East Anglia Hub Wind Farms

Airspace Change Proposal Submission ACP-2023-79

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1 Introduction

1.1 Introduction

This Airspace Change Proposal (ACP) supports the development of three wind farm sites in the southern North Sea, between 30 and 70km off the coast of East Anglia. These sites are named East Anglia 1 North (EA1N), East Anglia 2 (EA2) and East Anglia 3 (EA3); the geographic locations of the sites are shown in Figure 1 below. Collectively, the 3 sites are known as the East Anglia Hub (EA Hub). The wind farms have the potential to deliver up to a combined 3.1 gigawatt (GW) of installed capacity, making it one of the largest offshore opportunities in the world. The most northerly site is located approximately 100km to the east of National Air Traffic Services (NATS) Cromer Primary Surveillance Radar (PSR) and 106km to the east of the Norwich Airport Radar. Collectively the EA Hub will consist of up to 242 wind turbines with a maximum blade tip height of 300 metres (m) above lowest astronomical tide (LAT) for EA1 and EA2 and 196m above LAT for EA3.

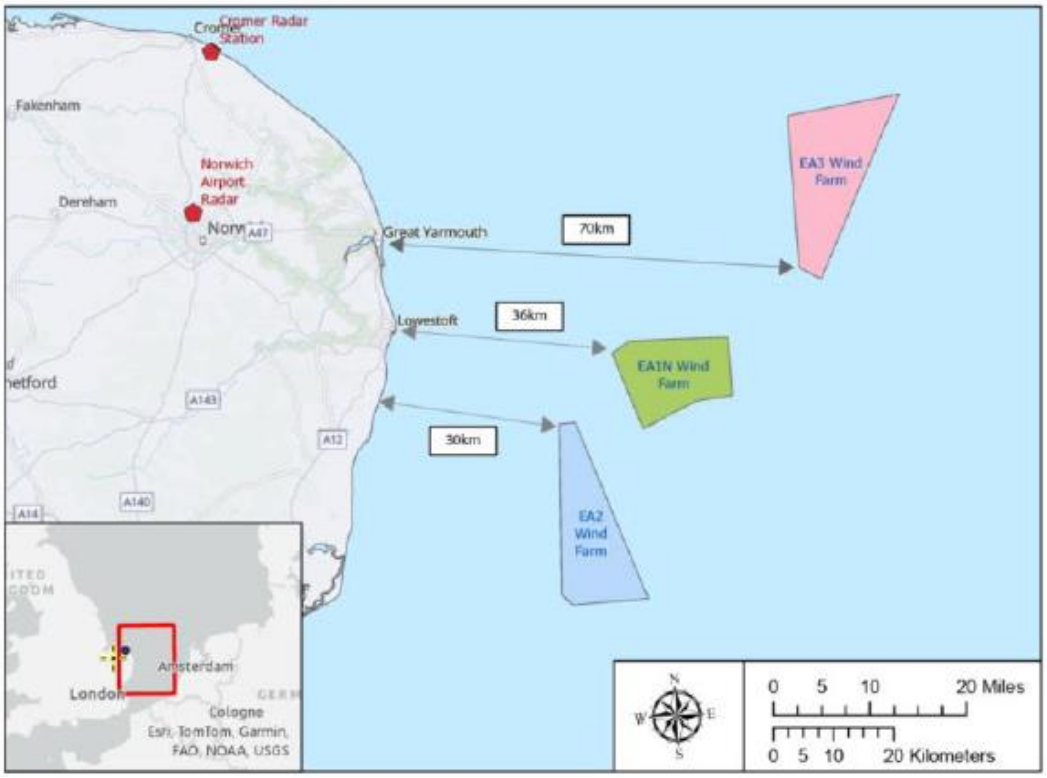


Figure 1 – EA Hub Wind Farm Locations.

More detailed information on the current airspace environment and structure in the vicinity of the proposed developments is provided later in this document. This document also includes information on the usage of the EA Hub Wind Farm geographical areas by current airspace users, before describing the justification for

this airspace change. This document will describe the design options that have been considered and those that have been discounted before highlighting the final two design options that were used during the formal engagement activity.

1.2 Who is the Change Sponsor?

ScottishPower Renewables Ltd (SPR) are the Change Sponsor (CS) for this ACP.

1.3 Purpose of the Document

The purpose of this document is to provide information regarding the proposal to establish PSR Range Azimuth Gating (RAG) blanking and Transponder Mandatory Zone (TMZ) solutions at the locations of the proposed EA Hub Wind Farms, which will mitigate the effects of the detection of unwanted wind turbine radar returns from the Cromer PSR. This document has been prepared by Osprey Consulting Services Limited, on behalf of SPR and in accordance with Civil Aviation Publication (CAP) 1616 (Ref 001).

2 Executive Summary

2.1 The Drivers for Change

The wind turbine generators (WTGs) which form the EA Hub Wind Farm development have the potential to be detected by the Cromer PSR. This would cause unacceptable interference through the creation of false radar returns (radar clutter). This radar clutter could affect the ability of an Air Traffic Control Officer (ATCO) to identify primary radar aircraft returns and increase the risk of an ATCO not detecting a potential confliction between aircraft.

To mitigate against this risk, measures need to be put in place prior to any of the wind farms becoming operational, to ensure that aircraft can be identified. The CS aims to have the wind farms operational on the following dates:

- EA1N March 2030
- EA2 March 2028
- EA3 March 2026

The proposed mitigation is to deploy RAG blanking on the Cromer PSR to remove all primary radar returns in the area of the wind turbines from the radar display. RAG radar blanking blocks any primary radar return within selected ranges and azimuth sectors. When primary blanking in any area is complete, the RAG radar blanking will remove primary radar returns from aircraft within the blanked area. To mitigate against this removal of primary radar coverage, it will be necessary to establish an airspace solution over the consented wind farms so that aircraft can be visible to Air Traffic Control (ATC) via another means. This secondary mitigation will be the implementation of a TMZ.

2.2 Statement of Need

A DAP1916 Statement of Need (SoN) [Ref 002] was submitted to the Civil Aviation Authority (CAA) via the Airspace Change Portal in November 2023.

The SoN is a required document as part of the ACP submission. Its purpose is to capture details of the sponsor of the ACP, alongside details pertaining to the objectives of the ACP, a summary of the issue or opportunity that the ACP is seeking to address, a description of the current airspace design, and a description of the current prevailing air traffic situation.

The text at paras 2.2.1 to 2.2.4 are extracted directly from the DAP 1916 Statement of Need (DAP1916V2-934), as submitted in November 2023:

2.2.1 The Objective of the Proposed Change

The objective of the proposed airspace change is to mitigate safety concerns and ensure that aviation operations remain unhindered in the planned development area

of the EA Hub Offshore Wind Farm's wind turbine generators comprising of EA1N, EA2 & EA3 in the North Sea.

2.2.2 A Summary of the Issue or Opportunity this ACP is Seeking to Address

The purpose of this ACP is to address safety concerns regarding any potential false radar contacts that may be caused by the EA Hub Wind Farm development. The proposal also seeks to mitigate issues raised by NATS regarding 'Primary Surveillance Radar at Cromer, and its associated air traffic services'. Although the Ministry of Defence (MOD) have commented on the potential for similar concerns to their air surveillance and control operations, a separate technical solution workstream is being conducted in parallel to this proposed ACP, under the Joint Aviation Task Force Working Group.

2.2.3 A Description of the Current Airspace Design

The East Anglia (EA) Hub is planning to locate wind turbine generators in the North Sea, east of Norwich, and comprises of three wind farms (EA1N, EA2, & EA3). All three sites are located within 16km of each other and are proposed to be situated in current Class G, uncontrolled airspace. Part of each proposed site is situated beneath or in close proximity to a combination of established Control Areas (CTA), , Aerial Tactics Areas (ATA), Transponder Mandatory Zones (TMZ) airspace and Air Traffic Service Routing and Helicopter Main Routing Indicators (HMRI).

2.2.4 A Description of the Current Prevailing Air Traffic Situation

In the Class G uncontrolled airspace in the vicinity of the proposed development areas, low traffic levels have been assessed, primarily because of the significant distance of the sites from the nearest point of land, approximately 30km from Lowestoft, Norfolk. This area is open to all users, and the CS is aware that various general and operational activities, including those of the MOD, general aviation (GA), and Search and Rescue operations conducted by the Maritime and Coastguard Agency (MCA), occur within the proposed area. These entities are some of the stakeholders with whom the CS has engaged with throughout the airspace change process.

2.2.5 Alignment with the CAA Airspace Modernisation Strategy

This proposal aligns with the key principles of the CAA's Airspace Modernisation Strategy (AMS) [Ref 003] as follows:

- **Safety:** Maintaining the UK's high level of aviation safety is paramount. A comprehensive safety assessment has been conducted at each step of this ACP to ensure the final design achieves this goal. The chosen mitigation strategy, RAG blanking with TMZ at 2 locations, prioritises safety by eliminating radar clutter from wind turbines while still enabling ATC to track aircraft using transponders when operating within the TMZ.
- **User Integration:** Stakeholder engagement throughout the process considered the needs of all airspace users, including existing traffic and potential future developments. The design options that were considered managed the airspace in a flexible, near real-time operation, and tried to ensure that multiple users could access the airspace for the longest time possible.

- **Efficiency:** The proposed solutions balance efficient airspace utilisation with the technical requirements of the wind farm and prioritises safety throughout the design. The design options to be considered aimed where possible to introduce the least complex airspace design to satisfy the objectives of the ACP.
- **Sustainability:** While the wind farms themselves promote environmental sustainability, the airspace solution minimises any potential increase in fuel burn or flight path deviations. However, the design options considered, provide an overall improvement in environmental impact, and ensure that the benefits of the wind farm green energy production can be realised.

2.3 High-Level Aims, Objectives, and Requirements for the ACP

2.3.1 Why an Airspace Solution is Needed:

The EA Hub Wind Farms pose a significant threat to the safe and effective operation of ATC services provided by users of the PSR at Cromer. Without appropriate mitigation of the EA Hub Wind Farms, the clutter created by the operational wind turbines will affect the safe and effective provision of a radar-based Air Traffic Service (ATS).

The wind turbines could be detected by PSR, generating false radar returns (clutter) that could:

- Distract controllers: Clutter can appear as "twinkling" objects and mask real aircraft targets, potentially leading to missed conflicts.
- Reduce radar effectiveness: Clutter can overload the radar system, causing desensitisation and loss of legitimate aircraft targets.
- Compromise separation assurance: Clutter makes it difficult for controllers to maintain safe separation distances between aircraft.

2.3.2 Requirement for Mitigation:

Without mitigation measures, the wind farm development will:

- Significantly impact the performance of an ATC radar and potentially compromise air traffic safety.
- Prevent the issuance of a development consent for the EA Hub Wind Farms project.

2.3.3 Proposed Mitigation and Potential Compromise

The proposed solution involves deploying RAG on the Cromer PSR. RAG will suppress clutter from the wind turbines on the radar display, significantly enhancing the safety of ATC operations. However, RAG also removes primary radar returns from aircraft within the blanked area.

To compensate for the loss of primary radar coverage and ensure continued and efficient ATC services, this ACP recommends establishing a two TMZ airspace solution over the wind farms. While these TMZs will ensure uninterrupted visibility of transponder-equipped aircraft, they may introduce a minor compromise for non-

transponder equipped aircraft. Non-Transponder equipped aircraft may need to route around the TMZs if they cannot establish two-way communication with ATC, or their request to transit the TMZs cannot be approved.

2.3.4 Performance Against Design Principles

The chosen mitigation strategy prioritises safety by eliminating wind turbine clutter from the radar displays, directly addressing a critical safety concern. Additionally, the proposed TMZ design offers a user-centric approach.

- **User Integration:** The TMZ designs minimise airspace restrictions for the vast majority of transponder-equipped modern aircraft. While non-transponder equipped users may require alternative routing in some cases, the overall impact on airspace users is minimised.

- **Efficiency:** The proposed solution avoids complex airspace redesign. By utilising existing technologies (RAG and TMZ), the chosen option achieves the mitigation goals efficiently.

In assessment performance of the final design airspace option against the DPs, the following points were addressed:

- **MDP3:** Option 15 partially meets this DP due to the potential increase in track mileage of non-transponding aircraft. However, as shown in the Aviation Study [Ref 004], the volume of non-transponding aircraft utilising this airspace is expected to be negligible.

- **BDP3:** Option 15 uses slightly more airspace than the other carried forward Option, Option 13. However, due to the nature of the additional airspace being unusable due to the London/Amsterdam FIR boundary, Option 15 was chosen as the final option because it creates a more sympathetic shape for controllers and pilots alike.

2.4 Assumptions and Constraints

According to the Department of Energy, wind farms are expected to generate renewable energy for approximately 30 years. Bearing this in mind, it is challenging to predict the lifespan of any radar systems currently operating in the area. This proposal assumes that any future change to this radar system, including upgrades or removal, will be effectively managed by the provider. This provider will remain cognisant of the established mitigation measures for this development to ensure continued safe operation.

As radar technology is constantly evolving, it is anticipated that advancements in areas like advanced clutter filtering or next-generation radar systems could offer a fully technical solution for wind turbine clutter in the future. If such a solution becomes available, it could potentially reduce or eliminate the need for TMZs at the EA Hub site. The specific process for reviewing and potentially removing the TMZs would be determined at that time, considering factors such as the effectiveness of the new technology and the potential impact on airspace users in that area.

2.5 Summary Description of the Current Airspace and Operation

2.5.1 Airspace Classification:

The airspace surrounding the proposed EA Hub Wind Farm development sites is predominantly located within Class G airspace. This is uncontrolled airspace where aircraft can operate without needing to contact ATC.

It is mandatory for all aircraft in the United Kingdom (UK) to operate a transponder when flying above FL100. A transponder transmits a signal identifying the aircraft and its altitude. This signal is received by a ground-based Secondary Surveillance Radar (SSR), which displays the information to ATC.

The Clacton CTA Sector 5 (Class A airspace) which will be above the proposed EA 2 Offshore Wind Farm (OSWF) site, has a base of FL 85. This will be discussed in more detail in sections 3 and 4.

2.5.2 Flight Rules and Routing:

- **Visual Flight Rules (VFR):** Most aircraft operating in this area are expected to be flying under VFR. This means they rely on visual reference for navigation and separation from other aircraft. There are no designated flight paths within Class G airspace.
- **Instrument Flight Rules (IFR):** Aircraft flying IFR in this airspace would rely on instrument-based navigation systems to determine their position, heading and level. Whilst there is no requirement to operate a radio, or gain approval to use the airspace, most users would maintain communication with ATC, to ensure that they are kept up to date with the traffic situation and location of other possible conflictions. Whilst separation from other aircraft remains the pilot's responsibility, flying IFR means that sometimes a look out may not be appropriate and therefore ATC may assist.

2.5.3 Surrounding Airspace Features:

- **Transponder Mandatory Zones:** The Norfolk TMZ which will lie to the north of EA Hub 3 is not expected to be implemented until 2028 at the earliest but has already been granted CAA approval for the subsequent implementation. To the east of the development sites is an area called the North Sea area Amsterdam, which is a combined Radio and Transponder Mandatory Zone (RMTZ).
- **Control Areas (CTA):** The Clacton CTA 5 and 6 sit above a small section of the proposed wind farm area. Both CTAs are classified as Class A Airspace.
- **Lakenheath Aerial Training Areas (ATA):** The Lakenheath ATA, is an area used by both UK and United States Airforce (USAF) fast jet aircraft, and whilst not prohibited, pilots are strongly advised to avoid these areas.
- **Low Flying Area(LFA):** The proposed development sites are all situated with LFA 5 which is an area used by military aircraft to carry out low-level flying training.
- **Air-to-Air Refuelling Area (AARA):** Parts of the proposed development areas are located within AARA 9. This is a defined part of airspace that allows

assured use of the airspace for tanking operations, which means that during tanking operations, controllers are to assure separation of other traffic.

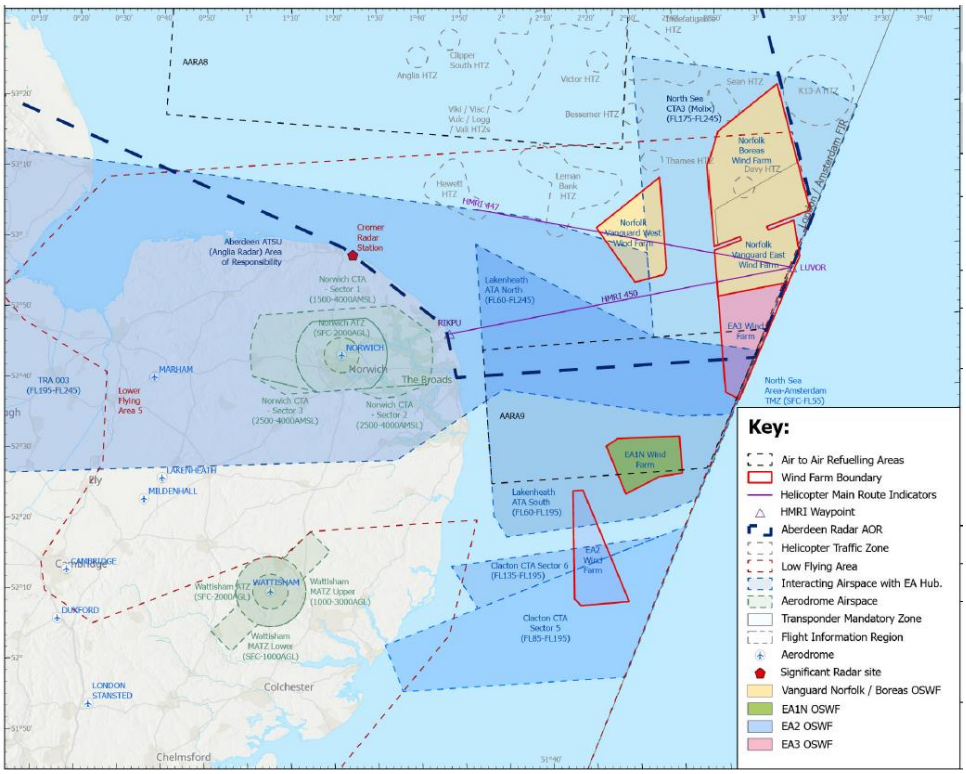


Figure 2 – Current Airspace in the Vicinity of the EA Hub Development Area

2.6 Airspace Usage:

A two-week traffic survey conducted in June 2024 revealed low-density air traffic in the vicinity of the proposed wind farm sites. The survey captured aircraft equipped with transponders, identifying only 7 General Aviation (GA) aircraft entering the proposed TMZ boundaries during the survey period. These 7 aircraft transited the proposed sites a total of 10 times, with one aircraft entering all 3 sites.

To account for potential non-transponding traffic, the study results would normally have a scaling factor applied. However, in this instance, due to the proximity of the London/Amsterdam FIR boundary, and the mandatory requirement within Amsterdam Airspace to have a transponder in order to operate, the presence of this TMZ on the other side of the FIR boundary[1][2] and the Amsterdam CTA, coupled with the fact that the study showed all traffic transiting east to west or vice versa (no aircraft were observed operating from the UK coastline to the development areas and back again), means that the Amsterdam Airspace requirement to have a transponder take priority and thus it was assessed that no non-transponding aircraft are likely to utilise this airspace in the directions that the Aviation Study identified.

[1] TMZ North Sea Area Amsterdam - Netherlands AIP ENR 6-2.6
[2] Netherlands AIP GEN 1.5 Section 4.1

Overall, the current airspace surrounding the EA Hub development site experiences low-density traffic, particularly for non-transponding GA aircraft.

2.7 Summary Description of the Changes to Airspace Design and Operation

The presence of the EA Hub Wind Farms could create radar clutter on ATC radar screens, making it difficult for ATC to see aircraft. To address this safety concern, two changes are proposed to the airspace design and operation as follows:

- **Range Azimuth Gating (RAG) Blanking:** A permanent setting will be applied to ATC radars to electronically suppress the radar clutter caused by the wind turbines. This will create a "blank" area on the radar screens where the wind farm is located.
- **Temporary Mandatory Zone:** To compensate for the loss of radar information within the RAG blanked area, new airspace zones called TMZs will be established over the proposed wind farm sites. The TMZs will be active in line with the opening hours of the Controlling Authority (CA), 78 Sqn. Swanick Military (Mil) and joint with Anglia Radar for the EA3 TMZ.

2.7.1 How different aircraft will be affected:

- **Transponder-equipped aircraft:** Most modern aircraft carry a device called a transponder which allows them to be identified by ATC. These aircraft will still be visible to ATC within the TMZs and can fly through them without needing special permission, and there is no requirement for the aircraft to communicate with ATC.
- **Non-transponder-equipped aircraft:** Aircraft with a transponder cannot be identified by ATC radar within the RAG blanked area. These aircraft will not be allowed to fly through the TMZs without obtaining permission from ATC beforehand.

2.7.2 Option 15 – Proposed 2 TMZs and RAG Blanking, FIR Aligned and with Norfolk TMZ Overlap.

The specific shapes of the TMZs will on most sides closely follow the outlines of the wind farms, like a “rubber band,” to minimise the overall airspace impact. The TMZs will also include a small buffer zone for safety.

In addition to this (as per Figure 3 below), the airspace to the south of EA1N and east of EA2 has been filled to create a more user-friendly shape for controller and pilots. As part of the design options evaluation, this void was assessed as unusable due to being surrounded by TMZs (including on the other side of the FIR boundary).

Lastly, and again illustrated in Figure 3 below, the northern edge of the TMZ above EA3 overlaps the Norfolk TMZ, which is due to be in place above the Vanguard and Boreas Wind Farms. This provides a degree of future proofing against potential issues with the Norfolk TMZ, which has already been delayed until 2028 at the earliest.

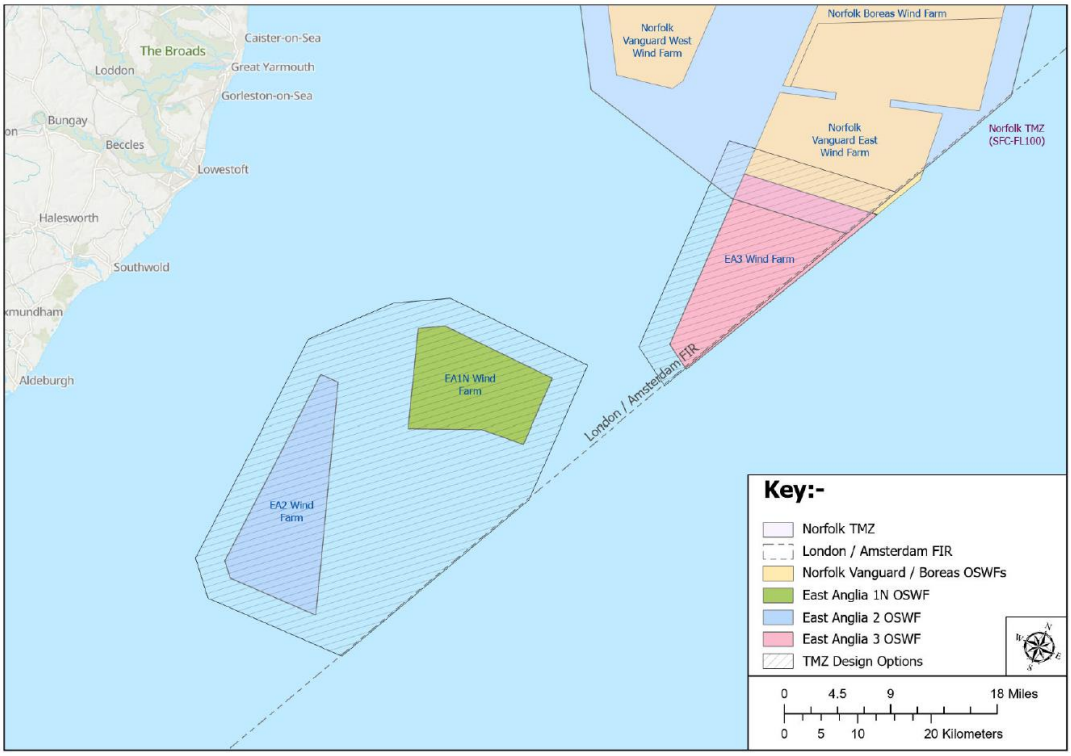


Figure 3 – Option 15 - 2 TMZs and RAG Blanking, FIR Aligned, Norfolk TMZ Overlap.

Option 15 (Figure 3 above) avoids creating complex shapes around the two TMZ designs for the EA Hub by joining EA2 and EA1N and then EA3 with the proposed Norfolk TMZ. Figure 3 illustrates how the "rubber-banded" outline simplifies the airspace design compared to following the exact wind farm footprint. This simplifies airspace management for ATC and improves situational awareness for pilots, making flight planning in the area easier.

Option 15 ensures that ATC can maintain a clear picture of air traffic, even with the wind farm present, and continue providing an air traffic service.

2.7.3 TMZ Activation Details

The TMZs will be active 24/7, with the CA being 78 Sqn, Swanwick Mil and joint with Anglia Radar for the TMZ for EA3. As Clacton CTA 5 is be located above the southern half of EA2, this southern portion of the TMZ will be limited to FL85 to avoid the Class A airspace.

2.8 Summary of Options Analysis

2.8.1 Design Principles

At the initial stage of the Design Process, the CS identified 9 design principles (DP) to guide the selection of a solution for the wind farm's impact on ATC radar. These DPs addressed safety, policy, environment and technical issues for all airspace users. Aviation and community stakeholders and members of the National Air Traffic

Management Advisory Committee (NATMAC) were engaged to review the proposed DP's and suggest if any additional DPs were necessary. The final list of DPs was subsequently approved by the CAA (shown in Tables 1, 2 and 3).

2.8.1 Design Principles (DPs)

Design Principle Area	Mandatory Design Principles
MDP 1 - Safety	The airspace change proposal must maintain a high standard of safety and should seek to enhance current levels of safety.
MDP 2 - Policy	The airspace change proposal should not be inconsistent with relevant legislation, the CAA's airspace modernization strategy or Secretary of State and CAA's policy and guidance.
MDP 3 - Environment	The airspace change proposal should deliver the Government's key environmental objectives with respect to air navigation as set out in the Government's Air Navigation Guidance 2017.

Table 1 – Mandatory Design Principles

Design Principle Area	Discretionary Design Principles (DDP)
DDP 1 – Technical 1 (Other aviation stakeholders)	The airspace change proposal should consider the impacts on Air Navigation Service Providers (ANSP) and other aviation stakeholders, such as nearby airport operators.
DDP 2 – Technical 2 (Ministry of Defence requirements)	The airspace change proposal should be compatible with the requirements of the Ministry of Defence.
DDP 3 – Technical 3 (Accessibility for all airspace users)	The airspace change proposal should satisfy the requirements of operators and owners of all classes of aircraft, including general aviation and other civilian airspace users

Table 2 - Discretionary Design Principles

Design Principle Area	Bespoke Design Principles (BDP)
BDP 1 – BDP Policy	The airspace change proposal should ensure that the design of the proposed TMZ complies with the CAA TMZ Policy[3].

[3] SARG Policy Statement 123: Policy for Radio Mandatory Zones and Transponder Mandatory Zones (13 Jan 2022). [Ref 005].

Design Principle Area	Bespoke Design Principles (BDP)
BDP 2 – Technical 3 (Airspace)	The airspace change should be designed to fit with existing background airspace classification and any known planned changes.
BDP 3 – Technical 4 (Airspace)	The volume of airspace affected should be the minimum necessary to deliver a safe solution to counter the effects of wind turbine generators on ATC surveillance infrastructure.

Table 3 - Bespoke Design Principles

2.8.2 List of Options and Design Principles Evaluation

Following successful completion of Stage 1, several design options (DO's) were identified to provide the required mitigation. The following comprehensive list of DO's were proposed for consideration:

Option 0: Baseline (Do nothing)

- The EA Hub Wind Farms are not constructed, and the benefits of the wind farms will not be realised.

Option 1: Temporary wind turbine suspension of operation

- Intermittent mitigation against radar clutter. ANSPs would tactically request the suspension of the wind farm operation subject to aircraft traffic levels and routings. This would not be very effective, and the time required to stop the wind turbine operation would not have been conducive with airspace operations.

Option 2: SSR Alone operations

- With SSR Only Operations, the PSR would be deselected to remove wind turbine induced clutter. Non-transponding[4] aircraft would therefore remain undetectable throughout the entire area of coverage of the Cromer PSR system. This would lead to an unacceptable loss of situational awareness for the controller and an inability to provide an effective radar service.

Option 3: The use of In-fill radar

- This would provide radar data from an existing or new source located in an area that does not detect the East Anglia Hub OSWF turbines. This radar would still ensure effective low-level coverage in the area of development. Whilst this idea is feasible, it is prohibitively expense,

[4] A non-transponding aircraft is also known as a non-participating aircraft in the context of the use of SSR.

would require planning permission and would need to be safety assessed to ensure that is 100% safe and accurate for use.

Option 4: Introduction of Class D or E Airspace

- This would have seen the introduction of more restrictive airspace (controlled airspace) in the area of the wind farm development. With this option, safety would be comprised due to the continued detection of radar clutter which could lead to a loss of SA for controllers. The introduction of classified airspace would increase the complexity of the current airspace and limit its use by other air users. Other air users needing to route around the area would generate increased emissions.

Option 5: Class E+ Transponder Mandatory Zone Airspace

- Like Option 4, this would have altered the airspace classification and at this time, the introduction of Class E+ airspace does not provide a provision to go down to the surface and therefore would not have been a viable mitigation for this project.

Option 6: Radio Mandatory Zone (RMZ)

- Much like a TMZ, the RMZ is an area where airspace users must use a radio to gain access to a portion of the airspace. This is more restrictive, as a radio licence is required to operate one, and there is a financial impact on users gaining the licence and having an operational radio in their aircraft. This is much more restrictive than a TMZ and does not address the underlying RAG blanking which would eliminate the clutter.

Option 7: RAG Blanking Only:

- RAG blanking involves removing received radar clutter from the ATC Radar Data Display Screen (RDDS) to avoid any confusion for a controller. However, this also means that within the area of the RAG the PSR will also not display any primary radar aircraft returns. RAG blanking effectively creates a 'black hole' in the radar coverage overhead the wind farm location.

Option 8: 3 TMZs Only

- This option provides the placement of a TMZ over the proposed EA OSWF sites perimeter without the use of RAG blanking. This would not remove the EA Hub wind turbine induced radar clutter from showing on the Cromer PSR displays. The objective of establishing a TMZ, is not to prevent aircraft from operating near the wind turbines, merely to require that they operate a transponder when entering the TMZ. The TMZ area would be the minimum required to restrict non-transponder equipped aircraft overflying the EA OSWF sites.

- A TMZ only option, without the removal of wind turbine clutter through blanking, will not provide sufficient mitigation against clutter generated by the wind turbine generators.

Option 9: 3 TMZs, RAG Blanking, No Buffers

- This option involves a TMZ over the OSWFs in addition to the use of RAG blanking to remove wind turbine induced radar clutter from the Cromer PSR ATC displays. This option does not introduce any safety buffers.
- The TMZ and RAG blanking solution reduces the amount of primary radar clutter visible to controllers. Additional procedural mitigation may be developed by the CA to allow aircraft that are not fitted with a transponder to transit through the airspace. However, the lack of a 2nm safety buffer leaves an identified safety risk without appropriate mitigation.

Option 10: 3 TMZs, RAG Blanking, Norfolk TMZ Overlap

- This option provides three distinct TMZ and RAG blanking airspace solutions. Each TMZs perimeter is extended to include a 2nm buffer within UK airspace. The EA3 TMZ overlaps the Norfolk TMZ.
- A TMZ buffer zone aims to increase safety. However, due to the proximity of EA1N and EA2, an adequate buffer zone reduces the gap between the two TMZ's to only 1.6nm, leading to an increased risk of TMZ infringement by a non-transponding aircraft. In addition, the TMZ's various shapes would be unsympathetic to controllers and pilots which would unnecessarily increase their workloads.

Option 11 – 3 TMZs, RAG Blanking, Norfolk TMZ Adjoined

- This option provides three distinct TMZ and RAG blanking solutions. Each TMZs perimeter is extended to include a 2nm buffer. The EA3 TMZ does not overlap the Norfolk TMZ.
- A TMZ buffer zone aims to increase safety, but the reduced gap between EA1N and EA2 may offset this benefit. The risk of TMZ infringement is increased compared to other options and the TMZ areas would be unsympathetic to controllers and pilots, unnecessarily increasing their workloads. The lack of a TMZ buffer on the Northern edge of EA3 means that this option is not future proofed should the Norfolk TMZ not go ahead as planned.

Option 12 – 3 TMZs, RAG Blanking, Extended Norfolk TMZ Boundary

- This option provides three distinct TMZ and RAG blanking solutions. EA1N and EA2 TMZs perimeter is extended to include a 2nm buffer. The EA3 TMZ provides an extended shape to simplify the perimeter boundary between the EA3 TMZ and the Norfolk TMZ. This option includes an overlap into the Norfolk TMZ.

- The addition of a TMZ buffer zone aims to increase safety, but the reduced gap between EA1N and EA2 may make this difficult to transit. The risk of TMZ infringement is therefore increased compared to other options and the EA1N and EA2 TMZ areas would be unsympathetic to controllers and pilots. However, the airspace included as EA3's TMZ has been increased to facilitate a more user-friendly shape.

Option 13 – 2 TMZs, RAG Blanking, Norfolk TMZ Overlap

- This option provides two distinct TMZ and RAG blanking airspace solutions, by combining the previously separate EA1N and EA2 TMZs in earlier options. Each TMZ's perimeter is extended to include a 2nm buffer within established UK airspace. This option also overlaps the Norfolk TMZ.
- The safety benefits of the buffer zones are further complimented by the closure of the funnel between EA1N and EA2. The TMZ's areas are more sympathetic to controllers and pilots than in earlier options.
- However, to the south and east of the joint EA1N and EA2 TMZ, up to and along the FIR boundary, an area of airspace has been created that would be unusable by non-transponding aircraft who would need to route around the combined TMZ.

Option 14 – 2 TMZs, RAG Blanking, Norfolk TMZ Adjoined

- This option provides two distinct TMZs and RAG blanking airspace solution, combining EA1N and EA2 TMZs. Each TMZ's perimeter includes a 2nm buffer. This option does not overlap the Norfolk TMZ.
- However, this is not extended along the northern edge of the EA3 TMZ as this option does not overlap the Norfolk TMZ. The safety benefits of the buffer zone are complimented by the closure of the funnel between EA1N and EA2. The TMZ's areas are more sympathetic to controllers and pilots.
- To the south and east of the joint EA1N and EA2 TMZ, up to and along the FIR boundary, an area of airspace has been created that would be unusable by non-transponding aircraft who would need to route around the combined TMZ
- The lack of a TMZ buffer on the Northern edge of EA3 means that this option is not future proofed should the Norfolk TMZ not go ahead as planned.

Option 15 – 2 TMZs, RAG Blanking, FIR, Norfolk TMZ Overlap

- This option provides two distinct TMZs and RAG blanking airspace solution, combining EA1N and EA2 TMZs into a single large TMZ that runs along the London/Amsterdam FIR. Each TMZ's perimeter is extended to include a 2nm buffer. This option also overlaps the Norfolk TMZ perimeter.
- The safety benefits of the buffer zone are further complimented by the closure of the funnel between EA1N and EA2. The TMZ's areas are more

sympathetic to controllers and pilots than in earlier options. This option overlaps the Norfolk TMZ.
- The 'unusable' airspace to the south and east of EA1N and EA2 has been incorporated into the TMZ creating a simpler solution for controllers and pilots alike.

Option 16 – 2 TMZs, RAG Blanking, FIR, Norfolk TMZ Adjoined

- This option provides two distinct TMZs and RAG blanking airspace solution, combining EA1N and EA2 TMZs into a single large TMZ that runs along the London/Amsterdam Flight Information Regions (FIR). EA1N and EA2 TMZ's perimeter are extended to include a 2nm buffer. However, this is not extended along the northern edge of the EA3 TMZ and this does not overlap the Norfolk TMZ perimeter.
- This option provides two distinct TMZs with a buffer zone and RAG blanking. Each TMZs perimeter is extended to include a 2nm buffer around the consented area within established UK airspace. However, this is not extended along the northern edge of the EA3 TMZ as this option does not overlap the Norfolk TMZ. The safety benefits of the buffer zone are further complimented by the closure of the funnel between EA1N and EA2. The TMZ's areas are more sympathetic to controllers and pilots than in earlier options.
- The 'unusable' airspace to the south and east of EA1N and EA2 has been incorporated into the TMZ creating a simpler solution for controllers and pilots alike. The lack of a TMZ buffer on the Northern edge of EA3 means that this option is not future proofed should the Norfolk TMZ not go ahead as planned.

Option 17 – TMZ, RAG Blanking, Norfolk TMZ Overlap

- This option provides a single TMZ and RAG blanking airspace solution around all three wind farm developments. The TMZ southeastern perimeter aligns with the London/Amsterdam FIR. This option also overlaps the Norfolk TMZ. Whilst arguably the safest and simplest option, the sheer volume of airspace used is beyond what is required and the size imposes a non-compliance with policy and other design principles and notably may have the most significant effect from an environmental perspective.

All the options above were scored against the DPs, with each receiving a score of either: Met, Partially Met or Not Met. The CS decided that any option that did not at least partially meet a DP would not be able to progress. If an option Met or Partially Met a DP, then it would be considered and progress to further engagement with Stakeholders. This approach allowed the CS to either Accept or Reject a DO based on how it performed against the DP. The simplified outcome is shown in Table 4. For a more detailed overview, The Design Principles Evaluation (DPE) document is available on the ACP Portal.

Design Options[1]	MDP1	MDP2	MDP3	DDP1	DDP2	DDP3	BDP1	BDP2	BDP3	DPE Outcome
Option 0 (*'Do Nothing Option'*)	M	M	M	M	M	M	M	M	M	Reject *
Option 1	NM	NM	P	NA	NM	P	NA	M	NM	Reject
Option 2	NM	NM	M	P	P	P	NA	M	NM	Reject
Option 3	P	M	M	P	NM	P	NA	M	M	Reject
Option 4	NM	NM	P	NM	P	P	NA	P	P	Reject
Option 5	NM	NM	P	NM	NM	NM	M	P	NM	Reject
Option 6	NM	P	P	NM	P	P	P	M	M	Reject
Option 7 (*'Do Minimum Option'*)	NM	NM	P	NM	NM	P	NM	M	M	Reject
Option 8	NM	NM	P	P	M	P	M	M	M	Reject
Option 9	NM	M	P	M	M	P	M	M	M	Reject
Option 10	NM	P	P	M	M	M	M	M	P	Reject
Option 11	NM	P	P	M	M	M	M	P	P	Reject
Option 12	NM	P	P	M	M	P	M	M	P	Reject
Option 13	M	M	P	M	M	M	M	M	M	Accept
Option 14	M	M	P	M	M	M	M	P	M	Reject
Option 15	M	M	P	M	M	M	M	M	M	Accept
Option 16	M	M	P	M	M	M	M	P	P	Reject
Option 17	M	NM	NM	M	M	NM	M	M	NM	Reject

* To be carried forward for comparison purposes only.

Table 4 – DPE Outcome Matrix Summary (M – Met, P – Partial, NM – Not Met)

Options 14 and 16 were rejected due to their vulnerability should changes relating to the Norfolk TMZ arise and not progress as planned.

As shown in Table 2 above, 17 Design Options were reviewed as part of this DPE. Options 1-6 will not be taken forward, primarily due to the lack of a TMZ and RAG blanking solution. Options 1-6 failed to meet at least one DP, with the majority failing to meet 2 of the MDPs.

Options 7-17 all included a TMZ and RAG blanking solution. Options 7-12 will not be carried forward, primarily due to failing MDP 1 (amongst other failures). As stated above, options 14 and 16 will not be carried forward due to their vulnerability relating to the potential of the Norfolk TMZ not progressing as planned.

Therefore, the viable options below (options 13 and 15) were carried forward for stakeholder engagement into the Stage 3 CONSULT/ENGAGE phase of the CAP 1616 ACP process:

- **Option 13** – This option provides two distinct TMZs and a RAG blanking airspace solution. Each TMZ's perimeter is extended to include a 2nm buffer within established UK airspace. This option includes the plan for the TMZ associated with EA3 to eventually be adjacent to the approved but not yet implemented Norfolk TMZ. As it is unknown at this juncture which TMZ will be implemented first, this option includes a TMZ buffer on its northern edge which ensures safety, should it be implanted first or the Norfolk TMZ not come to implementation.
- **Option 15** – This option provides two distinct TMZs and a RAG blanking airspace solution. Each TMZ's perimeter is extended to include a 2nm buffer within established UK airspace. The EA1N/EA2 combined TMZ is extended to

the London/Amsterdam FIR. This option includes the plan for the TMZ associated with EA3 to eventually be adjacent to the approved but not yet implemented Norfolk TMZ. As it is unknown at this juncture which TMZ will be implemented first, this option includes a TMZ buffer on its northern edge which ensures safety, should it be implanted first or the Norfolk TMZ not come to implementation.

Option 15 (2 TMZs, RAG Blanking, FIR, Norfolk TMZ Overlap) is the option being taken forward as, post DP evaluation and consultation, it is deemed as the most suitable option. The TMZ's areas are more sympathetic to controllers and pilots than in earlier options. This option is future proofed against any issues relating to the Norfolk TMZ. Also, the unusable airspace to the south and east of EA1N and EA2 has been incorporated into the TMZ creating a simpler solution for controllers and pilots alike.

Please note that although it has been rejected in the DPE, the 'Do-Nothing' option was taken forward into Stage 3 CONSULT/ENGAGE for comparative purposes only as the baseline scenario for stakeholders.

2.8.3 Appraisal Update

A Hazard Identification (HazID) meeting took place on 21st March 2024 as part of the overall Safety Assessment of the ACP, and several rounds of stakeholder engagement have also taken place. NATS decided after internal review that they would not attend the HazID meeting, stating that they would instead, 'respond to the consultation and take that opportunity to highlight any potential safety issues should any be identified'.

NATS have not highlighted to the CS any limitation on the Cromer PSR relating to the addition of 2 RAG blanking's. NATS did however state during engagement that they would prefer Option 13. Whilst this was noted by the CS, the CS is progressing with Option 15 as the preferred option, due to its simpler shaped TMZ above EA1N and EA2, which, despite utilising more airspace, is more sympathetic to controllers and pilots.

2.9 Summary of Engagement

Throughout the development of the final airspace design option, stakeholders potentially impacted by the proposed RAG Blanking and TMZs were actively engaged to gather feedback and ensure their voices were heard.

2.9.1 Stages 1 & 2 of the Airspace Change Process

Stakeholders were invited to participate in defining the nine key DPs that would guide the development of a solution (Table 1, 2 and 3); however, no changes, amendments or suggestions were made. Details of these engagement activities, including a summary of the responses received, can be found in the Design Principles Stakeholder Engagement document (A2 – Stakeholder Engagement Record [Ref 006] and Stage 3 Stage 3 Stakeholder Engagement Document [Ref 007] available on the EA Hub Wind Farm airspace change portal.

2.9.2 Stage 3: Focused Engagement on Option 13 and 15

A dedicated 6-week engagement period was held specifically to gather feedback on Options 13 and 15, the final proposed DO's. Stakeholders were informed about the proposed changes through various channels, including email, social media posts, and an online engagement document. This document provided details on the engagement process, the current airspace situation, the proposed changes with Options 13 and 15, and the potential impacts. Stakeholders were encouraged to submit their feedback through a convenient online form. The 6-week engagement period closed on 8th December 2024.

2.9.3 Feedback Received and Influence on Outcome

A total of eight responses were received during the Stage 3 engagement period. Feedback was largely indifferent or positive. However, the Ministry of Defence (MOD), through their Defence Airspace and Air Traffic Management (DAATM) section have stated that they do not support the ACP. They highlighted many concerns (available in the Engagement Summary Report [Ref 008] which were all suitably addressed by the CS. NATS stated that whilst they supported the ACP, they preferred Option 13. This preference was noted, again as part of the Engagement Summary Report, however, the CS still felt that Option 15 was the most viable option to take forward. Therefore, the CS was able to move forward with Option 15 without the need for further re-engagement.

2.9.4 Rationale for No Re-engagement

The CS believes that re-engagement is not necessary for the following reasons.

- **Broad Stakeholder Acceptance:** The lack of negative feedback during the Stage 3 engagement suggests that stakeholders are generally accepting of the proposed design (Option 15). The only objection came from the MOD, and whilst their points were all noted, they will not influence the final design option.

- **Exhaustive Exploration and Design Principles:** Stakeholders were engaged in the earlier stages (Stages 1 & 2) where design principles were established, but did not provide any feedback. As shown in the DPE document [Ref 009], Option 15 emerged as the most feasible solution, due to the 'unusable' airspace to the south and east of EA1N and EA2 being incorporated into the TMZ, creating a simpler solution for controllers and pilots alike and it meets all the established design principles, addressing safety, economic impact, environmental factors, and operational considerations for all airspace users.

- **Technically Feasible Solution:** NATS have not highlighted any issues relating to the technical feasibility of employing the proposed design option (Option 15) on the Cromer PSR.

Considering these factors, the CS is confident that Option 15 represents the best possible solution that addresses the radar clutter issue from the wind farms, whilst minimising airspace restrictions for most aircraft users.

2.10 Summary of Anticipated Impacts

The proposed airspace change is designed to address radar interference caused by the EA Hub Wind Farms, ultimately enhancing safety for all airspace users. This section outlines the anticipated impacts across various stakeholders and aspects of airspace management.

2.10.1 Impact on Airspace Users

- **General Aviation**: A transponder requirement within the TMZs may impact some GA users who lack this equipment. There will be the opportunity to request entry into the TMZ using 2-way communications with the CA. Displaced non-transponder-equipped GA traffic may affect other airspace users, but due to the low levels of traffic in and around the proposed site, this impact is expected to be minimal.

- **Military Aviation:** The MOD through DAATM expressed concerns about the introduction of the EA Hub Wind Farms. DAATM confirmed during engagement that they object to the ACP and provided a thorough explanation as to why they have taken this stance. All their concerns have been evaluated by the CS and they are confident that all the MOD concerns have been addressed and will not result in a change to the final design option.

- **Commercial Aviation:** As commercial aircraft in the UK will use a transponder and the various airways highlighted in Section 3, there is expected to be no impact on this type of airspace user.

2.10.2 Safety Impact

The primary objective of the airspace changes is to improve safety by mitigating radar interference and ensuring a clear radar picture for ATC. This will enhance situational awareness and allow for more informed decision-making by ATCOs. A comprehensive safety assessment has been developed and through a Hazard Identification meeting, all relevant points have been addressed and further mitigation introduced as required.

2.10.3 Impact on Aircraft Operators and Owners

The transponder requirement within the TMZ may necessitate upgrades for some GA users. Alternatively, these users can still request to transit the TMZs area without a transponder subject to the Controlling Authorities workload and the traffic in the TMZ. Due to the low-level traffic density in and around the area of the development, there is expected to be minimal impact on users.

2.10.4 Impact on Spaceflight Activities

There are no Spaceflight activities or ACPs notified in this area and the proposed changes are not expected to affect spaceflight activities.

2.10.5 Environmental Impact

The displaced air traffic due to the TMZs may cause slightly more greenhouse gas emissions, and fuel burn. However, this is expected to be negligible compared to the wind farm's environmental benefit of providing over 3 million homes with green electricity. There will be no noise impact to local communities due to the geographic location of the development area over the sea.

2.10.6 Impact on Air Traffic Services

78 Sqn, Swanwick Mil has agreed to be the Controlling Authority, along with Anglia Radar. Controller workload may increase due to additional communication with aircraft transiting the TMZ. However, the increase is anticipated to be manageable and may improve situational awareness for controllers. There is not expected to be any significant impact to other ATC providers who rely on the Cromer PSR for their radar data.

2.10.7 Impact on national security

The MOD has been consulted throughout the process, and despite their objection (which has been addressed), the proposed mitigation strategy is not expected to negatively impact national security.

2.10.8 Overall Conclusion

The proposed airspace change is designed to have a minimal negative impact on airspace users whilst addressing the radar clutter issue. Option 15 (2 TMZs, RAG Blanking, FIR, Norfolk TMZ Overlap) has been identified as the most favourable option. It is the option with the highest amount of support from the Stakeholder feedback, adherence to the AMS objectives, and has minimal impact on airspace users. The environmental benefits of the wind farm significantly outweigh any minor inconveniences caused by the airspace change.

2.11 Assessment of criteria for the Secretary of State for Transport's Call-in Process

While the Secretary of State for Transport's call-in process typically applies during Stage 5 of the ACP, it is still prudent to assess this Level 3 ACP against the relevant call-in criteria outlined in the Air Navigation Directions 2017. This assessment will determine if the proposal warrants escalation to the Secretary of State.

The call-in criteria focus on airspace changes with potentially significant national implications. Here is an analysis of why this proposal is unlikely to trigger the call-in process.

- **Strategic National Importance:** The proposed changes are specific to the EA Hub Wind Farms and do not hold broader strategic significance for the national airspace.
- **Economic Impact:** The ACP is not anticipated to have a substantial positive or negative impact on the UK's economic growth.
- **Noise Impact:** Crucially, the wind farm and the proposed airspace changes are located over the sea. This eliminates the possibility of a 10,000 net

increase in people subjected to noise levels exceeding the 54 dB LAeq[5] 16hr threshold, nor will there be any identified adverse impact on health or quality of life for communities on land.

Based on this assessment, the proposed airspace change is not expected to meet any of the call-in criteria set forth in the Air Navigation Directions 2017. Therefore, the Secretary of State's call-in process is unlikely to be triggered for this Level 3 ACP.

2.12 Timeline for Implementation

To ensure a smooth transition to the proposed airspace change, several key activities must be completed before implementation. For EA3, these activities are targeted for AIRAC cycle 13/2025 with an effective date of 25th December 2025. For the TMZ covering EA1N and EA2, these activities are targeted for AIRAC cycle 13/2027, with an effective date of 23rd December 2027.

2.12.1 Formal AIRAC[6] Change Submission

By the 26th September 2025, the CS will submit a formal Change Request to NATS to amend the Aeronautical Information Publication (AIP), initiating the official implementation process for the TMZ associated with EA3. This will fall in line with AIRAC 13/2025.

By the 24th September 2027, the CS will submit a formal Change Request to NATS to amend the AIP, initiating the official implementation process for the TMZ associated with EA1N and EA2. This will fall in line with AIRAC 13/2027.

2.12.2 Staff Training

Training will be provided for ATCOs at 78 Sqn, Swanwick Mil and Anglia Radar. This training will ensure they are fully prepared to operate as the TMZ CA by the implementation date. (These dates are to be confirmed based on the projected operational date for the EA Hub Wind Farms).

2.12.3 Engineering Updates

Equipment modifications will be undertaken on the Cromer PSR by NATS. These modifications will ensure the facilities can accommodate the PSR blanking and display the TMZs on radar screens. This work will be completed concurrently with

[5] A weighted, equivalent continuous sound level
[6] Aeronautical Information Regulation and Control

the training program. (These dates are to be confirmed based on the projected operational date for the EA Hub Wind Farms).

2.12.4 Letters of Agreement (if applicable)

If required, completion and sign-off on any Letters of Agreement (LOAs) with stakeholders will be finalised before implementation. (These dates are to be confirmed based on the projected operational date for the EA Hub Wind Farms).

At this time, it is not expected that any LOAs will be required.

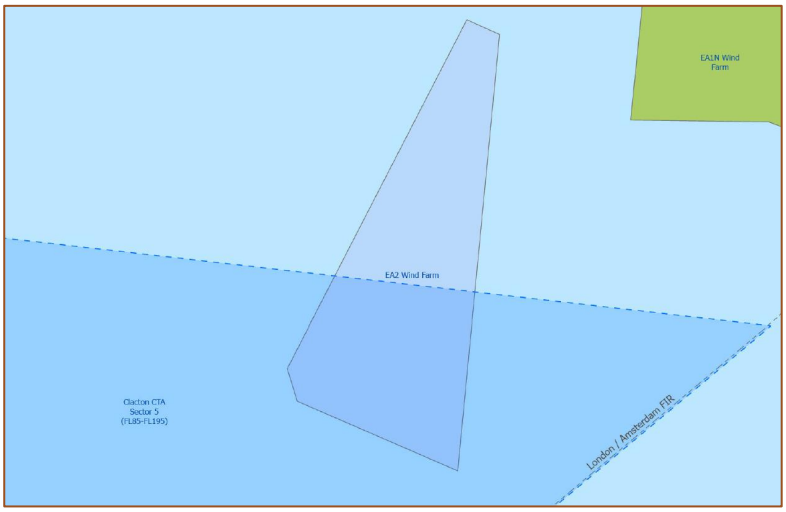
This pre-implementation plan ensures all necessary steps are completed in a timely manner, paving the way for a successful implementation on the targeted operational date. This date is currently not expected to be before 1st March 2026.

3 Detailed Description of the Current Airspace and Operations

3.1 Structure

The airspace above the proposed EA Hub Wind Farm development sites is predominantly located within Class G airspace, which extends from the ground up to FL 195. It is uncontrolled airspace, meaning that aircraft can fly through it without needing a flight plan, contacting ATC, or displaying any transponder signal for ATC detection, unless operating above FL 100[7]. The only deviation from this is the southern half of the airspace above the proposed EA2 site which is located within the Clacton CTA Sector 5 (Figure 4). The Clacton CTA Sector 5 extends from FL 85 to FL 195.

Aside from the Clacton CTA 5, there are no ATS routes within this Class G airspace, and aircraft are free to navigate unrestricted in any direction, as long as they comply with the minimum weather visibility requirements for VFR operations[8]. Aircraft flying under IFR and receiving an ATS can also fly in this airspace. In such cases where a pilot is operating under IFR, then they may request a deconfliction service[9] from ATC who will provide directional information to the pilot to ensure a minimum of 5nm lateral separation or 3,000ft vertical separation[10] between the aircraft receiving a radar derived ATS and any other aircraft in the area, unless suitable coordination[11] has been agreed, where these original lateral and vertical requirements can be reduced.



[7] UK Civil AIP – GEN 1.5 – Section 5.3
[8] UK Civil AIP - ENR 1.2 Visual Flight Rules
[9] CAP 774 - Ch4 - 4.1 (Definition)
[10] CAP 774 - Ch4 - Para 4.10
[11] Coordination is the process of obtaining agreement on clearances, transfer of control, advice, or information to be issued to aircraft, by means of information exchanged between air traffic services units or between controller positions within such units. (ICAO Doc 9426)

Figure 4 – Illustration of the Clacton CTA Sector 5 above EA2 OSWF.

3.1.1 Surrounding Airspace Features

- **Transponder Mandatory Zones:** The Norfolk TMZ which will lie to the north of EA Hub 3 is not expected to be implemented until 2028 at the earliest but has already been granted CAA approval for the subsequent implementation. To the east of the development sites is an area called the North Sea area Amsterdam, which is a combined Radio and Transponder Mandatory Zone (RMTZ) and it is active from surface (SFC) to Flight Level (FL) 55. This zones require all aircraft to operate transponders, allowing ATC to identify and track them as they transit the area[12][13].
- **Control Areas (CTA):** The Clacton CTA 5 and 6 sit above a portion of the proposed EA Hub 2 Wind Farm area, and CTA 5 is active from FL85 to FL195, and CTA 6 is active from FL135 to FL195. Both CTAs are classified as Class A Airspace.
- **Lakenheath Aerial Training Areas (ATA):** The Lakenheath ATA, is an area used by both UK and United States Airforce (USAF) fast jet aircraft, and whilst not prohibited, pilots are strongly advised to avoid these areas. The Lakenheath ATA has two areas, North and South. ATA North is active[14] from FL60 – FL245, whilst ATA South is active from FL60 to FL195.
- **Low Flying Area(LFA):** The area of the 3 proposed development sites are all situated with LFA 5 which is an area used by military aircraft to carry out low-level flying training. This area is active from SFC to 2,000 feet (FT) above ground level (AGL) or Mean Sea Level (MSL)
- **Air-to-Air Refuelling Area (AARA):** Parts of the proposed EA 1N and EA 3 development sites are located within AARA 9. This is a defined part of airspace that allows assured use of the airspace for tanking operations, which means that during tanking operations, controllers are to assure separation of other traffic. AARA 9 when activated operates from 2,000ft to FL50. This area is permanently available for use and is only used by USAF military helicopters.

Figure 5 shows the above surrounding airspace features and shows how they interact with the proposed development site locations.

[12] TMZ North Sea Area Amsterdam - Netherlands AIP ENR 6-2.6
[13] Netherlands AIP GEN 1.5 Section 4.1
[14] Peak activity Mon-Thu 0700-2300 (0600-2200) and Fri 0700-1700 (0600-1600)

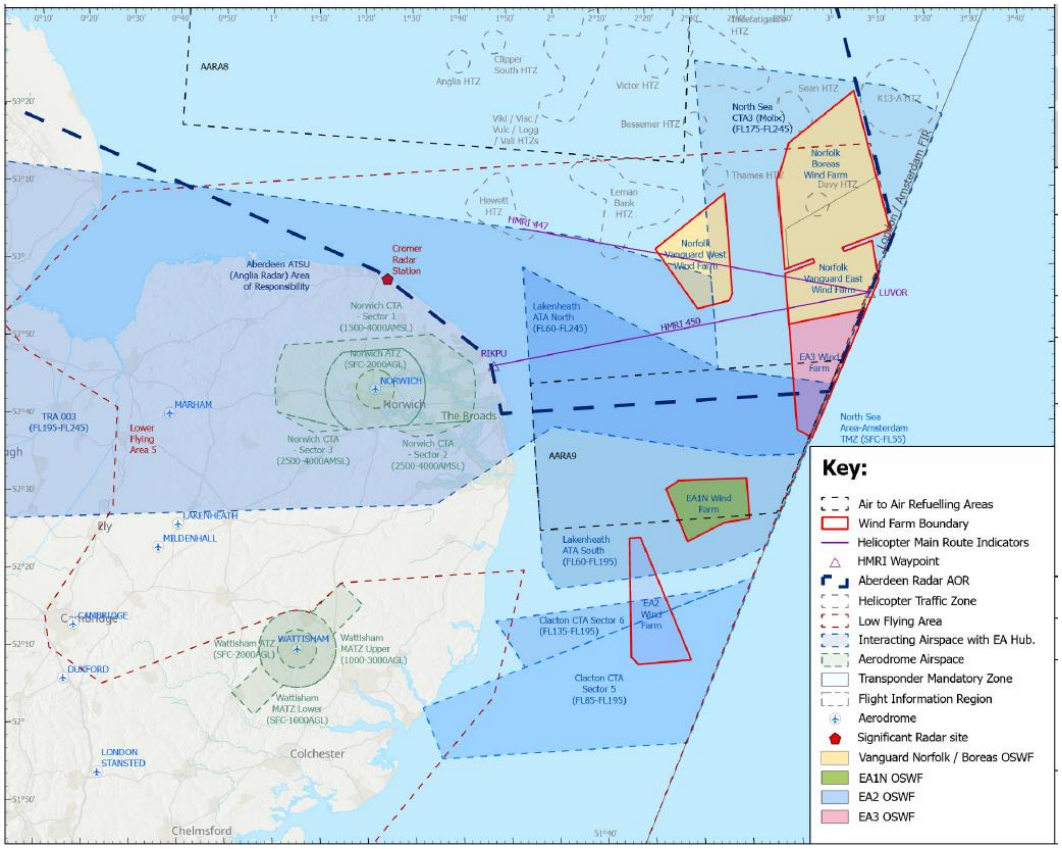


Figure 5 – Airspace in the vicinity of the EA Hub Development Area

3.1.2 Transponder Requirement

In accordance with CAA policy[15], all civilian aircraft operating above FL100 within UK airspace must carry and operate a functioning transponder. This electronic equipment transmits a signal that identifies the aircraft and its altitude, which is then picked up by a ground based SSR and displayed on ATC screens.

3.2 Airspace Usage

To ensure that the most up to date aviation data was used to analyse the potential aviation impact of the proposed TMZs, the CS conducted a traffic survey. The aim of the traffic survey was to determine the density of transiting GA traffic in the area of the proposed EA Hub TMZs and estimate the number of aircraft potentially affected by the proposed airspace solution. The CS did not identify military or commercial aircraft during this survey, as these have the use of a transponder and therefore would not be expected to be affected by any TMZ.

3.2.1 Traffic Survey Methodology

FlightRadar24 (FR24).com was chosen as the primary data source for this survey. It is considered one of the most comprehensive aircraft tracking websites available,

[15] UK Civil AIP – GEN 1.5 – Section 5.3

using various data sources including Automatic Dependent Surveillance-Broadcast (ADS-B), Multilateration (MLAT), FlightAware (FLARM), and Open GNSS (OGN). The survey covered a two-week period between 1st June 2024, and 14th June 2024 and data was collected 24 hours per day. The survey focused on GA aircraft at or below 10,000 ft altitude (max height of the proposed TMZs) within this designated airspace. As all military aircraft have the option to operate with a transponder, they were not included.

3.2.2 Survey Results

During the survey period, only 7 GA aircraft were observed. These 7 aircraft transited the proposed EA Hub TMZ boundary a total of 10 times, with 1 aircraft entering all 3 proposed development sites. This data would suggest minimal GA traffic would be affected by the proposed TMZs. The details of the findings can be found in Table 5.

Hub	Date	Time (UTC)	Registration	Type	Altitude
EA1N	1/6/24	0830	G-JMOS	PA-34	5,000
EA1N	9/6/24	1507	G-RDDM	C-182	8,500
EA2	1/6/24	0835	G-JMOS1	PA-34	5,000
EA2	2/6/24	1305	N10CD	SR-22	9,000
EA2	12/6/24	0605	G-MOFO	C-172	2,700
EA2	12/6/24	1210	P-HPWW	DA-62	10,000
EA2	12/6/24	1420	G-MOFO2	C-172	1,700
EA2	13/6/24	0912	D-EBTO	C-172	5,000
EA3	1/6/24	0850	G-JMOS4	PA-34	5,000
EA3	11/6/24	1234	N166BZ	R66	1,000

Table 5 – Details of the 2024 Aviation Survey

Table 6 displays the GA interaction per EA Hub Wind Farm and extrapolates the interactions to a 12-month period (Transponder Aircraft). Although only 7 GA aircraft were observed during the period, they interacted a total of 10 times with the proposed development area, and therefore that is the data that has been extrapolated to produce the estimated 12-month data for the purpose of this study.

Hub	2 Week Findings	Extrapolated to 12-month period
EA1N	2	52
EA2	6	156
EA3	2	52
Total	**10**	**260**

Table 6 – Extrapolated Aviation Data – 12 Months

The high-level heat map of the 7 aircraft that entered the proposed TMZ boundaries are detailed below in Figure 6. From this information it shows that all the aircraft that transited the EA Hubs crossed the FIR boundary in one direction or another. Figure 7 shows a much more detailed display of the transit data. The routes are shown in various colours but there is no specific detail associated with each colour.

Figure 6 – High-Level Overview of the Flight Data

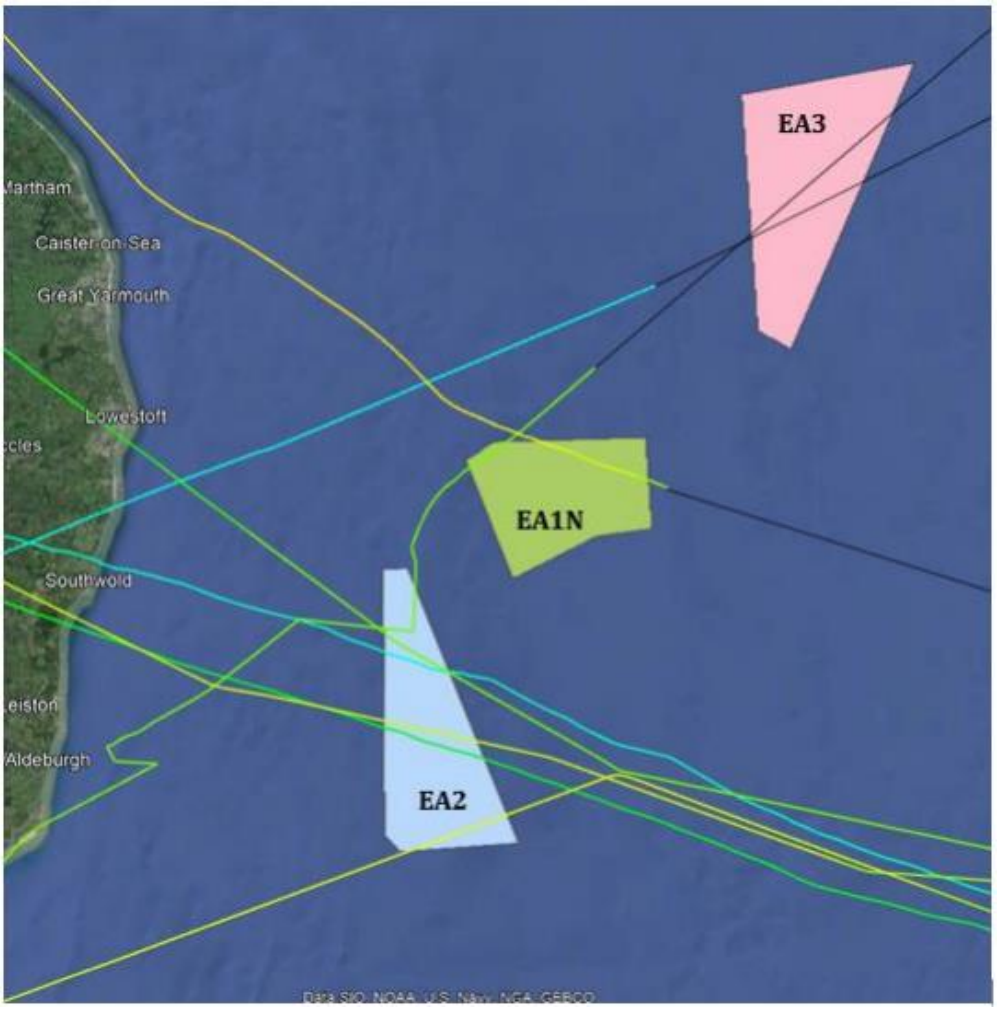


Figure 7 – Detailed View of Flight Data

3.2.3 Extrapolating Annual Traffic Figures

Extrapolating the findings from the two-week survey to a full year suggests that approximately 260 transponding GA aircraft movements might transit the area annually.

3.2.4 Accounting for Non-Transponding Traffic

To estimate the maximum potential effect of the proposed development, a scaling factor would usually be applied to the GA traffic data. This survey required aircraft to have suitable equipment onboard to be displayed on FR24; however, it is not a mandatory requirement in the UK for all aircraft to have such equipment. Therefore, GA movements in the area may have occurred that have not appeared in the survey. To compensate, the following scaling calculation has been applied.

Data from CAA CAP 2498A[16], paragraph 4.5.2 suggests that as of 2021, 46% of aircraft on the 2021 UK Register operate Mode-S Transponder. As the operation of

[16] Minimum Technical Standards for Electronic Conspicuity and Associated Surveillance

Mode-S is required to enter a TMZ in the UK, then the aviation study results would usually be scaled to include those aircraft that do not operate Mode-S.

However, when an aircraft crosses the London/Amsterdam FIR boundary from the UK, based on the flight data of the GA aircraft logged during the aviation study, it enters either the TMZ North Sea Area Amsterdam which is active from SFC to FL 55 (approximately 5,500ft amsl), or it enters the Amsterdam CTA which is active from FL55-FL195. Within both these pieces of airspace, the carriage and operation of a transponder is mandatory[17][18]. Therefore, despite there being a requirement to scale the number of non-transponding aircraft that operate close to the TMZs, the Amsterdam FIR TMZ requirement takes priority and thus no non-transponding aircraft can cross the FIR boundary in either direction.

As the aviation study demonstrates, all of the observed aircraft during the 2-week period transited east to west and vice versa, and no aircraft were observed operating from the UK coastline to the development areas and back again.

3.2.5 Conclusion

The traffic survey captured data on 7 GA aircraft over the two-week period, all of which transited the proposed EA Hub TMZ boundary while routing to/ or from the Amsterdam FIR boundary. Since the carriage of a transponder is mandatory within the Amsterdam FIR when entering a TMZ or CTA, non-transponding aircraft wouldn't be able to use this route. Therefore, applying a scaling factor to account for unobserved non-transponder aircraft wouldn't be accurate.

Additionally, the observed flight paths did not show any GA aircraft operating solely within the UK FIR. While this doesn't definitively prove the absence of non-transponding local traffic, it suggests that there would be minimal impact on such potential traffic. The CS is therefore content that the tracks observed during the study period reflect an accurate usage picture of the area and consider that the implementation of a TMZs would have minimal effect.

[17] TMZ North Sea Area Amsterdam - Netherlands AIP ENR 6-2.6
[18] Netherlands AIP GEN 1.5 Section 4.1

4 Detailed Description of the Changes to Airspace Design and Operation

4.1 Introduction

This section details the proposed changes to airspace design and operation to mitigate the potential impact of the EA Hub Wind Farms on ATC radar functionality and safety. The proposed design aligns with the key principles of the CAA's AMS while considering the existing traffic situation and user needs.

4.1.1 Addressing Radar Clutter

The presence of the wind farm poses a challenge for ATC radar systems. Wind turbines can generate clutter on radar displays, potentially obscuring aircraft returns and hindering ATC's ability to maintain situational awareness. To address this safety concern, two mitigation measures are proposed:

4.1.2 Range Azimuth Gating (RAG)

RAG will be deployed on the Cromer PSR. This technology electronically filters out clutter from the wind turbines, eliminating their misleading returns from the radar display. However, RAG also has a drawback: it suppresses primary radar returns from aircraft within the designated blanked area.

4.1.3 Transponder Mandatory Zone

To compensate for the loss of primary radar coverage caused by RAG, the establishment of a TMZ over the wind farm areas is recommended. This airspace classification mandates all aircraft operate a transponder within the zone, unless express permission to operate without one has been sought from the CA. Transponders are electronic devices that identify and broadcast an aircraft's position and altitude data to ATC.

4.1.4 Impact on Different Types of Aircraft

The proposed mitigation strategy has varying implications for different types of aircraft as follows:

4.1.5 Transponder-Equipped Aircraft

These aircraft are readily identifiable by ATC due to their transponders. They will remain visible within the TMZ and can freely transit the airspace.

4.1.6 Non-Transponder-Equipped Aircraft

These aircraft lack transponders and cannot be actively identified by ATC. They will be prohibited from entering the TMZ without obtaining prior clearance from the CA.

4.2 TMZ Design and Operation

4.2.1 Option 15 – Proposed 2 TMZs and RAG Blanking, FIR Aligned and with Norfolk TMZ Overlap.

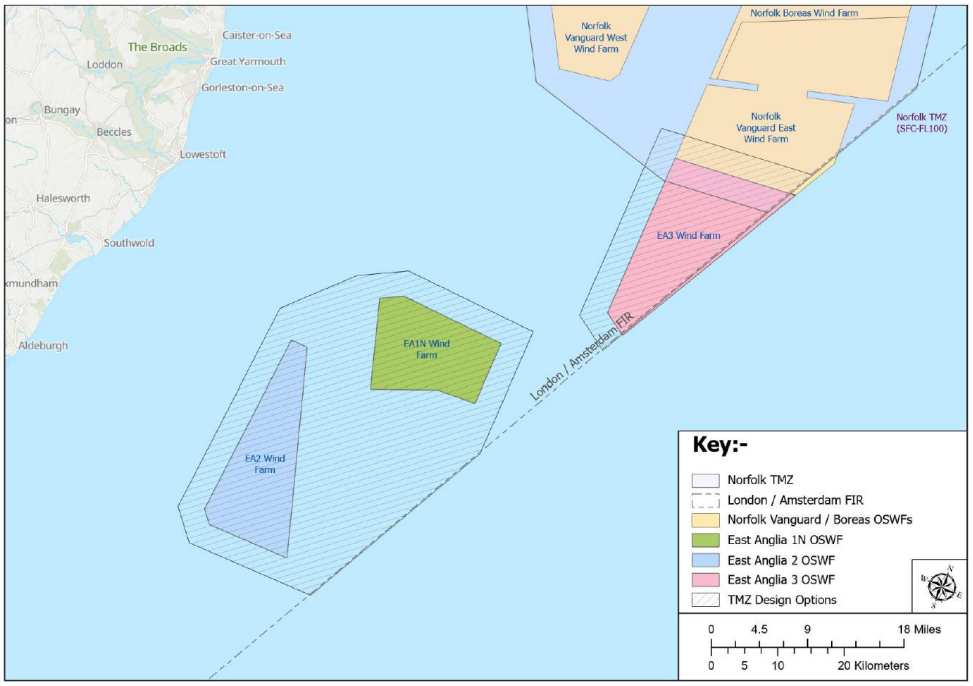


Figure 8 – Option 15 - 2 TMZs and RAG Blanking, FIR Aligned and with Norfolk TMZ Overlap.

The TMZ design (Figure 8) shows how the design has avoided creating complex shapes around the two TMZs for the EA Hub by joining EA2 and EA1N together under one TMZ and also how the EA3 hub TMZ will be adjacent with the proposed but as yet unimplemented Norfolk TMZ.

The proposed TMZs will be specifically designed to:

- **Minimise Airspace Impact:** Aside from the airspace to the south of EA1N, the TMZ's shape will closely follow the wind farm's outline, minimising the overall airspace volume affected. This "rubber band" approach reduces the impact on surrounding airspace users compared to a box-shaped zone.

- **Connection to Proposed TMZ:** The approved but not yet established TMZ to the north (the Norfolk TMZ) will be connected to the TMZ for EA3, ensuring a smooth flow of traffic and avoiding any potential "choke points" in the airspace. It is unclear at this point which TMZ will be implemented first as the Norfolk TMZ has been delayed until at least early 2028[19], but it is expected that the build date for EA3 remains on track to be March 2026. Once the remaining TMZ has been implemented in the area of the EA Hub 3 and the

[19] Norfolk Windfarm Statement

Vanguard/Boreas Development , a smooth flow of traffic across the TMZs will have been established, and any potential choke points in the airspace will have been avoided.

- **Maintain situational awareness:** The adoption of the proposed measures will enhance situational awareness for both ATC and airspace users. By eliminating wind turbine clutter and ensuring transponder usage within the TMZs, ATC can maintain a clear picture of air traffic and provide safe air traffic services.

4.2.2 Clacton CTA Sector 5

The Clacton CTA 5 is located above the southern half of EA2 as is shown in Figure 9. Here, the design for the TMZ is for the top level of the southern half of the TMZ to be limited to FL85, to match the lower limit of CTA 5 and avoid this Class A airspace.

This means that a sectored TMZ will be required for the airspace above EA2, which will be incorporated into the joint EA1N and EA2 TMZ. This change to the TMZ structure follows precedence set for the implementation of the London Array TMZ[20] which is also affected by the Clacton CTA.

Figure 9 – Illustration of the Clacton CTA Sector 5 above EA2 OSWF.

4.2.3 Hours of Operation

The RAG blanked area will be permanently active on ATC equipment and the two TMZs covering the EA Hub development site will operate 24 hours a day. Non-transponder equipped aircraft can request permission to enter the airspace on a

[20] UK Civil AIP ENR 2.2 – Section 4

case-by-case basis. Any change which requires specific opening hours will be clearly communicated in the UK Civil AIP for all airspace users.

4.2.4 Impacted Airspace

The implementation of the two TMZs will have minimal impact on the airspace above the proposed wind farm development sites. Their shapes are designed to minimise the airspace volume required to establish them. The proposed TMZ planned to be above EA3 has redundancy built into its design in the form of a northern buffer which would be essential should the approved (not implemented) Norfolk TMZ fail to be implemented. Should the Norfolk TMZ be implemented, then the TMZ associated with EA3 will be adjacent to the Norfolk TMZ, creating a sympathetic shape which will enhance pilot and controllers' situational awareness. All the TMZ designs submitted to the CAA for approval have ensured no choke points are established, and they maintain safety in the area of the wind farms.

4.3 Compliance with Regulations

The proposed airspace design adheres to the relevant International Civil Aviation Organisation (ICAO) standards and recommended practices, as well as applicable UK CAA policies. The design prioritises safety while minimising disruption to existing traffic patterns and user's needs. Data from the traffic survey conducted during Stage 2 of the ACP process (Table 5 & 6) has been used to assess the potential impact on airspace users and inform the design choices.

5 Detailed Description of Anticipated Operational Impacts

5.1 Introduction

This section explores the anticipated operational impacts of the proposed airspace changes associated with the EA Hub Wind Farm developments on various stakeholders and air traffic operations. It builds upon the summary provided earlier in the report.

5.2 Operational Impact on Airspace Users

5.2.1 General Aviation

The introduction of the TMZs will mandate transponder usage within the designated airspace. This requirement may pose a challenge for some GA aircraft that lack transponders; however, these non-transponder equipped aircraft can still request permission to enter the TMZ by establishing two-way communication with the CA. Whilst displaced non-transponder equipped GA traffic might cause minor disruptions to other users, the low traffic density in the vicinity of these proposed TMZs minimises this impact.

5.2.2 Military Aviation

The MOD objected to the ACP at the formal engagement stage on various grounds including impacts on AARA 9, ATS provision, the Lakenheath ATA and 78 Sqn coverage. Their concerns and points have all been noted by the CS and it was deemed that none of their concerns would impact the final proposed option (Option 15). In a positive note, the MOD stated that Option 15 would prevent confusion by avoiding the gap between the TMZ and the FIR boundary.

The CS has been made aware by the MOD that there is a plan in place for the Cromer radar to be replaced with an equivalent radar that promises better performance over the area of the proposed wind farm development. Whilst this wouldn't negate the MOD's objection, it would reduce the severity of the impact. The new radar isn't planned to be operational until 2027/2028, so the impact of the TMZ over EA1N and EA2 could be reduced, if the replacement plan and timescales are approved and met.

5.2.3 Commercial Aviation

As most commercial aircraft in the UK operate with transponders, particularly those who seek to cross the FIR boundary, the proposed changes are expected to have minimal impact on commercial air traffic. NATS, the air navigation service provider, supports the implementation of Option 13 to mitigate potential radar interference at their Cromer PSR. However, the CS believes that this would lead to a portion of unusable airspace being created between the EA1N/EA2 TMZ and the FIR boundary, therefore, Option 15 remains their preferred option.

5.3 Operational Efficiency, Complexity, Delays and Choke Points

There is no impact for operational efficiency, complexity, delays, and choke points in the current situation. The flight patterns detected based on the evidence collected during the 2-week Aviation Study suggests that GA activity tends to either fly east to west across the FIR boundary and vice versa or stay within close proximity to the coastline. With the introduction of the proposed airspace solution, thought has been applied to ensure there are no choke points in the design, the airspace has been designed to be as user friendly and uncomplicated as possible, and as the airspace solution largely uses the minimum airspace required to maintain safety, there are unlikely to be any delays, and operational efficiency will not be affected. The CS acknowledges that small delays may be inevitable for any non-transponding aircraft operating in the area, but this is expected to be low-level traffic density, based on the findings from the study.

5.4 Impact on Stakeholders

5.4.1 Aircraft Operators and Owners

The transponder requirement within the TMZs may necessitate upgrades for some GA aircraft operators. However, non-transponder aircraft can still request access to the TMZs and the outcome will be subject to the CA's workload and prevailing traffic conditions within the appropriate TMZ. Due to the low traffic density, minimal impact on users is anticipated.

5.4.2 Other Airspace Users

While there may be minor disruptions for other airspace users due to the potential rerouting of non-transponder-equipped GA traffic, the overall impact is expected to be minimal.

5.5 Impact on Air Traffic Services

Swanwick Mil (78 Sqn): Alongside Anglia Radar (EA3 only), this entity has agreed to be the CA for the TMZs. The MOD has said that the proposed developments could cause an increase in workload due to an increase in complexity. However, due to the simplicity of the TMZ shapes, and the forecast lack of non-transponding traffic in the area, the CS deems this to be manageable by the ATC provider and may even improve situational awareness for controllers.

National Air Traffic Services: The impact on ATC providers which rely on the Cromer PSR for radar data is expected to be minimal, with NATS at an early part of analysis confirming that a TMZ/RAG solution would be their preferred mitigation solution.

5.6 Impact on National Security

The MOD has been actively involved throughout the engagement process. The proposed mitigation strategy, including the establishment of a TMZs, is not

anticipated to have any impact on national security, and the MOD stated that the impacts of these wind farm developments to Air Defence are planned to be mitigated through an alternative programme for technical radar mitigation which sits outside of this ACP submission.

5.7 Overall Conclusion

The proposed airspace changes are expected to have minimal negative impacts on airspace users, outweighed by the significant environmental benefits associated with the wind farm development. Option 15 – 2 TMZs, RAG Blanking, alignment with the FIR boundary and Norfolk TMZ Overlap, has been identified as the most favourable design option due to its focus on minimising disruption, sympathetic shapes for pilots and controllers, alignment with the majority of stakeholder feedback, and adherence to the objectives of the CAA's AMS.

6 Supporting Infrastructure and Resilience

6.1 Introduction

This section examines the anticipated impacts of the proposed airspace change on supporting infrastructure and resilience. It analyses these impacts against relevant regulations, policies, and guidance documents.

6.2 Communication Equipment and Services

The introduction of the TMZs will not require changes to existing communication equipment and services. Transponding aircraft operating within the TMZs will not be required to communicate with the CA unless they wish to, however, non-transponding aircraft requiring access will need to establish contact with the CA on designated radio frequencies, published in the AIRAC update and contained with the UK Civil AIP.

6.3 Navigations Equipment and Services

The proposed changes have no impact on conventional navigation equipment and services. Existing procedures and infrastructure for these systems remain fully operational. The airspace design is also compatible with existing satellite-based navigation (SBN) procedures and specifications. RNAV (Area Navigation) capabilities are not expected to be affected.

6.4 Surveillance Equipment and Services

6.4.1 Primary Radar

The primary objective of the airspace design is to address the radar clutter issue caused by the wind farms. The proposed deployment of RAG on the Cromer PSR eliminates wind turbine clutter from radar displays. However, this also suppresses primary radar returns from aircraft within the blanked area. To ensure that this does not have a detrimental impact on safety, the introduction of TMZs over the blanked areas will mitigate the impact of the blanking.

6.4.2 Secondary Surveillance Radar and Electronic Conspicuity

SSR is not impacted by any radar blanking and will remain fully operational within the TMZs, ensuring continued aircraft identification and tracking. The mandatory transponder requirement within the TMZ mitigates the limitations of primary radar coverage in this area. All transponder compliant aircraft will be identifiable by ATC due to their transponders acting as electronic conspicuity devices, transmitting aircraft identification and position data.

6.4.3 Contingency Procedures

In the unlikely event of both primary and secondary radar failure, operational units affected will implement their already established loss of surveillance equipment contingency procedures. If their rules allow, they may wish to operate by providing a procedural service, and where required, information on the outage will be promulgated as a Notice to Aviation (NOTAM) to keep airspace users fully informed.

6.4.4 Communications and Infrastructure Availability

The existing communication infrastructure, including R/T (Radio Telephony) Designated Operational Coverage (DOC), has sufficient capacity to handle the anticipated traffic volume within the TMZs.

6.4.5 System Failure and Contingency Planning

The potential effects of equipment, procedural, or personnel failures on airspace management have been considered. Contingency plans are already in place at the affected units to address these scenarios and maintain safe and efficient air traffic operations. Specific examples of these contingency measures may include:

- Utilising alternative navigation aids, communication channels, or surveillance methods in case of specific system failures.
- Implementing procedural separation measures (if approved) to maintain safety when necessary.
- Maintaining appropriate staffing levels at ATC facilities to ensure adequate service provision.
- Regularly reviewing and updating contingency plans to reflect evolving technologies and procedures.

6.4.6 Staffing Requirements (Controlling Authority)

The proposed airspace change is not expected to necessitate any increase in ATC staffing levels at 78 Sqn or Anglia Radar, despite concerns highlighted by DAATM on behalf of the MOD. The existing ATC teams are qualified and experienced in managing the airspace in this area. However, potential adjustments to workload distribution and training may be considered based on post-implementation monitoring and analysis.

7 Regulations, Policies and Harmonisation

7.1 Introduction

This section analyses the proposed EA Hub Wind Farms airspace change proposal against relevant regulations, policies, and guidance material. It also addresses potential requests for dispensations and demonstrates compliance with key principles.

7.2 Regulations and Policies

7.2.1 SARG[21] Policy 123 (13 Jan 2022) - Policy for Radio Mandatory Zones and Transponder Mandatory Zones (TMZs)

The proposed airspace change adheres to this policy by establishing TMZs around the wind farms, requiring all aircraft within their boundaries to be equipped with functioning transponders. This ensures continued safe operation of ATC despite potential wind turbine clutter on radar displays.

7.2.2 SARG Policy (12 Feb 24) Policy for the Establishment and Operation of Special Use Airspace [Ref 010]

This policy will be followed in establishing the EA Hub Wind Farms TMZs as a special use airspace. The proposal ensures compatibility with existing special use airspace and will not create an undue burden on other airspace users.

7.3 Interaction with Existing Airspace Structures

The proposed TMZs will be designed to integrate seamlessly with existing domestic and international en-route structures, Terminal Manoeuvring Areas (TMAs), and CTAs. Here's how connectivity will be achieved:

En-route structures: The TMZs will be established at a sufficient altitude to avoid any impact on existing en-route minimum flight levels.

TMAs and CTAs: The TMZ boundaries have been carefully designed to ensure no impact on existing TMAs and CTAs.

7.4 Airspace Buffer Requirements

The CAA policy statement on the establishment and operation of special use airspace was considered during the detailed design phase of the TMZs. 2nm buffer zones will be established around the TMZs (except where that buffer would overlap the FIR boundary[22]) to ensure adequate separation between the proposed wind farms and

[21] Safety and Airspace Regulation Group

[22] The buffer to the north of EA Hub 3 will remain in place until the Norfolk TMZ is established and then the two TMZs respective boundaries will match

non-transponding aircraft who may operate too close to the TMZs and disappear if no buffers were implemented.

7.5 Letters of Agreement

LOAs will be prepared (if required) with relevant stakeholders, including the MOD and neighbouring ANSPs, to ensure coordinated implementation and management of the Airspace Change. Should they be required, these LOAs will address potential airspace user concerns and establish clear communication protocols.

7.6 Access to Airspace

The proposed airspace change is committed to providing equitable access to all airspace users. The TMZs will not be implemented through "management by exclusion." Access to Airspace will be achieved via the following.

Stakeholder Engagement: Extensive engagements were held with airspace users, including GA operators, to understand their needs and concerns. The final design took into account any feedback received in order to minimise disruption to existing flight patterns.

Published Procedures: Clear and concise procedures for entering, transiting, and exiting the TMZs will be published in relevant aeronautical publications. This will ensure all airspace users have access to the information necessary for safe and efficient operations.

Monitoring and Review: The impact of the airspace change on traffic patterns will be continuously monitored. Adjustments to the design of the TMZs or operating procedures may be implemented if necessary to maintain equitable access.

By following these principles, the EA Hub Wind Farm ACP aims to strike a balance between safety, efficiency, and equitable access for all airspace users.

8 Safety

8.1 Safety Case

This section outlines the safety considerations for the proposed RAG blanking and TMZ solutions around the proposed EA Hub Wind Farms. The Safety Case demonstrates how the proposed airspace change maintains a high standard of safety and integrates effectively with existing operations. The safety assessment is aligned with CAA guidance, including CAP 760: Guidance on the Conduct of Hazard Identification, Risk Assessment, and the Production of Safety Cases [Ref 011].

8.2 Introduction

The EA Hub Wind Farms will introduce potential hazards to ATC operations due to wind turbine clutter on radar displays. To mitigate these risks and ensure continued safe operation of ATC, two TMZs will be established around the proposed wind farm development. This section details the anticipated impacts of the RAG blanking and TMZs, associated safety assessments, and proposed mitigation strategies.

8.3 Anticipated Impacts

The primary objective of the airspace change is to address radar clutter caused by the proposed wind farms, which could hinder ATC's ability to maintain situational awareness and potentially compromise safety. The proposed RAG and TMZs with a transponder requirement for entry ensures clear identification of aircraft within the designated zones, enhancing overall airspace safety for all users.

The primary impact of the EA Hub Wind Farms is the degradation of ATC radar performance due to wind turbine clutter. This can lead to:

- **Reduced Situational Awareness:** ATC may have difficulty tracking aircraft in the vicinity of the wind farms.
- **Inaccurate Radar Data:** Clutter can introduce errors in position and altitude information displayed to ATC.
- **Increased Workload for ATC Controllers:** Controllers may need to rely on alternative methods (e.g., voice communication) to maintain separation between aircraft.

8.4 Safety Assessment Work

A comprehensive safety assessment has been conducted, addressing potential hazards associated with the RAG and TMZs, and incorporating additional mitigation measures, as necessary. The assessment is aligned with CAP 760 and includes the following.

Hazard Identification: A structured HazID process was conducted in March 2024 to identify all potential hazards associated with the introduction of the RAG and TMZ

solution. This process involved participation from relevant stakeholders, including ATC personnel, engineers, and air traffic safety experts. The methodology employed brainstorming sessions and a workshop to comprehensively explore potential failure scenarios.

8.4.1 Proposed Mitigations

The following mitigation strategies will be implemented to address the safety concerns associated with the proposed RAG and TMZ solutions.

- **Radar Blanking:** PSR displays will be electronically blanked for all users of the NATS Cromer Radar feed, including, NATS, Aberdeen Airport, Norwich Airport, Maastricht Upper Air Control (UAC) and the MOD in the area of the wind farms. RAG technology will be employed to minimise clutter in the proposed development sites, whilst still preserving real aircraft data on ATC screens in other areas.
- **TMZ Implementation:** The TMZs will require all aircraft within their boundaries to be equipped with functioning transponders. This ensures that ATC can track and identify aircraft.
- **Communication Protocols:** Clear communication protocols will be established between ATC and aircraft operating within the TMZs.
- **Training and Procedures:** ATC personnel at affected locations will undergo comprehensive training on the operation of the TMZs and the potential impact on radar displays. Updated procedures will be developed to address potential safety concerns arising from the TMZs, ensuring controllers can maintain the safe separation of air traffic.
- **Safety Management System (SMS) Integration:** The operation of the TMZs implementation will be via NATS and will apply to all NATS radar users. This application of the TMZs by NATS will be subject to the NATS SMS for such airspace changes. Non-NATS radar users will be required to implement their own TMZ display modification which satisfies their own SMS procedures. This ensures continuous monitoring, risk assessment, and improvement of safety procedures related to the TMZ.

8.5 Conclusion

The proposed EA Hub Wind Farms RAG and TMZ solutions, along with the mitigation strategies outlined above, will effectively address the safety concerns associated with wind turbine clutter on ATC radar. The Safety Case demonstrates a commitment to maintaining a high standard of safety while facilitating the integration of this renewable energy infrastructure.

9 Environmental Assessment

9.1 Noise

The proposed development sites are situated between 30 and 88km off the east Anglian Coast and as such there will be no noise impact to local communities due to the geographic location of the development areas over the sea. The CS believes that there is no change at all in noise levels or its distribution such that people will be affected on the ground. To that end, the CS is content that there will be no changes from the current baseline without the airspace solution when compared to the Year 1 and Year 10 baselines with the airspace solution in place. As there will be no change, the current baseline without the airspace change has not been assessed.

9.2 Greenhouse Gas Emissions (GHG)

If approved for delivery, the EA Hub Wind Farms will provide green electricity for over 3 million homes in the UK. This is a wider benefit enabled by, but not directly attributable to, this proposal. This wind farm will contribute directly to the UK Governments aim of decarbonising all sectors of the UK economy to meet our net zero target by 2050.

There is not expected to be any change to fuel burn for commercial airlines as flight plannable routes will remain unchanged and commercial aircraft will be unaffected by this proposal as they are all transponder equipped.

GA users which are not equipped with a transponder or radio would be required to route around the TMZs. However, as shown in the Aviation Study, non-transponder equipped aircraft are highly unlikely to transit this area due to the London/Amsterdam FIR boundary, which requires the use of a transponder in order to enter the Amsterdam Airspace, due to the presence of both the TMZ North Sea Area Amsterdam (active from SFC to FL 55) and the Amsterdam CTA (active from FL55-FL195) on the eastern side of the FIR boundary. Further to this, all observed transponding traffic routed east to west and vice versa, with no aircraft routing solely within the UK FIR. While this doesn't definitively prove the absence of non-transponding local traffic, it confirms that it is highly unlikely that any non-transponding aircraft will operate in this area and thus the potential for an increase in GHG due to the implementation of these TMZ's is very low.

9.2.1 Future Baseline Scenario Without the Airspace Change Proposal

As detailed in the DPE Document[23], the baseline scenario without the ACP is referred to as the 'do nothing' scenario. Due to the nature of the development areas, the EA Hub Wind Farms will not be constructed without suitable mitigation. Therefore, without this ACP, the status quo would remain, and thus Class G airspace will remain, allowing aircraft to operate anywhere whether it operates a transponder or not. Aircraft will be free to transit the development area in any direction and height they

[23] EA Hub DPE Document Link

require with no restrictions imposed. Therefore the 'do nothing' scenario will have no impact on future GHG emissions.

9.2.2 Design Option 15 with the Airspace Change proposal

In this scenario, the CS addresses the situation in which Option 15 has been implemented within the development area. This means that in line with the rules governing a TMZ, an aircraft that is not operating a transponder cannot enter the TMZs, unless the CA has granted permission. This scenario assumes that the CA for EA Hub TMZs (EA 3) are provided by both Anglia Radar and Swanwick Military (78 Sqn), and the CA for the EA1N and EA 2 Hub TMZ provided be Swanwick Military (78 Sqn)

From the perspective of a non-transponding aircraft, in the highly unlikely event that a non-transponding aircraft planned to transit the EA Hub TMZ's, the aircraft would be expected to either plan to avoid the TMZs during the flight planning stages or would be required to avoid the TMZs during their transit by taking a re-route. As a CA will be established, then a non-transponding aircraft could request to transit either of the TMZs, and this would be at the discretion of the controller and dependent on controller workload and other traffic in either of the TMZs at the time.

The CS acknowledges that whilst any increase in track mileage due to the re-route would translate into an increase in GHG emissions, this scenario is highly unlikely due to the previously discussed requirement for a transponder to cross the FIR boundary.

9.2.3 Greenhouse Gas Emission Rationale

The CS, as mentioned previously, accepts that any increase in track mileage for a non-transponder aircraft having to avoid the TMZs may result in increased fuel usage and therefore a minimal increase in GHG. However, following on from the findings in the Aviation Study which has been submitted to the CAA, it can be seen from data obtained in 2024 that the predicted number of non-transponding aircraft that operate in the area of the proposed TMZs is negligible, with previously mentioned information from the Aviation Study supporting the view that there would likely be no non-transponding aircraft.

9.2.4 Findings

Data from the Aviation study, which took place over 2-weeks in June 2024, observed 7 GA aircraft transiting the proposed EA Hub TMZ areas. As can be seen from the conclusion of this document, (Section 2.6) it is expected that the number of non-transponder aircraft would be negligible and wouldn't be adversely affected by the application of the proposed airspace solution.

9.2.5 GHG Calculations

Due to the proximity of the London/Amsterdam FIR boundary, and both the TMZ North Sea Area Amsterdam (active from SFC to FL 55) and the Amsterdam CTA (active from FL55-FL195), the CS believes that the likelihood of non-transponding GA traffic utilising the proposed TMZs is minimal due to the requirement for mandatory

carriage and operation of a transponder[24][25]. Thus, the CS believes that there is no requirement for GHG calculations to be applied to this ACP. Any small GHG increase would be dwarfed by the potential benefit of the wind farm developments.

9.2.6 Conclusion

It is the opinion of the CS that with the low number of GA transponding aircraft (seven aircraft every 14 days), and the equally (predicted) low number of non-transponding aircraft (few to nil), that it would not be feasible to make any meaningful, accurate quantitative calculation as to the increase in greenhouse gas emissions. This assessment is made due to the requirement to have a transponder to transit the London/Amsterdam FIR boundary, and enter either the TMZ North Sea Area Amsterdam (active from SFC to FL 55) or the Amsterdam CTA (active from FL55-FL195) [26][27] which is located on the Amsterdam side of the FIR boundary, and is backed up by the results of the Aviation Study which shows all transponding traffic routing east to west and vice versa, with the addition of no observed traffic remaining solely within the London FIR.

The EA Hub Wind Farms are expected to provide green electricity for over 3 million homes in the UK. This would dwarf the possible increase in any aviation related CO_2 emissions. The CS has no data to suggest that traffic levels in the Class G airspace around the proposed development areas will increase over the next 10 years and is also content that it is highly unlikely that there will be any change to the main influencing factor of the FIR boundary in that time.

9.3 Local Air Quality

The impact on Local Air Quality is defined as impacts below 1,000ft, and due to the location of the proposed development site, as with the impact on noise on local communities, there will be no impact to people on the ground in terms of local air quality. To that end, the CS is content that there will be no changes from the current baseline without the airspace solution when compared to the Year 1 and Year 10 baselines with the airspace solution in place.

9.4 Tranquillity

The proposed development site is situated in the southern North Sea, between 30 and 88km off the coast of East Anglia, and as such there will be no impact to any communities on the ground. The CS believes there is no change at all in tranquillity levels for people on the ground, and to that end, the CS is content that there will be no changes from the current baseline without the airspace solution when compared to the Year 1 and Year 10 baselines with the airspace solution in place.

[24] TMZ North Sea Area Amsterdam - Netherlands AIP ENR 6-2.6
[25] Netherlands AIP GEN 1.5 Section 4.1
[26] TMZ North Sea Area Amsterdam - Netherlands AIP ENR 6-2.6
[27] Netherlands AIP GEN 1.5 Section 4.1

9.5 Biodiversity

The CS has completed an Environmental Impact Assessment (EIA) outside of this ACP which comprehensively evaluates the proposed wind farm development's impact on the offshore and onshore environment and is a separate process.

9.5.1 Regulatory Consents

Construction of the wind farm will require separate consents under the Electricity Act 1989 and the Marine and Coastal Access Act 2009. These consents will address the transmission infrastructure and the proposed export cable. These consents need to be assessed and granted before development of the wind farm site can proceed.

9.5.2 Habitats Regulations Assessment (HRA):

In parallel with this ACP, a HRA was conducted to ensure the airspace changes comply with relevant regulations. The HRA focused on the potential effects on European Sites from altered air traffic patterns or increased low-level movements (below 3,000ft) as outlined in CAP 1616i (Ref 012). The HRA specifically addressed the following question:

Q1. Are there any changes to air traffic patterns or number of movements expected below 3,000ft due to the airspace change proposal?

CAP 1616i specifically states that 'If the CS is able to answer no to Q1 or Q2, or yes to Q3 then the HRA is no longer required'.

9.5.3 HRA Findings:

The establishment of the TMZs and wind farms will not increase or reduce traffic movement numbers in the area, and therefore the CS believes that the number of movements will remain similar to the numbers operating in the area today.

9.5.4 Military and Civil Air Traffic Patterns, and Number of Movements

The HRA concluded that the proposed wind farm developments will have no significant impact on either military or GA traffic patterns. This finding is based on the fact that due to the location of the wind farm site, there are no military or civil air traffic patterns within the vicinity of the development sites that are affected by the development of this site.

9.5.5 Civil Airports

The development area is also outside the engagement zone for civil airport Instrument Flight Procedures (IFPs).

9.5.6 General Aviation Air Traffic Patterns, and Number of Movements

Studies conducted in the area show minimal GA activity (260 transponding GA movements per year). It is anticipated that non-transponder equipped aircraft operations in the vicinity of the TMZs would be so low in number, due to the need to have transponder to cross the London/Amsterdam FIR boundary and enter the Amsterdam Airspace, that they are deemed negligible, causing minimal impact on air traffic control workload.

9.5.7 Conclusion

The HRA examined the impact of three proposed wind farm developments (EA1N, EA2, EA3) and has answered NO to Q1 (above 9.5.2). Based on the HRA's findings, which align with CAP 1616i's guidelines, there is no requirement for a detailed HRA, confirming the fact that there will be no impact on European sites. Also, there are no expected changes to movement patterns or any increase in movement numbers below 3000ft.

This conclusion is based on the following:

- The wind farms are all located in Class G airspace (including the reduced height southern sector of the TMZ covering EA2).
- Military aircraft operating in the area use transponders and will not be affected by the TMZs.
- A two-week traffic survey identified minimal GA interaction with the proposed airspace.
- Both the TMZ North Sea Area and the Amsterdam CTA are on the Amsterdam side of the FIR boundary where a transponder is mandatory, therefore, it can be judged that the two-week traffic survey is accurate regarding non-transponding traffic. Therefore, there will be no change to existing movements.
- The wind farms are located away from main transit routes and close to the UK FIR boundary, further reducing potential impact on air traffic.

For each wind farm (EA1N, EA2, EA3), the CS has answered "no" to question 1 of the Early Screening Criteria set out in CAP 1616h. As a result, the CS has decided that no further HRA is required for any of the developments. A copy of the detailed EA Hub HRA [Ref 013] can be found on the ACP Portal.

10 Summary

The EA Hub Wind Farms project represents a significant investment in renewable energy generation, directly contributing to the UK's Net Zero ambitions. This proposal outlines the necessary airspace changes to ensure safe and efficient co-existence of the wind farms with existing aviation activities.

A comprehensive environmental impact assessment has been conducted, addressing noise, greenhouse gas emissions, local air quality, and any potential effects on tranquillity. The proposed TMZs adhere to relevant regulations and policies, including SARG policies for TMZs and Special Use Airspace. The CS is committed to maintaining equitable access to airspace for all users through its use of pre-implementation engagement, transparency surrounding published procedures, and continuous monitoring after implementation.

The final design option ensures no interaction with existing en-route networks, TMAs, and CTAs. If required, draft LOAs will be prepared with relevant stakeholders to further solidify coordinated implementation and management.

In Summary:

- The EA Hub Wind Farm airspace change proposal enables safe and efficient wind farm operations while minimising disruption to existing aviation activities.
- A comprehensive environmental impact assessment has been conducted, addressing noise, greenhouse gas emissions, local air quality, and potential effects on tranquillity.
- The proposed TMZs adhere to relevant regulations and policies, prioritising safety, and equitable access for all airspace users.
- The design ensures seamless integration with existing airspace structures and incorporates measures to mitigate potential impacts.
- The CS is committed to ongoing collaboration with stakeholders through continued engagement and, if required, draft LOAs.

The EA Hub Wind Farm airspace change proposal offers a balanced approach, prioritising safety, efficiency, and environmental responsibility. The CS is confident that this proposal aligns with the CAA's objectives and look forward to a positive consideration.

11 References

Ref	Title	Origin
001	CAP 1616 – Airspace Change Process (5th Edition – Jan 2024)	CAA
002	DAP 1916 (Version 1 – Nov 23)	Osprey
003	CAP 1711 - Airspace Modernisation Strategy (2nd Edition – Republished Feb 24)	CAA
004	EA Hub Aviation Study Data(V1 – Jun 24)	Osprey
005	SARG Policy 123: Policy for Radio Mandatory Zones and Transponder Mandatory Zones (13th Jan 22)	CAA
006	Design Principles: Stakeholder Engagement (V1 – 15th May 24)	Osprey
007	Stage 3 Stakeholder Engagement Document (V1 – 22nd Oct 24)	Osprey
008	Engagement Summary Report (V1 – 18th March 25)	Osprey
009	Design Principles Evaluation (V1 8th July 2024)	Osprey
010	SARG Policy for the Establishment and Operation Special Use Airspace (12 February 2024)	CAA
011	CAP 760 - Guidance on the Conduct of Hazard Identification, Risk Assessment, and the Production of Safety Cases (1st Edition – 10 Dec 10)	CAA
012	CAP 1616i Environmental Assessment Requirements and Guidance for Airspace Change Proposals (1st Edition – Nov 23)	CAA
013	Habitat Regulations Assessment (HRA) (V1 – 28th June 2024)	Osprey

12 Acronyms

Acronym	Definition
ACP	Airspace Change Proposal
ADS-B	Automatic Dependent Surveillance - Broadcast
AIP	Aeronautical Information Publication
AMS	Airspace Modernisation Strategy
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATS	Air Traffic Service
CA	Controlling Authority
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CTA	Control Areas
DP	Design Principle
DPE	Design Principal Evaluation
EIA	Environmental Impact Assessment
FT	Feet
FL	Flight Level
GA	General Aviation
GHG	Green House Gas
GW	Gigawatt
HAZID	Hazard Identification
HRA	Habitats Regulations Assessment
ICAO	International Civil Aviation Organisation
IFP	Instrument Flight Procedures
IFR	Instrument Flight Rules
LOA	Letters of Agreement
MCA	Maritime and Coastguard Agency
NATS	National Air Traffic Services
NOTAM	Notice to Aviation

Acronym	Definition
PSR	Primary Surveillance Radar
R/T	Radio Telephony
RAG	Range Azimuth Gating
RMZ	Radio Mandatory Zone
RNAV	Area Navigation
SBN	Satellite Based Navigation
SFC	Surface
SMS	Safety Management System
SON	Statement of Need
SSR	Secondary Surveillance System
TMA	Terminal Manoeuvring Area
TMZ	Transponder Mandatory Zone
UK	United Kingdom
VFR	Visual Flight Rules
WTG	Wind Turbine Generator

13 Glossary

Term	Meaning
Airspace Change Proposal	An ACP is a formal request submitted to the CAA to modify a designated airspace area. It outlines the proposed changes, justification, and potential impact on stakeholders. The CAA then assesses the ACP, considering safety, efficiency, and community feedback before making a decision.
Air Defence	In terms of radar, is all about using radar technology to detect, track, and identify potential threats in the airspace.
Area Navigation	A method of aircraft navigation that permits pilots to fly any desired course within the coverage of ground-based or space-based navigation aids or using the capabilities of self-contained onboard systems.
Automatic Dependent Surveillance - Broadcast	Technology in aviation that improves air traffic control and situational awareness.
Aeronautical Information Publication	A crucial document published by a country's civil aviation authority that provides essential information for safe and efficient air navigation within that country's airspace.
Airspace Modernisation Strategy	A long-term plan developed by aviation authorities to improve the efficiency, safety, and environmental impact of air traffic management within a specific airspace.
Air Navigation Service Provider	A public or private legal entity responsible for managing air traffic on behalf of a company, region, or country.
Air Traffic Control (Officer)	A service provided by ground-based air traffic controllers who ensure the safe, orderly, and efficient flow of air traffic in controlled airspace. The “Officer” is a highly trained professional responsible for the safe, orderly, and efficient flow of air traffic in controlled airspace.
Civil Aviation Authority	The public corporation responsible for overseeing and regulating all aspects of civil aviation in the United Kingdom.
Civil Aviation Publication	A document published by a national civil aviation authority that outlines regulations, procedures, and guidance for various aspects of civil aviation.
Control Areas	A designated piece of airspace extending upwards from a specified limit above the earth's surface.
Design Principle (Evaluation)	A guiding principle used to assess and develop modifications to controlled airspace. The evaluation is a crucial step in the ACP overseen by the CAA.

Term	Meaning
Environmental Impact Assessment	A process used to identify, predict, evaluate, and mitigate the potential environmental impacts of a proposed project, plan, or program.
Flight Level	The level of an aircraft using the International Standard Atmosphere of 1013.25 hector Pascals (hPa) or 29.92 inches of mercury (inHg) at sea level. (E.g., 5,000ft ≈ FL50)
Green House Gas	These gases act like a blanket around our planet, trapping some of the sun's heat and preventing it from escaping back into space.
Gigawatt	A unit of power equal to one billion watts.
Hazard Identification	A proactive safety analysis technique used during the initial stages of an aviation project.
Habitats Regulations Assessment	An assessment used to evaluate the potential impact of proposed airspace changes on protected habitats and species within the UK.
International Civil Aviation Organisation	A specialised agency of the United Nations (UN) responsible for coordinating and regulating international air travel.
Instrument Flight Procedures	A critical set of instructions pilots rely on to safely navigate an aircraft when they cannot rely solely on visual cues.
Instrument Flight Rules	Regulations that govern aircraft operation when relying solely on instruments for navigation, rather than visual cues outside the cockpit.
Letters of Agreement	A formal documents outlining collaborative arrangements between different entities.
Maritime and Coastguard Agency	An executive agency of the United Kingdom that is responsible for implementing British and international maritime law and safety policy.
Notice to Aviation	A critical message issued by aviation authorities to inform pilots and other aviation personnel about important information concerning flight operations.
Primary Surveillance Radar	A fundamental tool used in air traffic control (ATC) for detecting and tracking aircraft.
Radio Telephony	The use of two-way radio communication between aircraft and air traffic control (ATC), as well as between aircraft themselves.

Term	Meaning
Range Azimuth Gating	A technique used to improve target detection and reduce clutter, particularly at short ranges.
Radio Mandatory Zone	Designated airspace where aircraft are required to carry and operate functional radio equipment.
Satellite Based Navigation	A method of pinpointing your location anywhere on Earth (or near it) by using signals transmitted from orbiting satellites.
Safety Management System	A structured, organisation-wide approach to managing safety risks.
Statement of Need	A document outlining the rationale and justification for proposed changes to airspace regulations or procedures within the UK.
Secondary Surveillance System	A radar system that works in conjunction with transponders onboard aircraft to provide air traffic control (ATC) with essential information about the aircraft's position and identification.
Terminal Control Area	A designated airspace surrounding a major airport with high traffic volume.
Transponder Mandatory Zone	A designated airspace where all aircraft operating within the zone are required to carry and operate functional transponders.
Visual Flight Rules	Regulations governing the flight of aircraft in visual meteorological conditions (VMC).
Wind Turbine Generator	A machine that uses wind energy to generate electricity.