4.15.1

Volume 4, Appendix 15.1

Airspace analysis and radar modelling

Contents

1. Introduction

1.1 Overview

1.1.1 This document is the appendix to **Chapter 15: Civil and military aviation, Volume 2** of the Preliminary Environmental Information Report (PEIR) for Rampion 2. It provides detailed airspace analysis and radar modelling and outlines potential mitigation options.

1.1.2 The offshore array element of Rampion 2 covers an area of approximately 315km^2 between 13km and 25km from the coastline. The Proposed Development will have a generating capacity of up to 1,200MW.

1.2 Effects of Wind turbine generators (WTGs) on aviation

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

1.2.2 A potential impact on the National Air Traffic Service (NATS) En Route Limited (NERL) PSR facility at Pease Pottage was identified at the Scoping stage.

1.2.3 The significance of any radar impacts depends on the airspace usage and the nature of the Air Traffic Service (ATS) provided in that airspace. The classification of the airspace in the vicinity of Rampion 2 and the uses of that airspace (civil and military) are set out in this appendix.

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

1.3 Technical References

- Raytheon ASR-23SS radar: Raytheon ASR-23SS Series Factsheet.

1.4 Data

Introduction

1.4.1 The following data has been used to establish drawings and calculations used in this report:

NERL Pease Pottage Radar

1.4.2 The radar is a Raytheon ASR-23SS used for en-route Air Traffic Control (ATC).

- Latitude: 51.083419N;

- Longitude: 0.214375W; and
- Antenna Height: 30m above ground level (agl).

1.4.3 Additional data was derived from the Raytheon ASR-23SS factsheet.

Rampion 2 PEIR Assessment Boundary

1.4.4 The PEIR Assessment Boundary for Rampion 2 was supplied as a geo-referenced Shapefile:

- Rampion_FINAL_PEIRAssessmentBoundary_UTM30.shp.

WTGs

1.4.5 Up to 116 WTGs with maximum 325m tip height above LAT (Lowest Astronomical Tide) are being considered. The design parameters for these WTGs are shown in **Table 1-1**.

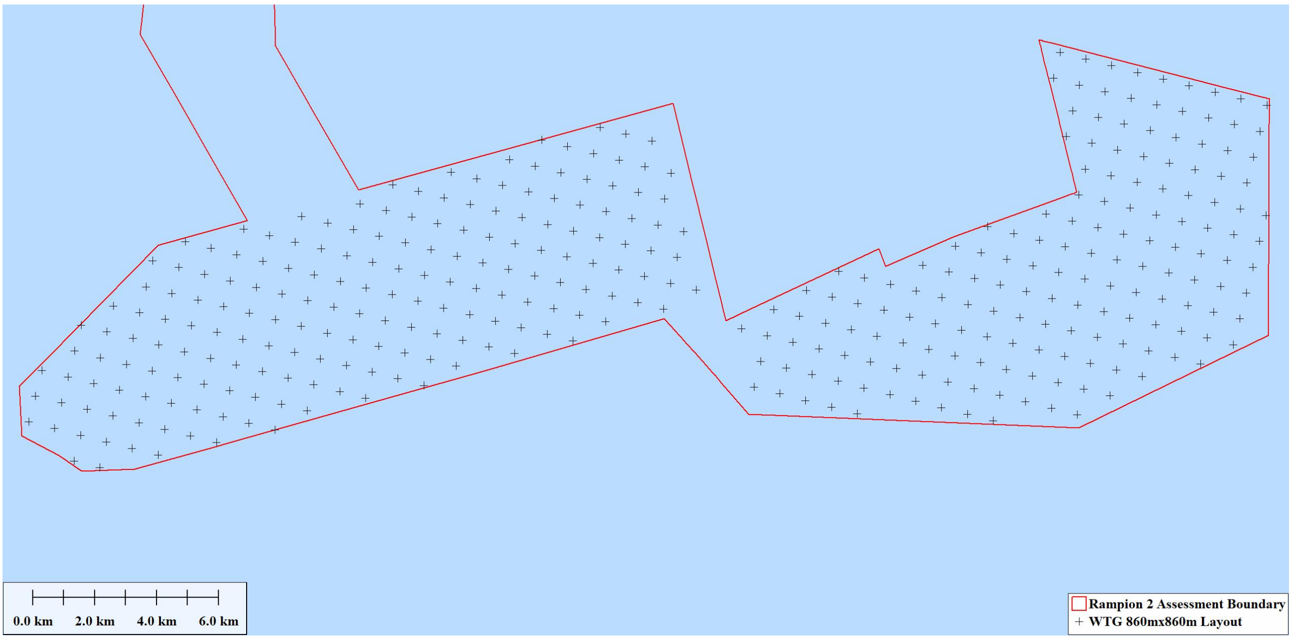
Table 1-1 WTG design parameters

Parameter	Larger WTG	Smaller WTG
Maximum blade tip height above LAT	325m	210m
Rotor diameter	295m	172m
Minimum WTG spacing	1720m	860m
Maximum number of WTGs	75	116

1.4.6 Note that blade tip heights are above LAT whereas radar assessments are based on tip heights above mean sea level (amsl). Mean sea level is generally higher than LAT, therefore amsl calculations incorporate an additional precautionary buffer.

1.4.7 An indicative WTG layout has been supplied, as shown in **Figure 1.1**.

Figure 1.1 Indicative WTG 860m x 860m layout



1.4.8 The layout shows a total of 354 WTG locations. It is not a representation of the final number of WTGs to be installed but rather indicates the possible locations for WTGs with a minimum inter-WTG spacing of 860m.

1.4.9 Worst-case layouts of 210m and 325m WTGs for Civil and Military Aviation are presented in **Section 3.5: Radar probability of detection**.

Terrain data

- ATDI UK 10m Digital Terrain Model (DTM).

Analysis tools

- ATDI HTZ communications V23.1.0 x64 release 1460 radio planning tool; and
- Blue Marble Global Mapper v21.1.1 Geographic Information System (GIS).

Mapping datum

1.4.10 UTM30 (WGS84 datum) is used as a common working datum for all mapping and geodetic references.

1.4.11 Mapping datum transformations are made using Global Mapper or Grid InQuest II Coordinate Transformation Program.

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

2. Airspace analysis

2.1 Introduction

2.1.1 This assessment is a review of potential impacts on aviation in the designated area for Rampion 2. For the purposes of this assessment, a maximum tip height of 1,100 feet (ft) amsl for the WTGs has been assumed, the equivalent to 325m rounded up to the nearest 100ft.

2.1.2 All information has been referenced from the UK Aeronautical Information Publication (AIP) available online from source and is therefore the latest information available. Additional information has been sourced from UK Civil Aviation Authority publications, as appropriate.

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

2.2 Scope

2.2.1 The scope of the assessment includes the offshore part of the Rampion 2 PEIR Assessment Boundary and the surrounding airspace relating to civil aviation, its use and potential impact. Each area is defined according to type of airspace, limitations and who the controlling authority is. Military aviation as well as Search and Rescue is also considered.

2.3 Current baseline

2.3.1 Airspace, in general terms, can be classified into a few different groups. These are, very simply stated, controlled, uncontrolled and special use airspaces. Aircraft in controlled airspace are being positively managed by ATC the entire time they are within that designated area. This type of airspace is generally used by airlines and corporate aviation. Aircraft in uncontrolled airspace are operating within a framework of rules but are not being controlled by ATC, although many pilots flying in this environment may choose to report their position, altitude, and intentions to ATC in order to benefit from the enhanced situational awareness that brings. Users of this airspace tend to be small aircraft engaged in training or private (social) flying. Special Use Airspace (SUA) is, as the name implies, designated areas wherein aircraft engage in specific activities within protected zones. An example of such flying would be military flight training.

2.3.2 Airspace in the UK is categorized into five classes, namely A, C, D, E, and G. The first four being types of controlled airspace with class G being uncontrolled.

2.3.3 An aircraft's position in space is referred to as either an Altitude or Flight level (FL). When aircraft altimetry instruments are set using a locally derived barometric pressure the resultant figure displayed is referred to as an altitude amsl. This is used up to a certain altitude. Above this altitude a common, internationally agreed, barometric setting of 1013.25 hectopascal (hPa) is used, the result being referred to as a FL. The objective being that aircraft in the same section of airspace are referencing their position in space against a common datum. This allows for either ATC, or pilot-to-pilot, separation of aircraft to take place.

2.3.4 The area of change from an altitude to a FL is referred to as the Transition Layer and consists of a (lower) transition altitude and a (higher) transition level, which are a minimum of 1,000ft apart. The transition altitude in the UK is set at 3,000ft, except for certain specified airspace, which is 5,000 or 6,000ft [1].

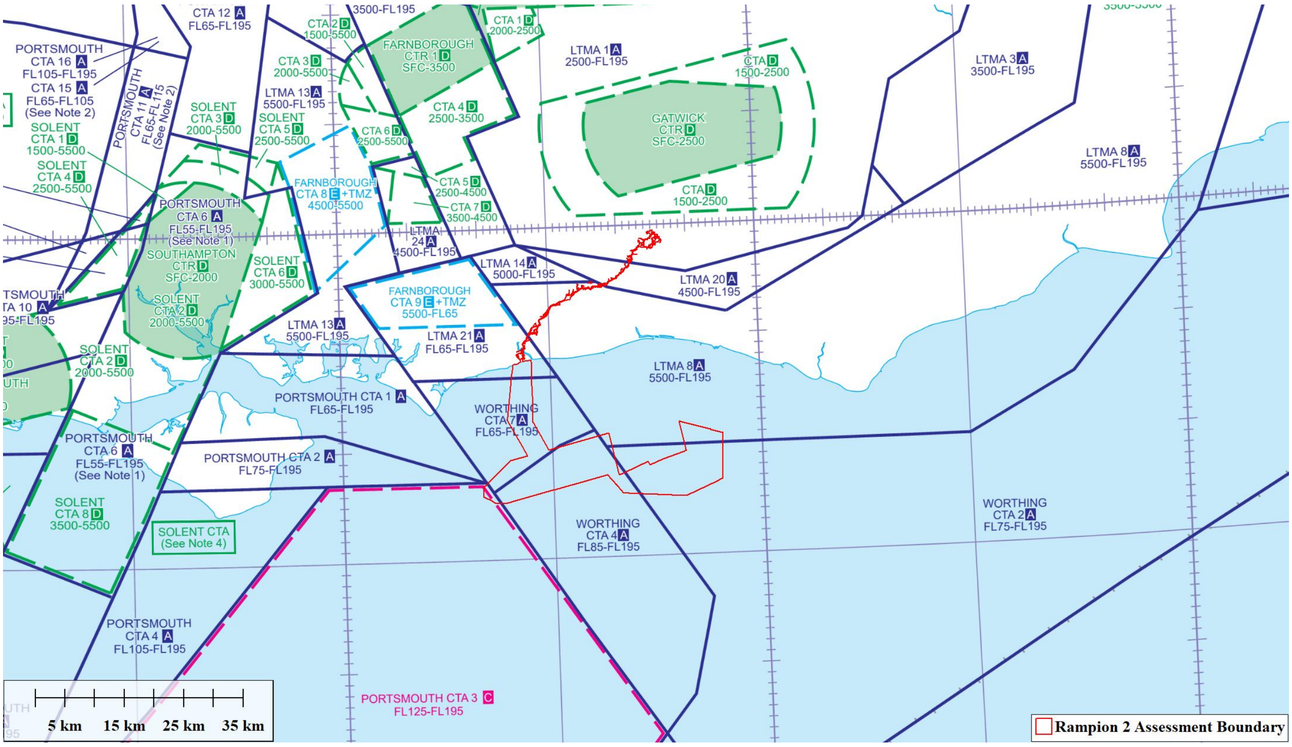
2.4 Airspace and Rampion 2

2.4.1 Rampion 2 is located approximately 13km, 7 nautical miles (nm), off the Sussex coast. From an aviation perspective, the PEIR Assessment Boundary lies within uncontrolled Class G airspace with controlled Class A airspace above that [2]. With reference to **paragraph 2.3.2**, airspace is divided into 5 Classes. Class A controlled airspace is the most strictly regulated of the classes whereby aircraft are positively controlled by ATC. Compliance with ATC clearances are mandatory, and aircraft are flown and navigated solely with reference to aircraft instruments. Certain onboard equipment is also a prerequisite. Flight in class G airspace is generally visual, meaning pilots fly and navigate with reference to the natural horizon and terrain features they see outside. Pilots are required to maintain minimum distances from notified obstacles, including WTGs, and may only fly within the minimum weather and visibility criteria.

2.4.2 The Class A airspace predominantly above Rampion 2 is the Worthing Control Area 4 and the Worthing Control Area 2 (CTA 4 and CTA 2). Other Class A airspace which is above smaller specific areas of the PEIR Assessment Boundary are the London Terminal Control Area 8 (LTMA 8) and Worthing CTA 7. The Portsmouth CTA 3 Class C airspace is situated above the extreme western edge of the PEIR Assessment Boundary. In **Figure 2.1** the PEIR Assessment Boundary can be seen in relation to controlled airspace in the vicinity. They are listed below along with the associated vertical limits.

- LTMA 8 5,500ft to FL195.
- Worthing CTA 2 FL75 to FL195.
- Worthing CTA 4 FL85 to FL195.
- Worthing CTA 7 FL65 to Fl195.
- Portsmouth CTA 3 FL125 to FL195.

Figure 2.1 Proposed Rampion 2 PEIR Assessment Boundary relative to controlled airspace

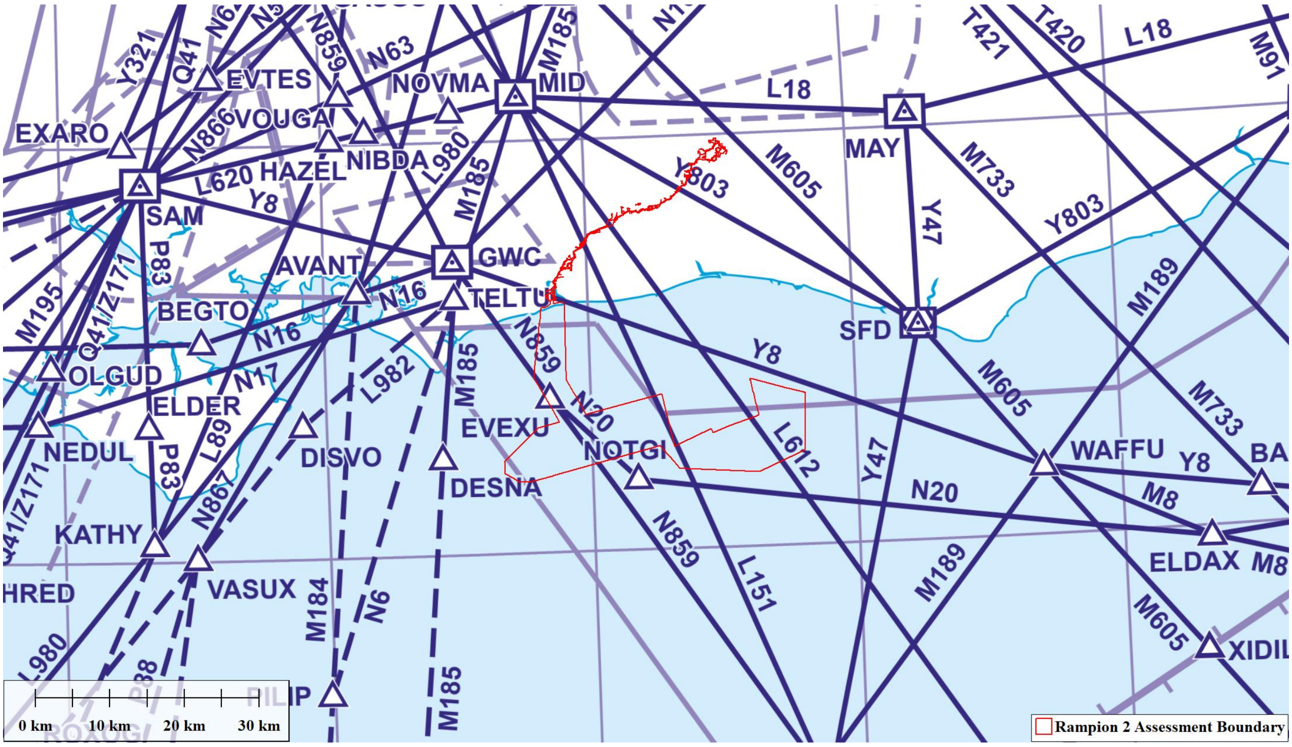


2.4.3 Air Traffic Service (ATS) routes are airways along which aircraft fly, navigating via ground-based electronic aids or, increasingly, 'GPS' waypoints. ATS routes are used where high levels of traffic move between areas. They may be stand-alone sections or embedded, either wholly or in part, within a segment of airspace. There are several portions of ATS routes within the airspace above the Offshore PEIR Assessment Boundary These routes also have defined vertical dimensions. The ATS routes relevant to the controlled airspace above the site are noted below, along with their vertical limits.

- L151 FL85 to FL460.
- L612 FL105 to FL245.
- N20 FL85 to FL245.
- N859 FL65/85 to FL245.

2.4.4 The airspace and ATS routes mentioned above are all controlled by London Control based at Swanwick. The ATS route structure in the vicinity of Rampion 2 is seen in **Figure 2.2**.

Figure 2.2 ATS route structure

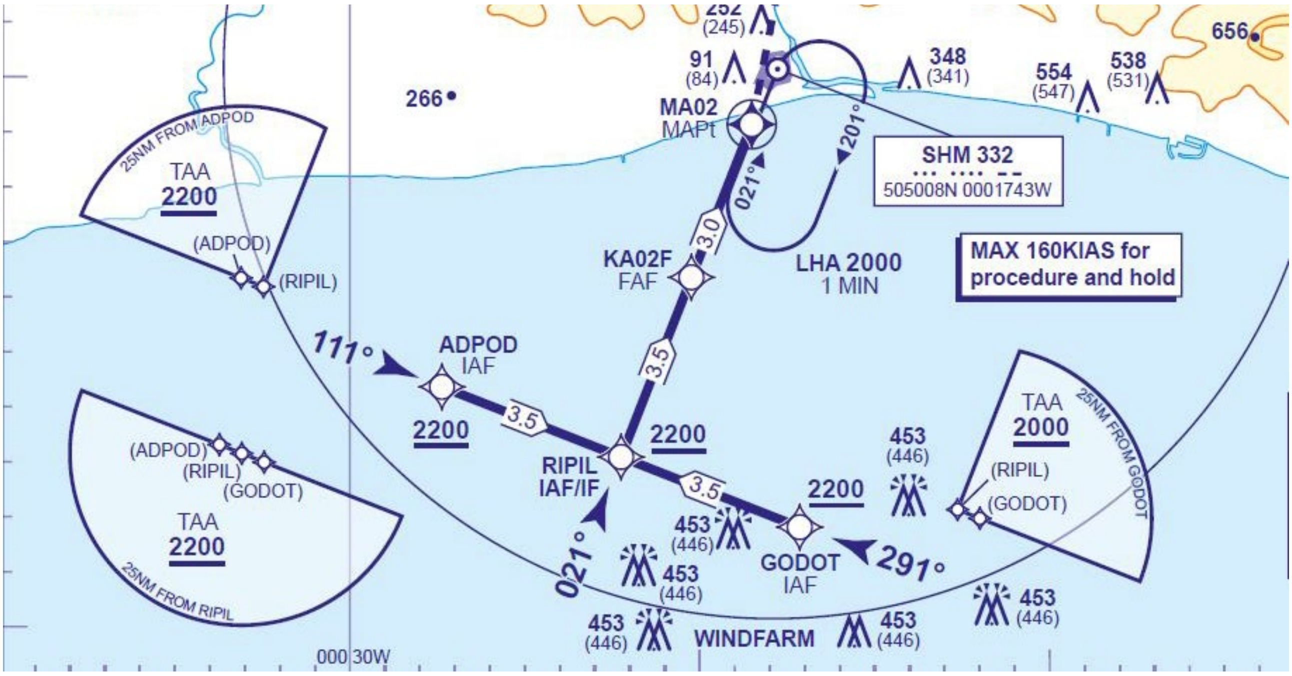


2.5 Shoreham Airport

2.5.1 Shoreham Airport is located approximately 9nm (16.5km) to the north of Rampion 2 and caters for both Instrument Flight Rules (IFR) traffic as well as aircraft operating under Visual Flight Rules (VFR). The airport has an asphalt main runway, orientated approximately north south.

2.5.2 An Aerodrome Traffic Zone (ATZ) is established at the airport as a circle of airspace extending from the ground to 2,000ft agl with a radius of 2nm. This is established for the protection of aircraft flying in the immediate vicinity of the airport. The airport has two Instrument Flight Procedures (IFPs) that are flown by aircraft using the Global Navigation Satellite System (GNSS) and are partly conducted outside of controlled airspace. One procedure is for aircraft landing towards the north, whilst the other procedure caters for aircraft landing towards the south. The instrument approach procedure for landing on the northerly facing Runway 02 (020 degrees magnetic) has parts of the routing passing over existing WTGs, as shown in **Figure 2.3**.

Figure 2.3 Extract of Required Navigation Performance (RNP) procedure for Runway 02 at Shoreham Airport



2.5.3 A zone, known as a Minimum Sector Altitude (MSA), ensuring a 1,000ft / 300m vertical obstacle clearance is established at airports providing obstacle protection for aircraft in flight. The circle has a 25nm (46km) radius and is divided into segments or sectors. Within this zone an altitude is published which provides protection. It may take the form of a single value, or several values within a sectorised circle. The published MSA for Shoreham Airport is 2,200ft amsl.

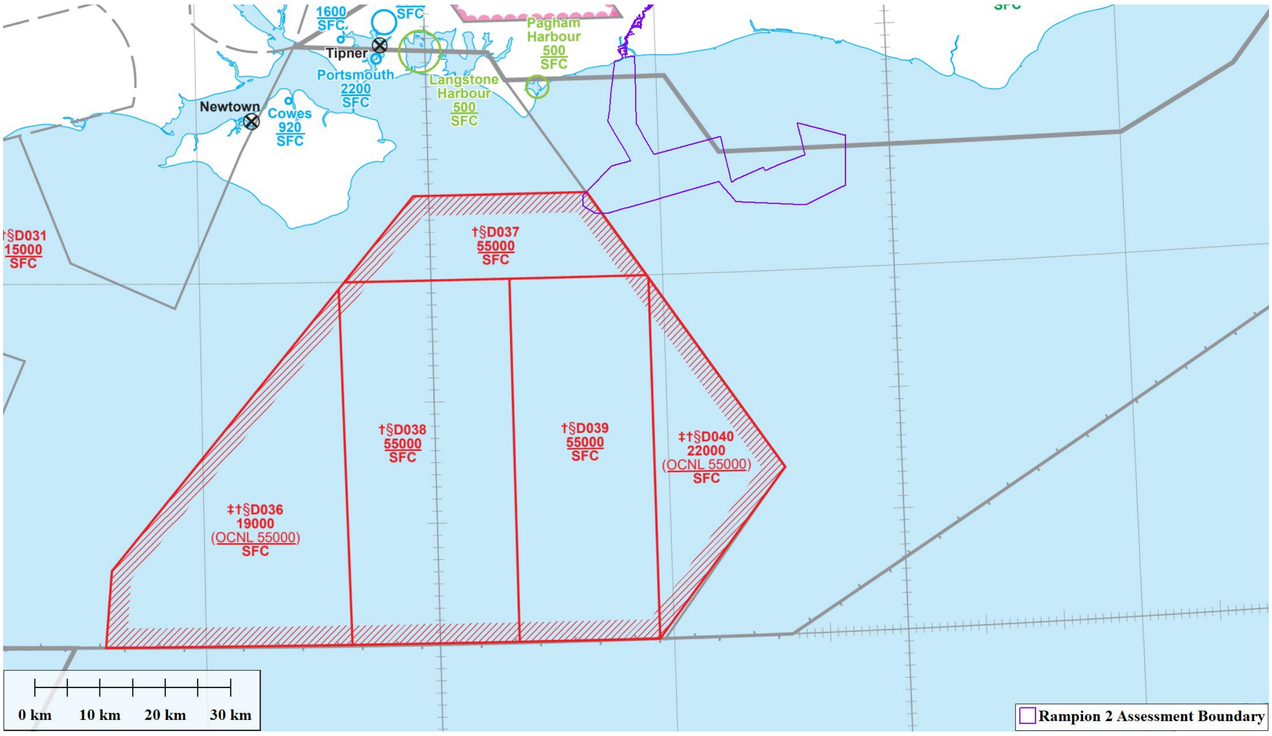
2.5.4 Terminal Arrival Altitudes (TAA) are associated with Required Navigation Performance (RNP) approaches and provide the same 1,000ft vertical obstacle protection as MSAs but are more specific to the 'entry' points into an RNP procedure.

2.5.5 If additional structures are introduced within the MSA/TAA area, it may be that these altitudes would need to be revised. For this protective zone to be validated a radius of 30nm is considered (25nm + a buffer of 5nm) and an IFP assessment of the approaches at Shoreham Airport will be required.

2.6 Military aviation

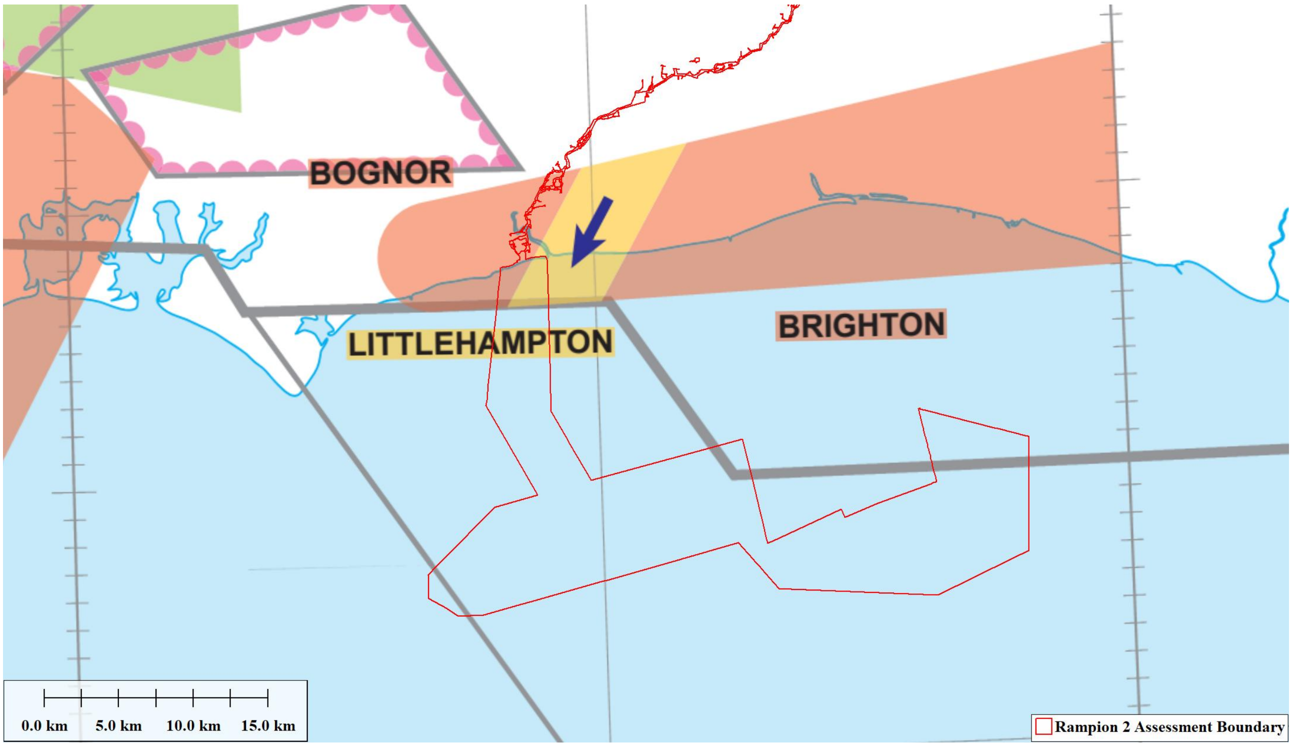
2.6.1 No areas of high or intensive military flying were identified above the offshore part of the PEIR Assessment Boundary. There are, however, adjacent Danger Areas (DAs) south east of the Isle of Wight, which are named as D036, D037, D038, D039 and D040. A small area of the eastern part of D037 could be affected by the western extent of the PEIR Assessment Boundary and further engagement with the Ministry of Defence would need to be undertaken in this regard. It may be that when the final positions of the WTGs are determined, the westernmost WTGs will not impact on D037. These DAs are operational from Monday to Friday and additionally may be activated by a Notice to Airmen (NOTAM), which is a way of disseminating information to large numbers of pilots and other relevant parties. The areas have vertical limits from the surface up to altitudes, at times, of 55,000ft amsl. The type of activity within these areas can range from low level flying to munitions release. **Figure 2.4** shows the danger areas.

Figure 2.4 Danger Areas to the west of Rampion 2



2.6.2 In addition to these DAs there are areas marked for avoidance by military aircraft. A small transit corridor in the vicinity of Littlehampton is established for the use of military aircraft flying between training areas. **Figure 2.5** shows the Military Avoidance Areas along the Sussex coast.

Figure 2.5 Military Avoidance Areas north of Rampion 2 with transit corridor shown



2.7 Helicopter and Search and Rescue Operations

2.7.1 Helicopter Main Routes (HMRs) have not been identified in the vicinity of the Proposed Development; however, it can be expected that military helicopters use the transit corridor mentioned in **paragraph 2.6.2** as they fly to and from the training (Danger) areas indicated in **paragraph 2.6.1**. In addition to this, it is highly probable that commercial helicopter flying will be conducted in the area in support of maritime operations and, of course, the offshore energy industry is very often reliant on helicopters in their maintenance programmes.

2.7.2 Search and Rescue (SAR) operations are a highly specialised undertaking involving not only aviation assets, but also small boats, ships and shore-based personnel. The random nature of people, watercraft or aircraft in distress makes it very difficult to determine routes taken by SAR aircraft. Fixed wing SAR aircraft will tend to stay at higher altitudes in a command-and-control role during major incidents, whilst helicopters will be used in a low-level role, sometimes in support of small rescue boats. In recent years offshore windfarms have become an increasingly common feature in UK waters, and therefore it must be assumed that SAR providers around the country have, in addition to specially trained crews, highly developed and robust Standard Operating Procedures to mitigate the obstacle threat, both day and night.

3. Radar Line of Sight Assessment

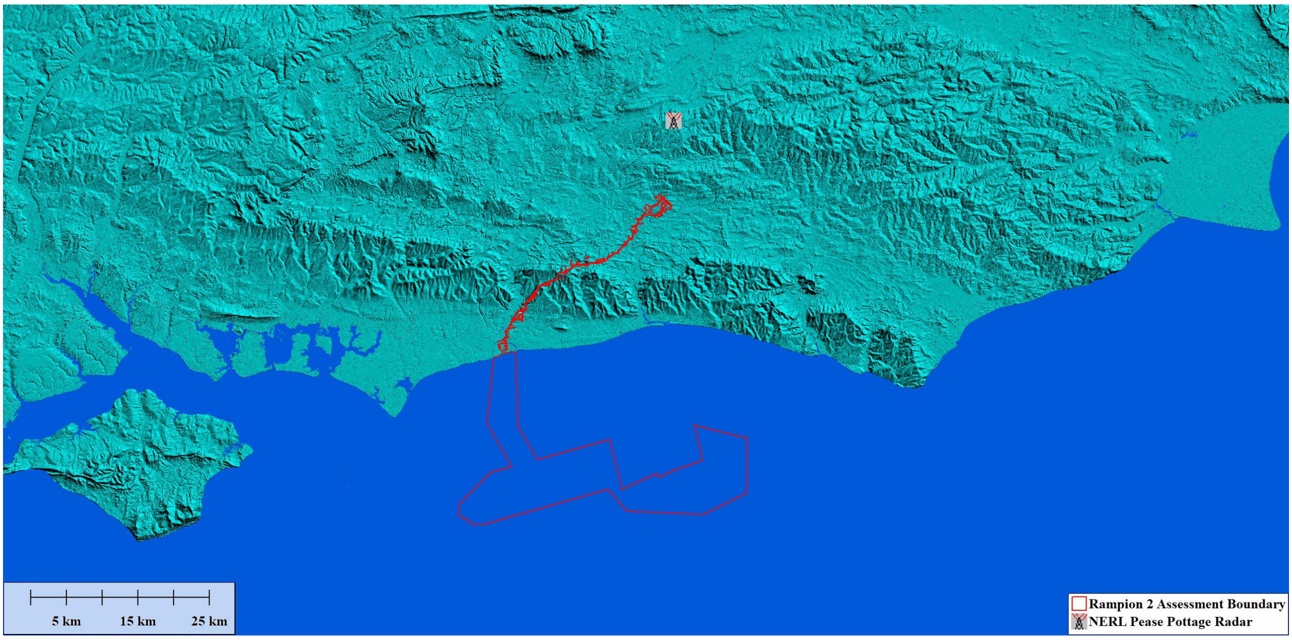
3.1 Methodology

3.1.1 Radar Line of Sight (RLoS) is determined by use of a radar propagation model (ATDI HTZ communications) using 3D DTM data with 10m horizontal resolution. Radar data is entered into the model and RLoS to the WTGs from the radar is calculated.

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

3.1.3 For PSR the principal source of adverse wind farm effects are the WTG blades, so RLoS is calculated for the maximum blade tip heights of the WTGs, for instance 210m and 325m amsl.

Figure 3.1 10m resolution DTM used for RLoS modelling

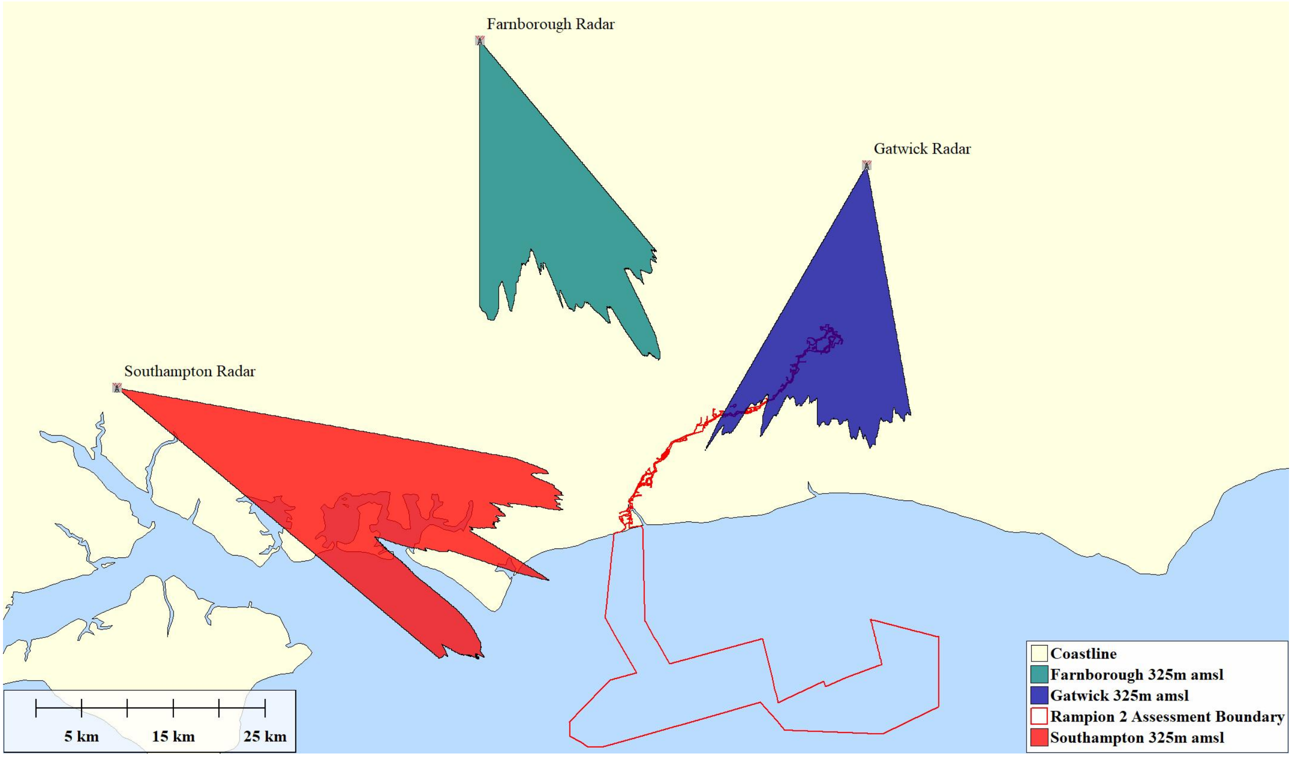


3.2 Licensed Airfields with Surveillance Radar

3.2.1 The closest radar equipped airfields to Rampion 2 are Gatwick, 49km to the north, Southampton, 61km to the north-west, and Farnborough, 68km to the north.

3.2.2 RLoS coverage from these airfield radars towards Rampion 2 for the maximum blade tip height of 325m amsl is shown in **Figure 3.2**.

Figure 3.2 Airfield Radars RLoS coverage



3.2.3 The extents of the RLoS coverage areas at 325m amsl for the three airfield radars show that there is no possibility for Rampion 2 WTGs to have any impact on their performance.

3.3 NERL Pease Pottage Radar

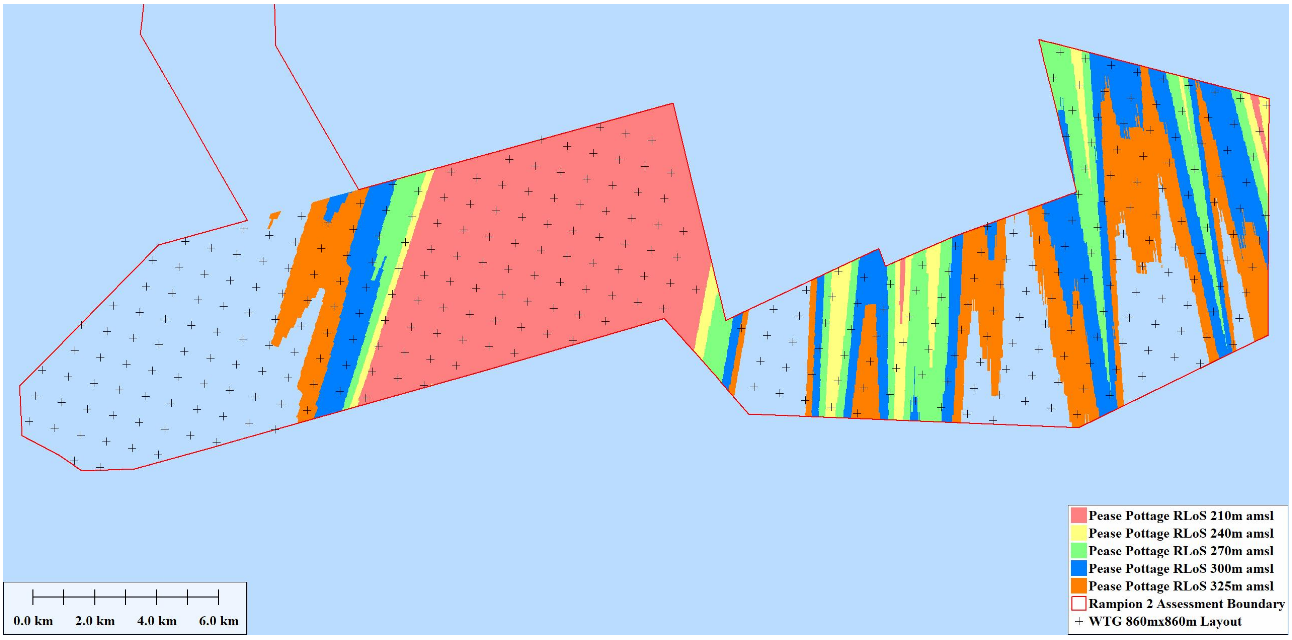
3.3.1 The closest Rampion 2 WTG indicative location is 43km from Pease Pottage PSR.

3.3.2 There is considerable intervening terrain which provides partial screening of the offshore part of the Rampion 2 PEIR Assessment Boundary.

3.4 Radar Line of Sight

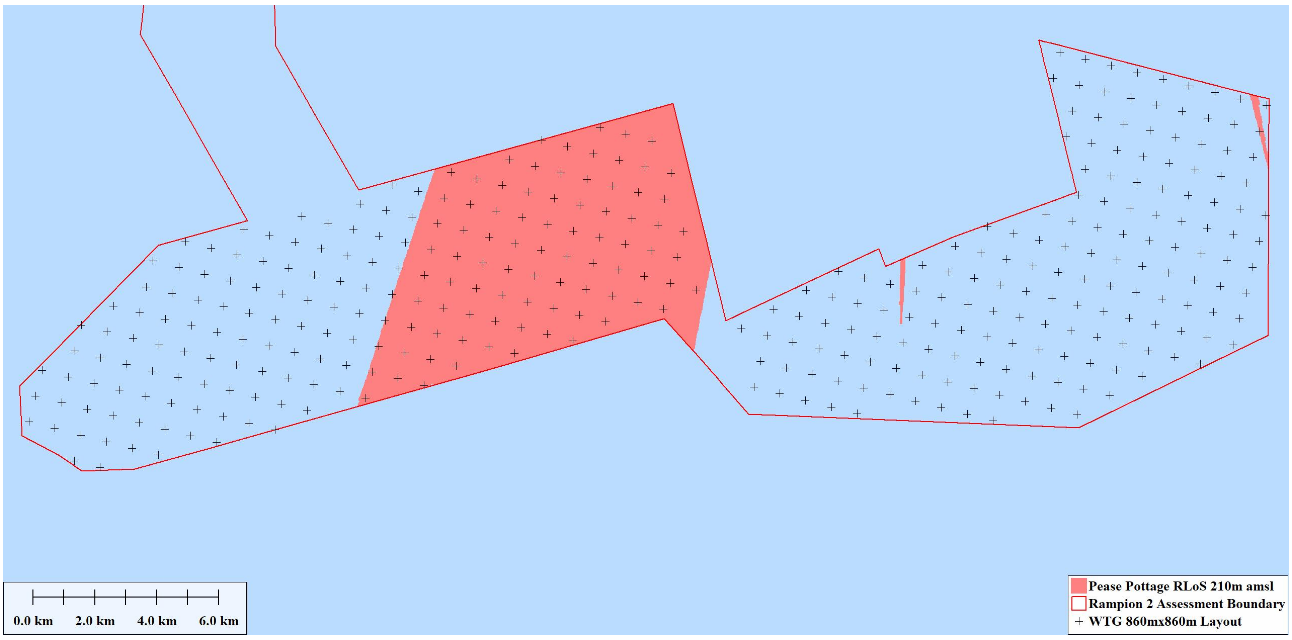
3.4.1 RLoS coverage from Pease Pottage across the Rampion 2 PEIR Assessment Boundary is illustrated in **Figure 3.3** for a range of blade tip heights between 210m and 325m amsl.

Figure 3.3 Pease Pottage RLoS coverage



3.4.2 The calculated RLoS from Pease Pottage radar to 210m WTGs within the Rampion 2 PEIR Assessment Boundary is depicted in **Figure 3.4**.

Figure 3.4 Pease Pottage RLoS to 210m WTGs

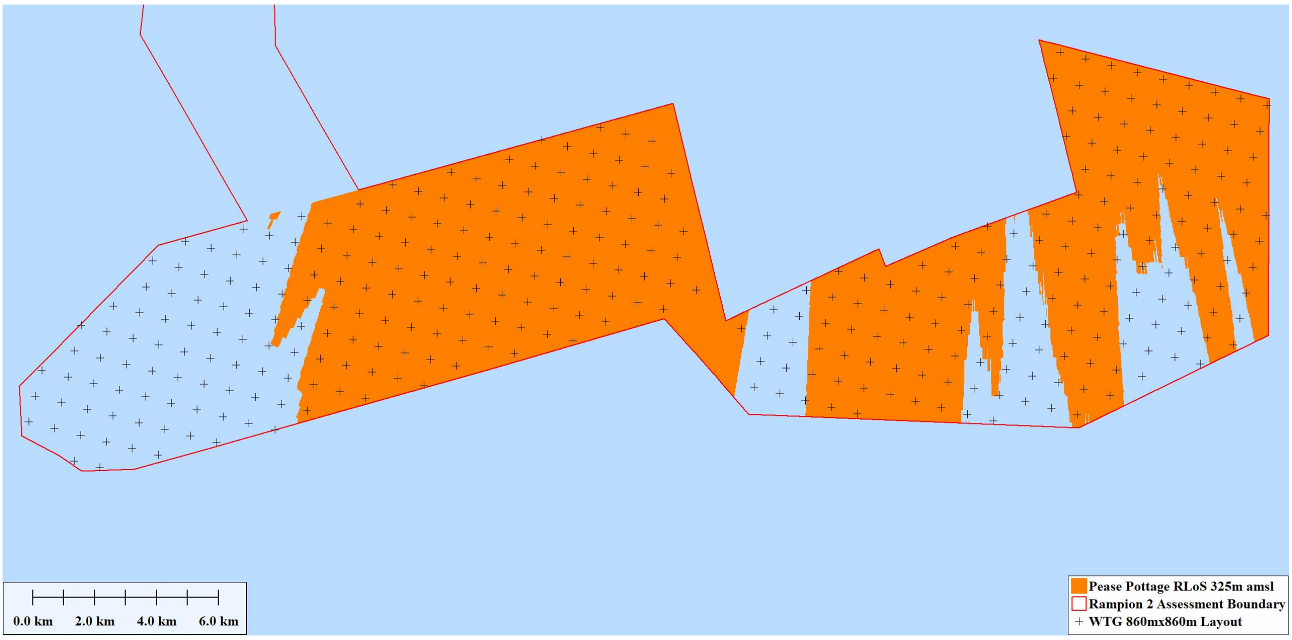


3.4.3 The shaded area depicts where Pease Pottage radar has RLoS to 210m WTGs.

3.4.4 At 210m, approximately 25 percent of the indicative WTG locations are in RLoS of Pease Pottage radar.

3.4.5 The calculated RLoS from Pease Pottage radar to 325m WTGs within the Rampion 2 PEIR Assessment Boundary is depicted in **Figure 3.5**.

Figure 3.5 Pease Pottage RLoS to 325m WTGs



3.4.6 The shaded area depicts where Pease Pottage radar has RLoS to 325m WTGs.

3.4.7 At 325m, approximately 68 percent of the indicative WTG locations are in RLoS of Pease Pottage radar.

3.5 Radar Probability of Detection

Overview

3.5.1 RLoS is only an indication as to whether the radar will 'see' a WTG. Depending on the radar configuration and the nature of the terrain screening, the Probability of Detection (Pd) may be greater or less than the RLoS distance.

3.5.2 Pd may be calculated by using a radio propagation model to determine radar signal path loss between the radar and WTGs, and from the technical characteristics of the radar.

3.5.3 Pease Pottage PSR is a Raytheon ASR-23SS. Parameters are taken from data published by Raytheon for a 16-module radar.

3.5.4 Path loss calculations are made to WTG locations within the indicative layout. By knowing the PSR transmitter power, antenna gain, 2-way path loss, receiver sensitivity and the WTG Radar Cross Section (RCS) gain, the Pd can be calculated.

3.5.5 The static parts of each WTG (tower structure) can be ignored in the calculation as these will be rejected by the radar Moving Target filter. Three parts of each WTG are considered for the calculations, with the WTG blade pointing vertically: the blade tip, the blade mid-point and the WTG nacelle. The calculations are made using the ITU526 propagation model.

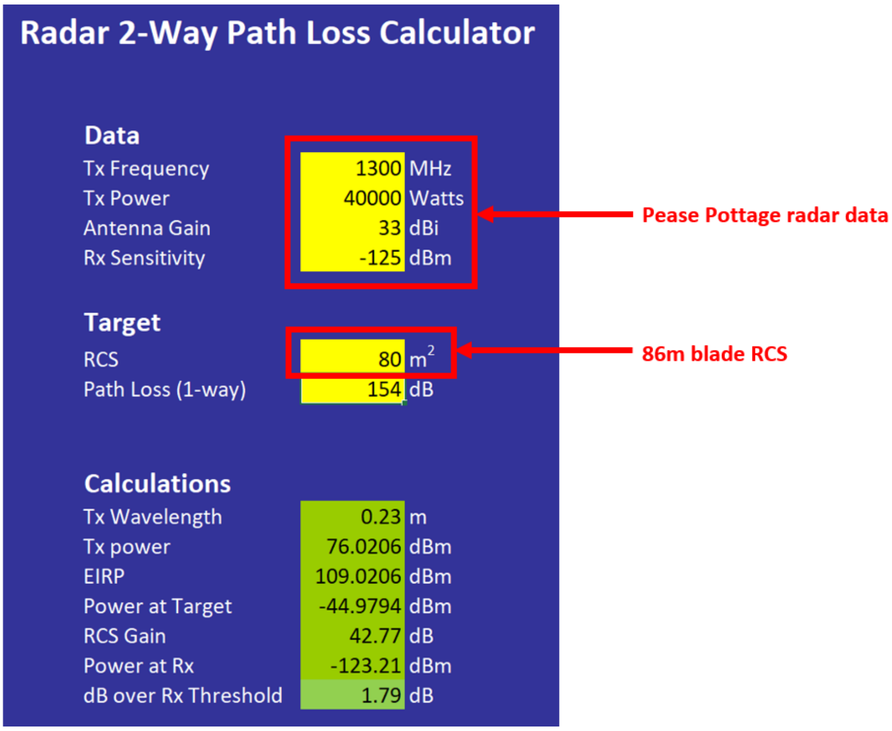
210m WTG Pd Modelling

3.5.6 The amount of radar energy reflected back to the radar from the WTG will depend on the RCS of the WTG blade. For a blade length of 86m (half of the 172m diameter) a nominal RCS of $80m^2$ is used to determine the energy reflected from each of the three points on the WTG (tip, mid-point and nacelle).

3.5.7 The received signal at the radar from each component part of the WTG is then summed to determine the total signal level. This is then compared with the radar receiver Minimum Detectable Signal level.

3.5.8 The parameters used for the Pd calculations are shown in **Figure 3.6**.

Figure 3.6 Pease Pottage radar Pd calculation for 210m WTGs

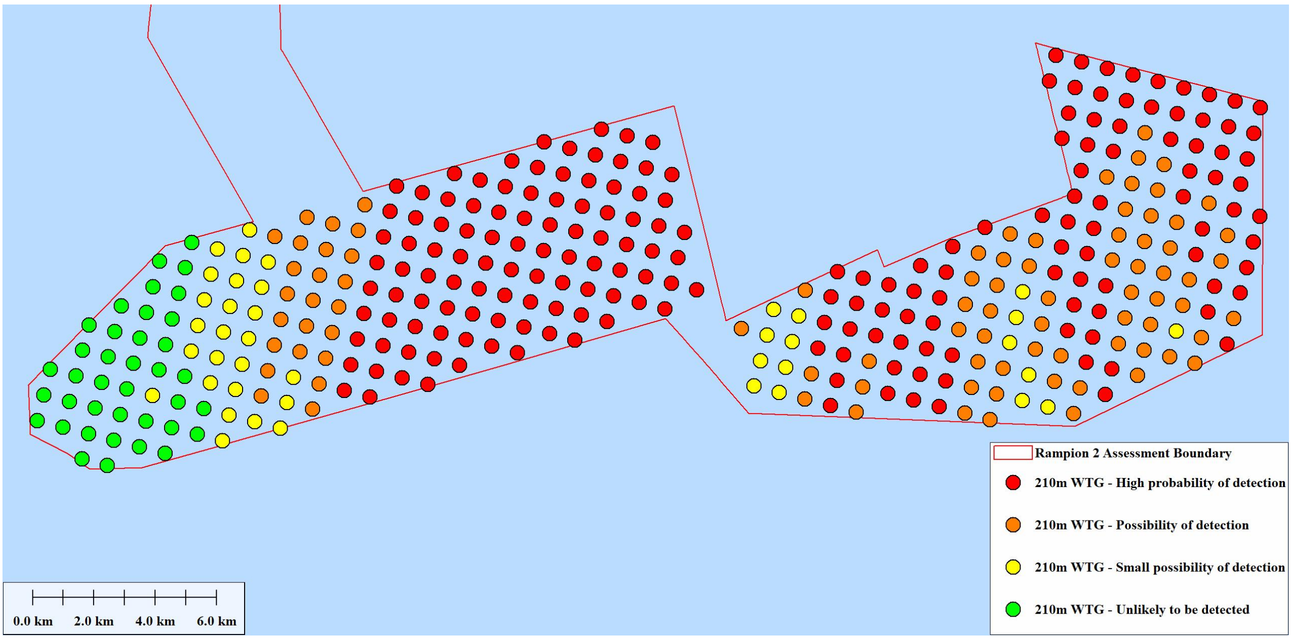

Radar 2-Way Path Loss Calculator

Data		
Tx Frequency	1300	MHz
Tx Power	40000	Watts
Antenna Gain	33	dBi
Rx Sensitivity	-125	dBm
Target		
RCS	80	m^2
Path Loss (1-way)	154	dB
Calculations		
Tx Wavelength	0.23	m
Tx power	76.0206	dBm
EIRP	109.0206	dBm
Power at Target	-44.9794	dBm
RCS Gain	42.77	dB
Power at Rx	-123.21	dBm
dB over Rx Threshold	1.79	dB

3.5.9 The results of the Pd calculations for 210m WTGs are presented graphically for each of the indicative WTG locations in **Figure 3.7**. The radar received signal level at each location is colour coded as follows:

- green is more than -6 decibel (dB) below the radar receiver threshold and unlikely to be detected;
- yellow is between -3dB and -6dB with a small possibility of detection;
- orange is between -3dB and +3dB with a possibility of detection; and
- red is above +3dB with a high probability of detection.

Figure 3.7 Pease Pottage radar – 210m WTG Pd

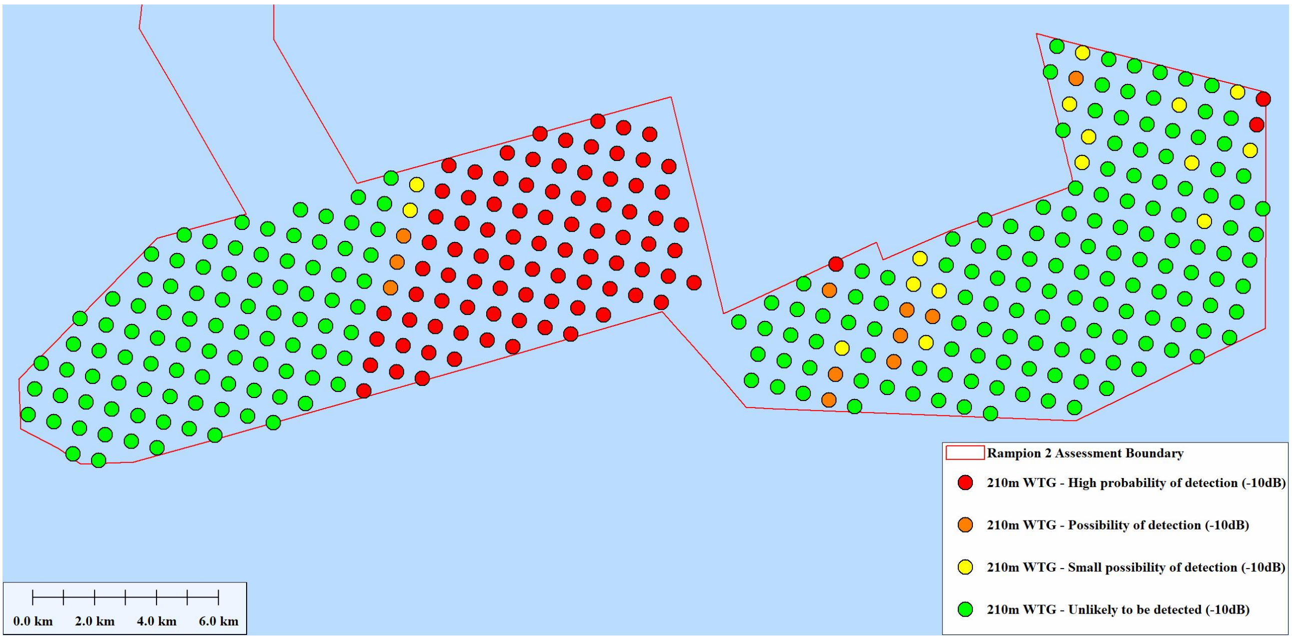


3.5.10 The Pd results show that for a blade tip height of 210m, WTGs are unlikely to be detected by Pease Pottage radar at 38 of the 354 indicative locations.

3.5.11 These results represent the worst-case as they are based on the optimum performance of the radar, however the gain of a radar antenna in the vertical axis is not uniform with elevation angle. Pease Pottage radar uses a modified Cosec^2 vertical antenna pattern which has reduced gain at low elevation angles to moderate the effects of ground clutter but high gain at elevations just a few degrees above the horizon. The actual antenna gain at the WTG elevations (between -0.10° and -0.18°) is expected to be significantly lower than the on-axis gain.

3.5.12 If the antenna gain at 0° is assumed to be 10dB lower than the on-axis gain, then the Pd results may be revised as shown in **Figure 3.8**.

Figure 3.8 Pease Pottage radar – 210m WTG Pd with reduced antenna gain



3.5.13 With a 10dB reduction in antenna gain, Pease Pottage radar is now unlikely to detect 210m WTGs at 238 of the 354 indicative locations.

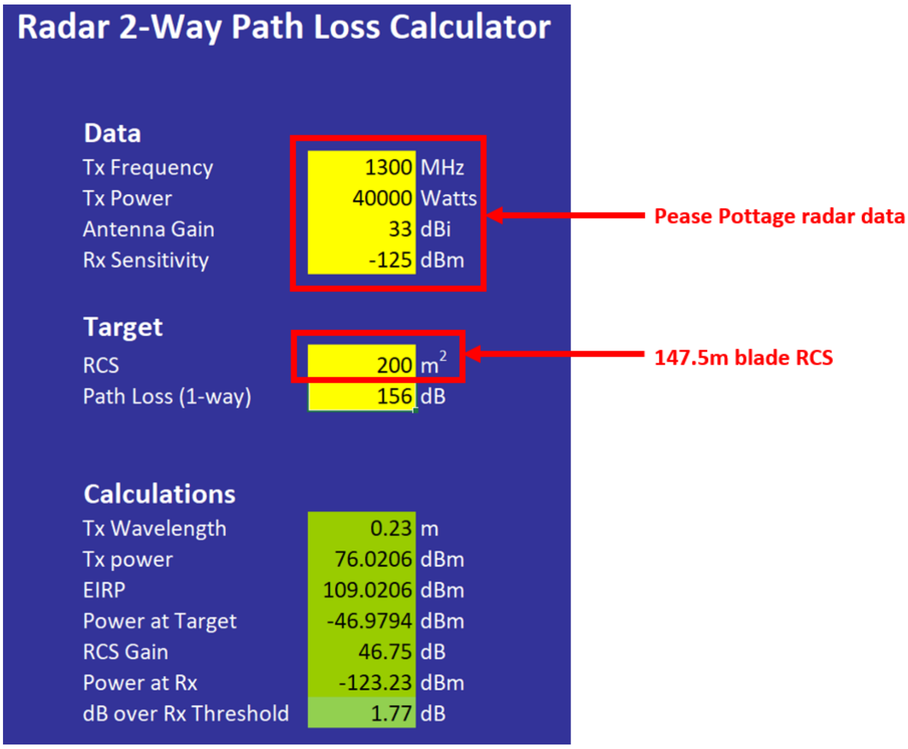
3.5.14 The radar operating authority will be able to confirm the actual antenna gain at an elevation of 0°.

325m WTG Pd modelling

3.5.15 For a blade length of 147.5m (half of the 295m diameter) a nominal RCS of 200m^2 is used to determine the energy reflected from each of the three points on the WTG (tip, mid-point and nacelle).

3.5.16 The parameters used for the Pd calculations are shown in **Figure 3.9**.

Figure 3.9 Pease Pottage radar Pd calculation for 325m WTGs



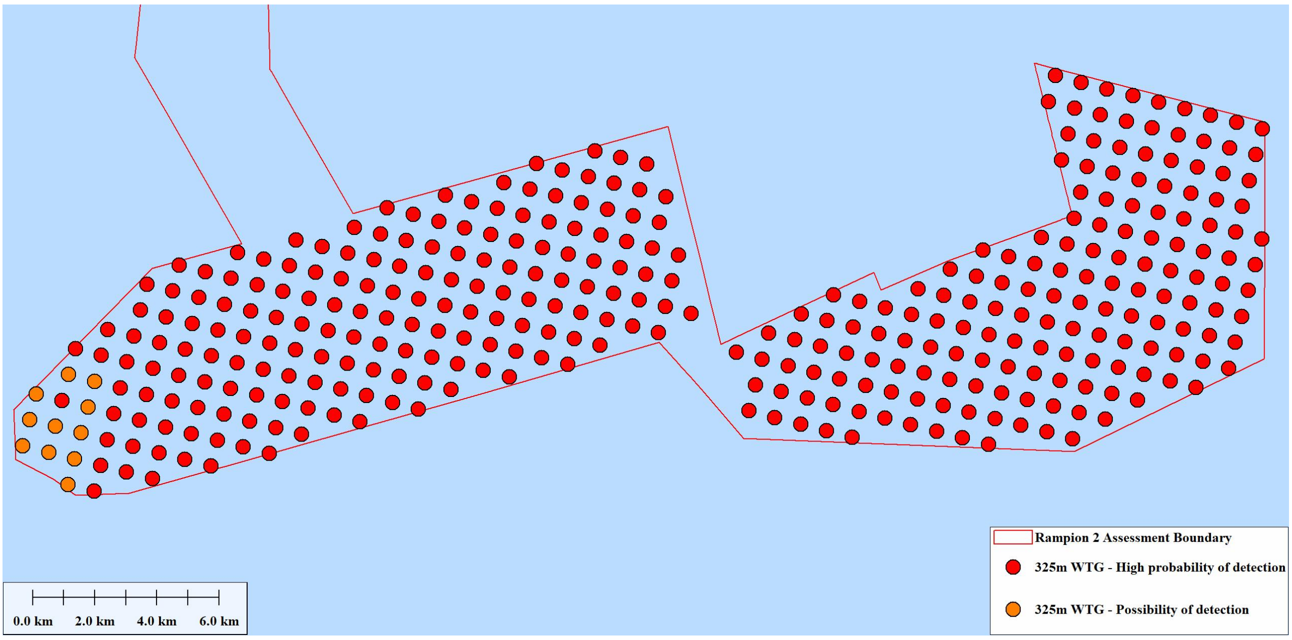
Radar 2-Way Path Loss Calculator

Data		
Tx Frequency	1300	MHz
Tx Power	40000	Watts
Antenna Gain	33	dBi
Rx Sensitivity	-125	dBm
Target		
RCS	200	m^2
Path Loss (1-way)	156	dB
Calculations		
Tx Wavelength	0.23	m
Tx power	76.0206	dBm
EIRP	109.0206	dBm
Power at Target	-46.9794	dBm
RCS Gain	46.75	dB
Power at Rx	-123.23	dBm
dB over Rx Threshold	1.77	dB

3.5.17 The results of the Pd calculations for 325m WTGs are presented graphically for each of the indicative WTG locations in **Figure 3.10**. The radar received signal level at each location is colour coded as follows:

- green is more than -6dB below the radar receiver threshold and unlikely to be detected;
- yellow is between -3dB and -6dB with a small possibility of detection;
- orange is between -3dB and +3dB with a possibility of detection; and
- red is above +3dB with a high probability of detection.

Figure 3.10 Pease Pottage radar – 325m WTG Pd

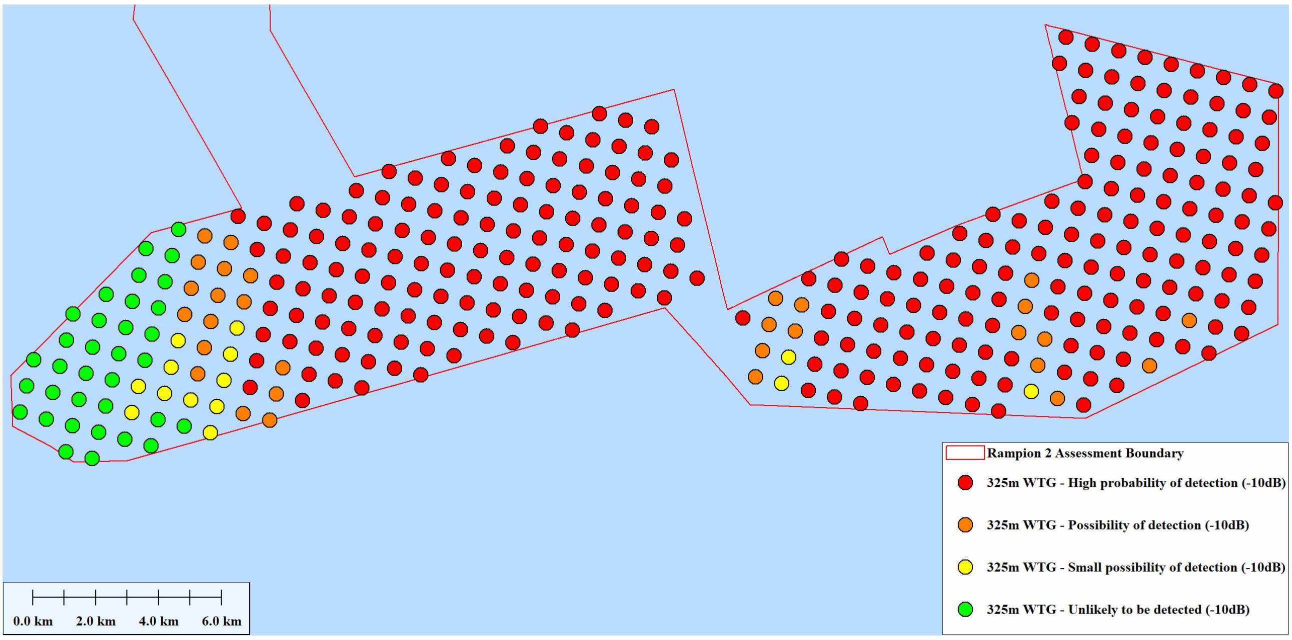


3.5.18 The Pd results show that for a blade tip height of 325m, WTGs are unlikely to be detected by Pease Pottage radar at none of the 354 indicative locations.

3.5.19 These results represent the worst-case as they are based on the optimum performance of the radar, however the gain of a radar antenna in the vertical axis is not uniform with elevation angle. Pease Pottage radar uses a modified Cosec^2 vertical antenna pattern which has reduced gain at low elevation angles to moderate the effects of ground clutter but high gain at elevations just a few degrees above the horizon. The actual antenna gain at the WTG elevations (between 0.06° and -0.07°) is expected to be significantly lower than the on-axis gain.

3.5.20 If the antenna gain at 0° is assumed to be 10dB lower than the on-axis gain, then the Pd results may be revised as shown in **Figure 3.11**.

Figure 3.11 Pease Pottage radar – 325m WTG Pd with reduced antenna gain



3.5.21 With a 10dB reduction in antenna gain, Pease Pottage radar is now unlikely to detect 325m WTGs at 34 of the 354 indicative locations. However, if the minimum spacing for 325m WTGs is applied (1,720m) then the number of indicative WTG locations is reduced to a maximum of 11.

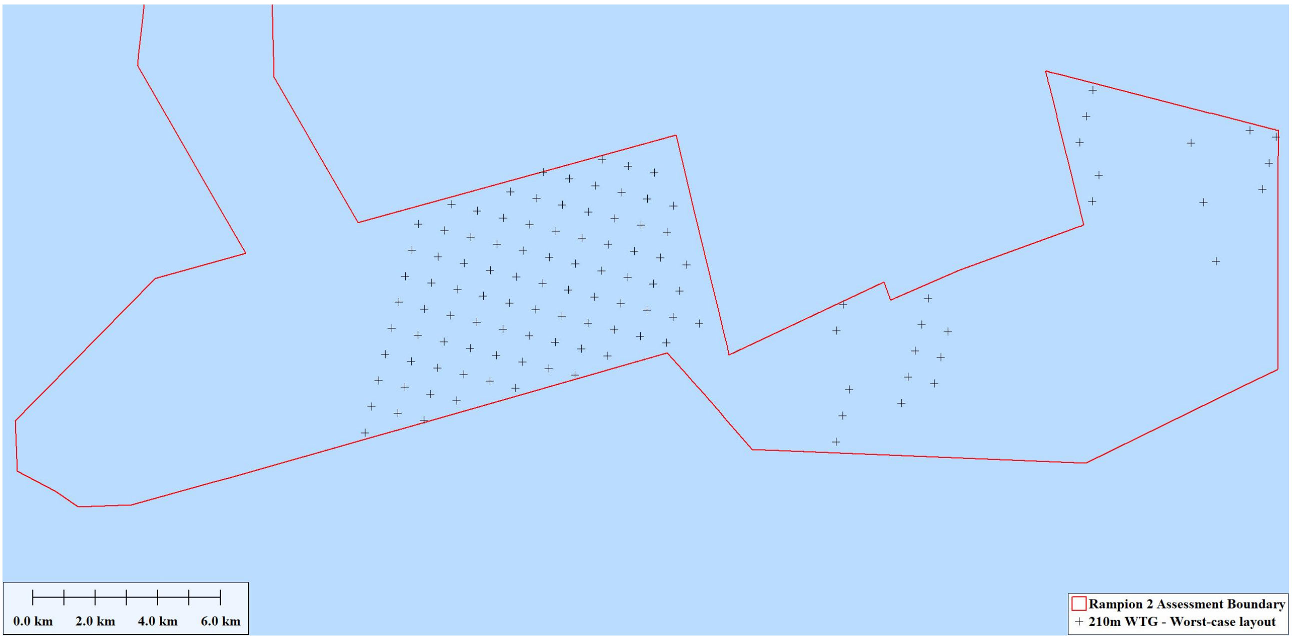
3.5.22 The radar operating authority will be able to confirm the actual antenna gain at an elevation of 0°.

Worst-case WTG layouts

3.5.23 The WTG Pd modelling allows for worst-case WTG layouts for both the minimum and maximum proposed blade tip heights to be depicted which are based on the likelihood of Pease Pottage radar detecting the WTGs.

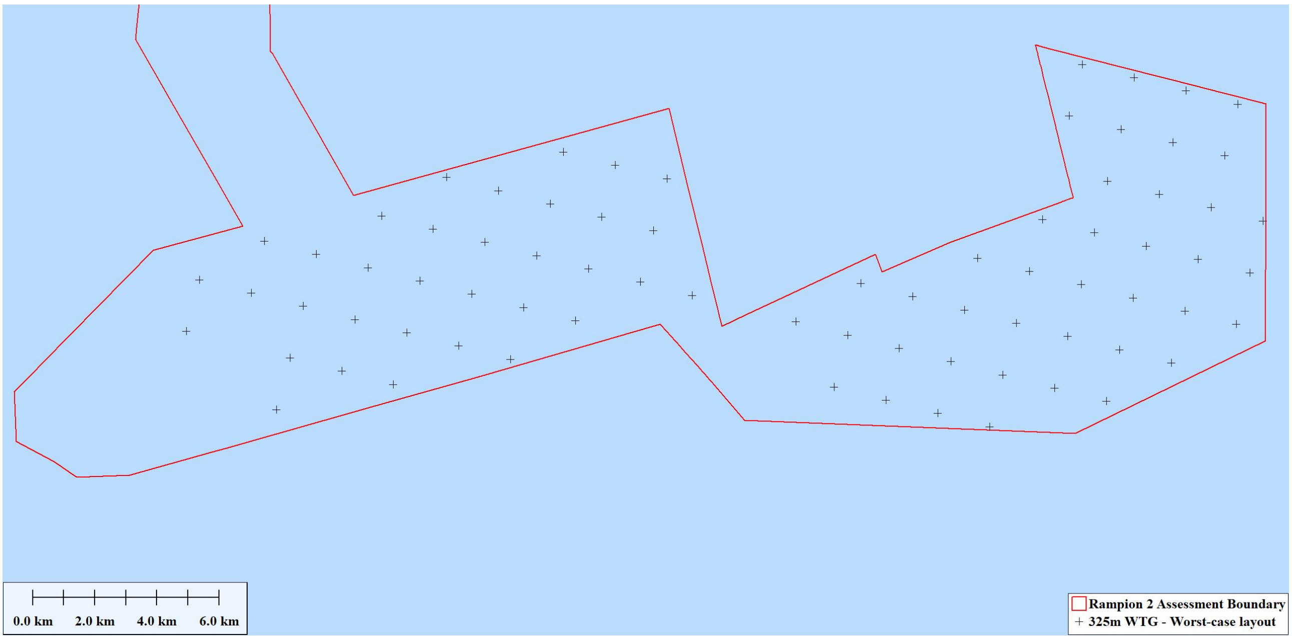
3.5.24 **Figure 3.12** shows the worst-case layout for 116 WTGs with a maximum blade tip height of 210m above LAT. The WTGs are located where they are most likely to be detected by Pease Pottage radar, with a minimum inter-WTG spacing of 860m.

Figure 3.12 210m WTG – Worst-case layout



3.5.25 **Figure 3.13** shows the worst-case layout for 75 WTGs with a maximum blade tip height of 325m above LAT. The WTGs are located where they are most likely to be detected by Pease Pottage radar, with a minimum inter-WTG spacing of 1720m.

Figure 3.13 325m WTG – Worst-case layout



3.6 Radar mitigation

Potential options

3.6.1 Possible mitigation options for WTGs that are detected by Pease Pottage radar include blanking of the radar in the impacted area, blanking combined with infill from an alternative radar feed, or blanking combined with the imposition of a Transponder Mandatory Zone (TMZ).

Transponder Mandatory Zone

3.6.2 A TMZ is an area in which the carriage and operation of a Secondary Surveillance Radar (SSR) transponder on board the aircraft is mandatory. This allows ATC to identify an aircraft target using solely SSR, within an area in which PSR clutter may otherwise have obscured the target.

3.6.3 There are several existing TMZs that have already been successfully established to mitigate the impact of offshore wind farms on PSRs, for example the London Array TMZ in the Outer Thames Estuary and the Moray Firth TMZ in Scotland.

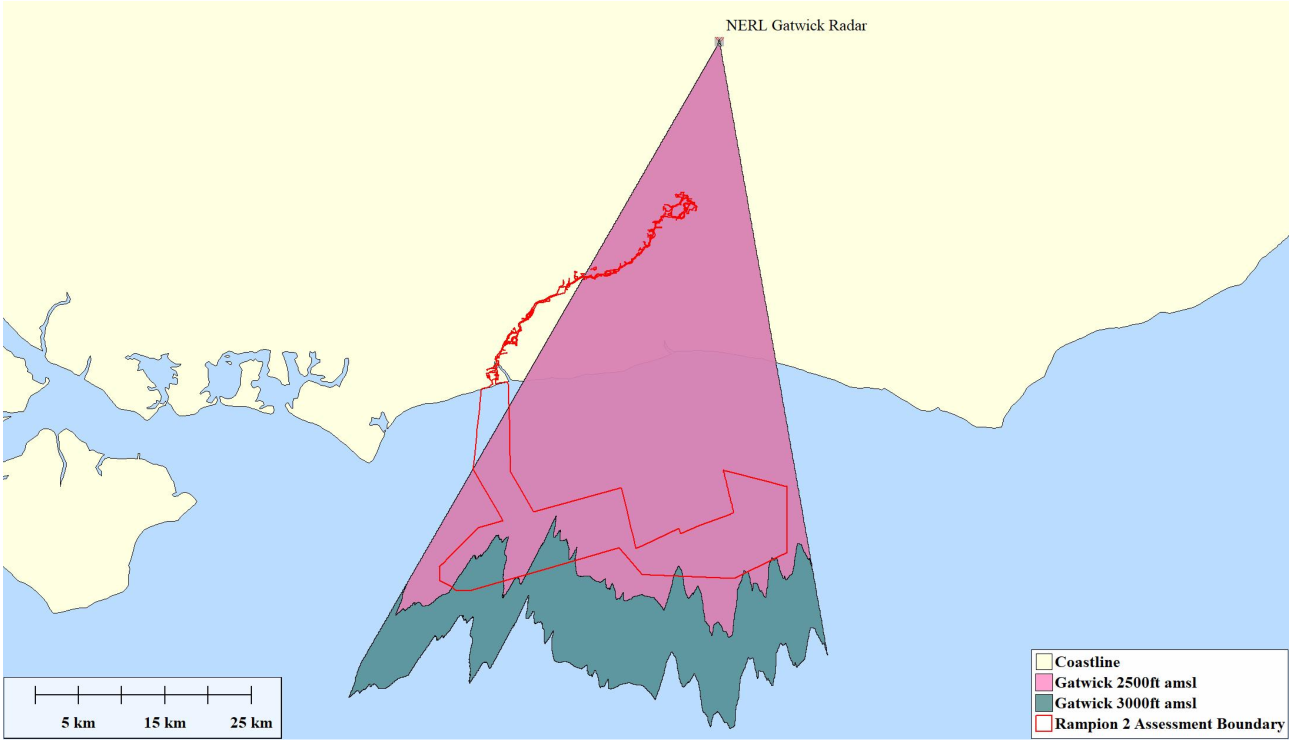
Infill radar coverage

3.6.4 NERL maintains a network of radars with overlapping coverage that feed data into a Multi Radar Tracking (MRT) system, producing an integrated picture for use at its control centres at Swanwick and Prestwick.

3.6.5 The following paragraphs examine the MRT radar feeds which may be available to NERL in the vicinity of Rampion 2. The radar sources investigated are the NERL facilities at Gatwick Airport and Bovingdon.

3.6.6 It has already been shown in **Section 3.2** that Gatwick's radar will not have RLoS of the Rampion 2 WTGs. Gatwick RLoS coverage in a sector encompassing the Rampion 2 PEIR Assessment Boundary is depicted in **Figure 3.14**.

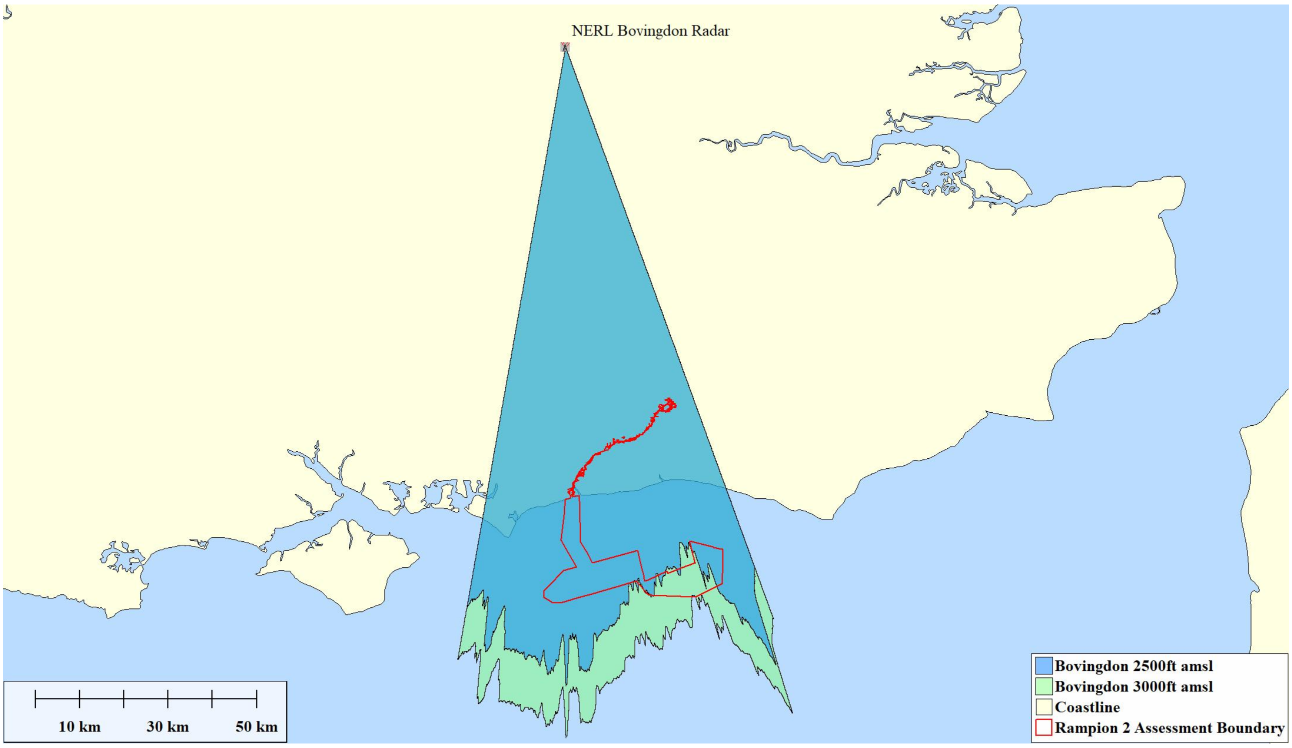
Figure 3.14 Gatwick radar RLoS coverage at 2,500ft and 3,000ft amsl



3.6.7 Gatwick radar has RLoS coverage down to 2,500ft amsl over more than half of the Rampion 2 PEIR Assessment Boundaryand RLoS coverage down to 3,000ft amsl over the whole site.

3.6.8 Bovingdon RLoS coverage in a sector encompassing the Rampion 2 PEIR Assessment Boundary is depicted in **Figure 3.15**.

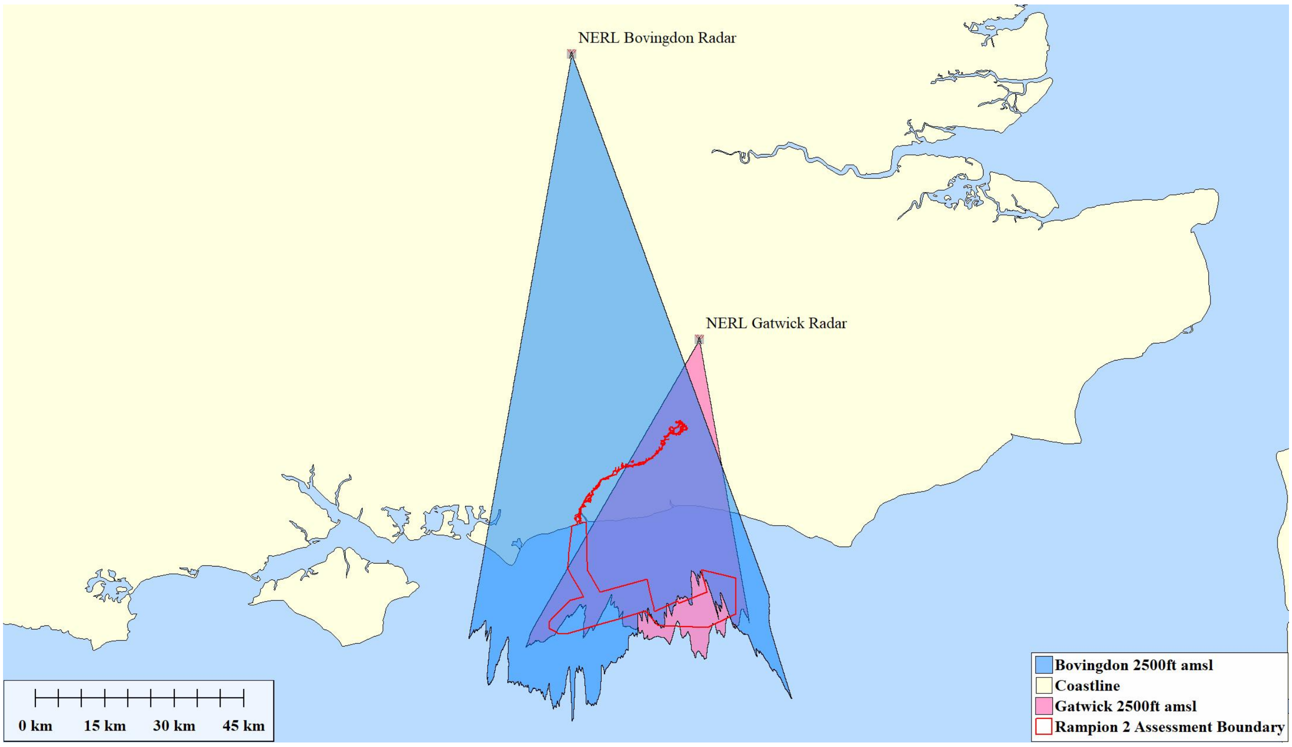
Figure 3.15 Bovingdon radar RLoS coverage at 2,500ft and 3,000ft amsl



3.6.9 Bovingdon radar has RLoS coverage down to 2,500ft amsl over more than half of the Rampion 2 PEIR Assessment Boundary and RLoS coverage down to 3,000ft amsl over virtually the whole site.

3.6.10 The combined Gatwick and Bovingdon RLoS coverage at 2,500ft amsl in the vicinity of Rampion 2 is depicted in **Figure 3.16**.

Figure 3.16 Gatwick and Bovingdon RLoS coverage at 2,500ft amsl



3.6.11 Between the two radars there is RLoS coverage down to 2,500ft amsl over virtually the whole of the offshore part of the Rampion 2 PEIR Assessment Boundary.

3.6.12 **Figure 3.14**, **Figure 3.15** and **Figure 3.16** illustrate the level of radar coverage from the Gatwick and Bovingdon radars should they be used for infill mitigation of Pease Pottage radar.

Engagement

3.6.13 Engagement with NERL will be required to determine the optimal mitigation solution and for its subsequent implementation.

4. Glossary of terms and abbreviations

Term (acronym)	Definition
agl	Above ground level
AIP	Aeronautical Information Publication
amsl	Above mean sea level
ATC	Air Traffic Control
ATS	Air Traffic Service
ATZ	Aerodrome Traffic Zone
Baseline	Refers to existing conditions as represented by latest available survey and other data which is used as a benchmark for making comparisons to assess the impact of development.
Baseline conditions	The environment as it appears (or would appear) immediately prior to the implementation of the Proposed Development together with any known or foreseeable future changes that will take place before completion of the Proposed Development.
Controlled airspace	Defined airspace within which pilots must follow Air Traffic Control instructions implicitly. In the UK, Classes A, C, D and E are areas of controlled airspace.
CTA	Control Area
DA	Danger Area
dB	Decibel
DTM	Digital Terrain Model
Flight Level (FL)	An aircraft altitude expressed in hundreds of feet at a standard sea level pressure datum of 1013.25 hPA.
ft	Feet
GIS	Geographic Information System

Term (acronym)	Definition
GNSS	Global Navigation Satellite System
HMR	Helicopter Main Route
Hectopascal (hPA)	Is the international unit for measuring atmospheric or barometric pressure.
IFP	Instrument Flight Procedure
IFR	Instrument Flight Rules
Impact	The changes resulting from an action.
LAT	Lowest Astronomical Tide
Likely Significant Effects	It is a requirement of Environmental Impact Assessment Regulations to determine the likely significant effects of the Proposed Development on the environment which should relate to the level of an effect and the type of effect.
LTMA	London Terminal Control Area
MRT	Multi Radar Tracking
MSA	Minimum Sector Altitude
NATS	National Air Traffic Service
NERL	NATS (En Route) plc
nm	Nautical Miles
NOTAM	Notice to Airmen
Pd	Probability of Detection
PEIR Assessment Boundary	The PEIR Assessment Boundary combines the search areas for the offshore and onshore infrastructure associated with the Proposed Development. It is defined as the area within which the Proposed Development and associated infrastructure will be located, including the temporary and permanent construction and operational work areas.

Term (acronym)	Definition
Preliminary Environmental Information Report (PEIR)	The written output of the Environmental Impact Assessment undertaken to date for the Proposed Development. It is developed to support formal consultation and presents the preliminary findings of the assessment to allow an informed view to be developed of the Proposed Development, the assessment approach that has been undertaken, and the preliminary conclusions on the likely significant effects of the Proposed Development and environmental measures proposed.
Primary Surveillance Radar (PSR)	A radar system that measures the bearing and distance of targets using the detected reflections of radio signals.
Proposed Development	The development that is subject to the application for development consent, as described in **Chapter 4**.
PSR	Primary Surveillance Radar
RCS	Radar Cross Section
RLoS	Radar Line of Sight
RNP	Required Navigation Performance
SAR	Search and Rescue
Scoping Report	A report that presents the findings of an initial stage in the Environmental Impact Assessment process.
Secondary Surveillance Radar (SSR)	A radar system that transmits interrogation pulses and receives transmitted responses from suitably equipped targets.
SUA	Special Use Airspace
TAA	Terminal Arrival Altitude
The Proposed Development / Rampion 2	The onshore and offshore infrastructure associated with the offshore wind farm comprising of installed capacity of up to 1200 MW, located in the English Channel in off the south coast of England.
TMZ	Transponder Mandatory Zone

Term (acronym)	Definition
Uncontrolled Airspace	Defined airspace in which Air Traffic Control does not exercise exclusive authority but may provide basic information services to aircraft in radio contact. In the UK, Class G is uncontrolled airspace.
VFR	Visual Flight Rules
WTG	Wind Turbine Generator

5. References

Government publications

United Kingdom Aeronautical Information Services, Aeronautical Information Publication, NATS AIS, (2021) and updated every 28-days through the internationally regulated Aeronautical Information Records and Circular (AIRAC) Cycle.