

MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Preliminary Environmental Information Report

Volume 2, chapter 16: Aviation and radar



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Final

Image of an offshore wind farm

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Prepared by:	Prepared for:
RPS	Morgan Offshore Wind Ltd.

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Glossary

Term	Meaning
Controlled airspace	Airspace in which Air Traffic Control exercises authority. In the UK, Class A, C, D and E airspace is controlled. Within controlled airspace flights are subject to air traffic control service with standard separation maintained between aircraft.
Flight Level	A standard nominal altitude of an aircraft, in hundreds of feet, based upon a standardised air pressure at sea-level.
Helicopter Main Route Indicator (HMRI)	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).
Instrument Approach	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.
Instrument Flight Rules (IFR)	The rules governing procedures for flights conducted on instruments.
Instrument Meteorological Conditions (IMC)	Weather conditions which would preclude flight by the Visual Flight Rules (VFR) (i.e. conditions where the aircraft is in or close to cloud or flying in visibility less than a specified minimum).
Minimum Safe 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.
Radar shadow	A region shielded from radar illumination by an intervening object (e.g. a wind turbine).
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. Aircraft operating in uncontrolled airspace may be in receipt of an ATS; however, within this classification of airspace, pilots are ultimately responsible for their own terrain and obstacle clearance.
Visual Flight Rules (VFR)	The rules governing flight conducted visually (i.e. with the crew maintaining separation from obstacles and other aircraft visually).
Visual Meteorological Conditions	A flight category which allows flight to be conducted under Visual Flight Rules (VFR) defined by in flight visibility and clearance from cloud

Acronyms

Acronym	Description
ACC	Area Control Centre
AGL	Above Ground Level
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
AMSL	Above Mean Sea Level
ANO	Air Navigation Order

Acronym	Description
APDO	Approved Procedure Design Organisation
ATC	Air Traffic Control
ATE	Air Traffic Engineering
ATDI	Advanced Topographic Development and Imaging
ATS	Air Traffic Service
BAE	British Aerospace
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAS	Controlled Airspace
CCS	Carbon Capture and Storage
cd	Candela
CNS	Communication Navigation and Surveillance
DCO	Development Consent Order
DGC	Defence Geographic Centre
FIR	Flight Information Region
HAR	Helicopter Access Report
HMRI	Helicopter Main Route Indicators
IAIP	Integrated Aeronautical Information Package
IFP	Instrument Flight Procedures
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
IoM	Isle of Man
IPC	Infrastructure Planning Commission
LARS	Lower Airspace Radar Service
LAT	Lowest Astronomical Tide
LoS	Line of Sight
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MilAIP	Military Aeronautical Information Publication
MOD	Ministry of Defence
MSA	Minimum Safe Altitude
NERL	NATS En-Route Limited

MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Acronym	Description
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
OREI	Offshore Renewable Energy Installations
OSP	Offshore Sub-station Platform
PDE	Project Design Envelope
PEI	Preliminary Environmental Information
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Areas
PSR	Primary Surveillance Radar
RAF	Royal Air Force
RCS	Radar Cross Section
RDDS	Radar Data Display Screen
RDP	Radar Data Processor
SAR	Search and Rescue
SSR	Secondary Surveillance Radar
TOPA	Technical and Operational Assessment
UKCS	UK Continental Shelf
UKLFS	UK Low Flying System
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

Units

Unit	Description
ft	Feet
km	Kilometre
m	Metre
nm	Nautical mile
yd	Yard

16 Aviation and radar

16.1 Introduction

16.1.1 Overview

16.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the assessment of the potential impact of the Morgan Offshore Wind Project Generation Assets (hereafter referred to as the Morgan Generation Assets) on aviation and radar. Specifically, this chapter considers the potential impact of the Morgan Generation Assets offshore during the construction, operations and maintenance, and decommissioning phases.

16.1.1.2 This chapter has been written by Osprey Consulting Services Ltd (Osprey), with the assessment undertaken with specific reference to the relevant legislation and guidance and draws upon information within volume 4, annex 16.1: Aviation and radar technical report of the PEIR, which contains:

- Appendix A, Helicopter Access Report (HAR) (Anatec, 2022), which details access to current Irish Sea (Liverpool Bay) oil and gas installations (platforms) near the Morgan Generation Assets
- Appendix B, Instrument Flight Procedures (IFP) assessment (Osprey, 2022) detailing published flight procedures of Irish Sea littoral aerodromes.

16.1.2 Purpose of chapter

16.1.2.1 The primary purpose of the PEIR is outlined in volume 1, chapter 1: Introduction of the PEIR. In summary, the primary purpose of an Environmental Statement is to support the Development Consent Order (DCO) application for the Morgan Generation Assets under the Planning Act 2008 (the 2008 Act). The PEIR constitutes the Preliminary Environmental Information (PEI) for the Morgan Generation Assets and sets out the findings of the Environmental Impact Assessment (EIA) to date to support the pre-application consultation activities required under the 2008 Act. The EIA will be finalised following completion of pre-application consultation and the Environmental Statement will accompany the application to the Secretary of State for development consent.

16.1.2.2 The PEIR forms the basis for statutory consultation which will last for 47 days and conclude on 4 June 2023 as outlined in volume 1, chapter 2: Policy and legislation of the PEIR. At this point, comments received on the PEIR will be reviewed and incorporated (where appropriate) into the Environmental Statement, which will be submitted in support of the application for Development Consent scheduled for quarter one of 2024.

16.1.2.3 This PEIR chapter presents an assessment of the potential impacts which may give rise to likely significant effects and

- Presents the existing environmental baseline established from desk studies and consultation
- Identifies any assumptions and limitations encountered in compiling the environmental information

- Presents an assessment of the potential impacts on aviation and radar arising from the Morgan Generation Assets, based on the information gathered and the analysis and assessments undertaken
- Presents any mitigation and/or monitoring measures identified which could prevent, minimise, reduce or offset the potential likely significant effects.

16.1.3 Study area

16.1.3.1 The aviation and radar study area (Figure 16.1) covers the aviation radar systems that provide radar coverage over the Morgan Array Area, and which may theoretically detect the highest wind turbine blade tip height of 324 meters (m) above Lowest Astronomical Tide (LAT). It has been defined on the basis of the Civil Aviation Authority (CAA) Civil Aviation Publication (CAP) 764 Policy and Guidelines on Wind Turbines (CAA, 2016a) consultation zones and criteria. Whilst not definitive, CAP 764 provides criteria for assessing whether any wind turbine development might have an impact on aviation related operations. Consideration of the potential for the Morgan Generation Asset wind turbines to impact on aviation receptors has been undertaken in accordance with the standard consultation distances stated in CAP 764. The aviation and radar study area is therefore defined in line with the CAP 764 consultation zones or criteria which considers the following:

- Within 30 kilometres (km) of an aerodrome with surveillance radar – although it is acknowledged that the distance quoted in CAP 764 (CAA, 2016a) can be greater than 30km dependent on a number of factors at individual aerodromes, including type and coverage of radar utilised. This has been considered in the assessment of radar effect:
 - Aerodrome radar to 75km
 - NATS en-route radar to 200km
- Offshore oil and gas platforms with helidecks that are located within a nine nautical mile (nm) CAA recommended 'consultation buffer' that surrounds the Morgan Array Area as considered in appendix A of volume 4, annex 16.1: Aviation and radar technical report of the PEIR
- Airspace coincident with published IFP to take into account an aerodrome's requirement to protect its IFPs
- Within 17km of a non-radar equipped licensed aerodrome with a runway of 1,100m or more. There are no such aerodromes within 17km of the Morgan Array Area.

16.1.4 Radar Line of Sight (LoS)

16.1.4.1 Radar detectable wind turbines can be a significant cause of radar false plots, or unwanted returns (clutter), as the rotating blades can trigger the Doppler threshold (e.g. minimum shift in signal frequency) of the Radar Data Processor (RDP) and therefore might be interpreted as aircraft targets. Additionally, the rotation of the wind turbine blades provides an indication to the radar system that the target acquired is moving and thus defeating Doppler processing techniques. This issue can be further compounded by a large number of wind turbines located together (i.e. the wind farm

as a whole) which leads to a cumulative effect over a greater volume of airspace with higher densities of radar clutter produced.

16.1.4.2 Generally, the larger a wind turbine the larger its Radar Cross Section (RCS) will be to the radar, thus resulting in more energy being reflected and an increased chance of it creating clutter. This clutter will be processed by the radar and presented to an air traffic controller on the Radar Data Display Screens (RDDS). False plots, clutter and reduced radar sensitivity may reduce the effectiveness of radar to an unacceptable level and compromise the provision of a safe radar service to participating aircraft and detection of aircraft targets. The generalised effects wind turbines have on radar systems are as follows:

- Twinkling appearance/blade flash effect can distract the air traffic controller from their primary task(s)
- Masking of real aircraft targets caused by increased clutter being displayed on the RDDS
- Increase in unwanted targets or false aircraft tracks
- Receiver saturation
- Target desensitisation causing loss of valid aircraft targets that are of a small RCS
- Shadowing behind the wind turbines caused by physical obstruction (blocking of radar transmitted signal)
- Degradation of target processing capability and processing overload
- Degradation of tracking capabilities including track seduction.

16.1.4.3 Without specific wind turbine mitigation processing capabilities, radar cannot distinguish between returns from wind turbines (false returns, or clutter) and those from aircraft. Air traffic controllers are required to assume that actual aircraft targets could be lost over the location of a wind farm. Furthermore, identification of aircraft under control could be lost or interrupted.

16.1.4.4 The aviation and radar study area (Figure 16.1) includes the Morgan Array Area and airspace between the Morgan Array Area and the UK mainland as follows:

- From the Ministry of Defence (MOD) West Freugh Primary Surveillance Radar (PSR) to the north of the Morgan Array Area to
- A point 30km west of the location of the Ronaldsway Isle of Man (IoM) Airport PSR to
- The location of the Royal Air Force (RAF) Valley PSR to the southwest of the Morgan Array Area to
- The location of the Clee Hill PSR to the southeast of the Morgan Array Area to
- The location of the Manchester Airport PSR to the southeast of the Morgan Array Area to
- The location of the Great Dun Fell PSR to the northeast of the Morgan Array Area to
- The location of the Lowther Hill PSR to the north northeast of the Morgan Array Area and back to the location of the MOD West Freugh PSR.

16.1.4.5 The cumulative aviation and radar study area (Figure 16.3), which includes other offshore wind farms in the north Irish Sea, is similar to the Morgan aviation and radar study area. Cumulative effects are considered in section 16.10.

MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

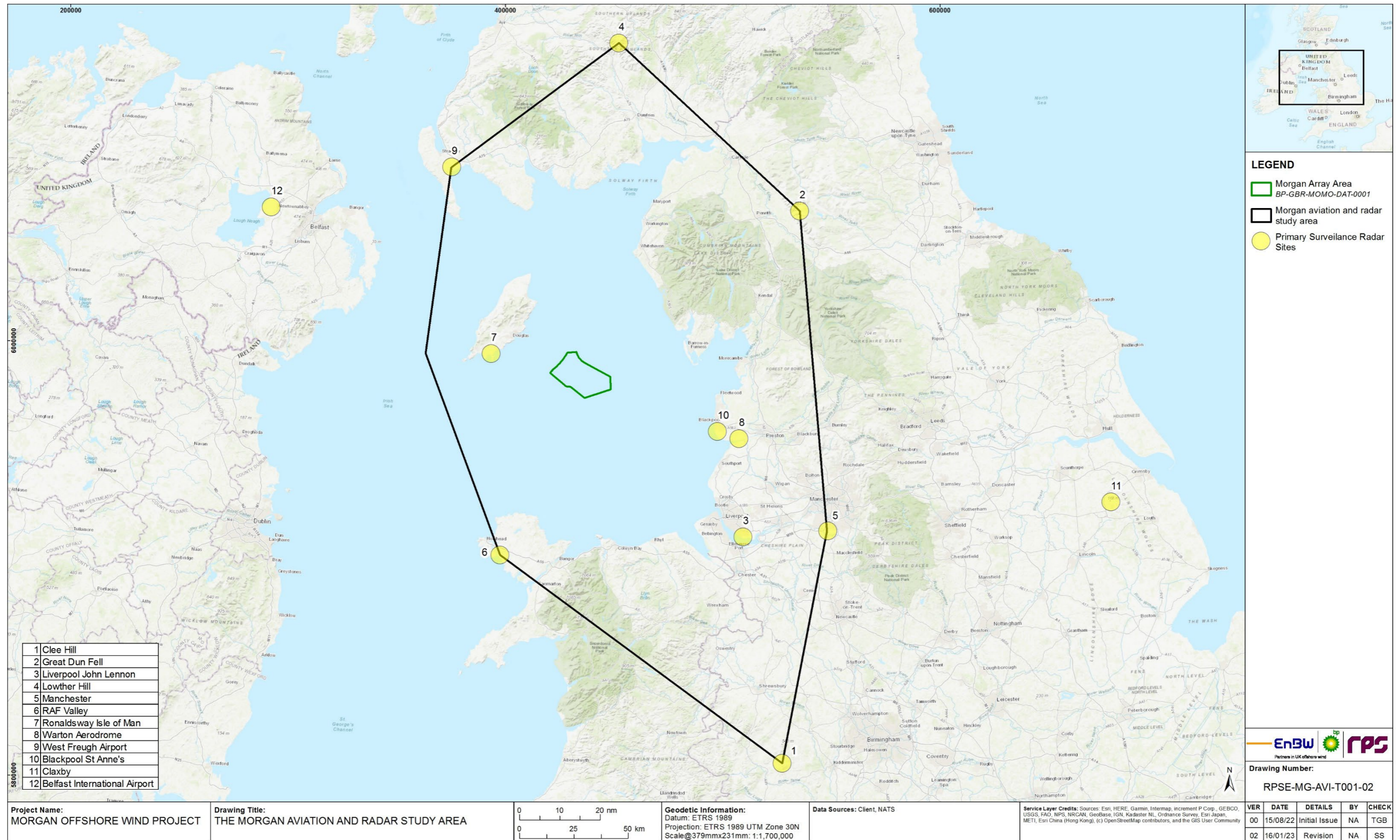


Figure 16.1: Aviation and radar study area.

16.2 Policy and legislative context

16.2.1 National Policy Statements

16.2.1.1 Planning policy on renewable energy infrastructure is presented in volume 1, chapter 2: Policy and legislation of the PEIR. Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to aviation and radar, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1; DECC, 2011a) and the NPS for Renewable Energy Infrastructure (EN-3, DECC, 2011b).

16.2.1.2 NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the assessment. These are summarised in Table 16.1 below. NPS EN-1 and NPS EN-3 also highlight a number of factors relating to the determination of an application and in relation to mitigation. These are summarised in Table 16.2 below.

16.2.1.3 Table 16.1 and Table 16.2 refer to the current NPSs, specifically NPS EN-1 (DECC, 2011a) and NPS EN-3 (DECC, 2011b). If the NPSs are updated prior to the application for Development Consent, the revised NPSs will be fully considered in relation to aviation and radar within the Environmental Statement.

Table 16.1: Summary of the NPS EN-1 and NPS EN-3 provisions relevant to aviation and radar.

Summary of NPS EN-3 and EN-1 provision	How and where considered in the PEIR
EN-1	
If the proposed development could have an effect on civil and military aviation (and/or other defence assets) an assessment of potential effects should be set out in the Environmental Statement.	Impacts arising from the construction, operations and maintenance and decommissioning phases of the Morgan Generation Assets have been assessed in section 16.8.
Consultation with the MOD, the CAA, NATS and any aerodrome - licensed or otherwise – likely to be affected by the proposed development should be completed.	A summary of consultation undertaken to date is presented in section 16.3.
Any assessment of aviation or other defence interests should include potential impacts of the project upon the operation of Communication, Navigation or Surveillance (CNS) infrastructure, flight patterns (both civil and military), other defence assets and aerodrome operational procedures. It should also assess the cumulative effects of the project with other relevant projects in relation to aviation and defence.	The assessment of civil and military aviation infrastructure is provided in section 16.8, and cumulative impacts within section 16.10.
EN-3	
Aviation and navigation lighting should be minimised to avoid attracting birds, taking into account impacts on safety.	Marking and lighting for aviation will be agreed post consent with the appropriate bodies including Trinity House, Maritime and Coastguard Agency (MCA), CAA and the MOD with regard of the relevant guidance outlined below. The requirement for approved marking and lighting post consent has been embedded in the project (Table 16.11).
Offshore Wind Projects will also need to assess impacts on civil and military radar and other aviation and defence interests.	Impacts on civil and military radar, and aviation and defence interests are assessed in section 16.8.

Summary of NPS EN-3 and EN-1 provision	How and where considered in the PEIR
Review of up-to-date research should be undertaken, and all potential mitigation options presented.	Mitigation is discussed in section 16.7.

16.2.1.4 In addition to the NPSs, there are a number of pieces of legislation, policy and guidance applicable to the assessment of aviation and radar.

Table 16.2: Summary of NPS EN-1 and NPS EN-3 policy on decision making relevant to aviation and radar.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the PEIR
The Infrastructure Planning Commission (IPC) should be satisfied that the effects on civil and military aerodromes, aviation technical sites and other defence assets have been addressed by the Applicant and that any necessary assessment of the proposal on aviation or defence interests has been carried out.	Civil and defence assets have been assessed in section 16.8.
If there are conflicts between the Government's energy and transport policies and military interests in relation to the application, the IPC should expect the relevant parties to have made appropriate efforts to work together to identify realistic and pragmatic solutions to the conflicts. In so doing, the parties should seek to protect the aims and interests of the other parties as far as possible.	Consultation activity is included within Table 16.3, mitigation is provided in section 16.7.
Where a proposed energy infrastructure development would significantly impede or compromise the safe and effective use of civil or military aviation or defence assets and or significantly limit military training, the IPC may consider the use of 'Grampian', or other forms of condition which relate to the use of future technological solutions, to mitigate impacts.	Civil and military aviation infrastructure of relevance is assessed in section 16.8.

16.2.2 Legislation

16.2.2.1 CAA CAP 393: The Air Navigation Order (ANO) (CAA, 2022). Sets out the provisions of the ANO as amended together with regulations made under the Order. It is prepared for those concerned with day-to-day matters relating to air navigation that require an up-to-date version of the air navigation regulations and is edited by the legal advisers' department of the CAA. CAP 393 also includes application of aviation obstruction lighting to wind turbines in UK territorial waters.

16.2.3 Guidance

16.2.3.1 The following documents provide aviation guidance:

- CAA CAP 168 Licensing of Aerodromes (CAA, 2022a): Sets out the standards required at UK licensed aerodromes relating to their management systems, operational procedures, physical characteristics, assessment and treatment of obstacles and visual aids

- CAA CAP 764 Policy and Guidelines on Wind Turbines (CAA, 2016a): Aids aviation stakeholders to help understand and address wind energy related issues thereby ensuring greater consistency in the consideration of the potential impact of proposed wind farm developments
- CAA CAP 437 Standards for Offshore Helicopter Landing Areas (CAA, 2021a): Provides the criteria applied by the CAA in assessing helicopter landing areas for worldwide use by helicopters registered in the UK. It includes design of winching area arrangements located on wind turbine platforms to represent current best practice
- CAA CAP 670 Air Traffic Services Safety Requirements (CAA, 2019): Sets out the safety regulatory framework and requirements associated with the provision of an Air Traffic Service (ATS)
- CAA CAP 032 UK Aeronautical Information Package (AIP) (CAA, 2022b): Contains information, updated every 28 days, which contains information of lasting (permanent) character essential to air navigation
- RenewableUK suggests that information regarding construction should be passed to the Defence Geographic Centre (DGC) (at dvof@mod.gov.uk) at least 10 weeks in advance of the obstacle type(s) erection detailing position, height (tip of arc) and type of aviation lighting. Once reported, all will be included in the DGC Obstruction database and all that meet aviation chart inclusion criteria will be published for broader awareness
- Appropriate information about the site construction and any associated lighting (where applicable), for example the height and temporary location of construction cranes, should be provided to the NATS Aeronautical Information Service (AIS) (for promulgation in applicable aviation publications including the UK Integrated Aeronautical Information Package (IAIP)).

16.3 Consultation

- 16.3.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to aviation and radar is presented in Table 16.3. Further detail is presented within volume 4, annex 16.1: Aviation and radar technical report of the PEIR.

Table 16.3: Summary of key consultation issues raised during consultation activities undertaken for the Morgan Generation Assets relevant to aviation and radar.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or were considered in this chapter
1 January 2022	NATS Technical and Operational Assessment	NATS informed that there will be a predicted impact to NATS St Anne's and Lowther Hill PSR systems created by the radar detection of the operational wind turbines and the creation of unwanted radar returns.	The impact to NATS infrastructure is considered in section 16.8.3.8.
29 March 2022	British Aerospace (BAE) Warton Email with letter attachment	Details of the project were provided which contained information regarding the position and development parameters of the windfarm together with an invite to provide any aviation related safeguarding comments on the Morgan Generation Assets. No response was received.	The impact to BAE Warton infrastructure is considered in section 16.8.3.11.
25 April 2022	Manchester Airports Group (MAG) Email	MAG requested the completion of an IFP assessment in order to establish that the IFP safeguarded areas will not be impacted by the Morgan Generation Assets.	The Applicant will commission an IFP assessment by a CAA Approved Procedure Design Organisation (APDO), the results of which will be available and included in the Environmental Statement.
4 May 2022	Noordzee Helikopters Vlaanderen (NHV) Email	NHV provide helicopter support to both Spirit Energy (including Harbour Energy) and ENI, who stated to NHV that impacts of varying degrees will be experienced by helicopter operations, completed in poor weather conditions, to their offshore hydrocarbon platforms due to the creation of obstacles.	The Applicant acknowledges the impact and is continuing to engage with those offshore hydrocarbon industries impacted. The HAR is provided in appendix A of volume 4, annex 16.1: Aviation and radar technical report of the PEIR.
6 May 2022	Liverpool Airport Email	Radar LoS analysis predicts that the Morgan Array Area will not be detectable by the Liverpool Airport PSR. In the response to engagement, the airport did not raise concerns regarding the potential for radar effect. The airport requested the completion of an IFP assessment in order to establish the IFP safeguarded areas will not be impacted by the Morgan Generation Assets.	Volume 4, annex 16.1: Aviation and radar technical report of the PEIR describes the method of radar LoS analysis and the results which predict that the Liverpool Airport PSR will not theoretically detect the operational wind turbines of the Morgan Generation Assets at a blade tip height of 324m above LAT. However, Liverpool Airport has requested a flight trial to establish effect to the Liverpool Airport PSR. During consequent consultation it was agreed that there was no requirement for a radar trial during permitting. The IFP assessment is provided in appendix B of volume 4, annex 16.1: Aviation and radar technical report of the PEIR.
14 July 2022	MOD Scoping Opinion	The MOD note that potential impact to BAE Warton and RAF Valley PSR systems should be considered in the Environmental Statement.	The impact to BAE Warton infrastructure is considered in section 16.8.3.11 Volume 4, annex 16.1: Aviation and radar technical report of the PEIR describes the method of radar LoS analysis and the results which predict that the RAF Valley PSR will not theoretically detect the operational wind turbines of the Morgan Generation Assets at a blade tip height of 324m above LAT; therefore, the RAF Valley PSR is not considered further. The impact to the West Freugh PSR is considered in section 16.8.3.10.
11 August 2022	Isle of Man Ronaldsway Airport Scoping Opinion	The Isle of Man Government welcomed that effect to Ronaldsway Airport will be taken into account as part of the EIA.	The impact to the Isle of Man Airport is considered in section 16.8.3.9.
20 January 2023	Isle of Man Ronaldsway Airport Online meeting	Ronaldsway Airport Air Traffic Control (ATC) asked for clarification of their stakeholder status to better understand their degree of involvement in the engagement process. The Applicant presented the approach to assessing affects and preliminary impact assessment results highlighting the need to engage further on potential mitigation options once the airport has reviewed the PEIR. Ronaldsway Airport agreed to further engagement post-PEIR and initiation of the Statement of Common Ground (SoCG) process, noting that the format and commercial aspects associated with further engagement were to be agreed. It was noted that the airport will hopefully soon be finalising a five year IFP update, review of procedures and ILS is also approaching completion and DME infrastructure will be changing, so this as a good opportunity to work together.	Stakeholder status was provisionally addressed in the meeting and followed up with a post-meeting note. Further meetings are proposed pre-PEIR submission to present the PEIR assessment, and a post-PEIR meeting to discuss the response to that. Next steps will be to map out the engagement process and SoCG.

16.4 Baseline environment

16.4.1 Desktop study methodology

16.4.1.1 Information on aviation and radar within the aviation and radar study area was collected through a detailed desktop review of existing studies and datasets as listed in Table 16.4 which also provides the summary of reports and sources utilised in the desktop study. The documents listed in section 16.2.1, and section 16.2.3 and the consultation responses provided in Table 16.3 informed the desktop study.

Table 16.4: Summary of key desktop reports and information sources.

Title	Source	Year	Author
CAA Visual Flight Rules Charts	NATS	2022	CAA/Ordnance Survey/NATS
MOD Military Aeronautical Information Publication (MilAIP)	MOD	2022	MOD
MCA Maritime Guidance Note (MGN 654) Safety of Navigation Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response.	MCA	2021	MCA

16.4.1.2 NATS Visual Flight Rules (VFR) Charts (CAA, 2022) are sectional aeronautical charts which are designed for visual navigation of slow to medium speed aircraft. The topographic information featured consists of a judicious selection of visual checkpoints used for flight under VFR.

16.4.1.3 The MOD MilAIP (MOD, 2022) contains information pertinent to aviation operations solely of a military nature. All users must use the Civil AIP in conjunction with the MilAIP, to attain the full aeronautical information coverage of the UK.

16.4.1.4 MGN 654 highlights issues that need to be taken into consideration when assessing the impact on navigational safety and emergency response (Search and Rescue (SAR)).

16.4.1.5 Osprey utilised the Advanced Topographic Development and Imaging (ATDI) ICS LT (Version 22.4.7 x64) tool to model the terrain elevation profile between the identified PSR systems and the Morgan Array Area. Otherwise known as a point-to-point radar LoS analysis, the result is a graphical representation of the intervening terrain and the direct signal LoS (considering earth curvature and radar signal properties). This is a limited and theoretical desk-based radar modelling study which is frequently used in order to establish the potential for individual wind farm developments to create an effect to aviation radar. However, there are unpredictable levels of atmospheric signal diffraction and attenuation within a given radar environment that can influence the probability of a wind turbine being detected. The analysis is designed to give an indication of the theoretical likelihood of a wind turbine being detected by the assessed

radar system. The qualitative definitions utilised in the radar LoS assessment are defined in Table 16.5.

Table 16.5: Qualitative definition of radar LoS.

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

16.4.1.6 Radar detectability of wind turbines does not automatically provide justification for an objection from radar stakeholders. Other factors will determine the nature and severity of the operational impact on the receptor, including:

- The consideration of airspace structure and classification in the wind turbine vicinity
- The operational significance of the airspace to the operator
- The range of the development from the radar source
- Aircraft traffic patterns and procedures
- The type of radar service provided to air traffic using the airspace.

16.4.1.7 No site-specific surveys have been undertaken to inform the EIA for aviation and radar. This is because sufficient data exists in the public domain.

16.4.2 Airspace designations

16.4.2.1 The Morgan Array Area would be located within a multi-layered area of lower, Class G uncontrolled airspace and higher, Class C and Class D Controlled Airspace (CAS). The division of airspace and rules applicable to uncontrolled airspace and CAS is provided within volume 4, annex 16.1: Aviation and radar technical report of the PEIR.

16.4.2.2 Within the airspace above and surrounding the Morgan Array Area a number of published IFPs are used for the sequencing of aircraft. An IFP is a published procedure used by aircraft flying in accordance with Instrument Flight Rules (IFR) which is designed to achieve and maintain an acceptable level of safety in operations and includes an instrument approach procedure, a standard instrument departure, a planned departure route and a standard instrument arrival.

16.4.2.3 Above and surrounding the Morgan Array Area, the Class G airspace is used by both military and civil registered aircraft. Aircraft operating in the vicinity of the Morgan Array Area observe the airspace rules dependent on the classification of airspace they are operating in and the type of ATS they are receiving as follows:

- RAF Valley, a flying station on Anglesey, provides a Lower Airspace Radar Service (LARS)¹ to participating aircraft up to FL 100 within uncontrolled airspace to a radius of 40nm from the radar position (Valley), as well as a radar based ATS to aircraft inbound and outbound from the airfield
- British Aerospace (BAE) Warton also provides a LARS to aircraft on request up to FL 100 within uncontrolled airspace operating within a 40nm radius of the radar position (Warton). Furthermore, Warton also provides a radar based ATS to aircraft participating in test and experimental flying within specific airspace and to aircraft operating to and from the airfield
- Military air traffic controllers located at the Swanwick Area Control Centre (ACC) utilise NATS radar for the provision of ATS to aircraft flying outside of and crossing CAS above FL 100 within radar and radio coverage
- Ronaldsway (IoM) Airport is the main airport located on the IoM, the airport has scheduled services to the UK and the Republic of Ireland. Air traffic services are provided by the airport by controllers utilising the IoM PSR for provision of radar-based ATC services to aircraft inbound and outbound from the airport and to aircraft operating within IoM CAS
- Liverpool Airport is an international gateway with scheduled domestic, European and inclusive tour destinations feeding the holiday market. Ryanair and Wizz Air airlines operate to numerous destinations throughout Europe. ATC at the airport utilise the airport PSR for provision of radar-based ATC services to aircraft inbound and outbound from the airport and to aircraft operating within proximity of the airport CAS
- Manchester Airport is an international airport which during 2021 was the third busiest in the UK. The airport comprises three passenger terminals and a cargo terminal and is the only airport in the UK other than London Heathrow Airport to operate two runways over 3,280 yards (yd) (2,999m) in length. ATC at the airport utilise the airport PSR for provision of radar-based ATC services to aircraft inbound and outbound from the airport and to aircraft operating within proximity of the airport CAS surrounding the airport.

16.4.2.4 In aviation and airspace terms, the world is divided into Flight Information Regions (FIRs) for the allocation of responsibility for the provision of ATS to aircraft. Within CAS, NATS En-route Limited (NERL) (which is a subsidiary of NATS) are the main ATS provider utilising several long-range PSR and Secondary Surveillance Radar (SSR)² systems positioned to provide maximum coverage of UK airspace. Additionally, NATS has a licence obligation to provide radar data to other remote aviation stakeholders (such as the MOD) to a high quality and performance standard for the benefit of UK aviation as a whole. Any effect that the Morgan Generation Assets might have on NERL radar systems must be considered both in terms of effect on the civilian en-route services and in the context of its remote users such as the MOD and airports. There are no SSR systems located within the CAA suggested radius where impact is expected (10km); therefore, SSR is scoped out from further analysis.

¹ LARS – is available to all aircraft flying outside of controlled airspace (CAS) up to FL 100 within the limits of radio and radar cover. The provision of LARS is at the discretion of the controllers concerned because they may be fully engaged in their primary tasks. Therefore, occasionally, the service may not be available.

16.4.3 Military low flying operations

16.4.3.1 The UK Low Flying System (UKLFS) used for military low flying activity generally covers the open airspace over the entire UK land mass and surrounding sea areas generally out to 2nm from the coastline, from the surface to 2,000ft AGL (above ground level) or AMSL (Above Mean Sea Level) however, military low flying activities are conducted further offshore.

16.4.4 Military Practice and Exercise Areas

16.4.4.1 Military Practice and Exercise Areas (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. Airborne activity in PEXAs may be affected by obstructions created by the physical presence of wind turbines. However, there are no PEXAs located within close enough proximity to the Morgan Array Area to create an effect and consequently there will be no direct obstruction created to airborne activities conducted in PEXAs. Effects on PEXAs are confined to possible interference with radar used in the provision of a radar service to aircraft operating in the PEXA due to detection of operational wind turbines by the radar and the production of radar clutter.

16.4.5 Helicopter Main Route Indicators

16.4.5.1 A network of Helicopter Main Route Indicators (HMRI) is established to the east and southeast of the Morgan Array Area to support the transport of personnel and material to offshore oil and gas installations. The CAA recommend that 2nm either side of the HMRI centreline be kept clear of obstacles; no HMRI cross the Morgan Array Area and they are located at sufficient distance not to be impacted by the operation of the Morgan Generation Assets.

16.4.6 Helicopter platform equipped oil and gas platforms

16.4.6.1 In order to help achieve a safe operating environment, a CAA recommended consultation zone of 9nm radius exists around offshore helicopter decks which are located on oil and gas platforms. This consultation zone is not considered a prohibition on wind farm development within a 9nm radius of offshore helicopter operations but a trigger for consultation between the platform operators, the offshore helicopter operators, the operators of existing installations and wind developers to determine a solution that will maintain safe offshore helicopter operations in the presence of the wind farm. The basic requirement of the 9nm consultation zone is to provide airspace for the safe operation of helicopter instrument approaches in poor weather conditions where a low visibility approach profile is needed. Appendix A of volume 4, annex 16.1: Aviation and radar technical report of the PEIR lists those offshore platforms which are located within 9nm of the Morgan Array Area and assesses access to current Irish

² SSR differs from PSR systems in that it transmits an interrogation requesting a dedicated response. CAA guidance (CAP 764, 2016a) states that SSR systems are typically affected when wind turbines are located less than 10km from the radar position.

Sea (Liverpool and Morecambe Bay) oil and gas installations (platforms) near the Morgan Generation Assets.

16.4.7 Instrument Flight Procedures

- 16.4.7.1 IFP design covers the planning of routes used by pilots and air traffic control from take-off to landing and is a complex and highly regulated process. All IFP design must be undertaken by an approved procedure designer that is authorised by the relevant State. In the UK, all IFP design must be undertaken in accordance with CAA requirements. Wind turbines placed in proximity to IFP may adversely affect IFP safeguarded areas which may result in individual IFP being no longer fit for purpose without mitigation being applied. Appendix B of volume 4, annex 16.1: Aviation and radar technical report of the PEIR assesses those Irish Sea littoral aerodromes' flight procedures which are within 50nm of the Morgan Generation Assets.
- 16.4.7.2 Figure 16.2 provides an illustration of the airspace construction surrounding the Morgan Array Area.

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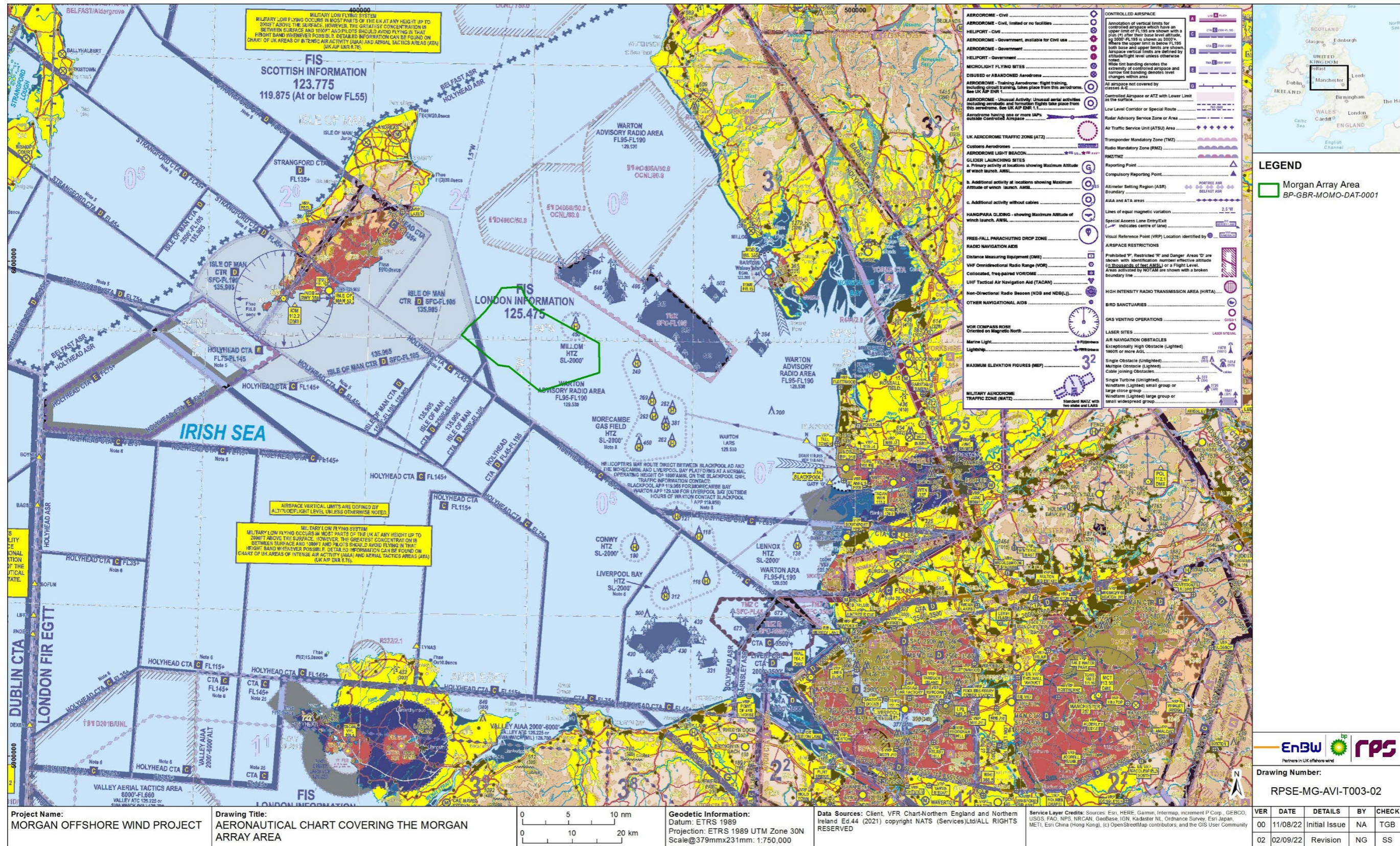


Figure 16.2: Aeronautical chart covering the Morgan Array Area.³

³ Data included in this product reproduced under licence from NATS (Services) Ltd © Copyright 2022 NATS (Services) Ltd. All rights reserved.

16.4.8 Radar Line of Sight

16.4.8.1 To inform the baseline, the radar LoS analysis has determined which radar systems have the potential to detect operational wind turbines at the maximum blade tip height placed within the Morgan Array Area. No wind turbine site layout is available at the time of writing; however, layout of wind turbines does not have a material effect on establishing if theoretical radar LoS is possible. Therefore, to enable the analysis, points of reference in the form of a regular grid pattern were established across the Morgan Array Area with turbines on all array vertices at the Maximum Design Scenario (MDS) blade tip height of 324m above LAT. Radar LoS analysis indicates theoretical detectability of the operational wind turbines placed in the Morgan Array Area at the maximum blade tip height of 324m above LAT by the following aviation PSR systems:

- Ronaldsway (IoM) Airport PSR
- NATS Lowther Hill PSR
- NATS St Anne's PSR
- MOD West Freugh PSR
- BAE Warton Airport PSR.

16.4.8.2 No other aviation PSR systems (including the RAF Valley PSR) will theoretically detect within the Morgan Array Area at a maximum blade tip height of 324m LAT. Volume 4, annex 16.1: Aviation and radar technical report of the PEIR provides the radar LoS analysis diagram results for individual radar systems.

16.4.9 Helicopter platform equipped oil and gas platforms

16.4.9.1 To inform the baseline, appendix A of volume 4, annex 16.1: Aviation and radar technical report of the PEIR has determined the extent to which the presence of wind turbines placed within the Morgan Array Area potentially affects helicopter access to (Liverpool and Morecambe Bay) oil and gas platforms. The assessment methodology to assess the operational impact has been accepted by helicopter operators and oil and gas platform owners/operators on several previous offshore wind farm development consents. The assessment indicates helicopter flight access (arrival and departure) restriction to the following platforms:

- Millom West Platform
- Conwy Platform
- Millom PLEM Wellhead
- Q1-3 Wellheads.

16.4.10 Instrument Flight Procedures

16.4.10.1 To inform the baseline, appendix B of volume 4, annex 16.1: Aviation and radar technical report of the PEIR, has determined the extent to which the presence of wind turbines placed in the Morgan Array Area, at the maximum blade tip height of 324m above LAT, potentially affects IFPs at the Irish Sea littoral aerodromes. The assessment indicates that IFPs at the following aerodromes would be affected:

- Ronaldsway (IoM) Airport

- RAF Valley
- BAE Barrow/Walney Island.

16.4.11 Future baseline scenario

16.4.11.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 require that "an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge" is included within the Environmental Statement. In the event that the Morgan Generation Assets does not come forward, an assessment of the future baseline conditions has been carried out and is described within this section.

16.4.11.2 It is difficult to define what the likely evolution of the aviation interests in the Irish Sea will be either with, or in the absence of the Morgan Generation Assets. The Oil and Gas Authority (OGA) Annual Report and Accounts (OGA, 2022) reported a predicted decline in gas production and usage. Operators continue to find it difficult to predict production accurately as older fields mature and their reliability reduces. The OGA have studied energy integration "in which a range of opportunities in the United Kingdom Continental Shelf (UKCS) which have the potential to make a very significant 30%+ contribution towards the UK's overall net zero target, both through Carbon Capture and Storage (CCS) and through CCS plus hydrogen. Offshore renewables (wind, wave and tidal) could well contribute a further 30%+ to the abatement required in 2050".

16.4.11.3 As old fields are decommissioned, helicopter use to those oil and gas platforms will decline; however, as helicopter support to offshore wind increases it is expected that there may be increased aviation activity as new offshore areas are developed to support net zero targets.

16.4.11.4 No change to the present airspace construction or usage above the Morgan Array Area is expected. Blackpool Airport have a desire to acquire an airport PSR, however, no further details are currently available.

16.4.12 Data limitations

16.4.12.1 The data used in this chapter is the most up to date publicly available information which can be obtained from the data sources as cited. Data has also been provided through consultation as detailed in Table 16.3 above.

16.4.12.2 The results of the LoS analysis are considered to be conservative in the establishment of results and are provided in order to establish the worst-case possibility of impact to aviation stakeholders. Radar LoS results are theoretical in nature however, analysis is based on an industry standard for establishing the impact to aviation radar systems from operational wind turbines and it is considered will not have an implication for the conclusions of the assessment.

16.5 Impact assessment methodology

16.5.1 Impact assessment criteria

16.5.1.1 The criteria for determining the significance of effects is a two-stage process that involves defining the magnitude of the impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in volume 1, chapter 5: EIA methodology of the PEIR.

16.5.1.2 The criteria for defining magnitude in this chapter are outlined in Table 16.6 below.

Table 16.6: Definition of terms relating to the magnitude of an impact.

Magnitude of impact	Definition
Major	Total loss of ability to carry on activities and/or impact is of extended physical extent and/or long-term duration (i.e. total life of project and/or frequency of repetition is continuous and/or effect is not reversible for project).
Moderate	Loss or alteration to significant portions of key components of current activity and/or physical extent of impact is moderate and/or medium-term duration (i.e. operational period) and/or frequency of repetition is medium to continuous and/or effect is not reversible for project phase.
Minor	Minor shift away from baseline, leading to a reduction in level of activity that may be undertaken and/or physical extent of impact is low and/or short to medium term duration (i.e. construction period) and/or frequency of repetition is low to continuous and/or effect is not reversible for project phase.
Negligible	Very slight change from baseline condition and/or physical extent of impact is negligible and/or short- term duration (i.e. less than two years) and/or frequency of repetition is negligible to continuous and/or effect is reversible.

16.5.1.3 The criteria for defining sensitivity in this chapter are outlined in Table 16.7 below.

Table 16.7: Definition of terms relating to the sensitivity of the receptor.

Sensitivity	Definition
Very High	Receptor or the activities of the receptor, is of critical importance to the local, regional or national economy and/or the receptor or the activities of the receptor, is highly vulnerable to impacts that may arise from the project and/or recoverability is long term or not possible.
High	Receptor or the activities of the receptor, is of high value to the local, regional or national economy and/or the receptor or the activities of the receptor, is generally vulnerable to impacts that may arise from the project and/or recoverability is slow and/or costly.
Medium	Receptor or the activities of the receptor, is of moderate value to the local, regional or national economy and/or the receptor or the activities of the receptor, is somewhat vulnerable to impacts that may arise from the project and/or has moderate to high levels of recoverability.

Sensitivity	Definition
Low	Receptor or the activities of the receptor, is of low value to the local, regional or national economy and/or the receptor or the activities of the receptor, is not generally vulnerable to impacts that may arise from the project and/or has high recoverability.

16.5.1.4 The significance of the effect upon aviation and radar is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The method employed for this assessment is presented in Table 16.8. Where a range of significance of effect is presented in Table 16.8, the final assessment for each effect is based upon expert judgement.

16.5.1.5 For the purposes of this assessment, any effects with a significance level of minor or less have been concluded to be not significant in terms of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.

Table 16.8: Matrix used for the assessment of the significance of the effect.

Sensitivity of receptor	Magnitude of impact			
	Negligible	Minor	Moderate	Major
Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	Negligible or Minor	Minor	Moderate	Moderate or Major
High	Minor	Minor or Moderate	Moderate or Major	Major
Very High	Minor	Moderate or Major	Major	Major

16.6 Key parameters for assessment

16.6.1 Maximum design scenario

16.6.1.1 The MDSs identified in Table 16.9 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the Project Design Envelope (PDE) provided in volume 1, chapter 3: Project description of the PEIR. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the PDE (e.g. different infrastructure layout), to that assessed here be taken forward in the final design scheme.

16.6.1.2 The assessment of potential impacts on aviation and radar is based on the MDS as identified from a design envelope and is specific to the potential impacts identified in this chapter. The key parameters for the MDS include consideration of the maximum number of wind turbines across the largest area and the maximum blade tip height of 324m above LAT.

16.6.1.3 The MDS for impacts on aviation radar services assumes that the entirety of the Morgan Array Area will be populated with wind turbines (74) and Offshore Substation Platforms (OSPs) (four) at the maximum blade tip height of 324m above LAT. This is because the largest area of the highest wind turbines will create the largest impact from a physical obstruction and radar interference perspective, leading to a greater

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effect on aviation services. Any aspects of the infrastructure that are lower in height than the wind turbines (four OSPs) and less than the extent of the Morgan Array Area will not create an incremental effect on aviation interests. Table 16.9 provides the MDS for impacts to aviation and radar.

Table 16.9: Maximum design scenario considered for the assessment of potential impacts on aviation and radar.

^a C=construction, O=operations and maintenance, D=decommissioning

Potential impact	Phase ^a			Maximum Design Scenario	Justification
	C	O	D		
Creation of physical obstacle to aircraft operations	✓	✓	✓	<p>Construction phase</p> <ul style="list-style-type: none"> Up to four years construction duration During the construction phase the potential creation of physical obstacles to aircraft operations will be gradual as the presence of infrastructure increases, reaching the maximum design scenario outlined below in the operations and maintenance phase. The maximum design scenario in terms of the presence of infrastructure would be on the completion of construction, during the operations and maintenance phase. <p>Operations and maintenance phase</p> <ul style="list-style-type: none"> Operational lifetime of up to 35 years Wind turbines: construction of 74 wind turbines with a maximum blade tip height of 324m above LAT Offshore Substation Platforms (OSPs): construction of four OSPs with a maximum height, inclusive of antenna structure of 75m above LAT. <p>Decommissioning phase</p> <ul style="list-style-type: none"> During the decommissioning phase creation of physical obstacles to aircraft operations would gradually decrease from the operational maximum design scenario as structures are removed and cut below the seabed. 	Maximum physical obstruction from the largest wind turbine to aviation operations due to size (and number) of infrastructure above LAT within the Morgan Array Area.
Wind turbines causing interference on civil and military PSR systems	✗	✓	✗	<p>Operations and maintenance phase</p> <ul style="list-style-type: none"> Operational lifetime of up to 35 years Wind turbines: operation of 74 wind turbines with a maximum blade tip height of 324m above LAT. 	<p>ATC may be unable to provide an effective surveillance service due to interference on radar displays.</p> <p>Impact duration present during operations and maintenance phase. Maximum number and height of wind turbines is the MDS as it provides the maximum potential interference to radar propagation in the area.</p>

16.6.2 Impacts scoped out of the assessment

16.6.2.1 Established on the baseline environment and the description of development outlined in volume 1, chapter 3: Project description of the PEIR, a number of impacts are proposed to be scoped out of the assessment for aviation and radar. These impacts are outlined, together with a justification for scoping them out, in Table 16.10.

Table 16.10: Impacts scoped out of the assessment for aviation and radar.

Potential impact	Justification
During construction there will be no effect on civil and military radar systems as wind turbines will not be rotating.	During scoping The Planning Inspectorate on behalf of the Secretary of State agreed that this matter can be scoped out of the EIA.
Transboundary impacts	During scoping The Planning Inspectorate agreed that given the distance of the Morgan Generation Assets from international boundaries, transboundary effects are unlikely to be significant and this matter can be scoped out of the EIA.
Impact to aviation activity in PEXAs	The MOD responded to scoping stating that the Eskmeals Test and Evaluation PEXA should be considered once the onshore cable corridor route is known; no other concerns with regard to PEXA were provided. The impact of the onshore cable corridor route on the Eskmeals Test and Evaluation PEXA will be considered in the Morgan and Morecambe Offshore Wind Farms: Transmission Assets (hereafter referred to as the Transmission Assets) application for Development Consent.
Impact to Meteorological Radar	During scoping The Planning Inspectorate agreed that given the distance of the Morgan Generation Assets from meteorological radar stations this matter can be scoped out.
Impact to HMRI's	During scoping The Planning Inspectorate agreed that given the distance of the Morgan Generation Assets from HMRI's this impact can be scoped out.
Impact to SSR	During scoping the Planning Inspectorate agreed that as there are no SSR systems located within the CAA suggested radius where impact is expected that potential interference to aviation SSR systems can be scoped out.
Increased helicopter traffic effects on available airspace	The Planning Inspectorate agrees that due to the prominence of Class G (uncontrolled airspace) that significant effects are unlikely and that this matter can be scoped out.
Impact to NATS Clee Hill, NATS Great Dun Fell, Manchester Airport, Liverpool Airport and RAF Valley PSR systems.	Radar LoS analysis as outlined within section 1.3.5.7 of the Morgan Aviation and Radar TR (Annex 26.1) concludes that these radar systems will not theoretically detect the operational wind turbines.

16.7 Measures adopted as part of the Morgan Generation Assets

16.7.1.1 For the purposes of the EIA process, the term 'measures adopted as part of the project' is used to include the following measures (adapted from IEMA, 2016):

- Measures included as part of the project design envelope of the Morgan Generation Assets which are integrated into the application for consent. These

measures are secured through the consent itself through the description of the development and the parameters secured in the DCO and/or marine licences (referred to as primary mitigation in the EIA Guide to Delivering Quality Development) (IEMA, 2016)

- Measures required to meet legislative requirements, or actions that are standard practice used to manage commonly occurring environmental effects and are secured through the DCO requirements and/or the conditions of the marine licences (referred to as tertiary mitigation in IEMA, 2016).

16.7.1.2 A number of measures (primary and tertiary) have been adopted as part of the Morgan Generation Assets to reduce the potential for impacts on aviation and radar. These are outlined in Table 16.11 below. As there is a secured commitment to implementing these measures for the Morgan Generation Assets, they have been considered in the assessment presented in section 16.8 below (i.e. the determination of magnitude and therefore significance assumes implementation of these measures).

Table 16.11: Measures adopted as part of the Morgan Generation Assets.

Measures adopted as part of the Morgan Offshore Wind Project	Justification	How the measure will be secured
Primary measures: Measures included as part of the project design		
Layout and regularity	The Morgan Generation Assets will consider MCA MGN 654 Safety of Navigation Offshore Renewable Energy Installations (OREI) - Guidance on UK Navigational Practice, Safety and Emergency Response, in addition to CAP 393 Air Navigation Order 2022, CAP 764 CAA Policy and Guidelines on Wind Turbines and CAP 437 Standards for Offshore Helicopter Landing Areas, where applicable.	Proposed to be secured through the DCO and deemed Marine Licence
Tertiary measures: Measures required to meet legislative requirements, or adopted standard industry practice		
Lighting and marking	The Morgan Generation Assets will be designed and constructed in accordance with relevant guidance from: <ul style="list-style-type: none"> Trinity House Provision and Maintenance of Local Aids to Navigation Marking Offshore Renewable Energy Installations Maritime and Coastguard Agency (MCA) Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response. Appropriate marking, lighting and aids to navigation will be employed during the construction, operations and maintenance, and decommissioning phases as appropriate to ensure the safety of all parties. Appropriate lighting, in line with MCA (2018) guidance, will ensure the offshore structures are visible for search and rescue and emergency response procedures. In addition, Morgan Offshore Wind Project lighting will conform to the following:	Proposed to be secured through the deemed Marine Licence

Measures adopted as part of the Morgan Offshore Wind Project	Justification	How the measure will be secured
	<ul style="list-style-type: none"> Red, medium intensity aviation warning lights (of variable brightness between a maximum of 2,000 candela (cd)) to a minimum of 10% of the maximum which would be 200cd) will be located on either side of the nacelle of significant peripheral wind turbines. These lights will flash simultaneously with a Morse W flash pattern and will also include an infra-red component All aviation warning lights will flash synchronously throughout the Morgan Array Area and be able to be switched on and off by means of twilight switches (which activate when ambient light falls below a pre-set level). Aviation warning lights will allow for reduction in lighting intensity at and below the horizon when visibility from every wind turbine is more than 5km (to a minimum of 10% of the maximum, i.e. 200cd) SAR lighting of each of the non-periphery wind turbines will be combi infra-red (IR)/200cd steady red aviation hazard lights, individually switchable from the control centre at the request of the MCA (i.e. when conducting SAR operations in or around the Morgan Array Area) All wind turbines will be fitted with a low intensity light for the purpose of helicopter winching (green hoist lamp). All wind turbines will also be fitted with suitable illumination (minimum one 5cd light) for identification signs. The location of all infrastructure (including wind turbines and OSPs) will be communicated to the UK Hydrographic Office (UKHO) so that they can be incorporated into Admiralty Charts and the Notice to Mariners procedures. 	
Notification	The DGC will be informed of the locations, heights and lighting status of the wind turbines, including estimated and actual dates of construction and the maximum height of any construction equipment to be used, prior to the start of construction, to allow inclusion on aviation charts and applicable documentation.	Proposed to be secured through the deemed Marine Licence

16.7.1.3 Where significant effects have been identified, further mitigation measures adopted (referred to as secondary mitigation, IEMA 2016) have been identified to reduce the significance of effect to acceptable levels following the initial assessment. These are measures that could further prevent, reduce and, where possible, offset any adverse effects on the environment. These measures are set out in section 16.8 below.

16.8 Assessment of significant effects

16.8.1.1 The impacts of the construction, operations and maintenance, and decommissioning phases of the Morgan Generation Assets have been assessed on aviation and radar. The potential impacts are listed in Table 16.9, along with the MDS against which each impact has been assessed.

16.8.1.2 A description of the potential effect on aviation and radar receptors caused by each identified impact is given below.

16.8.2 Creation of physical obstacle to aircraft operations

16.8.2.1 The construction, operation and maintenance, and decommissioning phases of the Morgan Generation Assets wind turbines will lead to the creation of multiple physical obstacles to flight. The MDS is represented by the 74 wind turbines with a maximum blade tip height of 324m above LAT and is summarised in Table 16.9.

Construction phase

Magnitude of impact

16.8.2.2 Wind turbine construction infrastructure above LAT could pose a physical obstruction to flight operations in the vicinity and specifically to military and other low flying operations including survey work and helicopters operating in the support of the renewable industries. Construction infrastructure, OSPs and erected wind turbines can be difficult to see from the air, particularly in poor meteorological conditions leading to potential increased obstacle collision risk. Furthermore, during the construction phase, the presence and movement of associated infrastructure may present a potential obstacle collision risk to aircraft flight operations.

16.8.2.3 A range of adopted measures, in the form of appropriate notification to aviation stakeholders, regularity of layout and lighting and marking to minimise effects to aviation flight operations would apply to the development of the Morgan Generation Assets. These will comply with current guidelines where appropriate and be agreed with the appropriate stakeholders and are outlined in Table 16.11. Pilots are obliged to plan their flying activities in advance and to be familiar with any en-route obstacles they may encounter; however, during flight, weather conditions or operational requirements may necessitate route adjustments. In Visual Meteorological Conditions (VMC), pilots are ultimately responsible for seeing and avoiding obstructions such as wind turbines and will be aware through notification procedures of the Morgan Generation Assets. Furthermore, when flying in Instrument Meteorological Conditions (IMC) pilots will be utilising on board radar which detects obstructions and be under the control of ATC with an appropriate level of radar service and flying at an altitude which provides the required separation from obstacles below them.

16.8.2.4 The impact is predicted to be of regional spatial extent, short term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

	Sensitivity of the receptor		
16.8.2.5	The MOD, ATC service providers and helicopter operators have been consulted with regard to the potential for the Morgan Generation Assets to create an obstruction to aviation activities conducted in the vicinity of construction infrastructure.	16.8.2.13	The impact is predicted to be of regional spatial extent and of long-term duration. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be minor .
16.8.2.6	The low flying aircraft operator is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be medium .		
	Significance of the effect		
16.8.2.7	Appendix A of volume 4, annex 16.1: Aviation and radar technical report of the PEIR lists those offshore platforms which are located within 9nm of the Morgan Array Area and assesses access to current Irish Sea (Liverpool and Morecambe Bay) oil and gas installations (platforms) near the Morgan Array Area.	16.8.2.14	Helicopter operators, the MOD and ATC service providers have been consulted regarding the potential for the Morgan Generation Assets to create an obstruction to aviation activities conducted in the vicinity of the operational wind turbines.
16.8.2.8	Appendix B of volume 4, annex 16.1: Aviation and radar technical report of the PEIR assesses those Irish Sea littoral aerodromes' flight procedures which are within 50nm of the Morgan Array Area.	16.8.2.15	The low flying aircraft operator and the ability to continue using the east Irish Sea airspace is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be medium .
16.8.2.9	Overall, the magnitude of the impact is deemed to be minor, and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of minor adverse significance, which is not significant in EIA terms.		
	Operations and maintenance phase		
	Magnitude of impact		
16.8.2.10	During the operations and maintenance phase of the Morgan Generation Assets, wind turbines and the OSPs could pose a physical obstruction to the flight of aircraft operating in the vicinity of the Morgan Array Area, specifically to aircraft operating at low-level. Helicopter operators, the MOD and ATC service providers have been consulted with regard to the potential for the Morgan Generation Assets to create an obstruction to aviation activities conducted in the vicinity of the wind turbines and OSPs.	16.8.2.16	Appendix A of volume 4, annex 16.1: Aviation and radar technical report of the PEIR lists those offshore platforms which are located within 9nm of the Morgan Array Area and assesses access to current Irish Sea (Liverpool and Morecambe Bay) oil and gas installations (platforms) near the Morgan Array Area.
16.8.2.11	A range of adopted measures, in the form of appropriate notification to aviation stakeholders, lighting and marking to minimise effects to aviation flight operations would apply to the development of the Morgan Generation Assets, as included in the commitments set out under Table 16.11. These commitments will comply with current guidelines and be agreed with the appropriate stakeholders.	16.8.2.17	Appendix B of volume 4, annex 16.1: Aviation and radar technical report of the PEIR assesses those Irish Sea littoral aerodromes' flight procedures which are within 50nm of the Morgan Array Area. Overall, the magnitude of the impact is deemed to be minor, and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of minor adverse significance, which is not significant in EIA terms.
16.8.2.12	Pilots are obliged to plan their flying activities in advance and to be familiar with any en-route obstacles they may encounter; however, during flight, weather conditions or operational requirements may necessitate route adjustments. In VMC conditions, pilots are ultimately responsible for seeing and avoiding obstructions such as wind turbines and will be aware through notification procedures of the Morgan Generation Assets. When operating IMC pilots may be utilising on board radar which detects obstructions and be under the control of ATC with an appropriate level of radar service and flying at an altitude which provides the required separation from obstacles below them.		
			Decommissioning phase
			Magnitude of impact
		16.8.2.18	During the decommissioning phase, the presence and movement of decommissioning infrastructure may present a potential collision risk to aircraft in the vicinity and specifically to low flying aircraft. A range of measures will be adopted as part of the Morgan Generation Assets to minimise environmental effects would apply to the decommissioning phase. These will comply with current guidelines and be agreed with the appropriate stakeholders and are outlined in Table 16.11. Pilots are obliged to plan their flying activities in advance and to be familiar with any en-route obstacles they may encounter; however, during flight, weather conditions or operational requirements may necessitate route adjustments. In VMC, pilots are ultimately responsible for seeing and avoiding obstructions such as wind turbines and decommissioning infrastructure and will be aware through notification procedures of the Morgan Generation Assets. When flying in IMC pilots will be utilising on board radar which detects obstructions and be under the control of ATC with an appropriate level of radar service and flying at an altitude which provides the required separation from obstacles below them. It is expected that any mitigation implemented will remain in place until the last wind turbine has been removed.
		16.8.2.19	The impact is predicted to be of regional spatial extent, short term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be minor .

Sensitivity of receptor

- 16.8.2.20 Helicopter operators, the MOD and ATC service providers have been consulted regarding the potential for the Morgan Generation Assets to create an obstruction to aviation activities conducted in the vicinity of decommissioning infrastructure.
- 16.8.2.21 The low flying aircraft operator and the ability to continue using the east Irish Sea airspace is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of effect

- 16.8.2.22 Appendix A of volume 4, annex 16.1: Aviation and radar technical report of the PEIR lists those offshore platforms which are located within 9nm of the Morgan Array Area and assesses access to current Irish Sea (Liverpool and Morecambe Bay) oil and gas installations (platforms) near the Morgan Array Area.
- 16.8.2.23 Appendix B of volume 4, annex 16.1: Aviation and radar technical report of the PEIR assesses those Irish Sea littoral aerodromes' flight procedures which are within 50nm of the Morgan Array Area.
- Overall, the magnitude of the impact is deemed to be minor, and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

16.8.3 Wind turbines causing interference on civil and military PSR systems

Operations and maintenance phase

Magnitude of impact

- 16.8.3.1 The operational wind turbines in the Morgan Array Area would be theoretically detectable by the NATS Lowther Hill and St Anne's PSR, MOD West Freugh PSR, the Ronaldsway (IoM) Airport and BAE Warton PSR systems. Wind turbines detectable by a PSR system might degrade the system by creating false targets, reduce system sensitivity, create radar shadowing behind the wind turbines and saturate the radar receiver leading to clutter potentially concealing real aircraft targets.
- 16.8.3.2 The ability of NATS and the airport authorities and operators of aviation PSR systems to accurately use their respective radar systems for the provision of an ATS, could be impacted by the presence of wind turbine interference and the production of radar clutter on radar displays.
- 16.8.3.3 All radar receptors aim to ensure 'clutter free' radar to continue to deliver a safe and effective ATS and to monitor UK airspace. Without mitigation, the impact created by the detection of operational wind turbines is predicted to be of regional spatial extent and of long-term duration, repetitious, and continuous. It is predicted that the impact will affect the receptor directly and the magnitude of effect is considered to be **moderate**.

Sensitivity of receptor

- 16.8.3.4 The ability of NATS and airport authorities to accurately use their respective radar systems for the provision of an ATS could be impacted in the presence of wind turbine interference and the production of radar clutter onto radar displays.
- 16.8.3.5 Both NATS and airport authorities aim to ensure 'clutter free' radar to continue to deliver a safe and effective ATS. The radar stakeholders are considered to be of high vulnerability, low recoverability and high value. The sensitivity of these receptor is therefore, considered to be **high**.

Significance of effect

- 16.8.3.6 Overall, the magnitude of the impact is deemed to be moderate, and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **moderate** adverse significance which is significant in EIA terms.

Mitigation and residual effect

- 16.8.3.7 An air traffic service provider such as NATS and the airport authorities affected may accept that although an impact may be present, that it can be managed and accepted by implementing operational mitigation in airspace that is not regularly used for the separation of aircraft. However, in the complex airspace in which the Morgan Array Area is located, operational acceptance of the effect created is unlikely to be acceptable to all ATC providers without mitigation, as portions of airspace may be more important to some ATC establishments than others, due to the role and responsibility of ATC provision allocated to them.

NATS PSR

- 16.8.3.8 In the case of NATS radar systems impacted (Lowther Hill and St Anne's PSRs) previous acceptable mitigation of wind turbine impact to these systems has been achieved through agreement by NATS of radar blanking and infill. The mitigation solution will be subject to commercial agreement between the Applicant and NATS and will be implemented by radar blanking of the affected areas of the Lowther Hill and St Anne's PSRs which will remove all wind turbine radar returns. However, all other radar returns in the blanked area will also be removed. To resolve this, radar data from another NATS radar asset such as the NATS Clee Hill or Great Dun Fell PSRs (which does not detect the wind turbines) will 'infill' the 'blanked' areas ensuring 'clutter free' radar coverage above the Morgan Array Area. Consultation with NATS continues with the expectation that, if required, a technical mitigation solution will be agreed, which will reduce the magnitude of the impact; therefore, when in place the residual effect to the impacted NATS PSR systems will be of **negligible** or **minor** adverse significance.

Ronaldsway (IoM) Airport PSR

- 16.8.3.9 Previously for other offshore wind farm developments, Ronaldsway Airport ATC have indicated that the airport's PSR may be capable of removing wind turbine clutter created by the detection of operational wind turbines through radar suppression system techniques which may be required to be completed by the radar manufacturer (Selex). Consultation with the airport continues with the expectation that, if required,

a technical mitigation solution will be agreed. With mitigation in place the residual effect to the impacted airport's PSR system is expected to be not significant in EIA terms.

MOD West Freugh PSR

16.8.3.10 The Applicant has completed a radar LoS analysis at the maximum blade tip height of 324m above LAT. Analysis results indicate that the wind turbines of the Morgan Array Area will be theoretically detectable by the MOD West Freugh PSR at the assessed height. MOD West Freugh operates a Watchman PSR that does not provide stand-alone technical mitigation options and there is a possibility that area optimisation of the inherent radar processing capability, if any, may not be sufficient to mitigate the predicted effect satisfactorily. The MOD has responded to scoping and did not indicate an impact to the West Freugh PSR in isolation. The Morgan Array Area lies outside the Luce Bay (West Freugh) PEXA and is 102km from the MOD West Freugh PSR (at the limits of the PSR's operational range). If a potential impact to the PSR is apparent it is considered that due to distancing, the potential effect can be operationally managed and accepted by the MOD as the operations conducted within the Luce Bay PEXA would not be impacted. Consultation with the MOD will continue as a part of the EIA process. With mitigation in place the residual effect to the impacted MOD West Freugh PSR system is expected to be not significant in EIA terms.

BAE Warton PSR

16.8.3.11 The MOD responded to scoping with concerns regarding a detrimental impact being created to the Warton PSR. Radar LoS analysis results indicate that theoretically the Warton PSR will detect the operational wind turbines at the maximum blade tip height of 324m above LAT which may create an unacceptable impact to the airport through the creation of radar clutter.

16.8.3.12 The Applicant will continue to engage with the MOD prior to and after the submission of the application for DCO and will seek to identify agreed mitigation for the BAE Warton PSR system. Consultation with the MOD will continue as a part of the EIA process. With mitigation in place the residual effect to the impacted BAE Warton PSR system is expected to be not significant in EIA terms.

Post-secondary mitigation residual effect

16.8.3.13 The previous paragraphs describing mitigation and residual effect provide an overview of potential technical radar mitigation techniques which may be applicable to impacted radar systems. Further engagement and agreement will be required with the respective radar receptor on the mitigation solution to be utilised. With the implantation of the proposed mitigation, the overall magnitude of the residual impact would be deemed to be minor and the sensitivity of the receptor considered to be low. The effect would then be of **minor** adverse significance which would not be significant in EIA terms.

16.8.4 Future monitoring

16.8.4.1 No aviation and radar monitoring to test the predictions made within the impact assessment is considered necessary.

16.9 Cumulative Effect Assessment (CEA) methodology

16.9.1 Methodology

16.9.1.1 The CEA takes into account the impact associated with the Morgan Generation Assets together with other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see volume 3, annex 5.1: Cumulative effects screening matrix). Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

16.9.1.2 The aviation and radar CEA methodology has followed the methodology set out in volume 1, chapter 5: EIA methodology of the PEIR. As part of the assessment, all projects and plans considered alongside the Morgan Generation Assets have been allocated into 'tiers' reflecting their current stage within the planning and development process, these are listed below.

16.9.1.3 A tiered approach to the assessment has been adopted, as follows:

- Tier 1
 - Under construction
 - Permitted application
 - Submitted application
 - Those currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact
- Tier 2
 - Scoping report has been submitted and is in the public domain
- Tier 3
 - Scoping report has not been submitted and is not in the public domain
 - Identified in the relevant Development Plan
 - Identified in other plans and programmes.

16.9.1.4 This tiered approach is adopted to provide a clear assessment of the Morgan Generation Assets alongside other projects, plans and activities.

16.9.1.5 The specific projects, plans and activities scoped into the CEA, are outlined in Table 16.12 and shown on Figure 16.3.

Table 16.12: List of other projects, plans and activities considered within the CEA for aviation and radar.

Project/Plan	Status	Distance from the Morgan Array Area (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Morgan Generation Assets
Tier 1						
Walney Extension 3 Offshore Wind Farm	Operational	7.6	Offshore Renewables	N/A	28/11/2014	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Walney Extension 4 Offshore Wind Farm	Operational	7.6	Offshore Renewables	N/A	28/11/2014	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Walney 2 Offshore Wind Farm	Operational	11.9	Offshore Renewables	N/A	01/11/2007	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
West of Duddon Sands Offshore Wind Farm Extension	Operational	15.2	Offshore Renewables	N/A	29/09/2008	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Walney 1 Offshore Wind Farm	Operational	15.5	Offshore Renewables	N/A	01/11/2007	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Ormonde Offshore Wind Farm	Operational	23.3	Offshore Renewables	N/A	01/01/2011	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Barrow Offshore Wind Farm	Operational	30.0	Offshore Renewables	N/A	01/03/2003	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Awel y Môr Offshore Wind Farm	Submitted but not yet determined	46.8	Offshore Renewables	Anticipated to commence in 2026	1 January 2030 to 1 January 2055	Project construction phase overlaps with the Morgan Generation Assets proposed construction phase. Project operational phase overlaps with the Morgan Generation Assets proposed operations and maintenance phase.
Gwynt y Môr Offshore Wind Farm	Operational	52.0	Offshore Renewables	N/A	03/12/2008	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Burbo Bank Offshore Wind Farm	Operational	56.0	Offshore Renewables	N/A	07/11/2014	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
North Hoyle Offshore Wind Farm	Operational	61.0	Offshore Renewables	N/A	01/01/2003	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Burbo Bank Offshore Wind Farm Extension	Operational	61.6	Offshore Renewables	N/A	29/10/2020	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Robin Rigg East Offshore Wind Farm	Operational	98.6	Offshore Renewables	N/A	10/09.2019	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Rhyl Flats Offshore Wind Farm	Operational	60.5	Offshore Renewables	N/A	01/01/2002	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Tier 2						
Mona Offshore Wind Project	Pre-application - PEIR	5.5	Offshore Renewables	01/01/2026	01/01/2030	Project operational phase overlaps with the Morgan Generation Assets proposed construction and operations and maintenance phases.
Morecambe Offshore Windfarm	Pre-application – Scoping Report	11.2	Offshore Renewables	01/01/2028 to 31/12/2029	01/01/2030 to 31/12/2065	Project construction phase overlaps with the Morgan Generation Assets proposed construction phase. Project operational phase overlaps with the Morgan Generation Assets proposed operations and maintenance phase.

MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

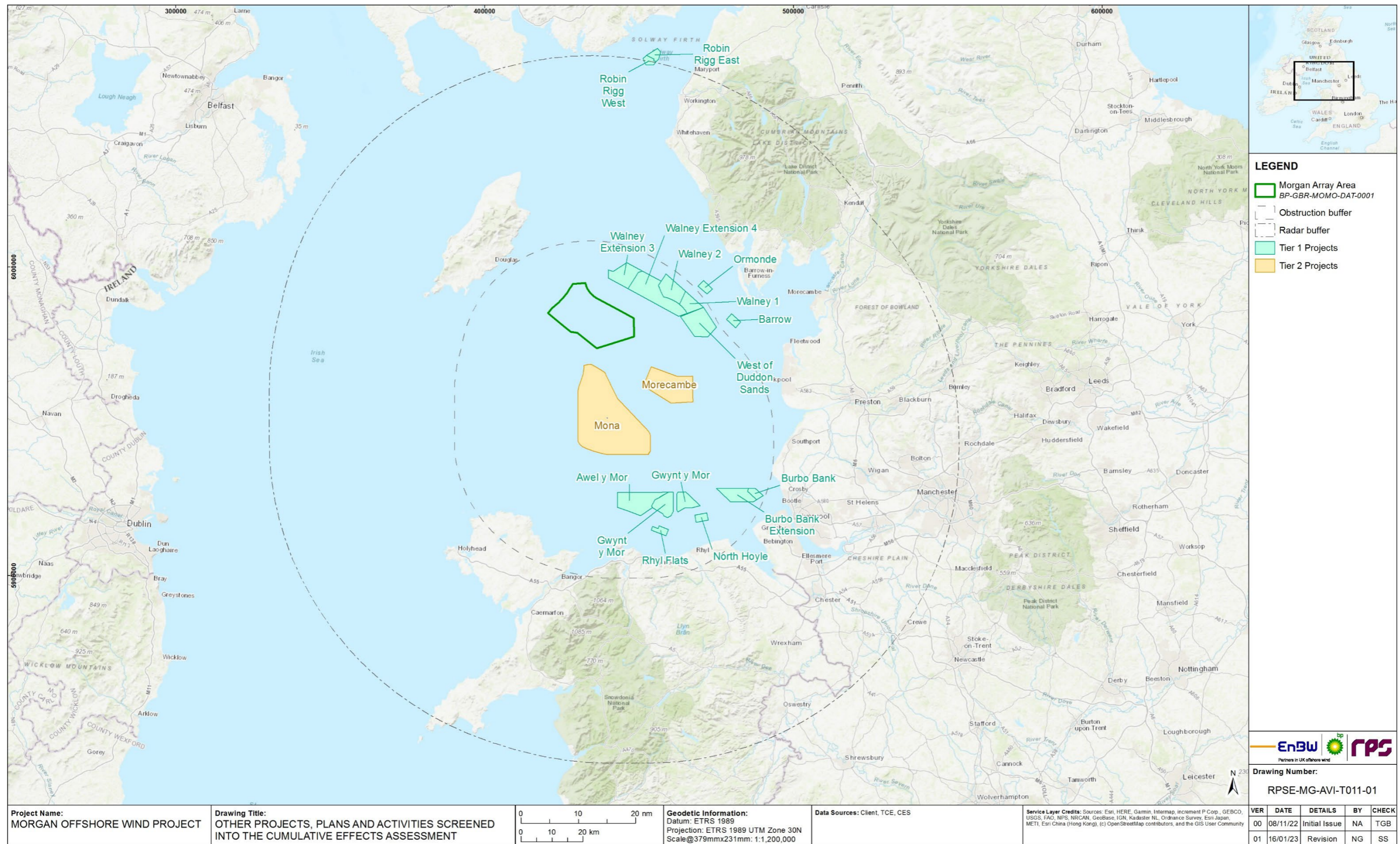


Figure 16.3: Other projects, plans and activities screened into the cumulative effects assessment.⁴

⁴ The Awel y Môr agreement for lease area extends further to the west than the application boundary presented, however Awel y Môr Offshore Wind Farm Ltd. have decided to develop in the area presented.

16.9.2 Maximum Design Scenario

16.9.2.1 The MDSs identified in Table 16.13 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been selected from the PDE provided in volume 1, chapter 3: Project description of the PEIR as well as the information in the public domain on other projects and plans, in order to inform an MDS.

Table 16.13: Maximum design scenario considered for the assessment of potential cumulative effects on aviation and radar.

^a C=construction, O=operations and maintenance, D=decommissioning

Potential cumulative effect	Phase ^a			Maximum Design Scenario	Justification
	C	O	D		
Creation of physical obstacle to aircraft operations	✓	✓	✓	<p>MDS as described for the Morgan Generation Assets (Table 16.9) assessed cumulatively with the following other projects/plan within 40km of the Morgan Array Area:</p> <p>Tier 1</p> <ul style="list-style-type: none"> • Walney Extension 3 Offshore Wind Farm • Walney Extension 4 Offshore Wind Farm • Walney 2 Offshore Wind Farm • West of Duddon Sands Offshore Wind Farm • Walney 1 Offshore Wind Farm • Awel y Môr Offshore Wind Farm • Gwynt y Môr Offshore Wind Farm • Burbo Bank Offshore Wind Farm • North Hoyle Offshore Wind Farm • Burbo Bank Offshore Wind Farm Extension • Rhyl Flats Offshore Wind Farm. <p>Tier 2</p> <ul style="list-style-type: none"> • Mona Offshore Wind Project • Morecambe Offshore Windfarm. 	This includes the presence of other developments which will have the potential to create a cumulative aviation obstacle and affect the available airspace for other users in the same region within a representative 40km buffer of the Morgan Array Area.
Wind turbines causing interference on civil and military PSR systems	✗	✓	✗	<p>MDS as described for the Morgan Generation Assets (Table 16.9) assessed cumulatively with the following other projects/plan within 100km of the Morgan Array Area:</p> <p>Tier 1</p> <ul style="list-style-type: none"> • Walney Extension 3 Offshore Wind Farm • Walney Extension 4 Offshore Wind Farm • Walney 2 Offshore Wind Farm • West of Duddon Sands Offshore Wind Farm • Walney 1 Offshore Wind Farm • Ormonde Offshore Wind Farm • Barrow Offshore Wind Farm • Awel y Môr Offshore Wind Farm • Gwynt y Môr Offshore Wind Farm • Burbo Bank Offshore Wind Farm • North Hoyle Offshore Wind Farm • Burbo Bank Offshore Wind Farm Extension • Robin Rigg East Offshore Wind Farm • Rhyl Flats Offshore Wind Farm. <p>Tier 2</p> <ul style="list-style-type: none"> • Mona Offshore Wind Project • Morecambe Offshore Windfarm. 	Maximum aviation and radar cumulative effect is calculated within a representative 100km buffer of the Morgan Array Area.

16.10 Cumulative Effects Assessment

16.10.1.1 The cumulative aviation and radar study area (Figure 16.3) which includes other offshore wind farms in the north Irish Sea, is similar to the Morgan aviation and radar study area. The cumulative aviation and radar study area draws upon information contained within volume 4, annex 16.1: Aviation and radar technical report of the PEIR.

16.10.1.2 The potential for cumulative effects, of the creation of an aviation obstacle and those effects created by the radar detection of the Morgan Generation Assets which exist to those radar systems that will also detect the Tiered wind farm developments listed in Table 16.12. An assessment of the potential impacts which may give rise to likely significant effects are considered in this section. Certain impacts assessed for the project alone are not considered in the cumulative assessment due to:

- The highly localised nature of the impacts (i.e. they occur entirely within the Morgan Array Area)
- Management measures in place for the Morgan Generation Assets will also be in place on other projects reducing their risk of occurring
- Where the potential significance of the impact from the Morgan Generation Assets alone has been assessed as negligible
- A lack of data or confidence in data preventing meaningful assessment.

16.10.1.3 The impacts excluded from the CEA for the above reasons are as follows:

- Wind turbines creating an impact to offshore helicopter operations to oil and gas platforms
- Impact to IFPs.

16.10.1.4 Therefore, the impacts that are considered in the CEA are as follows:

- Creation of physical obstacle to aircraft operations
- Wind turbines causing interference on civil and military primary surveillance radar systems.

16.10.1.5 A description of the significance of cumulative effects upon aviation and radar receptors arising from each identified impact is given below.

16.10.2 Creation of physical obstacle to aircraft operations

Tier 1/Tier 2

Construction phase

Magnitude of impact

16.10.2.1 There is potential for cumulative effect as a result of construction activities associated with the Morgan Generation Assets and other projects (Table 16.12). For the purposes of the PEIR, this additive impact has been assessed within 40km from the Morgan Array Area, which is considered to be the maximum range where the creation of an aviation obstacle to fixed wing and rotary aircraft operating offshore may occur

although some impacts are likely to be localised to the Morgan Array Area. The Tier 1 and 2 projects are listed in Table 16.13.

16.10.2.2 Aviation operations in the UK are highly regulated. The Morgan Array Area is located in airspace where the provision of an air traffic service is routine. The same rules of the air which maintain a safe operating environment in the current baseline will apply in the east Irish Sea during all phases of the Morgan Generation Assets and the provision of an air traffic service will not be affected.

16.10.2.3 The impact is predicted to be of regional spatial extent, short term duration, intermittent and low reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

16.10.2.4 The MOD, ATC service providers and helicopter operators have been consulted with regard to the potential for the Morgan Generation Assets to create an obstruction to aviation activities conducted in the vicinity of construction infrastructure.

16.10.2.5 The low flying aircraft operator is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of effect

16.10.2.6 Overall, the magnitude of the cumulative impact is deemed to be minor, and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor** significance, which is not significant in EIA terms.

Operations and maintenance phase

Tier 1/Tier 2

Magnitude of impact

16.10.2.7 There is potential for cumulative effect as a result of operational activities associated with the Morgan Generation Assets and other projects (Table 16.12). For the purposes of the PEIR, this additive impact has been assessed within 40km from the Morgan Array Area, which is considered to be the maximum range where the creation of an aviation obstacle to fixed wing and rotary aircraft operating offshore may occur although some impacts are likely to be localised to the Morgan Array Area. The Tier 1 and 2 projects are listed in Table 16.13.

16.10.2.8 Pilots are obliged to plan their flying activities in advance and to be familiar with any en-route obstacles they may encounter on their route of flight. The Morgan Generation Assets and other cumulative offshore developments considered within the CEA will be included within applicable military and civil aviation publications and charts; pilots will be aware of the presence of the developments through notification procedures. Notification of construction, operation and decommissioning of the wind farm and the lighting and promulgation on aviation charts of all wind farms, considered to provide a cumulative obstruction to aviation, will reduce any physical obstruction effect to aviation activities in the region of the Morgan Array Area. It is considered that low flying operations in the airspace available between the operational offshore wind farms, though constructed, and oil and gas infrastructure, and the lower volume of the

CAS above would not be affected by the operation of the Morgan Generation Assets. It is predicted that the impact will affect the aviation receptors operating in the airspace directly but without a change to present operating parameters.

16.10.2.9 The impact is predicted to be of regional spatial extent and of permanent duration. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

16.10.2.10 Helicopter operators, the MOD and ATC service providers have been consulted with regard to the potential for the Morgan Generation Assets to create an obstruction to aviation activities conducted in the vicinity of the operational wind turbines.

16.10.2.11 The low flying aircraft operator and the ability to continue using the east Irish Sea airspace is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of effect

16.10.2.12 Overall, the magnitude of the impact is deemed to be minor, and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of **minor** significance, which is not significant in EIA terms.

Decommissioning phase

Magnitude of impact

16.10.2.13 There is potential for cumulative effect as a result of decommissioning activities associated with the Morgan Generation Assets and other projects (Table 16.12). For the purposes of this chapter, this additive impact has been assessed within 40km from the Morgan Array Area, which is considered to be the maximum range where the creation of a cumulative aviation obstacle to fixed wing and rotary aircraft operating offshore may occur although some impacts are likely to be localised to the Morgan Array Area. The Tier 1 and 2 projects are listed in Table 16.13.

16.10.2.14 Aviation operations in the UK are highly regulated. The Morgan Array Area is located in airspace where the provision of an air traffic service is routine. The same rules of the air which maintain a safe operating environment in the current baseline will apply in the east Irish Sea during all phases of the Morgan Generation Assets and the provision of an air traffic service will not be affected.

16.10.2.15 The impact is predicted to be of regional spatial extent and short-term duration. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

16.10.2.16 The MOD, ATC service providers and helicopter operators have been consulted with regard to the potential for the Morgan Generation Assets to create an obstruction to aviation activities conducted in the vicinity of decommissioning infrastructure.

16.10.2.17 The low flying aircraft operator is deemed to be of low vulnerability, high recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of effect

16.10.2.18 Overall, the magnitude of the cumulative impact is deemed to be minor, and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor** significance, which is not significant in EIA terms.

16.10.3 Wind turbines causing interference on civil and military primary surveillance radar systems

Tier 1/Tier 2

Operations and maintenance phase

Magnitude of impact

16.10.3.1 There is potential for cumulative radar effect as a result of the Morgan Generation Assets, through the operations and maintenance phase and other projects (Table 16.12). For the purposes of this chapter, this additive impact to aviation radar has been assessed within 100km from the Morgan Array Area, which is considered to be the maximum range where radar cumulative effects may occur although some impacts are likely to be localised to the Morgan Array Area due to the unmitigated effect created by the detection of operational wind turbines. The Tier 1 and Tier 2 projects are listed in Table 16.13.

16.10.3.2 Theoretical radar LoS analysis for the NATS Lowther Hill, St Anne's PSRs together with detection of the operational wind turbines by the airport PSR at Ronaldsway (IoM), MOD West Freugh and BAE Warton indicate that the operational Morgan Generation Assets wind turbines with a tip height of 324m above LAT would be considered to be detectable (by varying degrees) to the PSR systems. Unmitigated, the potential cumulative effect will be to add to the radar clutter and possibly an increase in the individual signal processing demands of the predicted effected PSRs.

16.10.3.3 The impact is predicted to be of wider regional spatial extent and of permanent duration with loss to significant system components. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **moderate**.

Sensitivity of the receptor

16.10.3.4 Both NATS, MOD and airport authorities aim to ensure 'clutter free' radar to continue to deliver a safe and effective ATS. The radar stakeholders are considered to be of high vulnerability, low recoverability and high value. The sensitivity of these receptors is therefore, considered to be **high**.

Significance of effect

16.10.3.5 Overall, the magnitude of the impact is deemed to be moderate, and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **moderate** significance which is significant in EIA terms.

Mitigation and residual effect

16.10.3.6 Mitigation, as described in section 16.7, will be agreed (reducing the magnitude of the impact and receptor sensitivity); therefore, when implemented, the overall magnitude

of the impact would be deemed to be moderate and the sensitivity of the receptor considered to be low. With mitigation in place the effect is expected, therefore, to be of **minor** adverse significance which is not significant in EIA terms.

16.11 Future monitoring

16.11.1.1 As mitigation will have been required for those radar systems which are affected by operational and planned projects, no radar cumulative effect will be apparent and therefore with mitigation in place the residual effect will be **minor** which is not significant in EIA terms for all scenarios. No monitoring is therefore considered necessary.

16.12 Transboundary effects

16.12.1.1 A screening of transboundary impacts has been carried out and has identified that there was no potential for significant transboundary effects with regard to aviation and radar from the Morgan Generation Assets upon the interests of other states.

16.13 Inter-related effects

16.13.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the Morgan Generation Assets (construction, operations and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three phases (e.g. subsea noise effects from piling, operational wind turbines, vessels and decommissioning)
- Receptor-led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on aviation and radar, such as interaction or creation of an aviation obstacle, may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects may be short-term, temporary or transient effects, or incorporate longer term effects.

16.13.1.2 There are no inter-related effects that are of greater significance than those assessed in isolation. Inter-related effects are presented in volume 2, chapter 20: Inter-related effects (offshore) of the PEIR.

16.14 Summary of impacts, measures adopted and monitoring

16.14.1.1 Information on aviation and radar within the aviation and radar study area was collected through desktop review and consultation.

16.14.1.2 Table 16.14 presents a summary of the potential impacts, measures adopted as part of the Morgan Generation Assets and residual effects in respect to aviation and radar. The impacts assessed include:

- Creation of physical obstacle to aircraft operations

- Wind turbines causing interference on civil and military primary surveillance radar systems.

16.14.1.3 Overall, it is concluded that there will be the following significant effect arising from the Morgan Generation Assets during the operation and maintenance phase:

- Wind turbines causing interference on civil and military PSR systems.

16.14.1.4 Table 16.15 presents a summary of the potential cumulative impacts, adopted measures and residual effects. The cumulative impacts assessed include:

- Creation of physical obstacle to aircraft operations
- Wind turbines causing interference on civil and military primary surveillance radar systems.

16.14.1.5 Overall, it is concluded that there will be the following significant cumulative effect arising from the Morgan Generation Assets alongside other projects/plans:

- Wind turbines causing interference on civil and military primary surveillance radar systems. With mitigation in place the effect is expected therefore, to be of minor adverse significance which is not significant in EIA terms.

16.14.1.6 No potential transboundary impacts have been identified in regard to effects of the Morgan Generation Assets.

Table 16.14: Summary of potential environmental effects, mitigation and monitoring.

^a C=construction, O=operations and maintenance, D=decommissioning

Description of impact	Phase ^a			Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D							
Creation of physical obstacle to aircraft operations	✓	✓	✓	Layout and regularity Lighting and marking Notification	C: Minor O: Minor D: Minor	C: Medium O: Medium D: Medium	C: Minor O: Minor D: Minor	Not required	N/A	None
Wind turbines causing interference on civil and military PSR systems	×	✓	×	N/A	C: N/A O: Moderate D: N/A	C: N/A O: High D: N/A	C: N/A O: Moderate D: N/A	NATS – Radar blanking and infill. Ronaldsway (IoM) Airport – radar suppression techniques. MOD West Freugh – Optimise operational mitigation at limit of operational range. BAE Warton – A radar mitigation scheme will be agreed with the MOD which will remove the predicted impact created by the detection of the operational wind turbines.	C: N/A O: Not significant D: N/A	None

Table 16.15: Summary of potential cumulative environmental effects, mitigation and monitoring.

^a C=construction, O=operations and maintenance, D=decommissioning

Description of effect	Phase ^a			Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D							
Tier 1/Tier2										
Creation of physical obstacle to aircraft operations	✓	✓	✓	Layout and regularity Lighting and marking Notification	C: Minor O: Minor D: Minor	C: Medium O: Medium D: Medium	C: Minor O: Minor D: Minor	Not required	N/A	None
Wind turbines causing interference on civil and military PSR systems	×	✓	×	N/A	C: N/A O: Moderate D: N/A	C: N/A O: High D: N/A	C: N/A O: Moderate D: N/A	NATS – Radar blanking and infill. Ronaldsway (IoM) Airport – radar suppression techniques. MOD West Freugh – Optimise operational mitigation at limit of operational range. BAE Warton – A radar mitigation scheme will be agreed with the MOD which will remove the predicted impact created by the detection of the operational wind turbines.	C: N/A O: Not significant D: N/A	None

16.15 Next steps

- 16.15.1.1 The creation of multiple, above sea level obstacles close to helideck equipped offshore platforms are likely to affect helicopter operations to the platforms in poor weather conditions. The Applicant acknowledges the potential impact and is continuing to engage with those offshore hydrocarbon industries (platform and installation operators) that may be affected.
- 16.15.1.2 The creation of multiple, above sea level obstacles close to airports are likely to affect instrument flight operations to and from the airport. The Applicant acknowledges the potential impact and is continuing to engage with those airports affected.
- 16.15.1.3 Further consultation is required to refine the potential magnitude of impacts on aviation and radar facilities. This consultation shall continue between PEIR and submission of the application for consent such that the most up to date information can be used within the Environmental Statement.

16.16 References

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