MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Preliminary Environmental Information Report

Volume 4, annex 16.1: Aviation and radar technical report

Image of an offshore wind farm

April 2023
FINAL

Document status

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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.
Flight Level	A standard nominal altitude of an aircraft, in hundreds of feet, based upon a standardized air pressure at sea-level.
Instrument Flight Rules	The rules governing procedures for flights conducted with the crew making reference to aircraft cockpit instruments for situation awareness and navigation.
Instrument Meteorological Conditions	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).
Uncontrolled airspace	Airspace in which Air Traffic Control does not exercise any executive authority but may provide basic information services to aircraft in radio contact. In the UK, Class G airspace is uncontrolled.
Visual Flight Rules	The rules governing flight conducted visually (i.e. with the crew maintaining separation from obstacles, terrain 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
AGL	Above Ground Level
ANO	The Air Navigation Order (ANO) 2022 and Regulations
ANSP	Air Navigation Service Provider
AOC	Air Operators Certificate
ARP	Aerodrome Reference Point
ATC	Air Traffic Control
ATS	Air Traffic Service
BAE	British Aerospace
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAS	Controlled Airspace
CAT	Commercial Air Transport
CTA	Control Area
CTR	Control Zone
EASA	European Union Aviation Safety Agency
EIA	Environmental Impact Assessment
FL	Flight Level
GBS	Global Positioning System
GDF	Great Dun Fell
HAR	Helicopter Access Report
HMRI	Helicopter Main Route Indicator
HTZ	Helicopter Traffic Zone
IAIP	Integrated Aeronautical Information Package
IFP	Instrument Flight Procedure
IFR	Instrument Flight Rules
IoM	Isle of Man
ISAR	Integrated Search and Rescue
LAT	Lowest Astronomical Tide
LFA	Low Flying Area
LoS	Line of Sight
MAP	Missed Approach Point
MCA	Maritime Coastguard Agency
MDH	Minimum Descent Height
MDS	Maximum Design Scenario
MGN	Maritime Guidance Note
MOD	Ministry of Defence
NUI	Normally Unmanned Installation
NOGEPA	Nederlands Olie en Gas Exploratie en Productie Associatie
OCA	Obstacle Clearance Altitude
OLS	Obstacle Limitation Surfaces
OREI	Offshore Renewable Energy Installations
OSI	Offshore Storage Installation
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Area
PSR	Primary Surveillance Radar
RAF	Royal Air Force
RCS	Radar Cross Section
RDP	Radar Data Processor

Acronym	Description
SAR	Search and Rescue
SSR	Secondary Surveillance Radar
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
UKLFS	UK Low Flying System
VFR	Visual Flight Rules

Units

Unit	Description
%	Percentage
°	Degrees
ft	Feet
km	Kilometres
m	Metres
nm	Nautical mile
rpm	Rotations per minute

1 Aviation and radar technical report

1.1 Introduction

1.1.1.1 This technical report provides a detailed description of aviation and radar activity within the area of the proposed Morgan Offshore Wind Project Generation Assets (hereafter referred to as the Morgan Generation Assets) and the wider, east Irish Sea region. This information will be used to inform volume 2, chapter 16: Aviation and radar of the Preliminary Environmental Information Report (PEIR) being undertaken as part of the consenting process for the Morgan Generation Assets. Appendix 1, Helicopter Access Report (HAR) (Anatec, 2022), of this technical report contains details on weather and airspace access to current Irish Sea (Morecambe Bay) oil and gas installations (platforms) near the Morgan Generation Assets.

1.1.1.2 Appendix 2, Instrument Flight Procedures (IFP) assessment, Osprey Consulting Services, (Osprey, 2022) of this technical report details published flight procedures of Irish Sea littoral aerodromes.

1.1.1.3 This technical report has been produced by Osprey on behalf of RPS, which has been appointed as the lead Environmental Impact Assessment (EIA) consultant for the Morgan Generation Assets by the Applicant.

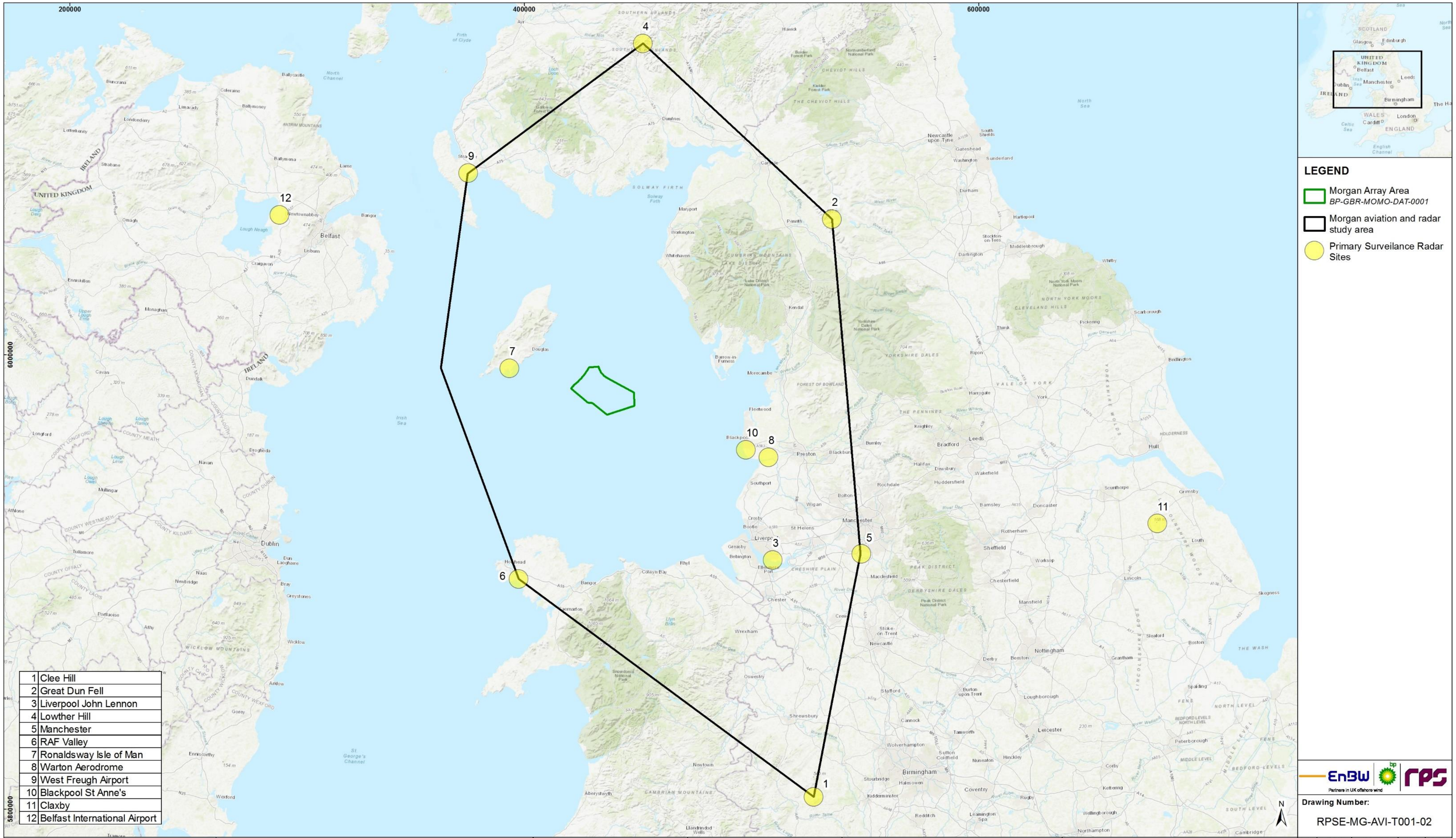
1.1.1.4 This technical report considers wind turbines once they are fully installed with regard to aviation and radar.

1.2 Study area

1.2.1.1 To identify and characterise aviation and radar receptors, a broad study area has been defined. The Morgan aviation and radar study area is presented in Figure 1.1.

1.2.1.2 The Morgan aviation and radar study area covers the aviation radar systems that potentially detect the maximum (highest) wind turbine blade tip (324m above Lowest Astronomical Tide (LAT)) height. It includes the airspace within the following points:

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



Project Name:	Drawing Title:	Geodetic Information:	Data Sources:
MORGAN OFFSHORE WIND PROJECT	THE MORGAN AVIATION AND RADAR STUDY AREA	Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@379mmx231mm: 1:1,700,000	Client, NATS

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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00	15/08/22	Initial Issue	NA	TGB
02	16/01/23	Revision	NA	SS

Figure 1.1: The Morgan aviation and radar study area.

1.2.1.3 There are a number of aerodromes which may be affected by the development of the Morgan Offshore Wind Project, highlighted within Figure 1.2. Approximate measurements have been taken from the closest boundary of the Morgan Array Area to the Aerodrome Reference Point (ARP):

- Ronaldsway, IoM Airport located on a bearing of 287°/28.1km
- RAF Valley located on a bearing of 200°/83.7km
- Liverpool Airport located on a bearing of 137°/91.9km
- Manchester Airport located on a bearing of 122°/119.6km
- Blackpool Airport located on a bearing of 110°/53.3km
- British Aerospace (BAE) Warton Aerodrome located on a bearing of 110°/63.4km
- MOD (QinetiQ) West Freugh Aerodrome located on a bearing of 325°/102.8km.

1.2.2 Airspace designation at the Morgan Array Area

1.2.2.1 The Morgan Array Area is located within Class G uncontrolled airspace which extends from the surface up to Flight Level (FL) 195 (approximately 19,500ft), as shown in Figure 1.3. A portion of the northwest corner of the Morgan Array Area, straddles a portion of a block of airspace known as the IoM Airport Control Area (CTA). The CTA is Class D controlled airspace established from an altitude of 2,500ft to FL 105 (approximately 10,500ft). Additionally, the northwest Morgan Array Area crosses into a small area of the IoM Control Zone (CTR) which extends from the surface to FL 105. Within Class G airspace, any aircraft, civil or military, can enter and transit the airspace without Air Traffic Control (ATC) clearance and subject only to a small set of mandatory rules, as stipulated in the UK Integrated Aeronautical Information Package (IAIP) (CAA, 2022) En-Route Section 1.4-2 Air Traffic Service (ATS) Airspace Description. Aircraft operating in this area may be in receipt of an ATS; however, within this classification of airspace, pilots are ultimately responsible for their own terrain and obstacle clearance. This is achieved through prudent planning (using published aviation charts, the UK IAIP and local aerodrome instructions) and diligent 'lookout' throughout the flight.

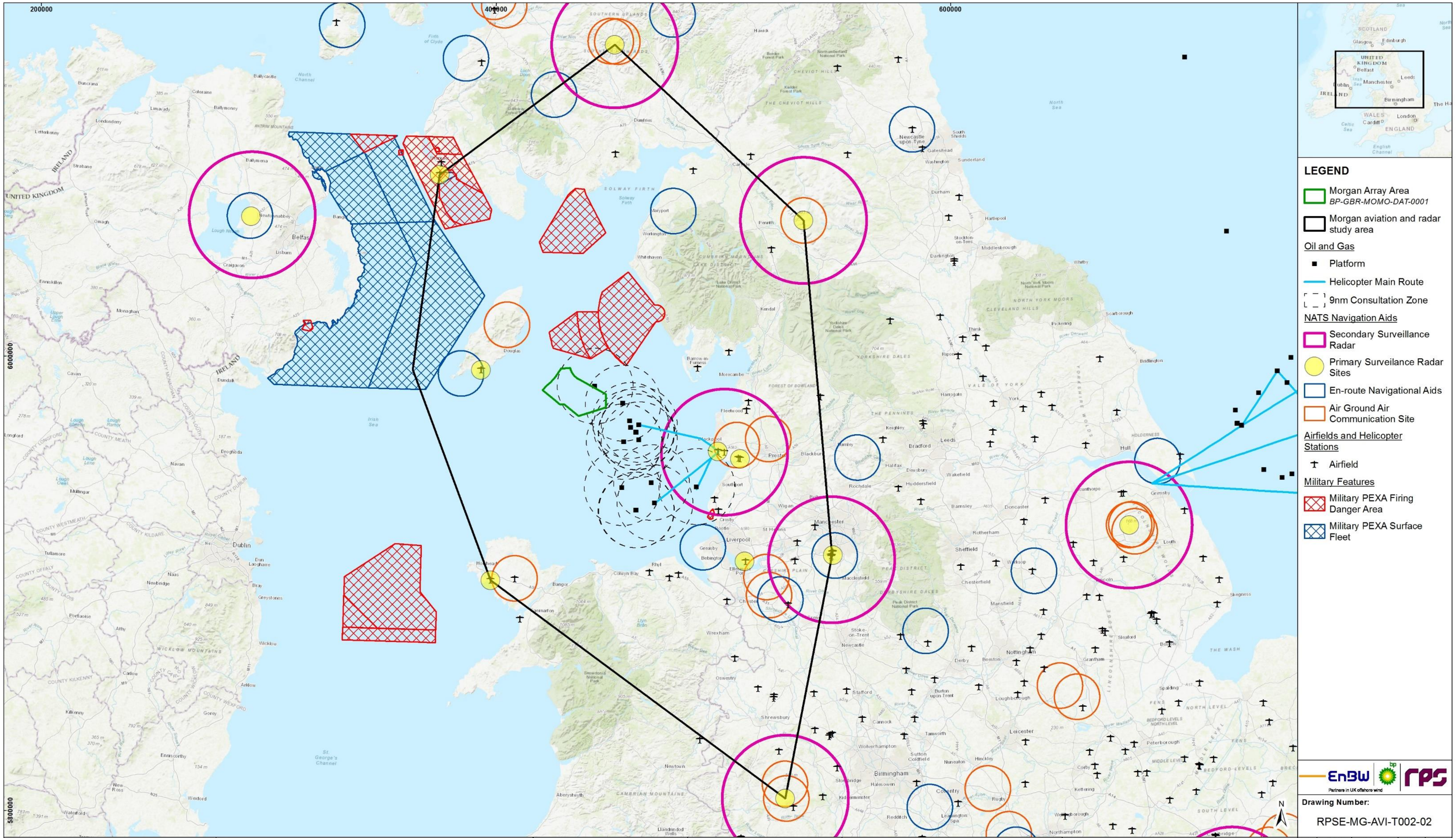
1.2.2.2 Aircraft operating in the Class D of the IoM CTA and CTR are predominately controlled by air traffic controllers located at Ronaldsway Airport. Within Class D airspace all flights are subject to air traffic control service, pilots must maintain two-way radio communication with ATC with standard separation maintained between aircraft dependent on whether they are flying under Instrument Flight Rules (IFR) or Visual Flight Rules (VFR).

1.2.2.3 The Millom Helicopter Traffic Zone (HTZ) is established around the Millom Field as a means of notification of helicopter activity engaged in platform approaches, departures and extensive uncontrolled inter-platform transit flying. HTZs consist of the airspace from sea level to 2,000ft contained within specific lateral dimensions that are notified via aeronautical charts and documents and adopt the airspace classification they sit in (in this case Class G uncontrolled airspace).

1.2.3 Helicopter Main Routes Indicators context

1.2.3.1 Helicopter Main Route Indicators (HMRIs) support the transport of personnel and equipment to offshore oil and gas installations. HMRIs are routes typically and routinely flown by helicopters operating to and from offshore destinations and are promulgated for the purpose of signposting concentrations of helicopter traffic to other airspace users. HMRI promulgation does not predicate the flow of helicopter traffic. Whilst HMRIs have no airspace status and assume the background airspace classification within which they lie (in the case of the Irish Sea, Class G), they are used by the Air Navigation Service Provider (ANSP) and helicopter operators for flight planning and management purposes. Civil Aviation Authority (CAA) Civil Aviation Publication (CAP) 764 (CAA, 2016) states that HMRIs have no defined lateral dimensions (only route centrelines are charted on navigation charts) and that 2 nautical miles (nm) either side of the route centreline should be kept obstacle free; no HMRIs cross the Morgan Array Area. The HMRI system in the east Irish Sea is shown in Figure 1.2.

1.2.3.2 In order to maintain a safe operating environment, the CAA recommend, in CAP 764 (CAA, 2016) a consultation zone of 9nm radius around offshore installations serviced by helicopters. This consultation zone is not considered a prohibition on development, but a trigger for consultation between offshore helicopter operators, the operators of existing installations and developers of proposed offshore wind farms, in order to determine a solution that maintains safe offshore helicopter operations. Appendix 1 HAR (Anatec, 2022), of this technical report contains details on weather and airspace access to current Irish Sea (Morecambe Bay) oil and gas installations (platforms) near the Morgan Generation Assets.



Project Name: MORGAN OFFSHORE WIND PROJECT

Drawing Title: RADAR LOCATIONS AND AVIATION FEATURES IN THE VICINITY OF THE MORGAN OFFSHORE WIND

0 10 20 nm / 0 25 50 km

Geodetic Information: Datum: ETRS 1989; Projection: ETRS 1989 UTM Zone 30N; Scale@379mmx231mm: 1:1,700,000

Data Sources: Client, NSTA, NATS, OceanWise,

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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00	11/08/22	Initial Issue	NA	TGB
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Figure 1.2: Radar locations and features within the vicinity of the Morgan Offshore Wind Project.

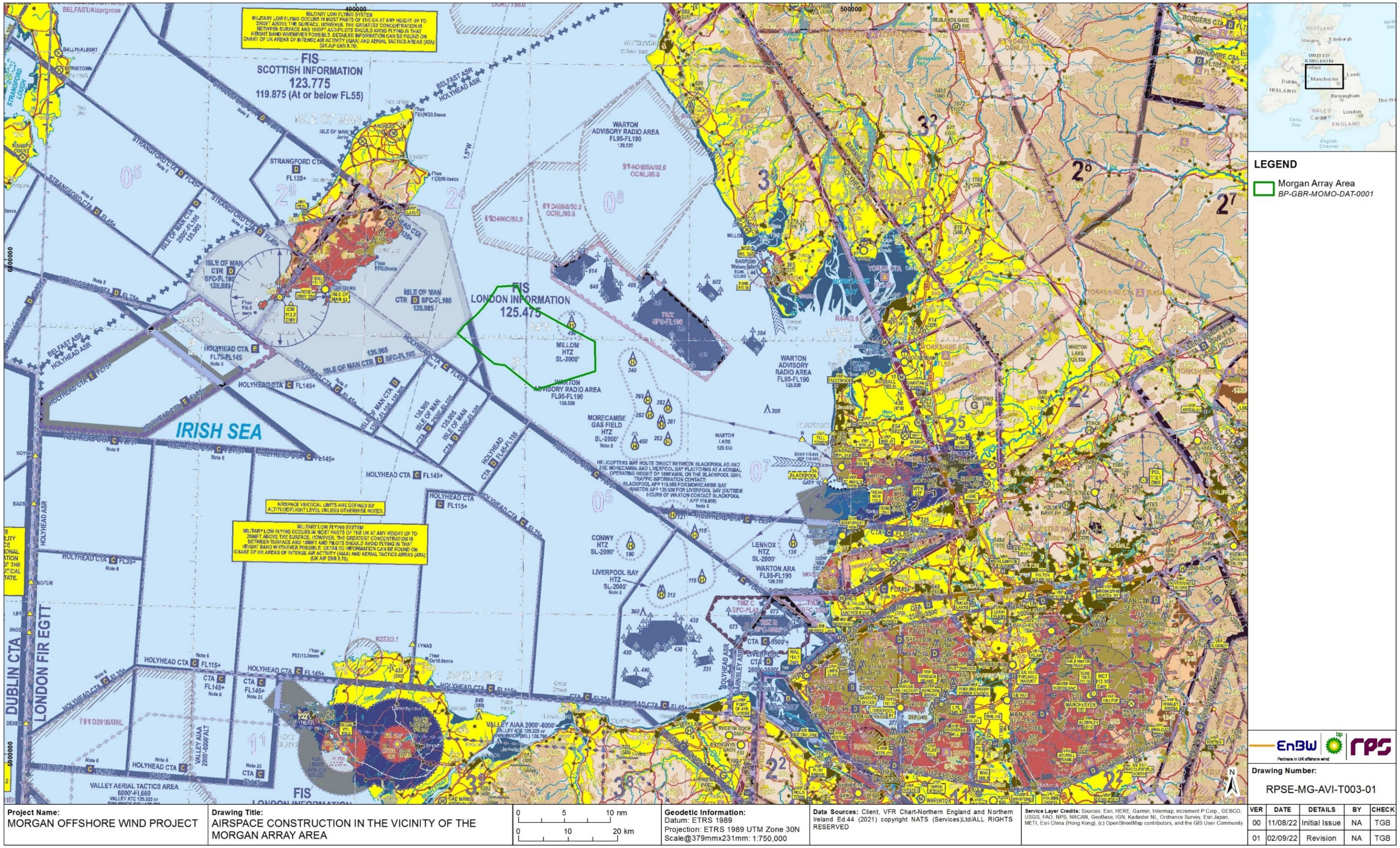

Figure 1.3: Airspace construction in the vicinity of the Morgan Array Area.[1]

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

1.2.3.3 There are no HMRIs located within the vicinity of the Morgan Array Area; however, the Morgan Array Area extends into the 9nm consultation zones established around seven platforms:

- Millom West located 0.4nm from the Morgan Array Area
- North Morecambe DPPA located 4.1nm from the Morgan Array Area
- North Morecambe located 4.1nm from the Morgan Array Area
- South Morecambe DP8 (N) located 6.6nm from the Morgan Array Area
- South Morecambe DP8 (S) located 6.6nm from the Morgan Array Area
- South Morecambe DP6 (N) located 7.6nm from the Morgan Array Area
- South Morecambe DP6 (S) located 7.6nm from the Morgan Array Area.

1.2.3.4 These platforms and their consultation zones are also presented in Figure 1.2. A 9nm consultation zone will also be a trigger for consultation with the operators of any subsea infrastructure and wells where mobile drilling rigs or vessels may require helicopter access. A Helicopter Access Report (HAR) has been completed which has assessed the potential impact to helicopter operations to those oil and gas platforms located within proximity to the Morgan Array Area. Appendix 1 to this technical report provides the HAR (Anatec, 2022). The HAR contains analysis of the potential of impact of helicopter operations to those platforms within 9nm of the Morgan Array Area, together with analysis conclusions.

1.2.4 Instrument Flight Procedures

1.2.4.1 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 2 to this technical report, IFP Assessment (Osprey, 2022), assesses those Irish Sea littoral aerodromes' flight procedures which are within 50nm of the Morgan Array Area together with analysis conclusions.

1.3 Desktop study

1.3.1.1 Through the desktop study the identification of all aviation and radar stakeholders potentially affected by the Morgan Array Area was established in accordance with regulatory guidelines on safeguarding distances from CAP 764.

1.3.1.2 The types of radar operating over the Morgan Array Area were considered, together with civil aviation agencies including NATS who are the main en-route ANSP in the UK, regional airports, offshore airborne Search and Rescue (SAR) and military operations of relevance to confirm the baseline.

1.3.1.3 The radar technical effects, radar Line of Sight (LoS), analysis between the maximum blade tip height and potentially affected civil and military aviation radar systems was completed to establish the theoretical detectability of the wind turbines to those regional radar systems which have the potential to be affected by their operation.

1.3.1.4 The aviation and radar baseline environment was defined through the identification and refinement of aviation and radar stakeholders via a desktop assessment utilising information available in the documents detailed in Table 1.1 that relate to aviation law, policy, process, guidance, and the promulgation of information to aviation stakeholders/operators.

1.3.1.5 No site-specific surveys were undertaken during this desk-based study. No consultation was undertaken during this desk-based study.

1.3.1.6 Information on aviation and radar activities within the Morgan aviation and radar study area was collected through a detailed desktop review of existing datasets. These are summarised in Table 1.1 below.

Table 1.1: Summary of key desktop sources.

Title	Source	Year	Author
UK IAIP	CAA/NATS	August 2022	CAA/NATS
UK Military Aeronautical Information Publication (AIP)	MOD	August 2022	MOD
MOD Lighting Review	MOD	January 2020	MOD
CAP 168 Licensing of Aerodromes	CAA	January 2022	CAA
CAP 393 The Air Navigation Order 2022	CAA	February 2021	CAA
CAP 437 Standards for Offshore Helicopter Landing Areas	CAA	July 2021	CAA
CAP 670 Air Traffic Services Safety Requirements	CAA	June 2019	CAA
CAP 738 Safeguarding of Aerodromes	CAA	October 2020	CAA
CAP 764 Policy and Guidelines on Wind Turbines	CAA	February 2016	CAA
CAP 777 ATC Surveillance Minimum Altitude Charts in UK Airspace Policy and Design Criteria	CAA	Edition 5, September 2018	CAA

Title	Source	Year	Author
European Union Aviation Safety Agency (EASA) Document 923 Safety Instruction Bulletin	EASA	2012	EASA
Marine Guidance Note (MGN) 654 Marine Guidance Note Safety of Navigation: Offshore Renewable Energy Installations (OREIs), Guidance on UK Navigational Practice, Safety and Emergency Response.	Maritime and Coastguard Agency (MCA)	April 2021	MCA
UK VFR Charts	CAA/NATS	April 2022	CAA/NATS
Statement of the OPERA group on the cohabitation between weather radars and wind turbines	OPERA	November 2009	OPERA

1.3.2 NATS Primary Surveillance Radar

1.3.2.1 There are a number of NATS PSRs which may be affected by the development of the Morgan Array Area; the closer ones are shown within Figure 1.2. The following approximate distances are taken from the closest boundary of the Morgan Array Area to each NATS PSR potentially affected:

- Clee Hill Radar located on a bearing of 154°/189.4km
- Great Dun Fell (GDF) Radar located on a bearing of 048°/115.9km
- Lowther Hill Radar located on a bearing of 007°/143.6km
- St Anne's Radar located on a bearing of 110°/55.9km
- Manchester (Airport) Radar located on a bearing of 123°/118.9km.

1.3.2.2 The following NATS PSRs provide en-route radar coverage over the Irish Sea airspace, the Morgan Array area is within the declared operational range of all of the NATS PSR sites:

- Lowther Hill
- GDF
- St Anne's
- Clee Hill.

1.3.3 Aerodrome Primary Surveillance Radar

1.3.3.1 Additional aerodrome PSRs are located at the airfields at:

- RAF Valley
- BAE Warton
- West Freugh
- Ronaldsway (IoM)
- Liverpool.

1.3.3.2 The Morgan Array Area is within the declared operational range of all of these sites (see Figure 1.2).

1.3.4 Secondary Surveillance Radar

1.3.4.1 CAP 764 states that wind turbine effects on Secondary Surveillance Radar (SSR) are traditionally less than those on PSRs but can be caused due to the physical blanking and diffracting effects of the wind turbine towers, depending on the size of the wind turbines and the array area. These effects are typically only a consideration when the wind turbines are located very close to the SSR (less than 10km). There are no SSR systems within 10km of the Morgan Array Area.

1.3.5 Radar Line of Sight modelling

1.3.5.1 The ATDI ICS LT (Version 22.4.7 x64) tool was utilised 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, taking into account earth curvature and radar signal properties.

1.3.5.2 It should be noted that this is a limited and theoretical desk-based study; in reality there are unpredictable levels of 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 likelihood of the wind turbine being detected such that the operational significance of the Morgan Array Area relative to the radar systems can be assessed. The aim of the LoS analysis is to determine which radar systems have the potential to detect operational wind turbines at the maximum blade tip height placed within a projected array area; the layout of wind turbines does not have a material effect on establishing theoretical radar LoS. Therefore, to enable the analysis, points of reference in the form of a regular grid pattern were established across the projected Morgan Array Area with wind turbines on all array vertices at the maximum tip height of 324m above LAT, which is considered to be the Maximum Design Scenario (MDS) for aviation. The model does not use precise planned/proposed wind turbine positions, but representative locations within the projected Morgan Array Area, on a 4km grid pattern of 38 wind turbines, ensuring an even distribution, The result for a particular location provides an indication of detectability of a wind turbine, based on a maximum upper blade tip height, within a 2km radius of that location; providing a result that covers the whole of the projected Morgan Array Area. The qualitative definitions utilised in the LoS assessment are defined in Table 1.2.

Table 1.2: LoS qualitative definitions.

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.

1.3.5.3 A radar LoS analysis across the Morgan Array Area has been completed in order to establish theoretical radar detectability of the wind turbines, placed within the Morgan Array Area to selected PSR systems located in the UK based on a maximum upper blade tip height of 324m LAT. This is a representative modelling 'datum' height and the error tolerance of the analysis model covers the wind turbine blade tip height of 324m above LAT. Radar operates by alternately transmitting a stream of high-power radio frequency pulses and 'listening' to echoes received back from targets within its radar LoS. Generally, air surveillance (aviation) radars employ a rotating antenna that provides 360° coverage in azimuth; the typical scan rate is 15 rotations per minute (rpm) thus illuminating a given target every four seconds.

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

1.3.5.5 Wind turbines are a significant cause of PSR false plots or clutter, as the rotating blades can trigger the Doppler threshold (minimum shift in signal frequency) of the Radar Data Processor (RDP) and therefore may be interpreted as aircraft movements (CAP 764). Significant effects have been observed on radar sensitivity caused by the substantial Radar Cross Section (RCS) of the wind turbine structural components (blades, tower and nacelle) which can exceed that of a large aircraft; the effect 'blinds' the radar (or the operator) to wanted targets in the immediate vicinity of the wind turbine. False plots and reduced radar sensitivity may reduce the effectiveness of the radar system itself to an unacceptable level and compromise the provision of a safe radar service to participating aircraft.

Radar Line of Sight modelling summary

1.3.5.6 Initial radar LoS modelling results indicate that theoretically the following PSRs would not detect the wind turbines (based upon a modelled maximum blade tip height of up to 324m LAT (an 'unlikely' or 'no' (Table 1.2) output from the modelling, allowing for model tolerance error):

- Clee Hill
- Great Dun Fell
- Manchester
- Liverpool Airport
- RAF Valley.

1.3.5.7 Due to the location of the Morgan Array Area possible effects are likely to the operations associated with the following PSRs due to detectability of the wind turbines:

- Lowther Hill; over 143km from the Morgan Array Area, but due to the vertical extent of the wind turbines, 90% of the array area are theoretically highly likely to be in radar LoS to this NATS PSR (Figure 1.4)
- St Anne's; over 55 km from the Morgan Array Area, the wind turbines are theoretically highly likely to be in radar LoS to this NATS PSR (Figure 1.5)
- West Freugh; over 102km from the Morgan Array Area, but due to the vertical extent of the wind turbines, the northeast elements are theoretically likely to be in occasional and intermittent radar LoS to this PSR (Figure 1.6)
- Ronaldsway (IoM); less than 30km from the Morgan Array Area, the wind turbines are theoretically highly likely to be in radar LoS to this aerodrome PSR (Figure 1.7)
- BAE Warton; 65km from the Morgan Array Area, the whole of the Morgan Array Area will be theoretically highly likely to be in radar LoS to this aerodrome PSR (Figure 1.8).

1.3.5.8 Radar clutter created by the Morgan Array Area from detectable wind turbines could cause air traffic controllers to lose aircraft track identity and hence they would be unable to maintain the appropriate separation standard on fixed airspace procedures or other aircraft manoeuvring under their control. Radar LoS analysis results for those aviation radar systems that have provided theoretical radar detectability of the Morgan Array Area are provided in Figure 1.4 to Figure 1.8 below.

1.3.6 Meteorological Office radar

1.3.6.1 The Statement of the European Union Meteorological Network Operational Programme for the Exchange of weather Radar information (OPERA) Group, on the cohabitation between meteorological weather radars and wind turbines, states that the deployment of wind turbines within 5km of weather radar is prohibited (OPERA, 2009). The Meteorological (Met) Office radar infrastructure is safeguarded by the Met Office. The Met Office works to wind turbine safeguarding guidelines that stipulate a 20km separation between any development and a weather radar system.

Met Office radar summary

1.3.6.2 The closest Met Office radar system is located at Hameldon Hill (Met Office, 2020), approximately 4.6km southwest of Burnley, Lancashire, over 100km from the Morgan Array Area. The actual type of the Met Office radar located at Hameldon Hill is unknown but is inconsequential.

1.3.7 Military low flying

1.3.7.1 The UK military low flying system covers the open airspace of the whole of the UK and surrounding overseas areas from the surface to 2,000 feet Above Ground Level (AGL) or Above Mean Sea Level (AMSL).

1.3.7.2 Major towns and cities are generally avoided by low flying aircraft; in some areas of the country, a combination of airspace restrictions and topographical features make it difficult for aircrew to greatly vary their routes. The Irish Sea Class G airspace (section 1.2.2), within which the Morgan Array Area sits, is in the MOD Low Flying Area (LFA) 17 (part of the UK Low Flying System (UKLFS)), between Cumbria (Lake District) and North Wales; transiting military aircraft do use this area to avoid the IoM and Manchester Airport Controlled Airspace (CAS) and to complete low flying training of aircrews. (Figure 1.3). Military low flying is a demanding but essential skill for military aircrew, gained through progressive training and continuous practice within the UKLFS. The ability to operate effectively at low level by day and night is vital to fast jet, transport aircraft and helicopters as they support forces on the ground.

1.3.8 Practice and Exercise Areas

1.3.8.1 There are a number of military Practice and Exercise Areas (PEXAs) surrounding the Irish Sea; Luce Bay (West Freugh), Kirkcudbright to the north and Eskmeals to the east. However, none of the aviation related PEXA are likely to be impacted by the Morgan Generation Assets. The airspace near the Morgan Array Area does not contain military restricted airspace or weapons ranges and would not be considered, by the MOD, to be of a priority in terms of the UKLFS.

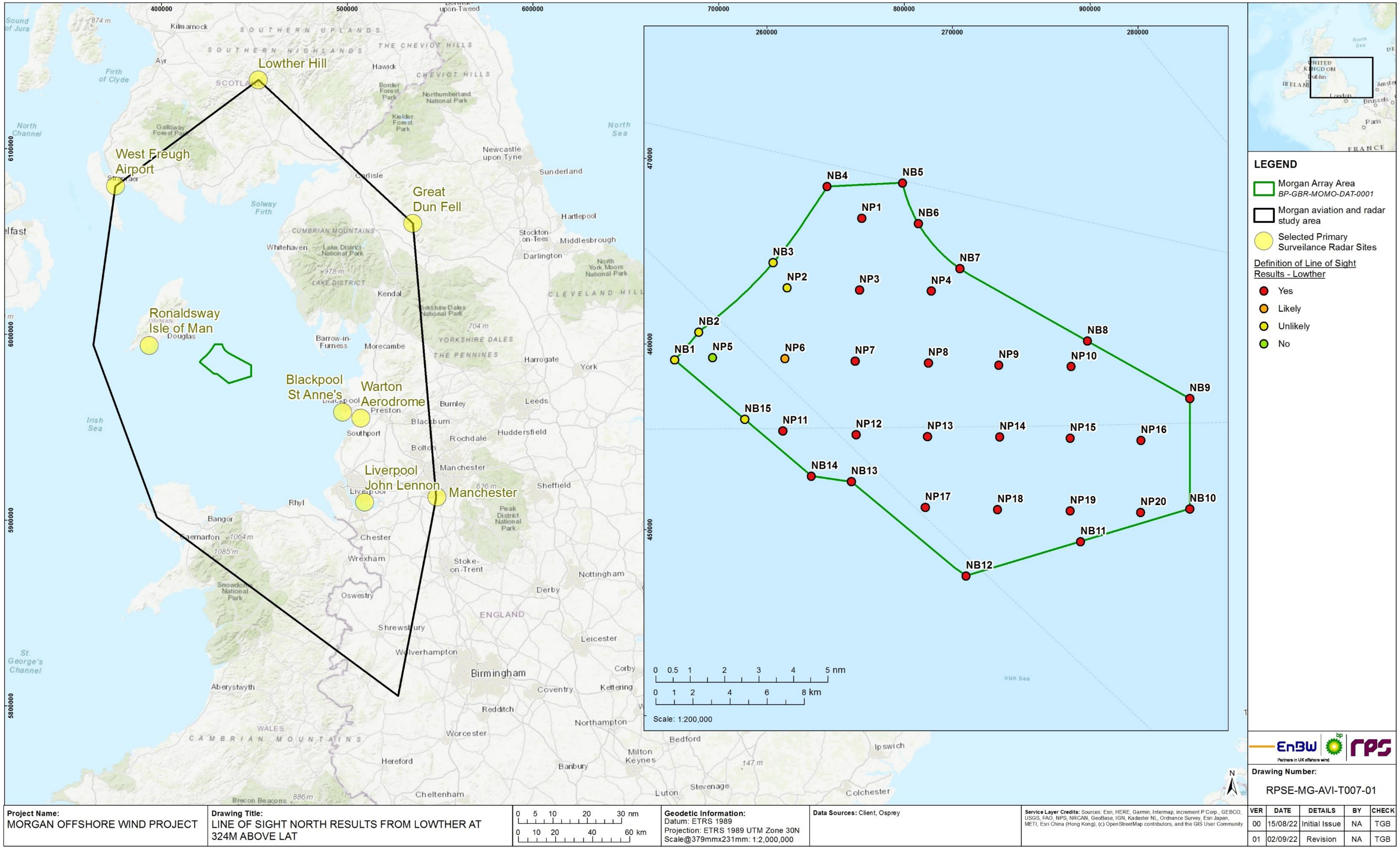


Figure 1.4: NATS Lowther Hill Radar LoS of the Morgan Array Area (not to scale).

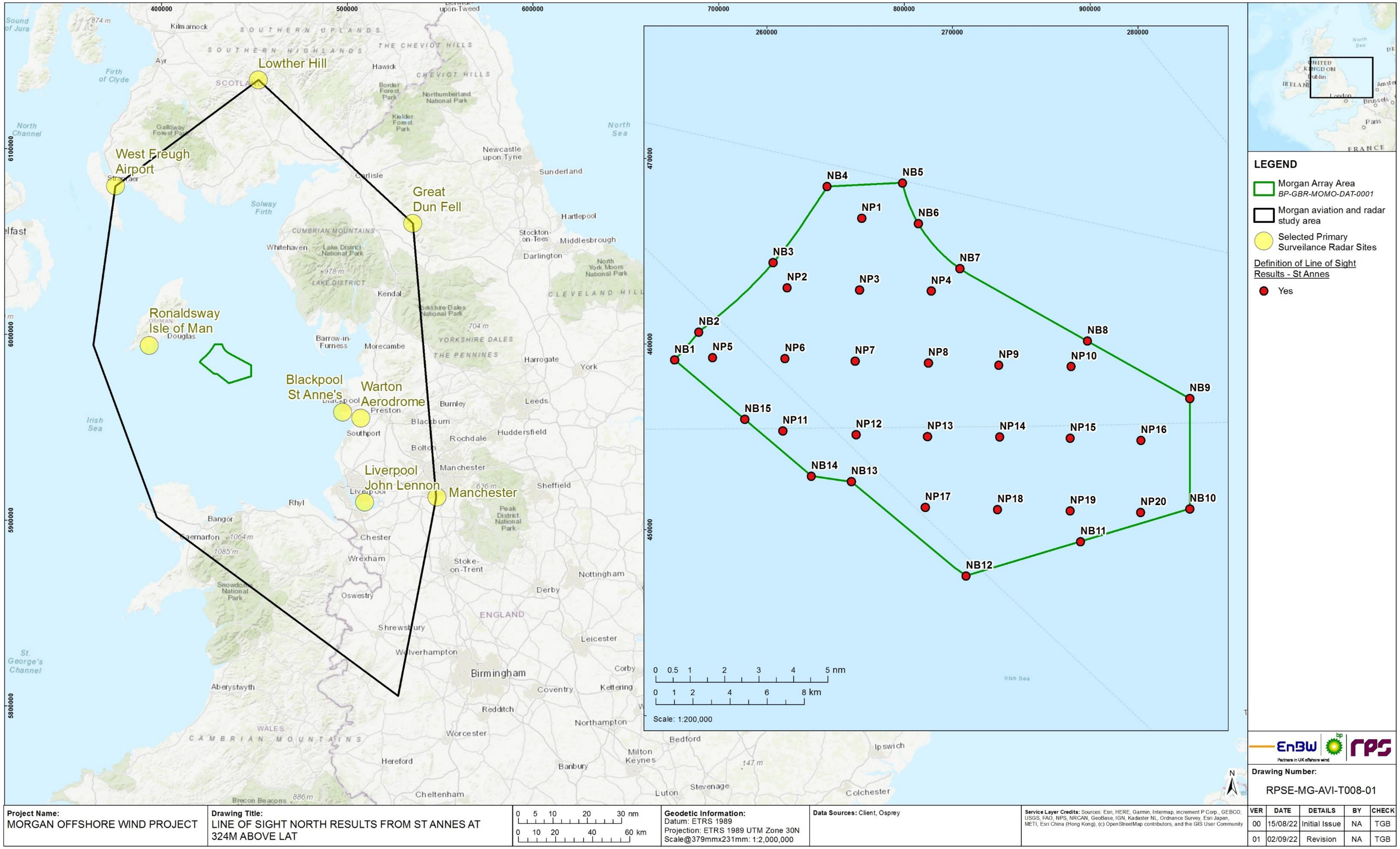


Figure 1.5: NATS St Anne's Radar LoS of the Morgan Array Area (not to scale).

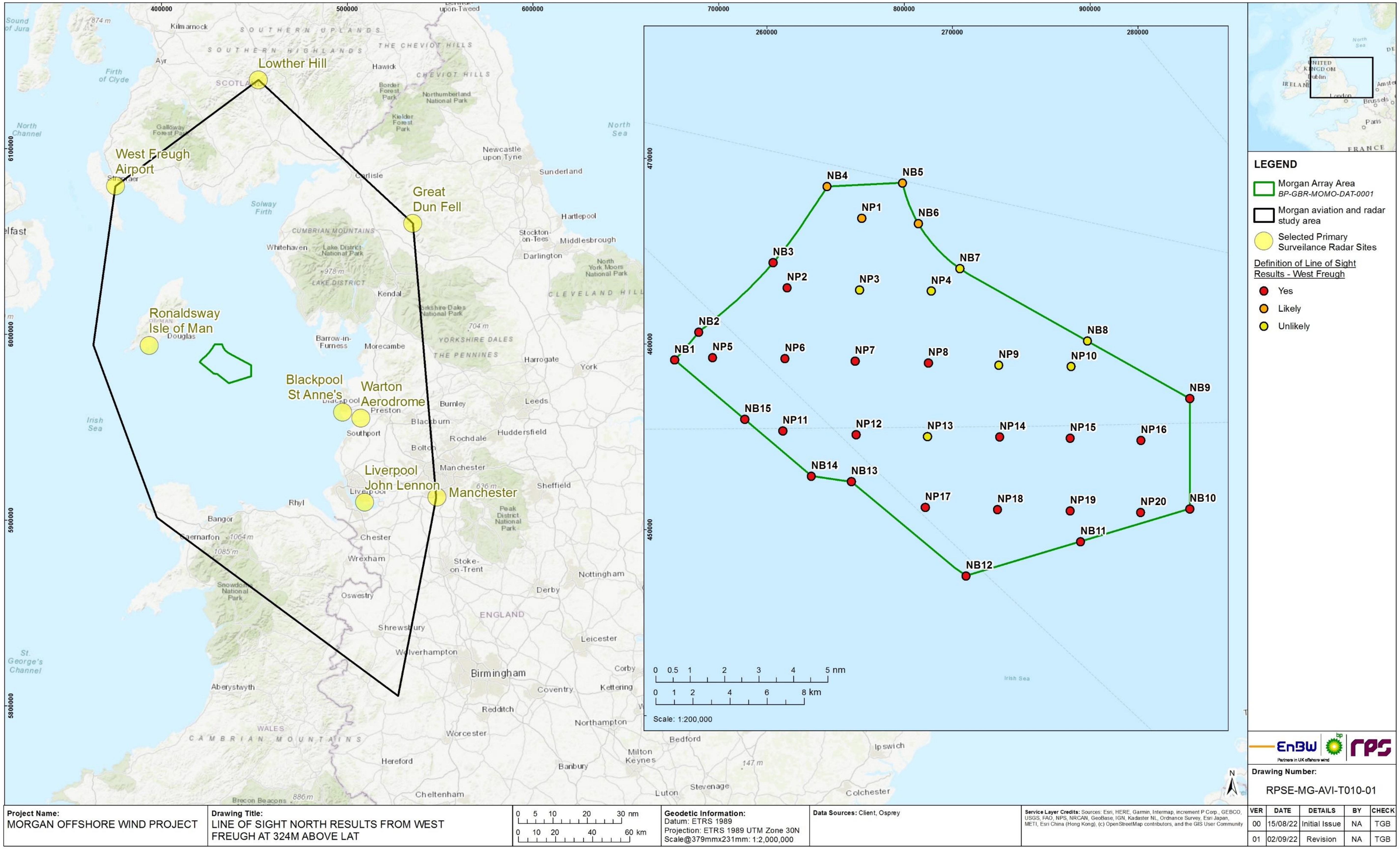


Figure 1.6: West Freugh Radar LoS of the Morgan Array Area (not to scale).

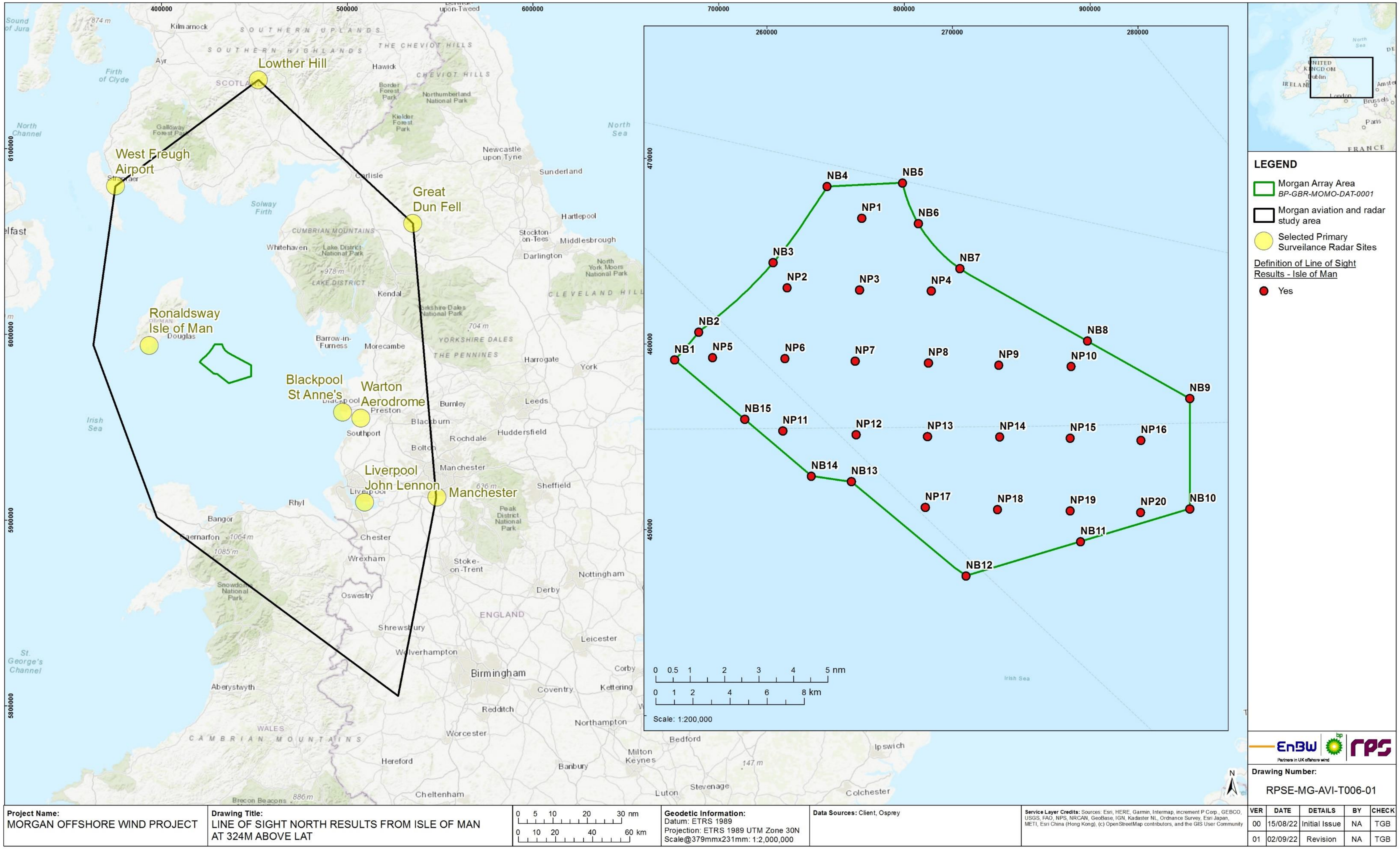


Figure 1.7: Ronaldsway (IoM) Airport Radar LoS of the Morgan Array Area (not to scale).

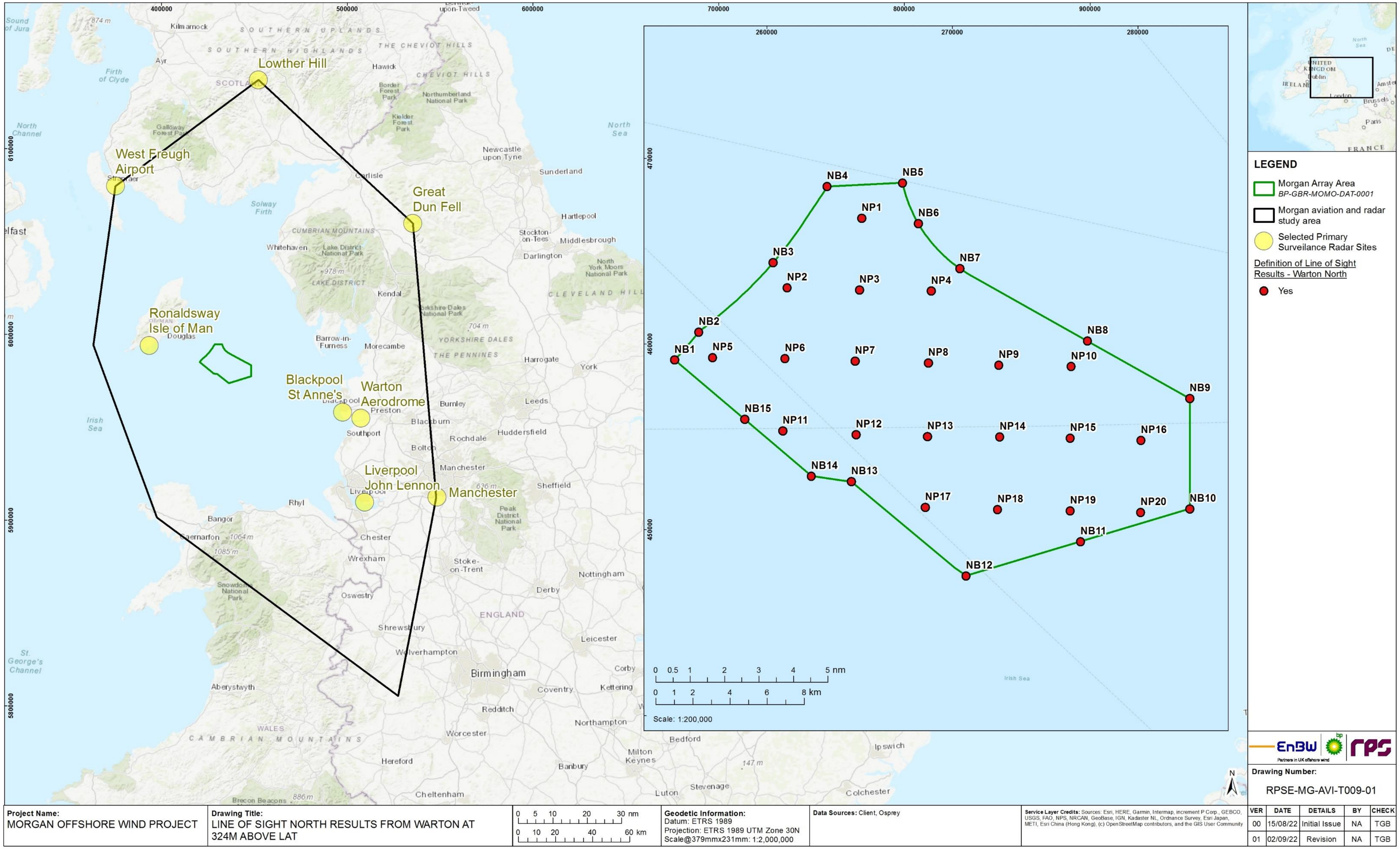


Figure 1.8: BAE Warton Radar LoS of the Morgan Array Area (not to scale).

1.3.9 Aeronautical Offshore Search and Rescue operations

1.3.9.1 The civil aviation operator Bristow Inc. VTOL (Bristow) are contracted to HM Coastguard (the MCA) to conduct UK maritime Search and Rescue (SAR) operations; SAR helicopter operations are overseen by the Flight Operations Division of the CAA. To complete the role Bristow operates under its Air Operator Certificate (AOC) which provides certain exemptions to execute SAR operations in low visibility and other conditions.

1.3.9.2 The development of the Morgan Generation Assets would lead to a change of the operating environment should airborne SAR operations be required within or close to the Morgan Array Area. When on an operational mission, SAR aircraft are not constrained by the normal rules of the air and operate in accordance with their AOC. This allows SAR pilots total flexibility to manoeuvre using best judgement thus making them highly adaptable to the environment and conditions in which they are operating.

1.4 Ronaldsway (IoM) airport

1.4.1.1 Ronaldsway, IoM Airport, is the main civilian airport on the IoM; owned by the Manx Government and operated by the Department of Infrastructure. It is in the south of the IoM at Ronaldsway near Castletown, 6nm southwest of Douglas, the island's capital. The airport has scheduled services to the United Kingdom and the Republic of Ireland and in 2018 just under one million passengers passed through the airport. Aircraft approaching from, and departing to, the east will transit above and close to the Morgan Array Area along the airways structure depicted in Figure 1.3.

1.4.2 Obstacle Limitation Surfaces

1.4.2.1 Flight operations at and within the vicinity of an aerodrome, can be affected by obstacles inside and outside the aerodrome's boundary. The CAA issues regulatory guidance (CAP 738) (CAA, 2020) on how aerodromes should manage operations in relation to obstacles and the licensing of an aerodrome depends on the extent to which these areas are free from current or new obstacles.

1.4.2.2 The regulatory guidance states that certain areas of the subject aerodrome's local airspace must be defined to assess the significance of existing or proposed obstacles in its vicinity; these are Obstacle Limitation Surfaces (OLS). The OLS are determined according to the classification of the aerodrome and its runway length. The safeguarded areas are represented by a number of complex 2-D planes and 3-D shapes around the aerodrome; the absence of obstacles within these areas contributes to the safety of both visual and instrument-based flight operations in the vicinity of the aerodrome.

1.4.2.3 For Ronaldsway (IoM), the runway length in excess of 1,100m but less than 1,200m results in an assumed Aerodrome Reference Code of 3, should the guidance stipulated in the CAP 168 [Chapter 3] be applied. In this instance, the maximum lateral extent of the OLS established for a Code 3 classification, is 10km from the IoM Airport ARP.

1.4.3 Instrument Flight Procedures

1.4.3.1 Licenced Airports ensure safe operations in the vicinity of the airport by minimising, as far as practicable, any penetration of the OLS. Whilst the OLS offers vital protection to aircraft against new and existing developments, they do not ensure that IFPs remain unaffected by such developments. It is vital that airports are made aware of any new development that may require an increase to the published Obstacle Clearance Altitude (OCA) associated with IFPs.

1.4.3.2 The CAA publishes a number of aeronautical charts related to procedures for the operation of aircraft to and from Ronaldsway (IoM) Airport. Figure 1.9 provides an illustration of a standard track which aircraft fly on arrival to the airport.

1.4.3.3 Elements of the Morgan Array Area are located underneath the IoM CTA which is airspace established to afford protection to its users. In order to fly in the CTA aircraft must be equipped to a certain standard and pilots must hold flying endorsements to operate in this classification of airspace. Furthermore, pilots must obtain clearance from ATC to enter such airspace, maintain two-way communication and follow instructions issued to them. Figure 1.9 below provides an illustration of an IoM Instrument Approach Chart for an approach to Runway 26 at the airport together with the proximity of the Morgan Array Area to the procedure; the 'VANIN' hold is located directly above and central to the Morgan Array Area. A number of other Ronaldsway IFPs and their containment areas are located close to the Morgan Array Area.

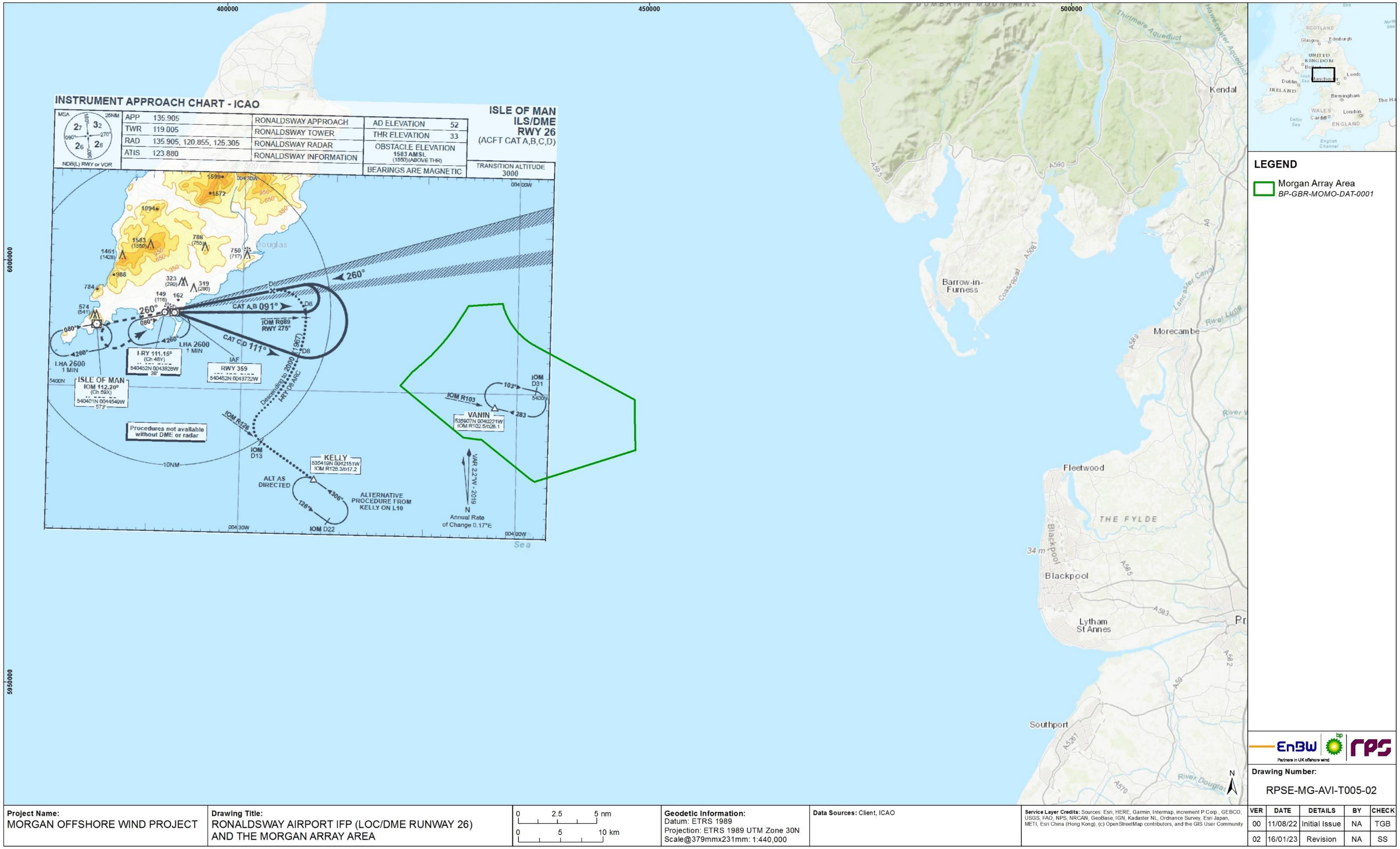


Figure 1.9: Ronaldsway (IoM) Airport IFP (LOC/DME Runway 26) and the location of the Morgan Array Area (green outline) (not to scale).

1.4.4 Ronaldsway (IoM) PSR

1.4.4.1 The Morgan Array Area is located within the Airport's PSR coverage area which provides data for the control of aircraft operating in the airspace above the Morgan Array Area.

1.4.4.2 Air Traffic Controllers are responsible for the control and separation of aircraft on departure and approach to the airport and other en-route air traffic. Controllers are required to maintain standard lateral separation of 5nm between aircraft under their control and unknown aircraft (or clutter that looks like a real aircraft or could be assumed to be masking returns from a real aircraft). Radar clutter created by the Morgan Generation Assets from detectable operational wind turbines could cause air traffic controllers to lose aircraft track identity and hence they would be unable to maintain the appropriate separation standard on these fixed procedures or other aircraft manoeuvring under their control.

1.4.5 Surveillance Minimum Altitude Chart

1.4.5.1 The minimum altitude available to ATC for vectoring arriving flights within the Surveillance Minimum Altitude Chart (SMAC) is 300m (984ft) above the highest obstacle within the SMAC or SMAC sector.

1.4.5.2 Figure 1.10 provides an illustration of the Ronaldsway (IoM) Airport SMAC together with the approximate location of the Morgan Array Area.

1.4.5.3 The minimum altitude available within the SMAC, or SMAC sector, is determined by reviewing obstacles within the boundary of the SMAC, or SMAC sector. It is possible for an aircraft to stray from the SMAC undetected by the pilot or the controller; consequently, obstacles outside the SMAC need to be considered when calculating minimum altitudes for use inside the SMAC. This area is referred to as a Primary SMAC Buffer (PSB) and attracts a full Minimum Obstacle Clearance (MOC) value of 300m (984ft). The width of the PSB is dependent on the surveillance radar lateral separation certified for use with the ATC SMAC. Once this review of obstacles has been completed, the addition of 300m (984ft) to the elevation of the highest obstacle within the resultant area will determine the minimum initial altitude available. The resultant figure is then rounded up to the nearest 'hundreds of feet'.

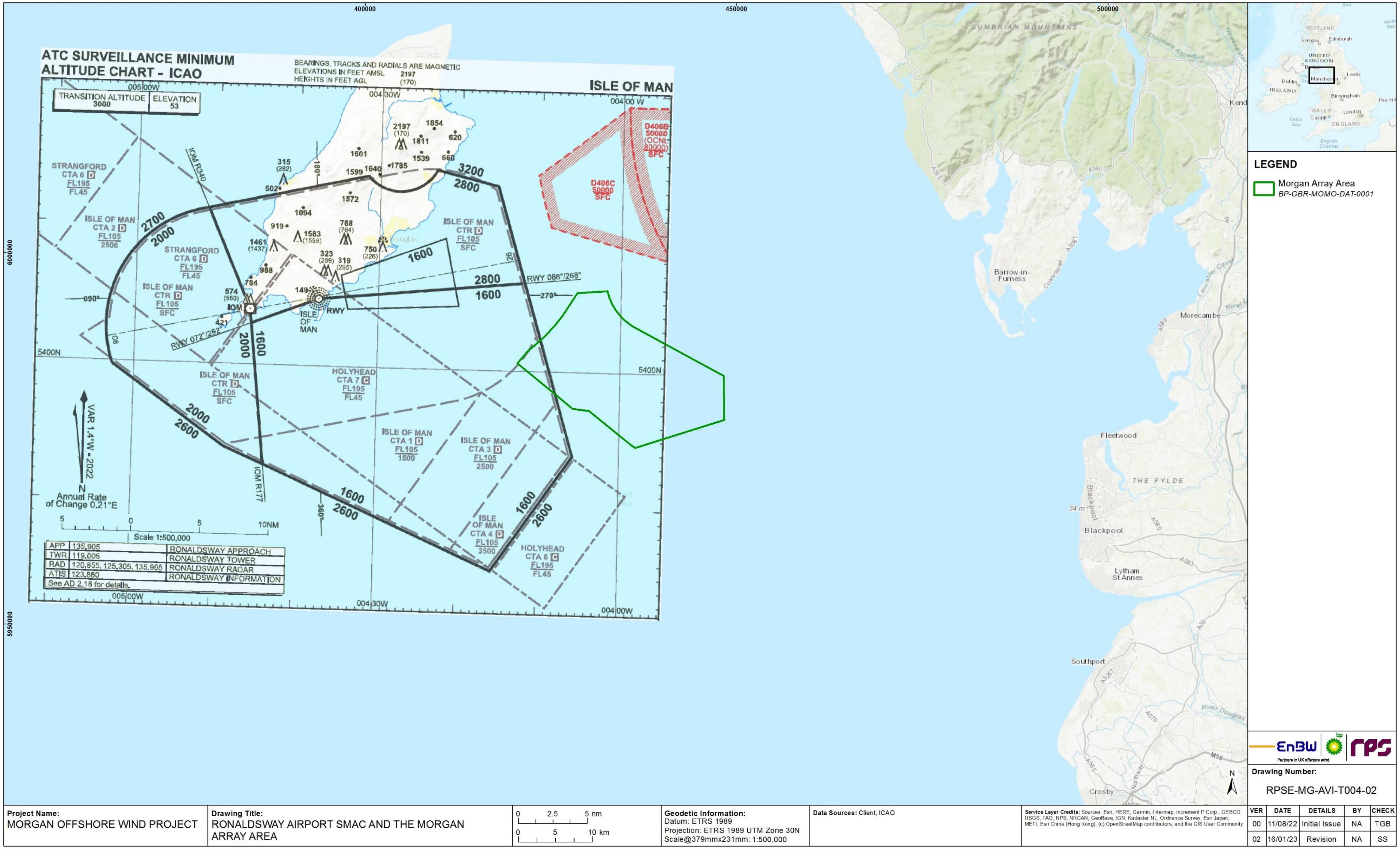


Figure 1.10: Ronaldsway (IoM) Airport SMAC and the approximate location of the Morgan Array Area (green outline) (not to scale).

1.4.6 Ronaldsway (IoM) airport summary

1.4.6.1 At its closest point the Morgan Array Area is located under 30km from the Airport ARP.

1.4.6.2 A number of the Airport's Instrument Approach Procedures are located close to the Morgan Array Area; these routes are safeguarded with the establishment of containment areas that may be compromised by the construction and presence of the Morgan Generation Assets. Appendix 2 to this technical report, IFP Assessment (Osprey, 2022), assesses and provides conclusions on the impact the Morgan Array Area will create to the Ronaldsway (IoM) OLS, IFP and SMAC at the assessed blade tip height of 324m above LAT.

1.4.6.3 Ronaldsway (IoM) Airport PSR system will theoretically detect wind turbines at a maximum blade tip height of 324m LAT (modelled at 320m AMSL and blade tips higher than this will be theoretically seen), as there is no blocking terrain between the PSR location and the Morgan Array Area.

1.5 References

Civil Aviation Authority (CAA) (2022a) UK Integrated Aeronautical Information Package (IAIP).

CAA (2016) Civil Aviation Publication (CAP) 764, Policy and Guidelines on Wind Turbines.

CAA (2022b) CAP 393, The Air Navigation Order (ANO).

CAA (2020) CAP 738, Safeguarding of Aerodromes.

CAA (2018) CAP 777, ATC Surveillance Minimum Altitude Charts in UK Airspace Policy and Design Criteria.

Maritime and Coastguard Agency (MCA) (2021) Marine Guidance Note (MGN) 654.

Ministry of Defence (MOD) (2020) Lighting Review.

Operational Programme for the Exchange of Weather Radar Information (OPERA) (2009). Statement on the cohabitation between weather radars and wind turbines.

Anatec Limited (Anatec) (2022) Mona and Morgan Offshore Wind Farm Helicopter Access Report (HAR)

Osprey Consulting Services (Osprey) Morgan and Mona Windfarms - Instrument Flight Procedure (IFP) Impact Assessment.

Appendix A: Helicopter Access Report (HAR)

A.1 Executive summary

A.1.1 Regulations

1.5.1.1 Commercial Air Transport (CAT) Regulations have been applied to identify the current helicopter access available without any nearby wind farms. The access is then updated to take account of the Morgan Generation Assets. Finally, in line with planning guidance, the cumulative effect of the Mona Offshore Wind Project and Morecambe Offshore Windfarm is included to assess the impact on helicopter access. The report applies a worse case assumption that wind turbines are built up to the proposed boundaries.

A.1.2 Meteorological data

1.5.1.2 The meteorological data analysed was from the Met Office Integrated Data Archive System (MIDAS) (Met Office, 2019). It contains land surface observations data from the Met Office station network that have been designated as public sector information and provided under an Open Government Licence. One dataset within the database contained hourly aviation data from RAF Valley. RAF Valley is situated on the northwest part of Anglesey.

1.5.1.3 A series of filters were applied to the meteorological data to identify Day and Night Visual and Instrument Meteorological Conditions, also when flying could not take place. The output is shown in tables for each year. In addition, the wind direction for Instrument Meteorological Conditions were analysed and plotted.

A.1.3 Analysis and results

1.5.1.4 The impact of the Morgan Generation Assets on helicopter access to 11 platforms, floating facilities and wellheads was assessed. The assessment indicated that there would be no impact on the following installations from the Morgan Generation Assets:

- Dalton R1 well
- Dalton R2 well
- North Morecambe DPPA platform (NUI)
- Whitehaven Wellhead
- Rhyl Wellheads
- South Morecambe DP8 platform (NUI)
- South Morecambe DP6 platform (NUI)
- South Morecambe DP4 (considered a wellhead as topside removed).

1.5.1.5 For the following installations the Morgan Generation Assets could restrict access under Instrument Meteorological Conditions:

- Millom West platform (NUI) - Millom West Platform will be located 0.4nm from the Morgan Array Area. This will prevent IMC access, resulting in a 7.6% average annual loss of access. Providing sufficient distance is provided for a day VMC approach, the access will be an average of 89.5% of daylight conditions
- Millom PLEM wellhead - With the Morgan Array Area situated 1nm away on Day VMC and some limited Night VMC operations would be possible when a Stabilised Approach does not encroach on the Morgan Generation Assets. This would provide average access of 89.5% of daylight conditions and up to 64.6% of night conditions. This is a logistics issue as emergency helicopter flights by the Coastguard would still be possible to a drilling rig or vessel working over the wellhead.
- Q1-3 Wellheads - With the Morgan Array Area situated 1nm away on Day VMC and some limited Night VMC operations would be possible when a Stabilised Approach does not encroach on the Morgan Generation Assets. This would provide average access of 89.5% of daylight conditions and up to 64.6% of night conditions. This is a logistics issue as emergency helicopter flights by the Coastguard would still be possible to a drilling rig or vessel working over the wellhead.

1.5.1.6 In the cumulative scenario where the Mona Offshore Wind Project and Morecambe Offshore Windfarm are also built, only impacted installations (as defined above) have the potential to result in a cumulative effect with another wind farm. However, since there is a 9nm clear approach from the NE into the prevailing south-westerly winds with more than 3nm available for a go-around or take-off, neither the Mona Offshore Wind Project nor the Morecambe Offshore Windfarm impact the installations and no cumulative impact is identified.

A.1.4 Safety considerations

1.5.1.7 The SAR helicopters operated on behalf of the MCA are not constrained by CAT meteorological limits. The Morgan Generation Assets will have a layout which will need to be compliant with MGN 654, and so SAR access to installations adjacent to the Morgan Generation Assets will still be available. SAR helicopters will be tasked for major incidents, accidents and urgent medivacs, rather than CAT helicopters. Therefore, any reduction in CAT helicopter access will result in a logistic impact on the installation operator, rather than a safety impact.

A.2 Introduction

1.5.1.8 Anatec were commissioned by the Applicant to undertake a Helicopter Access Report (HAR) for the purpose of informing the Aviation and Radar assessment of the proposed Morgan Generation Assets. Furthermore, this report was produced as part of the Applicant's obligations under CAP 764 (CAA, 2016), where the operator of any offshore helicopter destination within 9nm of a wind farm must be consulted at the planning stage of a wind farm.

1.5.1.9 The methodology used to assess the operational impact has been accepted by helicopter operators and oil and gas operators on a number of previous offshore wind farm projects. Eleven years of meteorological data from RAF Valley, situated on the north west of Anglesey, was extracted from the Met Office Integrated Data Archive System (MIDAS). The data was recorded hourly, resulting in 96,391 data points.

A.2.1 Commercial Air Transport regulations

1.5.1.10 Commercial Air Transport (CAT) flights, such as crew change flights to gas platforms, are regulated under the following requirements.

Offshore Approvals

1.5.1.11 Offshore operations are regulated under Specific Approval for Helicopter Offshore Operations (SPA.HOFO) (CAA, 2018):

1.5.1.12 "Offshore operation" means a helicopter operation that has a substantial proportion of any flight conducted over open sea areas to or from an offshore location. An offshore operation includes, but is not limited to, a helicopter flight for the purpose of:

- Support of offshore oil, gas and mineral exploration, production, storage and transport
- Support of offshore wind turbines and other renewable-energy sources
- Support of ships including sea pilot transfer.

Meteorological limits

1.5.1.13 The limitations presented within this section, based on CAT Regulations, have been applied to the meteorological data to identify when wind farms will affect helicopter access to the infrastructure presented in en-route descent.

1.5.1.14 An en-route descent, where a helicopter may descend from Instrument Meteorological Conditions (IMC) into Visual Meteorological Conditions (VMC), and so make a visual approach to the platform, is permitted when:

- Day – cloud base ≥600 feet (ft) and visibility ≥4,000 metres (m)
- Night – cloud base ≥1,200ft and visibility ≥5,000m.

Instrument Meteorological Conditions

1.5.1.15 IMC conditions are assumed to exist when the weather limits are below those for flight under VMC. When the conditions are below those for an en-route descent, an Airborne Radar Approach (ARA) is mandatory.

Airborne Radar Approach

1.5.1.16 An ARA is flown to a platform when the weather conditions are below the VMC limits. The minima for an ARA are:

a. A descent to a Minimum Descent Height (MDH) of 200ft by day or 300ft by night (or deck height plus 50ft if higher)

b. A Missed Approach Point (MAP) no closer than 0.75nm (1,390m) from the installation; this distance is based on the limitations of the Radio Detection and Ranging (Radar) in mapping mode and how it is displayed to the crew.

1.5.1.17 As the helicopter has to be below cloud and in sight of the installation before proceeding visually beyond the MAP, in practical terms this results in the following minimum weather conditions:

c. Day – cloud base ≥200ft and visibility ≥1390m

d. Night – cloud base ≥300ft and visibility ≥1390m.

A.2.2 Helicopter approach profiles

1.5.1.18 The distance required for a safe helicopter approach to an installation depends on the profile flown, which in turn depends on the meteorological conditions. There are three basic profiles: firstly, the most commonly flown is the day visual approach; in degraded visual conditions, such as night, a stabilised approach is flown; finally, in conditions of low visibility or low cloud the ARA is flown.

Day visual approach

1.5.1.19 A day visual approach can be conducted when the cloud base is greater than 600ft and the visibility is greater than 4,000m. This type of approach is routinely flown by day inside and adjacent to wind farms. For example, routine flights are flown by day to a platform inside the Hornsea Two Wind Farm where the closest wind turbine blades are 910m away; another example is the Blythe Platform which has wind turbines in an arc 1,200m from the helideck.

Stabilised approaches

1.5.1.20 In VMC but where degraded visual conditions exist such as at night, the helicopter industry best practice is to fly a stabilised approach (HeliOffshore, 2020). Part of the stabilisation criteria is the requirement to maintain a constant heading into wind for 1nm of the final approach. To enable this, the distance between the wind turbines and the helideck must allow enough space to position to the 1nm final point. So, typically 2nm is required in total. If sufficient distance is not available, then access to the installation would not be possible at night when the wind direction requires an approach in a direction from the wind farm towards the helideck.

Airborne Radar Approach profile

1.5.1.21 The ARA profile is shown in Figure A 1and Figure A 2. The helicopter's radar is used as the primary means of navigation and obstacle avoidance, supported by Global Positioning System (GPS).

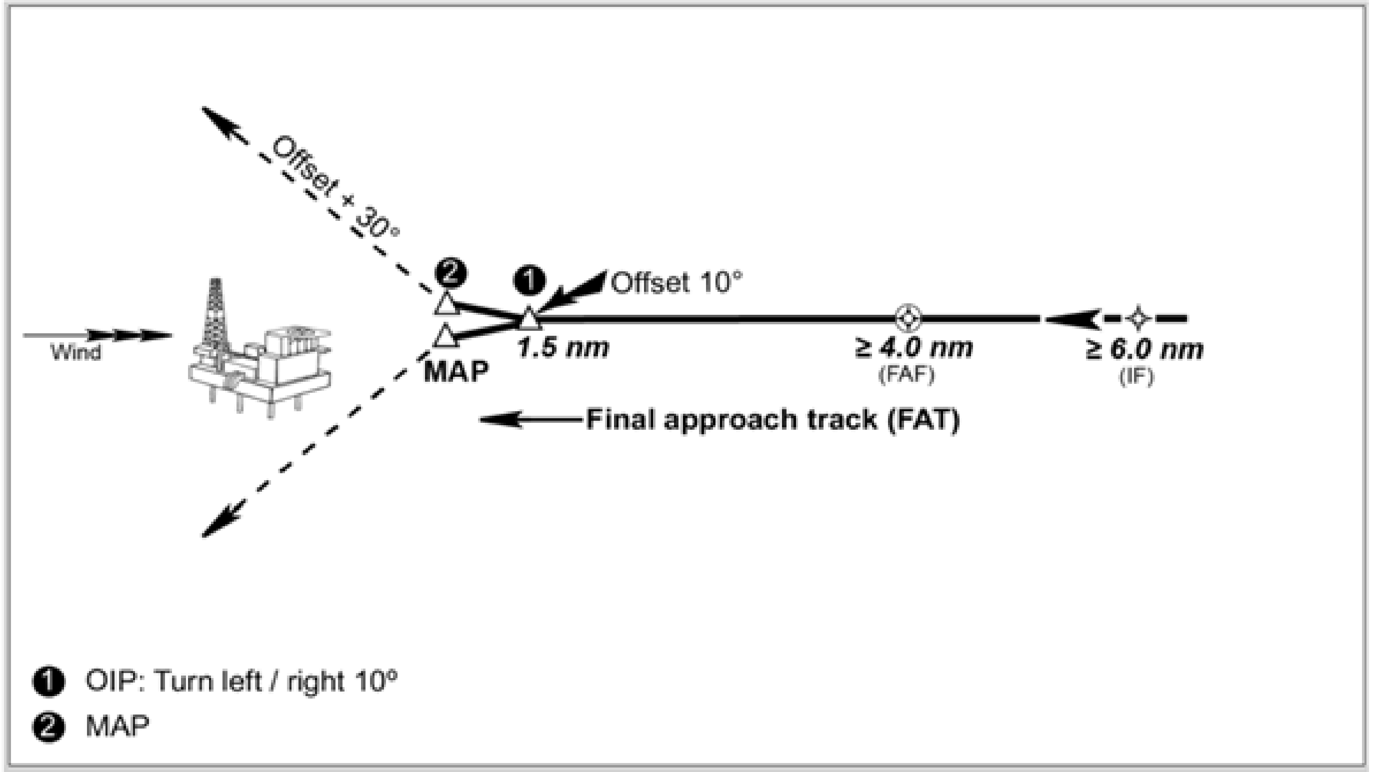


Figure A 1: ARA Horizontal Profile.

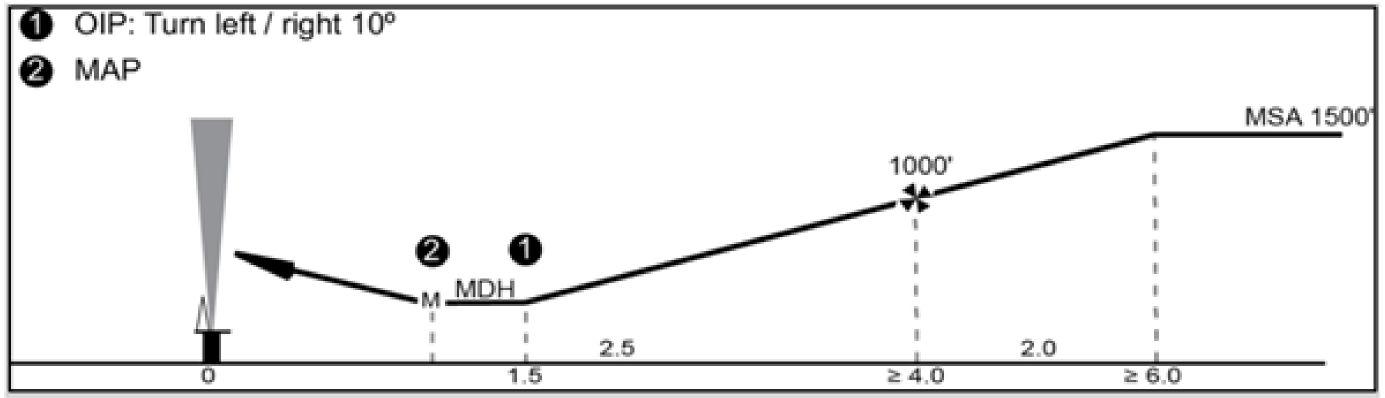


Figure A 2: ARA Vertical Profile.

1.5.1.22 For the purposes of this assessment, it is assumed a 9nm approach arc clear of obstructions is required for an ARA. This distance will allow a helicopter to conduct a direct approach, descending from the Minimum Safe Altitude overhead the wind turbines to achieve the Initial Approach Fix (IAF) at 1,500 ft, or to conduct an arc approach maintaining a 1nm lateral separation distance from the wind turbines.

A.2.2.1 No-fly conditions

1.5.1.23 Any of the following conditions would result in flights being cancelled, or being unable to land at an offshore installation:

a. Sea state (significant wave height) ≥6m

b. Wind speed ≥60 knots (kt); this is a general limit, but it should be noted that some Normally Unmanned Installations (NUIs) have values as low as 30kt due to reduced deck friction

c. Unable to land from an ARA – cloud base <200ft by day or <300ft at night or visibility <1,390m

d. Forecast Triggered Lightning (Wilkinson et al., 2012)

e. For a helicopter lacking an approval for flight in icing conditions, icing conditions occurring at 1,500ft when a VMC transit is not permitted is assessed.

1.5.1.24 It is noted that icing conditions are defined as an air temperature below 0 degrees Celsius (°C), with an inflight visibility less than 1,000m and visible moisture present. In practical terms this means that there is the potential for icing in cloud when the temperature is below 0°C. When a VMC transit is not permitted due to low cloud or poor visibility the conditions are IMC. In IMC over the sea, the aircraft has to avoid all obstacles by 1,000 ft vertically. A default value for obstacles over water is 500ft, and so the minimum transit height is 1,500ft above sea level. Using a lapse rate of 2°C per thousand feet, a surface temperature of 3°C or less indicates that any cloud at 1,500 ft or higher meets the definition of icing conditions.

1.5.1.25 The meteorological data used in this report did not include sea state or Triggered Lightning. Therefore, when the annual percentage of no-fly conditions was calculated, it is likely that this report will slightly underestimate the true value of no-fly conditions. Furthermore, high winds have not been included in the no-fly criteria as different operational limitations apply to various helidecks, ranging from 25kt to the standard 60kt. Reduced limitations are often temporary in nature, for example excessive guano causing the helideck to fail a friction test, resulting in a 30kt limitation. Furthermore, regulatory changes introduced under CAA Safety Directive SD-2022-001 (CAA, 2022) are likely to affect the frequency of access in future years as improved firefighting, helideck lighting and wind and motion limits will constrain access to any helideck which has not been upgraded. As it is not possible to predict which helidecks will be upgraded, current limitations for individual installations are identified in section A.6 but the generic limitations shown in Figure A 2 and Figure A 3 applied.

A.3 Methodology

1.5.1.26 This assessment has applied the CAT weather limits, as a series of filters, to the meteorological data provided in order to understand the potential operational impact on the gas infrastructure within 9nm of the wind farms.

1.5.1.27 Any planned obstructions within a radius of 9nm are taken into account in this assessment.

1.5.1.28 The assessment is focused on identifying any reduced access when operating under CAT Regulations, but access under SAR Regulations is also considered.

A.3.1 Assumptions

1.5.1.29 The following assumptions were used:

- As the exact locations and height of the wind turbines is not yet known, it is assumed that the boundary of the wind farm forms a solid wall of wind turbines and they are greater than 1,000ft high
- For an ARA, an approach arc clear of obstacles out to 9nm is required. This will allow a circling approach to a Final Approach Fix (FAF) at 6nm
- An approach up to 30° out of wind may be made providing the resulting angle of drift is no more than 10°.

A.3.2 Infrastructure assessed

1.5.1.30 The infrastructure assessed is shown in Figure A 1. The Helideck Certification Agency website (helidecks.org) was consulted for information on the operating period and approvals of helidecks.

Table A 1: Details of assessed infrastructure.

Installation Name	Type	Operator	Status	Distance from Morgan Array Area (nm)
Millom West	NUI Day Only	Spirit Energy	Active	0.4
Millom PLEM	Wellhead	Spirit Energy	Active	1.0
Q1-3 Wellheads	Wellhead	Chrysaor	Active	1.0
Dalton Well R1	Wellhead	Chrysaor	Active	3.3
Dalton Well R2	Wellhead	Chrysaor	Active	3.6
North Morecambe DPPA	NUI Day and Night	Spirit Energy	Active	4.1
Whitehaven Wellhead 113/27B-K	Wellhead	Spirit Energy	Active	4.9
Rhyl Wellheads	Wellhead	Spirit Energy	Active	6.2
South Morecambe DP8	NUI Day and Night	Spirit Energy	Active	6.6
South Morecambe DP6	NUI Day and Night	Spirit Energy	Active	7.6
South Morecambe DP4	NUI No Helicopter Certification Agency (HCA) Certificate	Spirit Energy	Topside Removed June 2021	9.0

A.3.3 Meteorological data provided

1.5.1.31 The meteorological data analysed was obtained from the MIDAS (Met Office, 2019). It contains land surface observations data from the Met Office station network that have been designated as public sector information and provided under an Open Government Licence. One dataset within the database contained hourly aviation data from RAF Valley. RAF Valley is situated on the northwest part of Anglesey. It is in the same air mass as the Morgan and Mona Array Areas and so will be representative of the conditions experienced in the wind farms. Hourly data from 1 January 2011 to 31 December 2021 was analysed; a total of 96,391 data points. There were 466 data points (0.5% of the total) where the wind value was missing.

1.5.1.32 The following parameters were used:

- Timestamp – year/month/day/hour/minute/second
- Visibility – recorded in decametres and converted to metres
- Cloud base – recorded in decametres and converted to feet
- Wind direction – degrees
- Wind speed – knots
- Air temperature – °C.

A.3.4 Meteorological analysis

1.5.1.33 The meteorological limits, defined in the Regulations were applied as a series of filters to the data. The filters identified when the conditions were:

- Day VMC
- Night VMC
- Day IMC
- Night IMC

- No-fly, when the conditions were below offshore limits and so an ARA could not be flown.

1.5.1.34 The data was then summarised in a series of tables and graphs to identify if and when CAT flights might have reduced access to the different offshore facilities.

A.4 Operational restrictions

1.5.1.35 This section will use the methodology described in Section A.3 and apply it to the operational helicopter environment. Following this, section A.6 onwards will identify any restrictions on helicopter access specific to the facilities shown in Figure A 1.

A.4.1 Approach limitations

1.5.1.36 Applying the meteorological limits described in section A.3.4 to the meteorological data provides the percentage of occasions when each approach type is permitted or required.

1.5.1.37 Figure A 2 shows the percentage of day and night VMC access, i.e., when an en-route descent into visual conditions can be made, and a visual approach and take-off to/from a platform is available. This takes no account of any obstructions within 9nm.

Table A 2: Day and Night VMC Access.

Year	Day VMC (%)	Day IMC (%)	Night VMC (%)	Night IMC (%)
2011	91.2	8.8	60.7	39.3
2012	89.9	10.1	64.8	35.2
2013	90.5	9.5	71.0	29.0
2014	93.3	6.7	69.2	30.8
2015	90.0	10.0	63.3	36.7
2016	89.2	10.8	67.5	32.5
2017	85.7	14.3	57.8	42.2
2018	88.6	11.4	66.6	33.4
2019	89.4	10.6	66.2	33.8
2020	88.3	11.7	63.2	36.8
2021	88.3	11.7	60.1	39.9
Mean	**89.5**	**10.5**	**64.6**	**35.4**

1.5.1.38 Figure A 2 does not consider when the conditions did not permit flying (i.e., the conditions identified in section A.3.4. An average of 2.8% of daylight conditions did not permit flying, so leaving 7.6% (10.5% - 2.8%) usable for IMC. For night conditions, 6.7% were unusable, leaving 28.8% (35.4% - 6.7%) usable. When considering the loss of access, the usable IMC figures should be applied and not all IMC periods. This information is presented in Table A 3. The no flying conditions identified are conservative, as no account could be taken of high sea states or Triggered Lightning which would further reduce the number of flyable hours.

Table A 3: Usable IMC access.

Year	Usable IMC Day (%)	Day IMC (%)	Day No Fly (%)	Usable IMC Night (%)	Night IMC (%)	Night No Fly (%)
2011	**5.3**	8.8	2.5	**31.6**	39.3	7.7
2012	**7.1**	10.1	3.0	**30.7**	35.2	4.5
2013	**6.7**	9.5	2.8	**22.6**	29.0	6.4
2014	**5.5**	6.7	1.2	**26.7**	30.8	4.1
2015	**7.2**	10.0	2.8	**29.5**	36.7	7.2
2016	**6.9**	10.8	3.9	**26.8**	32.5	5.7
2017	**10.1**	14.3	4.2	**32.9**	42.2	9.3
2018	**8.4**	11.4	3.0	**26.9**	33.4	6.5
2019	**8.8**	10.6	1.8	**28.2**	33.8	5.6
2020	**8.7**	11.7	3.0	**30.0**	36.8	6.8
2021	**8.8**	11.7	2.9	**30.3**	39.9	9.6
Mean	**7.6**	**10.5**	**2.8**	**28.8**	**35.4**	**6.7**

A.4.2 Wind data

1.5.1.39 The wind sectors for an approach and take-off, under Day IMC, are shown in Figure A 3. This shows that the predominant wind direction for Day IMC conditions is from the southwest. The no-fly conditions calculated are likely to be an underestimate, as the meteorological data set did not contain information on sea state or Triggered Lightning.

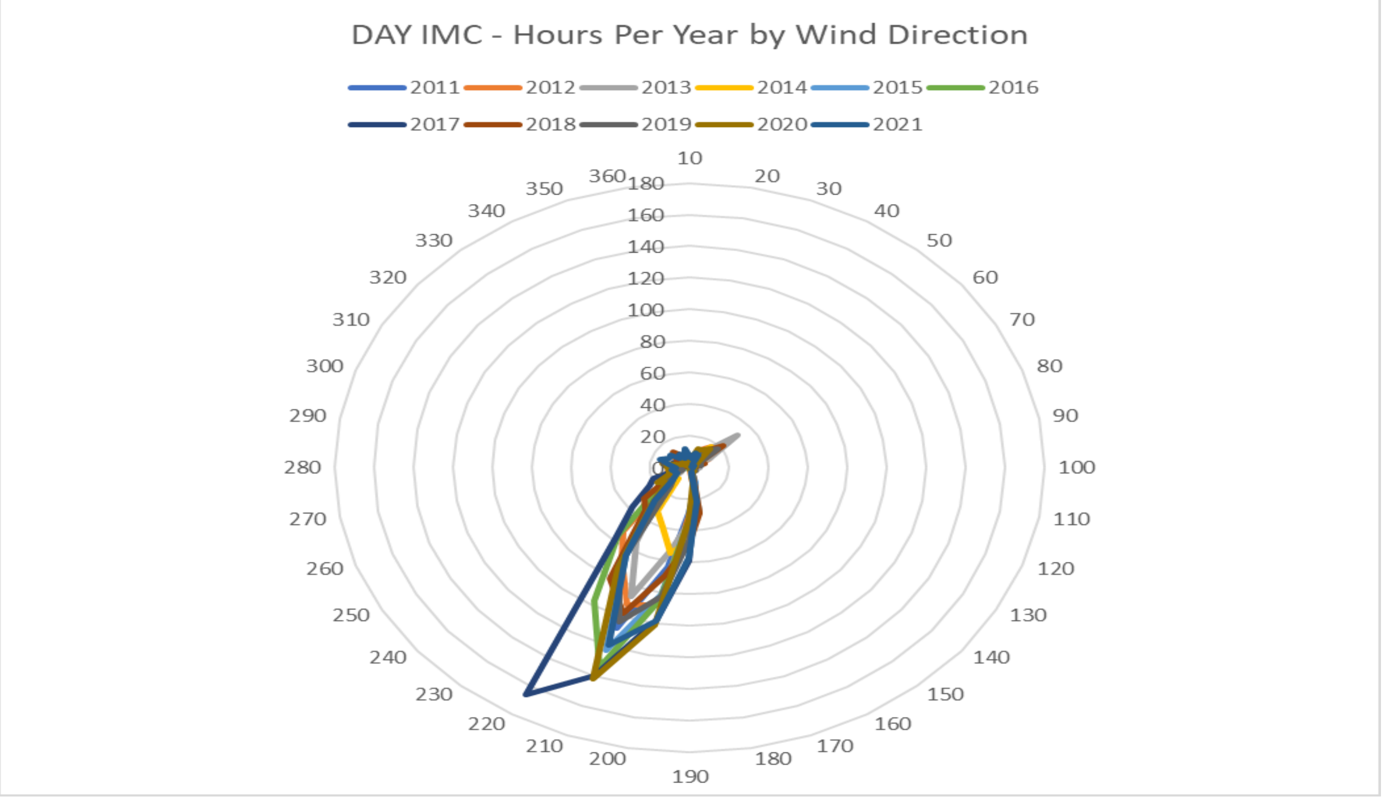


Figure A 3: DAY IMC Condition Wind Direction Hours Per Year.

1.5.1.40 Although the majority of flying will be conducted under daylight conditions, a number of the platforms are approved for night operations. Figure A 4 shows the day and night IMC hours from 2011-2021, and the wind directions which generated IMC.

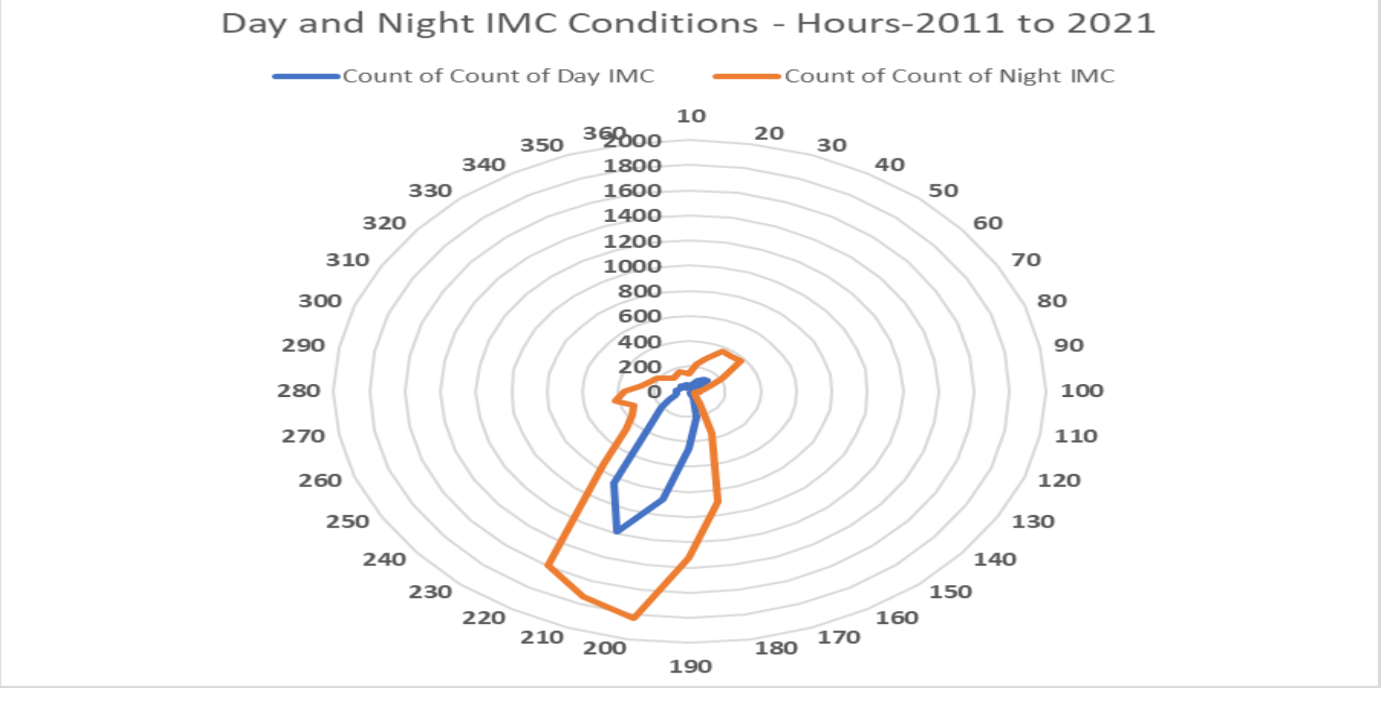


Figure A 4: Day and Night IMC Hours – 2011 to 2021.

A.5 Emergency conditions

1.5.1.41 The methodology used so far in this report addresses helicopter access under CAT Regulations. Emergency down manning of any installation, critical Medivacs and SAR are not constrained by CAT Regulations as these flights are generally flown by the Coastguard SAR aircraft operating under CAP 999 (CAA, 2014). The Coastguard helicopters are operated as State Aircraft under National Regulations and are not constrained by the higher weather limits in CAT Regulations. Also, commercial SAR can be flown with some alleviations from CAT Regulations. Such SAR arrangements have existed in the United Kingdom, Norway and the Netherlands for decades and include SAR coverage provided by the Integrated Search and Rescue (ISAR) Consortium in Aberdeen (formerly Jigsaw Aviation), SAR helicopters based in the Ekofisk Field, and SAR helicopters under contract to Nederlands Olie en Gas Exploratie en Productie Associatie (NOGEPA), the Dutch equivalent of Oil & Gas UK.

1.5.1.42 CAP 999 defines the SAR operating minima as:

Operating minima for the dispatch and continuation of a SAR operational flight are at the discretion of the aircraft commander. However, he is to consider the urgency of the task, crew and aircraft capability and the requirement to recover the aircraft safely.

1.5.1.43 Due to the SAR autopilot modes and enhanced sensors fitted to the Coastguard SAR helicopters, a shorter distance is required to enter the field and manoeuvre to land on platforms, even in poor weather. The Morgan Generation Assets will be designed in accordance with MGN 654 (MCA, 2021), which permits helicopter SAR operations within a wind turbine array, and so SAR access will also be available to platforms adjacent to the Morgan Generation Assets.

1.5.1.44 Furthermore, in the event of an emergency on the platform resulting in an explosion, fire or release of hydrocarbons, helicopters will be unable to land and so other means of escape, such as Totally Enclosed Motor Propelled Survival Craft (TEMPSC) and/or Seascape systems will be required. Although helicopters are usually the preferred means of down manning an installation, they cannot be the primary means of down manning in all cases.

1.5.1.45 Icing conditions will not affect the Coastguard SAR helicopters are they are certified and equipped for flight in icing conditions.

1.5.1.46 In summary, although a reduction in helicopter access under CAT Regulations will impose a logistic restriction on an offshore installation, it will not result in a reduced level of safety, as SAR helicopters will still be able to access an installation.

A.6 Infrastructure specific access

1.5.1.47 This section will now identify how helicopter operations would be constrained by current and future windfarms. It will be done in two parts: firstly, identifying current access and then taking account of any restrictions due to the Morgan Generation Assets. Section 7 will identify any cumulative impact from the Mona Offshore Wind Project and Morecambe Offshore Windfarm currently in the planning phase.

1.5.1.48 Platforms within 9nm of the Morgan Generation Assets were considered, as presented in Figure A 5.

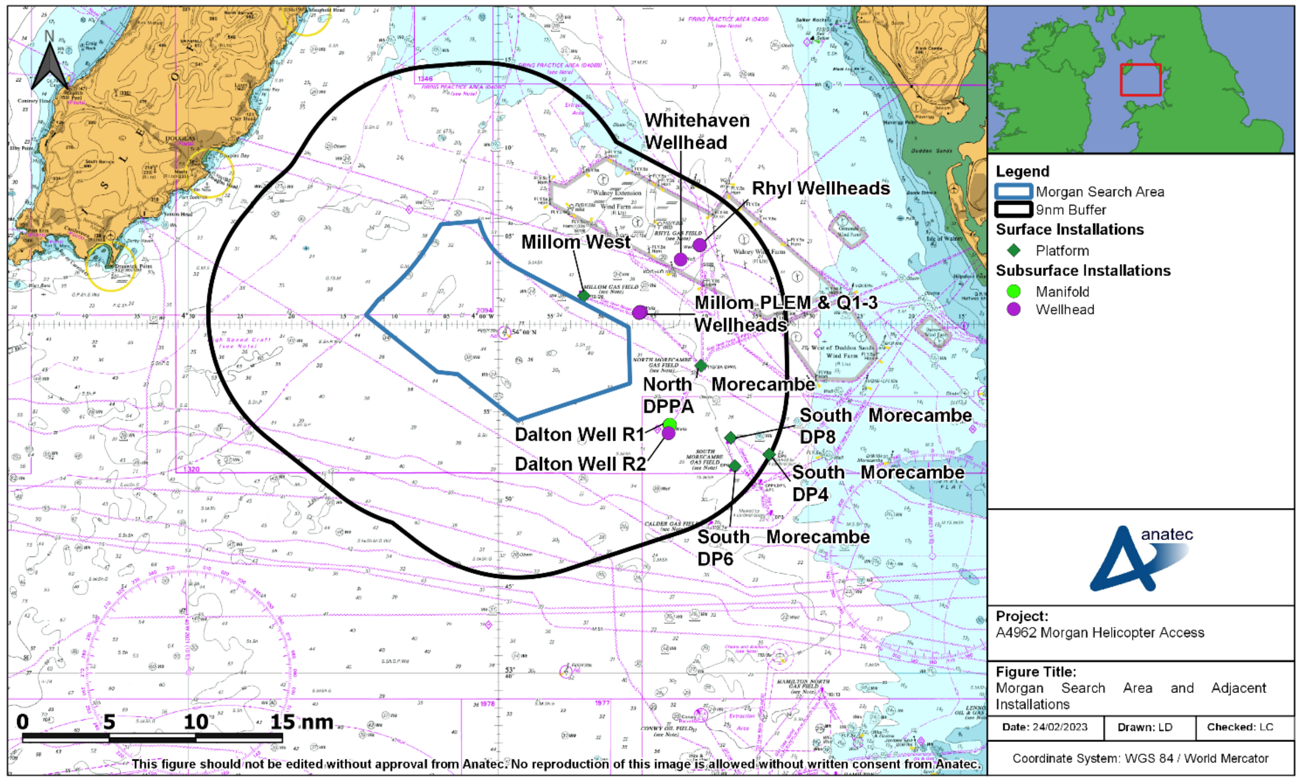
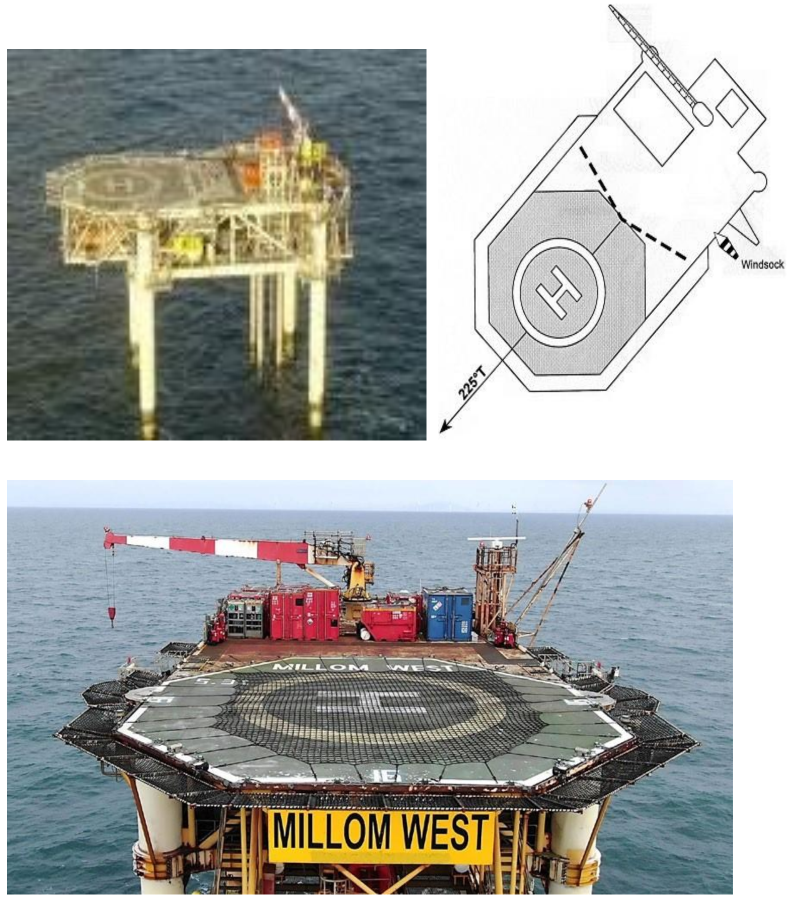


Figure A 5: Morgan Search Area and Adjacent Installations

1.5.1.49 The Helideck Certification Agency website was used to obtain current information on the certification standards of each helideck.

A.6.1 Millom West platform

HELIDECK Elev. **98 ft**	VAR **2 W**	POSITION **N54 01.6 W003 51.7**	**EGMX Millom West**		
HEIGHT OF INSTALLATION: **125** HIGHEST OBSTACLE WITHIN 5NM: **Check**			VHF **122.380**	NDB	Issue Date **29 Jun 2022**
FUELLING INSTALLATION: **No** STARTING EQUIPMENT: **No**			Operating Company **Harbour Energy**		Issued By **Helideck Certification Agency**
HELIDECK D value: **16.1m** P/R/H Category: **F** Max Weight: **5.3t** Circle & H Lights: **Not fitted**					



Wind (T°)	Kts	Limitation /Comment
	+25 +30	1. NUI 2. Daylight operations only - circle and "H" lights not fitted 3. No helicopter operations - perimeter net frames corroded 4. No helicopter operations due to poor friction surface 5. Table 1(T) if overflight of 5:1 items is unavoidable 6. East staircase access closed due to corrosion 7. No net fitted.

Figure A 6: Details of Millom West platform.

1.5.1.50 The Millom West platform is a NUI approved for day only operations. In addition, it currently has a wind speed limit of 25kt due to a corroded perimeter net. It is located on the northeast side of the Morgan Generation Assets, 0.4nm (741m) from the boundary.

A.6.1.1 Current access

1.5.1.51 At present there is the option of using an ARA to approach and land on the Millom West platform under daylight conditions only. For the period 2011 to 2021, access is available for 97.1% of daylight condition (Day VMC 89.5% (Figure A 2) plus 7.6% usable IMC (Figure A 3).

A.6.1.2 Future access

1.5.1.52 The distance to the Morgan Array Area is insufficient for an IMC approach. If sufficient distance was available for a VMC approach, then the access would an average of 89.5% of daylight conditions (i.e. an average annual loss of 7.6%). Operations to NUIs are not usually conducted when the forecast shows marginal conditions as NUIs tend to have limited domestic facilities for a prolonged stay.

1.5.1.53 For guidance on the distance required for a day VMC approach, routine operations are currently conducted to platforms within wind farms where turbine tips are 1,000m from the platform. The Blythe NUI in the Southern North Sea has several turbines within 1,200m of the platform's helideck.

A.6.1.3 Summary

1.5.1.54 The Millom West Platform will be located 0.4nm (741m) from the Morgan Array Area. This will prevent IMC access, resulting in a 7.6% average annual loss of access. Providing sufficient distance is provided for a day VMC approach, the access will be an average of 89.5% of daylight conditions.

A.6.2 Millom PLEM wellhead

1.5.1.55 The Millom PLEM wellhead is located 1nm to the east of the Morgan Array Area. Under usual conditions this would not present a problem. When a drilling rig or diving support vessel is required to work on the wellhead helicopter access might be required. Most drilling rigs and diving support vessels have helideck approved for both day and night operations. With the Morgan Array Area situated 1nm away on Day VMC and some limited Night VMC operations would be possible when a Stabilised Approach does not encroach on the Morgan Generation Assets. This would provide average access of 89.5% of daylight conditions and up to 64.6% of night conditions (see Figure A 2), assuming the helicopter operator did not restrict night operations. This is a logistics issue as emergency helicopter flights by the Coastguard would still be possible to a drilling rig or vessel working over the wellhead.

A.6.3 Q1-3 wellheads

1.5.1.56 These wellheads are close to the Millom PLEM Wellhead and so the same comments apply. As they belong to a different operator, the access details are repeated.

1.5.1.57 The Q1-3 Wellheads are located 1nm to the east of the Morgan Array Area. Under usual conditions this would not present a problem. When a drilling rig or diving support vessel is required to work on the wellheads helicopter access might be required. Most drilling rigs and diving support vessels have helideck approved for both day and night operations. With the Morgan Array Area situated 1nm away on Day VMC and some limited Night VMC operations would be possible. This would provide average access of 89.5% of daylight conditions and up to 64.6% of night conditions (see Figure A 2), assuming the helicopter operator did not restrict night operations. As explained in section A.5, this is a logistics issue as emergency helicopter flights by the Coastguard would still be possible to a drilling rig or vessel working over the wellhead.

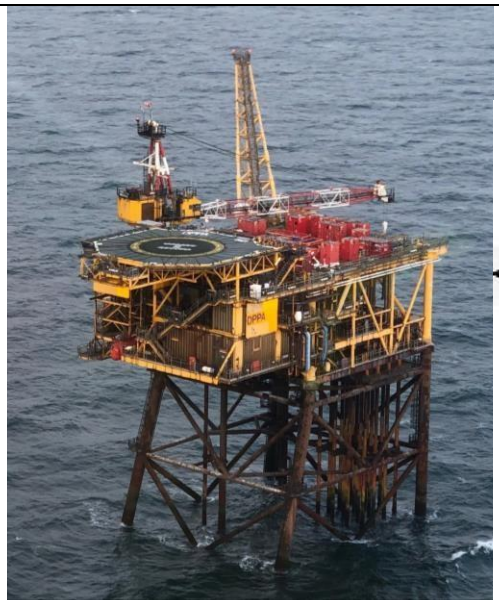
A.6.4 Dalton well R1 and R2

1.5.1.58 The R1 wellhead is located 3.3nm from the Morgan Generation Assets. The R2 is located 3.6nm from the Morgan Generation Assets. A drilling rig or diving support vessel may require to work over these wellheads.

1.5.1.59 The predominant wind direction for IMC conditions is from the southwest, see Figure A 3. The location of these wellheads allows a clear 9nm ARA approach in IMC. There will be no loss of access by day or night.

A.6.5 North Morecambe DPPA

HELIDECK Elev **153 ft**	VAR **2** **W**	POSITION **N53 57.57** **W003 40.35**	EGMS **DPPA**	
HEIGHT OF INSTALLATION: **210ft** HIGHEST OBSTACLE WITHIN 5NM: **Check**		VHF **122.380**	NDB	Issue Date **23 August 2022**
FUELLING INSTALLATION: **No** STARTING EQUIPMENT: **No**		Operating Company **Spirit Energy**		Issued By **Helideck Certification Agency**
HELIDECK D value: **18.7m** P/R/H Category: **F** Max Weight: **8.6t** Circle & H Lights: **Yes**				
Wind (T°)	**Kts**	**Limitation /Comment**		
		8. NUI 9. Table 1(T) if overflight of 5:1 items unavoidable 10. Call sign DPP-Alpha 11. H2 RFFS Large Compliant (Automated).		



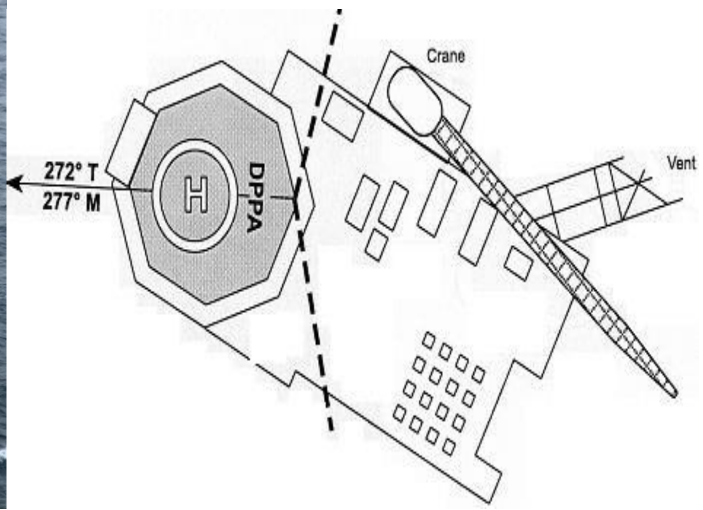


Figure A 7: Details of North Morecambe DPPA.

1.5.1.60 The North Morecambe DPPA is a NUI approved for day and night operations. It is located 4.1nm from the Morgan Array Area.

A.6.5.1 Current access

1.5.1.61 Currently there are no restriction on access. Current access is 97.1% of daylight condition (Day VMC 89.5% (Figure A 2) plus 7.6% usable IMC (Figure A 3)) and 93.4% of night conditions (Night VMC 64.6% (Figure A 2) and Usable Night IMC 28.8% (Figure A 3)).

A.6.5.2 Future access

1.5.1.62 Due to the location of the platform and IMC conditions prevailing with a southwesterly wind, sufficient distance is available for an ARA. Even with a westerly wind, taking account of the 1nm safety buffer and reduced performance following an engine failure, 4.1nm is a sufficient distance for a take-off into IMC or go-around.

A.6.5.3 Summary

1.5.1.63 Due to its location, and the fact that IMC conditions predominately exists with a south westerly wind, the Morgan Generation Assets will not affect access to the North Morecambe DPPA installation.

A.6.6 Whitehaven wellhead

1.5.1.64 The Whitehaven Wellhead is at the pre-commissioning stage of development. It is located 4.9nm from the Morgan Array Area. A drilling rig or diving support vessel may require to work over the wellhead.

1.5.1.65 The predominant wind direction for IMC conditions is from the southwest, see Figure A 3. The location of this wellhead allows a clear 9nm ARA approach in IMC. The Morgan Array Area is situated 4.9nm southwest of the wellhead, so allowing for the 1nm safety buffer and reduced helicopter performance following an engine failure, there is still a sufficient distance for a take-off into IMC or go-around from an ARA. Therefore, there will be no loss of access by day or night.

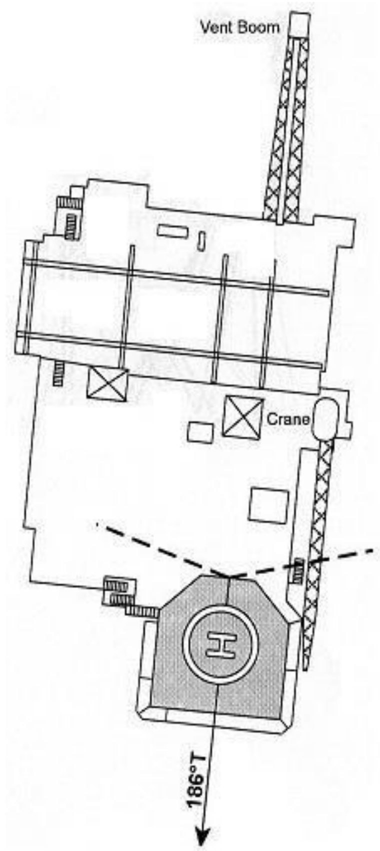
A.6.7 Rhyl wellheads

1.5.1.66 The Rhyl wellheads are located 6.2nm to the north east of the Morgan Array Area. A drilling rig or diving support vessel may require to work over the wellhead.

1.5.1.67 The predominant wind direction for IMC conditions is from the southwest, see Figure A 3. The location of the wellheads allows a clear 9nm ARA approach in IMC. The Morgan Array Area is situated 6.2nm southwest of the wellhead, so allowing for the 1nm safety buffer and reduced helicopter performance following an engine failure, there is still a sufficient distance for a take-off into IMC or go-around from an ARA. Therefore, there will be no loss of access by day or night.

A.6.8 South West Morecambe DP8

HELIDECK Elev **110 ft**	VAR **2 W**	POSITION **N53 53.50 W003 37.50**	EGMR **DP-8**		
HEIGHT OF INSTALLATION: **183ft** HIGHEST OBSTACLE WITHIN 5NM: **Check**			VHF **122.380**	NDB	Issue Date **25/7/2022**
FUELLING INSTALLATION: **No** STARTING EQUIPMENT: **No**			Operating Company **Spirit Energy**		Issued By **Helideck Certification Agency**
HELIDECK D value: **17.46** P/R/H Category: F Max Weight: **6.8** Circle & H Lights: Yes					



ind (T°)	Kts	Limitation /Comment
		12. NUI 13. Table 1(T) if overflight of 5:1 items unavoidable 14. Wireline gantry operations may infringe 210 sector - Local restrictions apply 15. Automatic self-oscillating monitors - H2- Large compliant.

Figure A 8: Details of the DP8 platform.

1.5.1.68 The DP8 platform is a NUI approved for day and night operations. It is located 6.6nm southeast of the Morgan Array Area.

A.6.8.1 Current access

1.5.1.69 Currently there are no restriction on access. Current access is 97.1% of daylight condition (Day VMC 89.5% (Figure A 2) plus 7.6% usable IMC (Figure A 3)) and 93.4% of night conditions (Night VMC 64.6% (Figure A 2) and Usable Night IMC 28.8% (Figure A 3)).

A.6.8.2 Future access

1.5.1.70 Due to its location, an unobstructed approach is available for an ARA, go-around and take-off into IMC conditions. There will be no reduction in access to the DP8 platform.

A.6.8.3 Summary

1.5.1.71 Due to its location, and the fact that IMC conditions predominately exists with a south westerly wind, the Morgan Generation Assets will not affect access to the DP8 platform.

A.6.8.4 South Morecambe DP6

<table>
<tr><td>HELIDECK
Elev **117 ft**</td><td>VAR **2**
W</td><td>POSITION
N53 51.9 W003 37.1</td><td colspan="3">EGMQ **DP-6**</td></tr>
<tr><td colspan="3">HEIGHT OF INSTALLATION: **262ft** HIGHEST
OBSTACLE WITHIN 5NM: **Check**</td><td>VHF
122.380</td><td>NDB</td><td>Issue Date
6/5/22</td></tr>
<tr><td colspan="3">FUELLING INSTALLATION: **No** STARTING
EQUIPMENT: **No**</td><td colspan="2" rowspan="2">Operating Company

Spirit Energy</td><td rowspan="2">Issued By
Helideck Certification Agency</td></tr>
<tr><td colspan="3">HELIDECK D value: **17.46**
P/R/H Category: **F**
Max Weight: **7.0**
Circle & H Lights: **Yes**</td></tr>
</table>

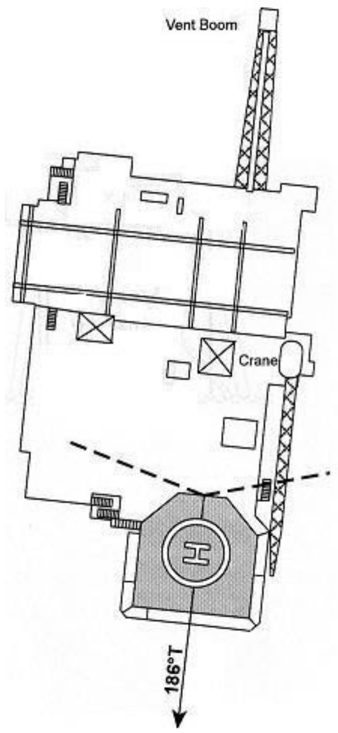


Figure A 9: Details of the DP6 platform.

1.5.1.72 The DP6 platform is a NUI approved for day and night operations. It is located 7.6nm southeast of the Morgan Array Area.

A.6.8.5 Current access

1.5.1.73 Currently there are no restriction on access. Current access is 97.1% of daylight condition (Day VMC 89.5% (Figure A 2) plus 7.6% usable IMC (Figure A 3)) and 93.4% of night conditions (Night VMC 64.6% (Figure A 2) and Usable Night IMC 28.8% (Figure A 3)).

A.6.8.6 Future access

1.5.1.74 Due to its location, an unobstructed approach is available for an ARA, go-around and take-off into IMC conditions. There will be no reduction in access to the DP6 platform.

A.6.8.7 Summary

1.5.1.75 Due to its location, and the fact that IMC conditions predominately exists with a south westerly wind, the Morgan Generation Assets will not affect access to the DP6 Platform.

A.6.9 South Morecambe DP4 platform

1.5.1.76 The South Morecambe topside was removed in 2021 and so it will be considered as being equivalent to a wellhead. The DP4 structure is located 9.0nm to the southeast of the Morgan Array Area. A drilling rig or diving support vessel may require to work over the wellhead.

1.5.1.77 The predominant wind direction for IMC conditions is from the southwest, see Figure A 3. The location of the wellheads allows a clear 9nm ARA approach in IMC. Due to the location of DP4 in relation to the wind farms, there will be sufficient space for a go-around, or take-off into IMC from a drilling rig or vessel on the location. Therefore, there will be no loss of access by day or night.

A.7 Cumulative Assessment

1.5.1.78 In addition to the Morgan Generation Assets, there is a proposal to develop the Mona Offshore Wind Project and Morecambe Offshore Windfarm. This section will identify the cumulative effect of the three wind farms. A.10 shows the Mona Offshore Wind Project and Morecambe Offshore Windfarm in relation to the Morgan Generation Assets.

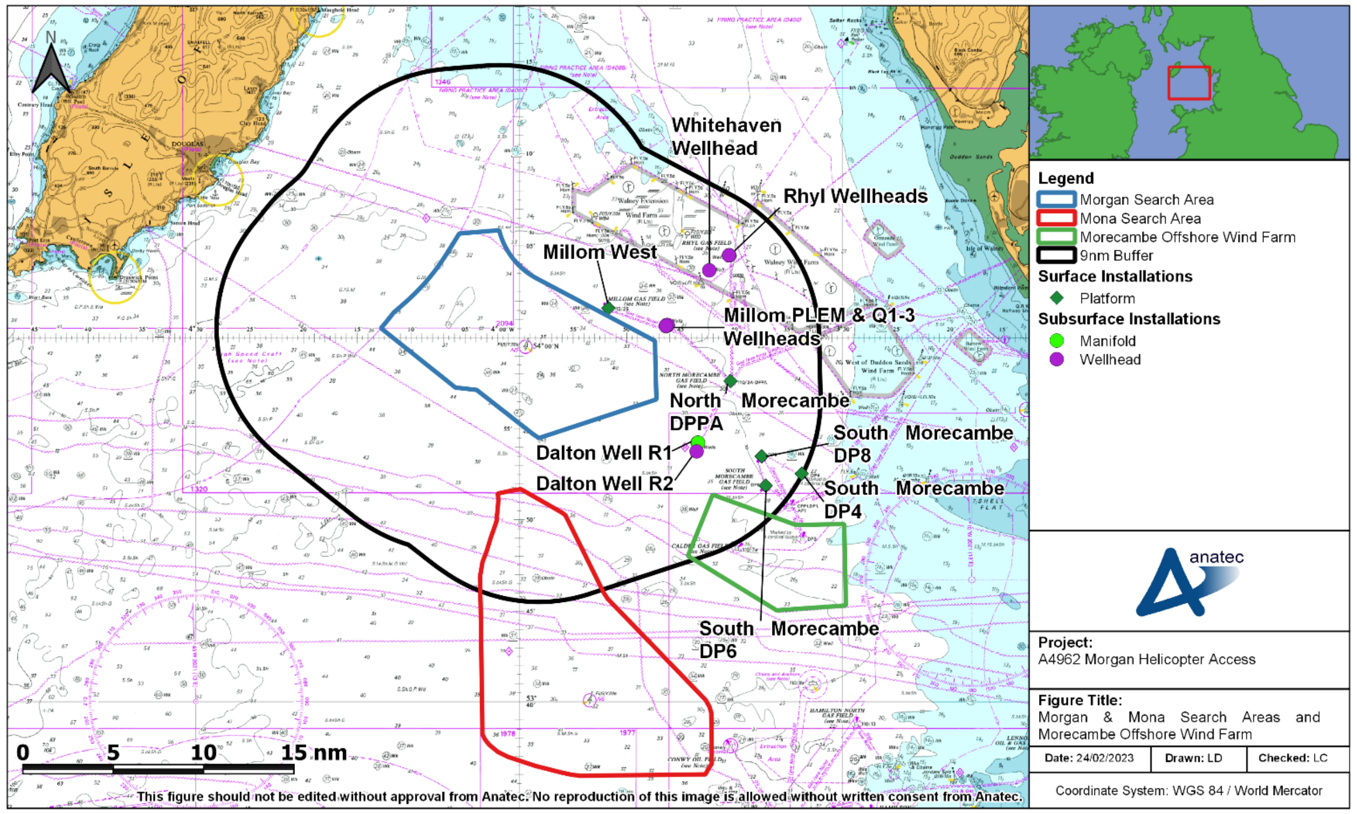


Figure A 10: The Morgan & Mona Search Areas and Morecambe Offshore Windfarm.

1.5.1.79 The cumulative assessment considers whether installations already impacted by the Morgan Generation Assets will have additional impact from the Mona Offshore Wind Project or Morecambe Offshore Windfarm. As demonstrated in Section A.6, the following installations are affected by the Morgan Generation Assets:

- Millom West platform
- Millom PLEM
- Q1-3 wellheads

1.5.1.80 Show that IMC conditions are most prevalent with a south-westerly wind direction. Since there is a 9nm clear approach from the NE into the prevailing south-westerly winds, with more than 3nm available for a go-around or take-off (see Figure A 10), these installations will not have their access altered by the presence of the Mona or Morecambe Offshore Windfarms.

1.5.1.81 Therefore no cumulative impact is identified.

Helicopter Icing Considerations

1.5.1.82 If the Mona Offshore Wind Project and/or Morecambe Offshore Windfarm was built, it is highly unlikely that it will increase the transit time to any of the installations due to icing, or other factors.

A.7.1 References

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Met Office (2019) Met Office MIDAS Open: UK Land Surface Stations Data (1853 current). Centre for Environmental Data Analysis. Available: http://catalogue.ceda.ac.uk/uuid/dbd451271eb04662beade68da43546e1. Accessed January 2023.

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Appendix B: Instrument Flight Procedure (IFP) Assessment