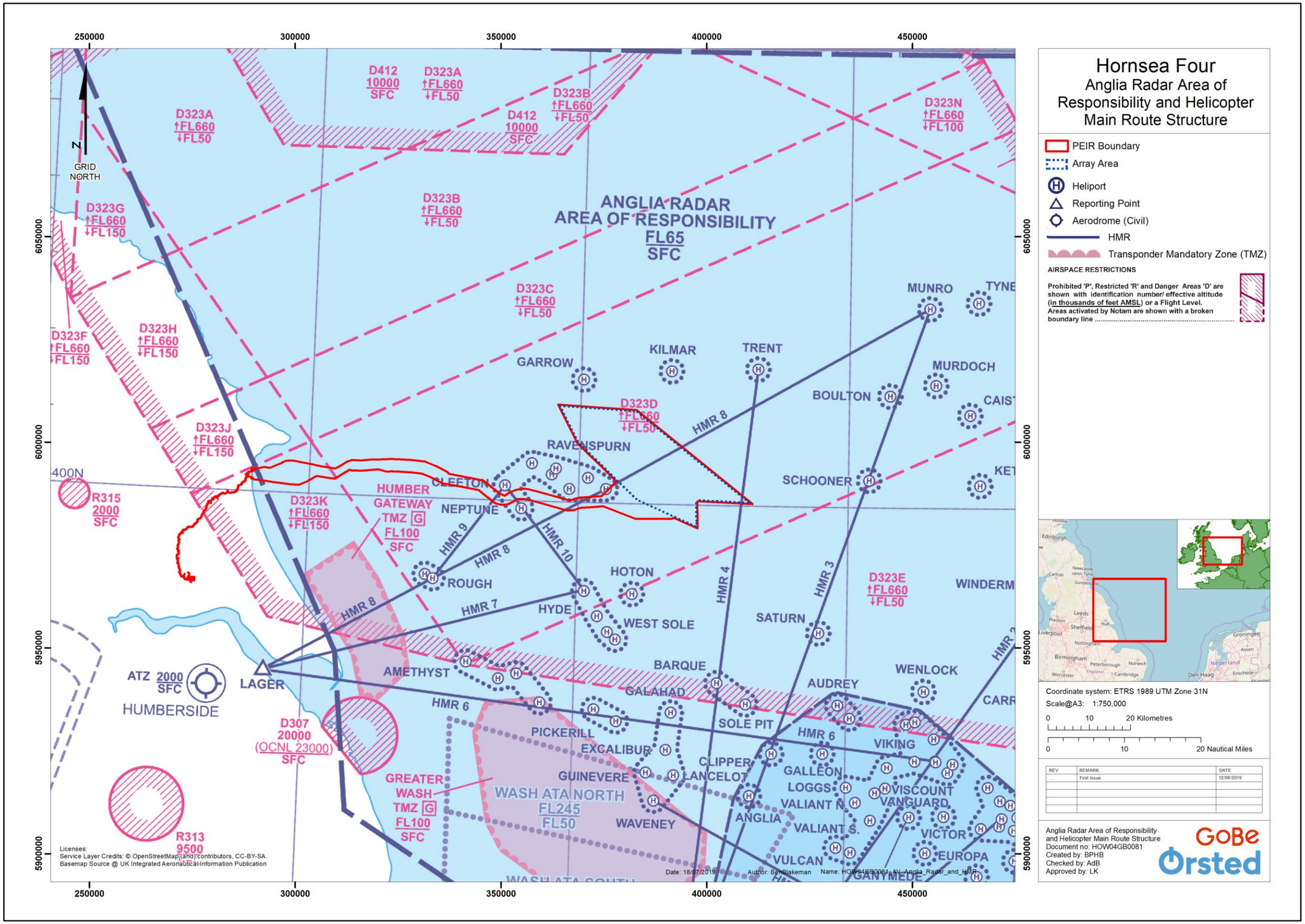
Helicopter Operations at Offshore Platforms

3.1.4.6 CAP 764 (CAA, 2016) provides for a 9 NM radius consultation zone around offshore installations; this consultation zone is not considered a prohibition on wind turbine development but a trigger for consultation between the platform operators, the offshore helicopter operators, the operators of existing installations and the wind farm developer to determine a solution for wind turbine positioning that would maintain safe offshore helicopter operations. Individual 9 NM consultation zones for several installations will extend across the Hornsea Four array area. Figure 7 provides the location of the aviation and radar study area and oil and gas platforms within 9 nm of the array area.

3.1.4.7 The basic requirement of the 9 NM consultation zone is to provide airspace for the safe operation of helicopter instrument approaches and Missed Approach Procedures (MAP), in poor weather conditions where a low visibility approach profile is needed to a platform.

3.1.4.8 Helicopters which operate to and from offshore platforms (installations) are fitted with weather radar which can be used to conduct an instrument approach in poor visibility. Airborne Radar Approaches (ARA) are used as a low-visibility approach procedure to the platforms and rely upon the on-board weather radar for obstacle detection and navigation. The radar is designed to display weather phenomena, such as rain, but can display obstacles such as the Oil and Gas platforms, or wind turbines. In Instrument Meteorological Conditions (IMC), in certain wind conditions, which dictate the direction of approach to the platform, a standard ARA procedure might not be available due to the proximity of wind turbines to the approach track.

3.1.4.9 It can be generally assumed that offshore support helicopters will be able to fly an ARA from any direction if the wind speed is below 2.5 m per second (m/s) (5 knots (kt). The prevailing winds in the southern North Sea are south-westerly; it is possible in some wind conditions that ARAs would be required to take place, to offshore platforms, over the Hornsea Four array area.



Hornsea Four
Anglia Radar Area of Responsibility and Helicopter Main Route Structure

- PEIR Boundary
- Array Area
- Heliport
- Reporting Point
- Aerodrome (Civil)
- HMR
- Transponder Mandatory Zone (TMZ)

AIRSPACE RESTRICTIONS

Prohibited 'P', Restricted 'R' and Danger Areas 'D' are shown with identification number/ effective altitude (in thousands of feet AMSL) or a Flight Level. Areas activated by Notam are shown with a broken boundary line .....

Coordinate system: ETRS 1989 UTM Zone 31N
Scale@A3: 1:750,000
0 10 20 Kilometres
0 10 20 Nautical Miles

REV	REMARK	DATE
-	First Issue	12/06/2019

Anglia Radar Area of Responsibility and Helicopter Main Route Structure
Document no: HOW04GB0081
Created by: BPHB
Checked by: AdB
Approved by: LK

GoBe Ørsted

Figure 6: HMR Route Structure - Southern North Sea (not to scale). Extract Reproduced from CAA digital map data © Crown copyright 2019 UK IAIP ENR.

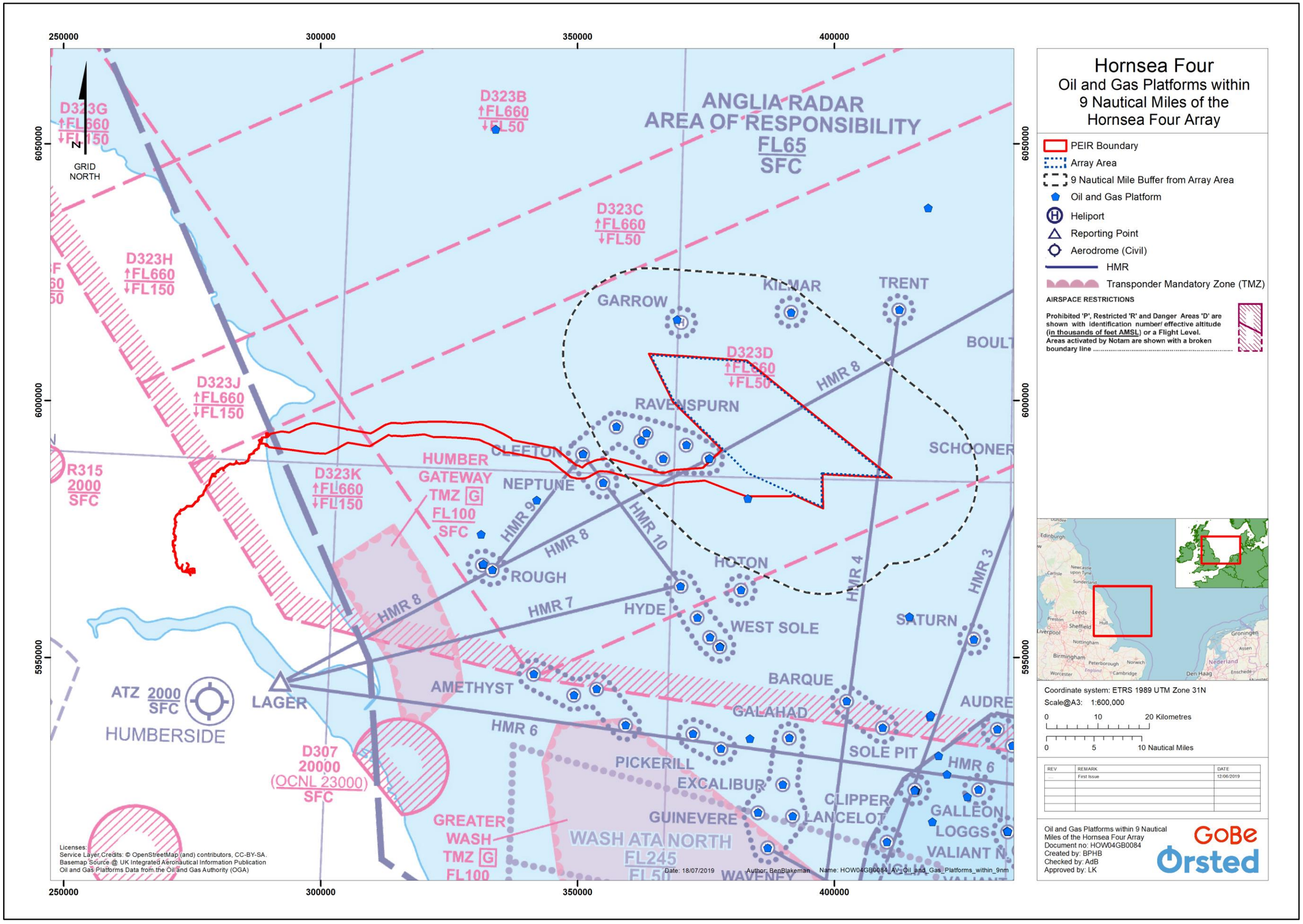


Figure 7: Oil and Gas Platforms in the location of the study area (not to scale). Extract Reproduced from CAA digital map data © Crown copyright 2019 UK IAIP ENR.

4 Other Aviation Considerations

4.1.1 Military ATC Radar

4.1.1.1 Military Air Traffic Management (ATM) is supported by Military ATC radars. These are typically standard airfield ATC radars with an instrumented range of 60 NM.

4.1.1.2 Analysis of the study area boundary and preliminary parameters (assuming 370 m wind turbine height) predicts that wind turbines would not be detectable by any aerodrome based Military ATC PSRs.

4.1.2 Military Low Flying Operations

4.1.2.1 The military UK Low Flying System (UKLFS) covers the open airspace of the whole UK land mass (excluding certain areas of dense urban conurbation) and surrounding sea areas out to 2 NM from the UK coast, from the surface to 2,000 ft agl or amsl; however, military low flying may be conducted beyond this area over the sea.

4.1.2.2 Notification through publication of the wind farm location in appropriate documentation together with the fitting of aviation lighting to wind turbines will mitigate the impact to military low flying activities.

4.1.2.3 The requirements for the lighting of wind turbines are contained in Article 223 of CAP 393 *The Air Navigation Order (2016) and Regulations* (CAA 2019).

4.1.2.4 For other offshore developments, the MOD have requested that offshore platforms are fitted with specific aviation lighting to maintain safety to military aviation activities.

4.1.3 Military Practice and Exercise Areas (PEXA)

4.1.3.1 Military PEXAs are areas available for training use primarily by the UK armed forces but also those of overseas nations. They can be over land or water, or both, and may involve the firing of live ammunition.

4.1.3.2 The study area is located below a PEXA known as the southern MDA which is established from FL 50 to FL 660. **Figure 4** provides an illustration of the study area within the lateral boundary of MDA D323D. Due to the base height of the MDA airspace, no physical obstruction is expected to be created to operations conducted in this MDA or other PEXAs.

4.1.4 Meteorological Radar

4.1.4.1 The Meteorological (Met) Office radar infrastructure is safeguarded by the MOD. Its weather radar network currently consists of 16 sites. The Met Office employs wind turbine safeguarding guidelines that may result in an objection for any development within 20 km of any affected weather radar.

4.1.4.2 Analysis of the study area and wind turbine parameters concludes that there are no weather radar stations within 20 km of the study area and therefore no impact on the Met Office radar capability is predicted.

4.1.5 Airborne Search and Rescue Operations

4.1.5.1 When on an operational mission, SAR aircraft are not constrained by the normal rules of the air, and operate in accordance with their Aircraft Operator Certificate (AOC). This allows SAR pilots total flexibility to manoeuvre using best judgement thus making them highly adaptable to the environment in which they are operating.

4.1.5.2 An Emergency Response Co-operation Plan (ERCoP) will be in place for the construction, operation and decommissioning phases of Hornsea Four. The ERCoP is completed initially in discussion between the developer and the Maritime and Coastguard Agency (MCA); SAR and Navigation Safety Branches.

4.1.5.3 Detailed completion of the plan will then be in cooperation with the Maritime Rescue Coordination Centre (MRCC), responsible for maritime emergency response. The ERCoP must then be submitted to, and approved by, the Marine Management Organisation (MMO) in consultation with the MCA. The ERCoP will detail specific marking and lighting of the wind turbines. The SAR helicopter bases will be supplied with an accurate chart of the Hornsea Four wind turbine Global Positioning System (GPS) positions.

4.1.5.4 The requirements for the lighting of wind turbines are contained in Article 223 of CAP 393 *The Air Navigation Order (2016) and Regulations* (CAA 2019).

5 Baseline Conclusions

5.1.1.1 NATS utilise the Claxby PSR to support their provision of ATS to aircraft operating between the UK and mainland Europe, and to those overflying the UK across the region of the study area. Additionally, Anglia Radar, based at Aberdeen Airport also employs NATS radar to support its ATS provision to aircraft of the Oil and Gas Industries within the lateral confines of its area of responsibility over the southern North Sea. A NATS TOPA was completed by NATS which predicted an unacceptable impact to the PSR caused by the radar detectability of the wind turbines.

5.1.1.2 The MOD through the ASACS Force is responsible for compiling a RAP to monitor the airspace in and around the UK in order to launch a response to a potential airborne threat. This is achieved through the utilisation of a network of long-range ADR. Any identified effect of wind turbines on ASACS radars that serve the airspace above the study area will reduce the capability of the ASACS force. Impact is predicted to the Trimingham ADR.

5.1.1.3 A network of HMRs is established to support the transport of personnel and materiel to offshore oil and gas installations; HMRs 4 and 8 cross through the study area.

5.1.1.4 In addition, a 9 NM radius consultation zone around each offshore oil and gas installations is established to allow for the safe operation of helicopter instrument approaches to and from platforms in poor weather conditions. The individual consultation zones of several offshore platforms extend across the study area. Normal helicopter operations, in accessing platforms using ARA, could be restricted due to poor inflight visibility and wind speed for a limited period of time during a year. The extent of this effect can be defined; however, the temporary nature of the effect will vary on a case by case basis.

5.1.1.5 Analysis of the study area and preliminary wind turbine parameters predicts that the Hornsea Four wind turbines would not be detectable by any aerodrome based Military ATC PSRs. Once notification procedures and lighting fitment is completed no impact is predicted to military low flying operation or activity in PEXAs.

5.1.1.6 Analysis of the study area and preliminary wind turbine parameters concludes that there are no weather radar stations within 20 km of Hornsea Four study area and therefore no impact on the Meteorological Office radar capability is predicted.

5.1.1.7 Live (operational) SAR operations are not constrained by the rules of the air and operate in accordance with the SAR AOC. This allows SAR pilots total flexibility to manoeuvre using best judgement thus making them highly adaptable to the environment in which they are operating.

5.1.1.8 An ERCoP will be in place for the construction, operation and decommissioning phases of Hornsea Four.

6 References

Civil Aviation Authority (2016) CAP 764 Policy and Guidelines on Wind Turbines.

Civil Aviation Authority (2019) CAP 393 The Air Navigation Order (2016) and Regulations.

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