

Norfolk Vanguard and Norfolk Boreas Wind Farms

Vanguard and Boreas Wind Farms

Gateway Documentation:

Stage 4

Airspace Change Proposal Submission



Authorship

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2. Executive Summary

- 2.1 The Wind Turbine Generators (WTGs) in the Vattenfall development have the potential to be detected by the Cromer Primary Surveillance Radar (PSR). This could cause unacceptable interference through the desensitization of the PSR and the creation of 'false' radar returns (known as radar 'clutter'). This could affect an Air Traffic Control Officer's (ATCOs) ability to identify primary radar aircraft returns and could increase the risk of an ATCO not detecting a conflict between aircraft. Large numbers of WTGs could also lead to saturation of the radar processing systems.
- 2.2 To mitigate against this risk, Vattenfall is proposing to deploy Range Azimuth Gating (RAG) onto a portion of the Cromer PSR to remove all primary radar returns from the WTGs from the wind farms. However, RAG will also remove primary radar returns from any aircraft within the blanked area. Owing to the removal of primary radar coverage, it will be necessary to establish a Transponder Mandatory Zone (TMZ) over the wind farms so that only aircraft equipped with a transponder, and hence visible to Air Traffic Control (ATC) via Secondary Surveillance Radar (SSR), or those with prior clearance from the controlling authority, will be permitted to overfly the wind farms (RAG blanked area) without first obtaining a clearance from ATC.
- 2.3 To facilitate the change summarised above, Vattenfall developed a set of 14 relevant design principles, used to evaluate design options; and further analysed and developed the leading option.
- 2.4 Vattenfall created a consultation strategy to identify, engage and target specific stakeholders; launched and completed a focused consultation; and finally, assessed and analysed the thirteen consultation responses – please see the table of references on Page 20 for links to the relevant documents.
- 2.5 As covered in the Stage 3 Collate and Review Responses document (Incorporating Stage 4A Update Design) (Ref 11), there were no response elements identified as having the potential to impact the proposed design.

3. Introduction

- 3.1 Vattenfall Wind Power Ltd. (Vattenfall) is developing two offshore wind farms in the North Sea. In total, the proposed wind farms will cover an area of approximately 1300 kilometres (km)². The proposed sites are located 47 km (25.4 Nautical Miles (NM)) off the Norfolk coast and will contain up to WTGs in each development.
- 3.2 Both Norfolk Boreas and Norfolk Vanguard are expected to have a power output of 1.8 Giga Watts (GW) each. This power output defines both projects individually as Nationally Significant Infrastructure Projects (NSIPs) under the planning act 2008.¹
- 3.3 Operational WTGs can interfere with air traffic control radars. Detection on the radar would have the potential to cause false radar returns to be displayed to an ATCO. This radar “clutter” could obscure primary returns from actual aircraft and could also interfere with radar tracking. This could affect an ATCO’s ability to identify primary radar aircraft returns and could increase the risk of the ATCO not detecting a conflict between aircraft. Large numbers of WTGs could also lead to saturation of the radar processing systems.
- 3.4 RAG, more commonly known as Radar Blanking, is the proposed solution to be deployed over the area of the wind farm before it is constructed, to prevent primary radar detection of the WTGs. However, radar blanking will also remove primary radar returns of aircraft within the blanked area. As such, a TMZ is required to be established in the same area so that aircraft will remain detectable to ATC using SSR.
- 3.5 This Airspace Change Proposal (ACP) only impacts flights over the high seas (23.4 NM offshore, owing to the TMZ buffer zone surrounding the proposed wind farm locations). Hence, in accordance with the Levels as defined in Civil Aviation Publication (CAP)1616, the Civil Aviation Authority (CAA) has categorised this proposal as a Level 2B change. In line with the requirements for a Level 2B change, the environmental impact assessment has been conducted on the basis of CO₂ emissions only. There would be no perceptible change to noise impacts to stakeholders on the ground; hence no noise analysis has been undertaken; equally, there will be no discernible change in impact on tranquillity or biodiversity.
- 3.6 Previous documents (Refs 4 - 7) have reduced the number of design concepts being considered to just one. This option can be summarised as follows:

RAG Blanking with a simplified polygon TMZ “rubber banded”² around the proposed wind farm locations extended to include a 2 NM buffer (Option D)

This TMZ with the associated RAG blanking has been assessed as the optimum solution to mitigate the impact of WTGs on the Cromer Primary Surveillance Radar (PSR) system as follows:

- RAG blanking which will suppress all primary radar clutter associated with the WTGs.
- Promulgation of a TMZ over the RAG blanked area will ensure that aircraft within the TMZ area are either transponder equipped and hence will remain detectable to ATC via SSR or have obtained clearance from the controlling authority prior to entering the TMZ.
- The dimensions of the TMZ include a 2 NM buffer which is adequate to ensure that ATC have sufficient time to identify when an infringement of the TMZ is taking place and take appropriate action.
- The proposed Option D (TMZ coupled with radar RAG blanking) provides effective and safe mitigation against the radar issues associated with WTGs.

¹ According to the [planning Act 2008](#), an Offshore wind farm is defined as a NSIP if its power output is greater than 100 Mega Watts (MW)

² Rubber banded- Shortest perimeter fully enclosing the wind farm developments. It is used to smooth an irregular perimeter.

- 3.7 Vattenfall completed a consultation on the changes presented here; involving the targeted set of stakeholders who would be affected by this change. The stakeholders had been fully engaged on the proposed changes prior to consultation. The consultation was open for an agreed 10-weeks and allowed Vattenfall to gather views and information on the proposed change. Stakeholders were requested to leave feedback via the online portal, which included a summary of the changes and the Consultation Document (Ref 10).
- 3.8 The respondents categorised their level of support for the proposed changes as either SUPPORT or NO COMMENT. No respondents categorised their level of support for the proposed changes as AMBIVILANT or OBJECT. No responses were received that suggested a change was required to the design (Ref 11). As such, the proposed design submitted here is the same as the design detailed in the consultation document (Ref 10).
- 3.9 If the proposal is approved by the CAA, the proposed design would be implemented not before AIRAC 13/2021.

4. Current Airspace Description

4.1 Structures and Routes

The wind farms are proposed to cover a combined area of approximately 1300 km². The proposed airspace change would include this entire area, with an additional 2 NM buffer zone surrounding the developments.

The proposed wind farms are located within UK and Dutch Class G airspace in the North Sea. At their closest point the wind farms will be 47 km from the Norfolk coastline. UK Air Traffic Service (ATS) routes L17, L6, L602 and L603 transit the wind farms location as do Helicopter Main Routes³ (HMRs) 445, 446, 447 and 450. See Figure 1 below:

³ Helicopter Main Routes (HMRs) are being renamed Helicopter Main Route Indicators (HMRI) AIRAC 04/2021 as detailed in ACP-2020-091.

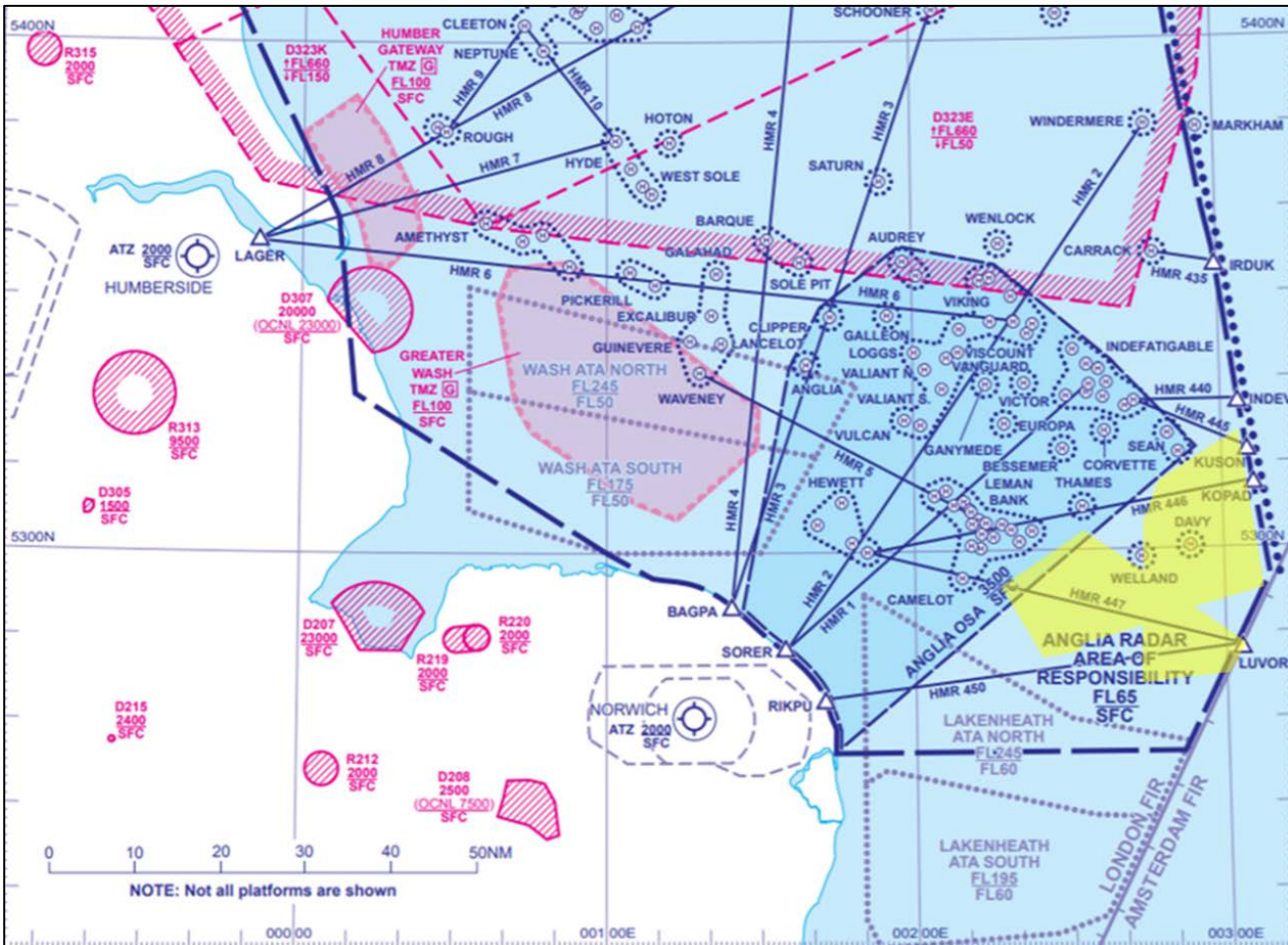


Figure 1: Current airspace within the North Sea (UK AIP ENR 6.25), Norfolk Vanguard and Norfolk Boreas developments are shown in yellow.

4.2 Operational Efficiency, Complexity, Delays and Choke Points

There are no proposed changes to air traffic patterns so there will be no impact for operational efficiency, complexity, delays and choke points.

4.3 Safety Issues

There are no current safety issues within the relevant areas of airspace. If the wind farms were constructed and no mitigation against radar clutter/interference were implemented, this could have the following impacts from the WTGs:

- Could cause clutter on radar displays (up to 180 WTGs in each wind farm).
- Clutter could make ATC tracking and identification of non-transponder equipped aircraft in the cluttered area impossible.
- Clutter could make ATC tracking and identification of transponder equipped aircraft in the cluttered area difficult due to obscuring.
- WTGs could create interference and saturation of radar processing due to excessive radar returns can degrade radar performance across the whole operating area of the radar.

Due to the above impacts a suspensive Condition⁴ will require that appropriate mitigation is put in place. Hence the 'do nothing' is not a viable option.

4.4 Environmental Issues

There are no specific environmental issues within the relevant areas of airspace, in the current operation. However, as planning approval is likely to be subject to a specific aviation Planning Consent Condition due to the impact of this development on the Cromer PSR, it would not be possible to build the wind farms in the current airspace without appropriate radar mitigation in place. This would prohibit the significant CO₂ benefits of ~ 6 million tonnes (MT) per annum from the production of clean electricity which the wind farms will enable.

5. Statement of Need

The following text is from the DAP1916 Statement of Need form, as submitted in August 2018:

The current/existing situation:

Vattenfall is proposing substantial wind farm developments in an eastern portion of the UK FIR off of the coast of East Anglia and partly in UK airspace delegated to the Dutch ANSP, LVNL. At lower levels Helicopters operate in the area of the proposed windfarms under the control of Anglian Radar (Aberdeen airport, NATS) and LVNL, whilst at higher levels, multiple airways cross the airspace concerned.

The issue:

As part of the planning process Vattenfall has engaged with stakeholders to assess the likely impacts of these developments. One such stakeholder is NATS who have highlighted the potential effects of Wind Turbine Generators (WTGs) on their ability to provide Air Traffic Services. As such NATS has lodged an objection to the planned windfarm development until such time as a suitable mitigation is established.

Action:

Vattenfall has employed NATS Services Ltd (NSL) to investigate potential impacts of the WTGs on NATS and other stakeholder operations. Preliminary investigation by NSL suggests that the Airspace Change Process (CAP1616) should be initiated in order to manage the development of airspace based mitigation options.

This project is classed as critical National infrastructure by the Department for Energy and Climate Change. As such, Vattenfall believes that the airspace change process should be initiated now so that the mitigation requirements and options can be investigated and understood prior to the project funding decision gate of Q2 2019.

⁴ A draft Planning Consent Condition will state that No erection of any wind turbine generator forming part of the authorised development may commence until the Secretary of State having consulted with NATS has confirmed satisfaction in writing that appropriate mitigation will be implemented and maintained for the lifetime of the authorised development and that arrangements have been put in place with NATS to ensure that the approved mitigation is implemented and in operation prior to erection of the wind turbine generators.

6. Proposed Airspace Description

6.1 Justification/Objectives for Proposed Design

The justification for this proposed airspace change is to enable the construction of the wind farms. Construction of the wind farms is expected to enable CO₂ benefits of approximately 6 MT per annum. This CO₂ benefit will only be realised if the airspace change is implemented and the wind farms are built and operate.

The objectives of this proposal are to:

- Ensure continued aviation safety in the region of the developments with no increased risk to an ATCOs ability to detect aircraft conflicts; and
- Meet any planning consent conditions for these wind farm developments to enable their construction and realise significant environmental benefits by the generation of renewable energy.

6.2 Proposed New Airspace and Usage

The proposed Primary Radar Mitigation Scheme (PRMS) for the Vattenfall developments is radar blanking of the wind farm array locations with a complimentary **Simplified polygon TMZ “rubber banded”² around the proposed wind farm locations extended to include a 2 NM buffer (Option D)**, Figure 2 illustrates the lateral extent of the proposed TMZ. The vertical extent of the TMZ will be from the surface to Flight Level (FL)100. Above FL100, all aircraft must operate a transponder (UK AIP ENR 1.6, para 2.2.2.1).



Figure 2: Proposed Vattenfall TMZ (Red Outline). Norfolk Vanguard and Boreas Developments (RAG blanked area) are shown in yellow.

The proposed wind farms will be located within UK and Dutch airspace in the North Sea. At their closest the wind farms will be 47 km (25.4 NM) from the Norfolk coastline. UK Air Traffic Service (ATS) routes L17 (Base FL175), L60 (Base FL175), L602 (Base FL175) and L603 (Base FL175) transit the wind farms location but will not be affected by this change as the vertical extent of the TMZ will reach at and below FL100. HMRs 445, 446, 447 and 450 all transit the proposed wind farm locations. This area, as shown in Figure 2 as the yellow polygon, will be RAG blanked.

The proposed shape of the TMZ is shown as a red outline in Figure 2. The shape of the TMZ was produced by “rubber banding” the proposed wind farm development sites to form a simplified polygon. A 2 NM buffer,

between the TMZ perimeter and the blanked region has been added, which is intended to give ATC some warning (and hence time to react) should an infringement occur:

- Non-transponding infringing aircraft travelling at 200 knots (kt) will take c.36 seconds from crossing the proposed TMZ perpendicular to the boundary, until it enters the blanked region (and disappears). An ATCO monitoring the radar would have that time to notice the potential for the aircraft to infringe the TMZ and take appropriate action.

The TMZ boundary shape is advantageous for the simplicity of display to pilots on in-cockpit electronic flight information system (EFIS), interpretation on aeronautical charts and documents and to ATC operators on radar displays. A simple shape is preferable for Human Factors reasons. This reasoning was used in previous wind farm TMZ mitigations to design the outer TMZ boundary and has been effective.

6.3 Changes between Consultation and Final Proposal

There are no changes to the final proposal as a result of consultation response, as described in the Stage 3 Step 3D Update Design document (Incorporating Stage 4A Update Design) (Ref 11).

The coordinates of the proposed TMZ boundary and draft AIP changes for the proposed TMZ area are provided in Annex 15.3 and 15.4.

7. Impacts and Consultation

Vattenfall completed engagement activities with stakeholders identified as those being most likely to be affected by the proposed design. These targeted stakeholders are listed in Annex 15.2. This engagement was primarily conducted via email exchanges and by telephone where needed. The Consultation Strategy Document (Ref 8) details all the engagement activities completed prior to the consultation formally commencing.

Vattenfall commenced a focused consultation on these proposed airspace changes on Monday 23rd November 2020. The consultation was conducted via an online portal where users could submit a formal response alongside viewing the Consultation Document (Ref 10). The consultation document provides information on how the consultation was administered; an overview into the current airspace; the proposed changes and impacts of the proposed changes.

The consultation was open for the agreed ten weeks; closing on Sunday 31st January 2021. A total of thirteen responses were received during this period. A full summary of how the consultation was run and assessment of responses can be found in the Stage 3 Collate and Review Responses Report (Incorporating Stage 4A Update Design) (Ref 11).

7.1 Net Impacts Summary

Category	Impact	Evidence
Safety/Complexity	No impact on complexity. There would be significant safety issues should no mitigation be in place and the wind farms are constructed.	See Sections 4.2 and 4.3
Capacity/Delay	No impact on capacity or delay.	See Section 4.2
Fuel Efficiency/CO ₂	No impact for commercial airlines. Negligible impact for GA users.	See Section 7.8 - 7.9
Noise – Leq/SEL	No impact	See Section 7.12
Tranquillity, visual intrusion (Areas of Outstanding Natural Beauty (AONB) & National Parks)	No impact	See Section 7.12
Local Air Quality	No impact	See Section 7.12
Other Airspace Users	This proposal would require all aircraft entering the TMZ area without ATC Clearance to be transponder equipped. In line with the Safety and Regulatory Group (SARG) policy on TMZs, “a pilot wishing to operate in a TMZ without serviceable transponder equipment may be granted access subject to specific arrangements agreed with the TMZ Controlling Authority.” ⁵ All affected users and stakeholders have been engaged and consulted with.	See Sections 7.2 - 7.6

7.2 Units Affected by the Proposal

This section determines the likely impact on operations based on consultation responses and operational analysis.

There will be no impact on any aircraft operations at levels above FL100 as above FL100 transponder carriage is mandatory and for this reason the TMZ ceases at FL100.

ATC services are provided in this region by Anglia Radar, Swanwick military, London Flight Information Service (FIS) and Amsterdam ATC. The Controlling Authority for the Vattenfall TMZ within UK airspace will be Anglia Radar, Swanwick Military. Amsterdam ATC have confirmed they will act as the controlling authority in the portion of the TMZ which is within airspace delegated to them. Airspace within the Dutch FIR bordering the London FIR is already designated as a TMZ and will not be affected by this change.

During Stage 1 of this process, fourteen Design Principles (DPs) were agreed with the CAA. These can be found in the Stage 1 Design Principles document (Ref 4). DP3 stated that the ‘Airspace change will maintain or enhance operational resilience of the ATC network’.

Vattenfall has engaged with the Ministry of Defence (MOD) through the Defence Airspace Air Traffic Management (DAATM) and the following ATC units and Airports throughout this airspace change process:

- Aberdeen ATC (Anglia Radar).
- NATS En-route (NERL).

⁵ SARG Policy for Radio Mandatory Zones and Transponder Mandatory Zones. August 2015.

- Luchtverkeersleiding Nederland (LVNL).
- Maastricht Upper Area Control (UAC).
- Humberside Airport.
- Norwich Airport.

A response was received to the consultation from the MOD through DAATM stating that they were content with the proposed PRMS.

Responses were received from NATS NERL and NATS Aberdeen ATC (Anglia Radar) and Norwich Airport supporting the proposed changes, and they were satisfied this would meet the required mitigation for the Cromer PSR, thus maintaining operational resilience and safety.

A response was received from the Guild of Air Traffic Control Officers (GATCO) supporting the proposed changes.

All consultation feedback is summarised in the Stage 3D Collate and Review Responses (Incorporating Stage 4A Update Design) document (Ref 11). No update was required to the design of the PRMS following consultation.

7.3 Access by Non-transponder Equipped Aircraft

This proposal would require all aircraft entering the area of the TMZ without ATC Clearance to be transponder equipped. In line with the SARG policy on TMZs, “a pilot wishing to operate in a TMZ without serviceable transponder equipment may be granted access subject to specific arrangements agreed with the TMZ Controlling Authority.” Should a non-transponder aircraft, that is less than 1% of traffic in this area (Ref 9), be unable to obtain the required clearance, they will be required to reroute to avoid the TMZ area.

7.4 Military Impact and Consultation

DP12 stated that the ‘Airspace change should be compatible with the requirements of the MOD’.

It is considered that there will be no adverse impact on military and public transport flights (including offshore helicopter operations) as these categories of aircraft are transponder equipped.

In the event of transponder failure pilots will be required to request clearance from the controlling authority of the TMZ to transit the TMZ or if no clearance obtained to reroute around the TMZ as per paragraph 7.3.

The MOD was consulted as a stakeholder via DAATM throughout the entire airspace change process.

The MOD responded to the consultation that they were content with the PRMS as described within the consultation document (Ref 10).

All consultation feedback is summarised in the Stage 3D Collate and Review Responses (Incorporating Stage 4A Update Design) document (Ref 11). No update was required to the design following consultation.

7.5 General Aviation (GA) Airspace Users Impact and Consultation

DP2 states that the airspace change should ‘Minimise negative impact on other airspace users, specifically GA and helicopters in support of UK Oil, Gas and Renewables industries.’

It is considered that there will be no adverse impact on general aviation as the majority of GA aircraft operating over the sea will be transponder equipped. GA users who fly without a transponder could be affected. This is assessed to be less than 1% of traffic in this area (Ref 9), who will be required to request clearance to transit the TMZ from the controlling authority to transit the TMZ or to reroute around the TMZ as per paragraph 7.3.

NATMAC members representing the GA community and local helicopter operators were engaged with throughout this airspace change process.

Responses were received from the following relevant NATMAC members;

- The British Gliding Association (BGA, NO COMMENT),

- The Airfield Operators Group (AOG, NO COMMENT),
- The Association of Remotely Piloted Aircraft Systems UK (ARPAS UK, SUPPORT),
- The British Microlight Aircraft Association (BMAA, No COMMENT), and
- The British Balloon and Airship Club (BBAC, SUPPORT).

Responses indicating the stakeholders level of support for the proposal as NO COMMENT have been taken as stakeholders have no objection to the proposed change.

Two local helicopter operators responded. NHV indicated their level of support as NO COMMENT as '*TMZs have little effect on commercial offshore traffic*' and Bristow SAR indicated they supported the change.

The Maritime and Coastguard Agency (MCA) responded that they support the change.

7.6 Commercial Air Transport Impact and Consultation

Vattenfall has engaged and consulted directly with airline operators who were identified as being relevant carriers within the associated area of airspace; this was completed through the NATMAC as listed in Annex A of the Stage 3 Consultation Strategy document (Ref 8). Commercial Air Transport Aircraft are transponder equipped and will remain unaffected by this airspace change.

No consultation responses were received from airlines.

7.7 CO₂ Environmental Analysis Impact and Consultation

The introduction of the Norfolk Vanguard and Norfolk Boreas wind farms is anticipated to provide CO₂ benefits of approximately 6 MT per annum, which is a wider benefit enabled by, but not directly attributable to, this proposal.

There is no expected change to fuel burn for commercial airlines as flight plannable routes will remain unchanged and airline aircraft are all transponder equipped. GA users may theoretically incur increased fuel burn if they are not equipped with a transponder and are required to route around the TMZ. However, the likely volume of non-transponder equipped aircraft which may pass through this area and any potential increase in fuel burn as a result would be negligible. (Ref 9).

7.8 Design Differences Since Consultation

There are no changes made to the design as a result of the consultation, or since consultation was completed.

7.9 Local Environmental Impacts and Consultation

As the proposal is offshore (25.4 NM from the Norfolk coast) and a Level 2B change, there are no local environmental impacts such as noise, visual intrusion, tranquillity or local air quality. Vattenfall did not target organisations whose primary interest is environmental impacts.

7.10 Economic Impacts

The development of this airspace change proposal has not been informed by any economic constraints or opportunities. All costs relating to implementation and adaptation are being met by the sponsor. Should the airspace change be implemented, and the wind farms built, the enabled 6 million tonnes of CO₂ benefit per annum would be significant (Ref 7).

8. Analysis of Options

8.1 Airspace Change Design Options

Vattenfall initially identified one solution for mitigating the radar clutter associated with WTGs (Ref 5) (radar blanking with TMZ), with four options as to how it could be implemented, and a 'do nothing' option. The four options considered were:

- Option A: RAG blanking and TMZ over the proposed wind farm locations.
- Option B: RAG blanking and TMZ over the proposed wind farm locations. TMZ extended to include a 2 NM buffer.
- Option C: RAG blanking over the proposed wind farm locations. Simplified polygon TMZ “rubber banded” around proposed wind farm locations with no buffer.
- Option D: RAG blanking over the proposed wind farm locations. Simplified polygon TMZ “rubber banded” around proposed wind farm locations extended to include a 2 NM buffer.

8.2 Design Options Assessment

The options were evaluated against the design principles (Ref 4 and 6). Only option D fully met all the DPs owing to the simpler TMZ perimeter in this design. The design options were appraised (Ref 7) against the CAP 1616 criteria. All options had the same impacts on communities and stakeholders. Options A and C were assessed as having a reduction in ATC Resilience owing to the absence of the 2 NM buffer. Option D was preferred to Option B owing to the simpler TMZ shape. To do nothing would prevent the construction of the wind farms and therefore the realisation of substantial CO₂ benefits.

Vattenfall specified a preferred solution, termed **Option D-RAG blanking over the proposed wind farm locations. Simplified polygon TMZ “rubber banded” around proposed wind farm locations extended to include a 2 NM buffer.** A full options appraisal was completed for this solution, which confirmed the option was the optimal solution to provide safe and effective mitigation against the radar issues associated with the radar detection of WTGs. This was the only option carried forward for consultation.

Following consultation, no update was required to the design.

The final design is hereby submitted because it best meets the design principles.

9. Airspace Description Requirements

	The proposal should provide a full description of the proposed change including the following:	Description for this proposal
a	The type of route or structure; for example, airway, UAR, Conditional Route, Advisory Route, CTR, SIDs/STARs, holding patterns, etc	TMZ See Section 6.2 for proposal area. Draft AIP (Annex 15.4)
b	The hours of operation of the airspace and any seasonal variations	H24
c	Interaction with domestic and international en-route structures, TMAs or CTAs with an explanation of how connectivity is to be achieved. Connectivity to aerodromes not connected to CAS should be covered	No impact on current connectivity
d	Airspace buffer requirements (if any). Where applicable describe how the CAA policy statement on 'Special Use Airspace – Safety Buffer Policy for Airspace Design Purposes' has been applied	N/A – this proposal does not change any existing/introduce new buffers
e	Supporting information on traffic data including statistics and forecasts for the various categories of aircraft movements (passenger, freight, test and training, aero club, other) and terminal passenger numbers	N/A - This proposal would have no impact on airspace usage – see Section 7
f	Analysis of the impact of the traffic mix on complexity and workload of operations	N/A - This proposal would have no impact on the traffic mix – see Section 4.2
g	Evidence of relevant draft Letters of Agreement, including any arising out of consultation and/or airspace management requirements	Existing LoAs are given in References 15 - 16
h	Evidence that the airspace design is compliant with ICAO Standards and Recommended Practices (SARPs) and any other UK policy or filed differences, and UK policy on the Flexible Use of Airspace (or evidence of mitigation where it is not)	TMZ will be implemented in accordance with ICAO SARPS
i	The proposed airspace classification with justification for that classification	No changes to existing CAS volumes or classifications
j	Demonstration of commitment to provide airspace users equitable access to the airspace as per the classification and where necessary indicate resources to be applied or a commitment to provide them in line with forecast traffic growth. 'Management by exclusion' would not be acceptable	See section 7.4 - 7.9
k	Details of and justification for any delegation of ATS	No change to the delegation of ATS

10. Safety Assessment

There is an overriding safety Design Principle (DP1) which states that the airspace change should 'Maintain or enhance current levels of safety.' Initial qualitative assessment from NATS Safeguarding (Ref 13) has confirmed that the proposed Option D TMZ design would provide adequate mitigation to fulfil the requirements of the NERL Cromer: PSR Mitigation Scheme.

This proposal will provide:

- Effective suppression of all primary radar clutter associated with the WTGs.
- The promulgation of a TMZ over the RAG blanked area will ensure that aircraft within the TMZ area are either transponder equipped and hence will be visible to ATC via SSR or have received prior clearance from the controlling authority.
- The dimensions of the TMZ include a 2 NM buffer which is adequate to ensure that ATC have sufficient time to identify when an infringement of the TMZ is taking place and take appropriate action.

Experience from previous wind farm developments has demonstrated that the implementation of radar RAG blanking coupled with an associated TMZ provides effective and safe mitigation against the radar issues associated with WTGs.

11. Operational Impact

	An analysis of the impact of the change on all airspace users, airfields and traffic levels must be provided, and include an outline concept of operations describing how operations within the new airspace will be managed. Specifically, consideration should be given to:	Evidence of compliance/ proposed mitigation
a	Impact on IFR general air traffic and operational air traffic or on VFR General Aviation (GA) traffic flow in or through the area	Minimal impact affecting only those aircraft flying without a transponder – sections 7.4 - 7.9
b	Impact on VFR operations (including VFR routes where applicable)	No impact on VFR operations unless aircraft is flying without a transponder – see section 7.6
c	Consequential effects on procedures and capacity, i.e. on SIDs, STARs, and/or holding patterns. Details of existing or planned routes and holds	N/A- No impact on procedures or capacity – see section 7.4, 7.5 and 7.9
d	Impact on aerodromes and other specific activities within or adjacent to the proposed airspace	No impact on aerodromes or other relevant activities
e	Any flight planning restrictions and/or route requirements	Only Transponder equipped aircraft permitted to enter the TMZ airspace without prior clearance from the controlling authority – see section 7.6

12. Supporting Infrastructure/ Resources

	General requirements	Evidence of compliance/ proposed mitigation
a	Evidence to support RNAV and conventional navigation as appropriate with details of planned availability and contingency procedures	N/A
b	Evidence to support primary and secondary surveillance radar (SSR) with details of planned availability and contingency procedures	Primary radar will be blanked to prevent clutter from the wind farms being displayed on radar screens. Implementation of the TMZ is to ensure only transponder equipped aircraft are within the blanked region unless they have been granted access by the controlling authority. Section 7.6
c	Evidence of communications infrastructure including R/T coverage, with availability and contingency procedures	Traffic uses the same regions as today in a similar manner from a communications infrastructure point of view. Demonstrably adequate for the region
d	The effects of failure of equipment, procedures and/or personnel with respect to the overall management of the airspace must be considered	Existing contingency procedures and management protocol will continue to apply as today
e	Effective responses to the failure modes that will enable the functions associated with airspace to be carried out including details of navigation aid coverage, unit personnel levels, separation standards and the design of the airspace in respect of existing international standards or guidance material	As above (12d)
f	A clear statement on SSR code assignment requirements	No change
g	Evidence of sufficient numbers of suitably qualified staff required to provide air traffic services following the implementation of a change	No training or additional qualifications required

13. Airspace and Infrastructure

	General requirements	Evidence of compliance/ proposed mitigation
a	The airspace structure must be of sufficient dimensions with regard to expected aircraft navigation performance and manoeuvrability to fully contain horizontal and vertical flight activity in both radar and non-radar environments	The proposed TMZ is designed to be as small as possible. See section 6
b	Where an additional airspace structure is required for radar control purposes, the dimensions shall be such that radar control manoeuvres can be contained within the structure, allowing a safety buffer. This safety buffer shall be in accordance with agreed parameters as set down in CAA policy statement 'Safety Buffer Policy for Airspace Design Purposes Segregated Airspace'. Describe how the safety buffer is applied, show how the safety buffer is portrayed to the relevant parties, and provide the required agreements between the relevant ANSPs/ airspace users detailing procedures on how the airspace will be used. This may be in the form of Letters of Agreement with the appropriate level of diagrammatic explanatory detail	The TMZ has a 2 NM buffer, intended for additional safety for ATC. See Section 6.2
c	The Air Traffic Management system must be adequate to ensure that prescribed separation can be maintained between aircraft within the airspace structure and safe management of interfaces with other airspace structures	Promulgation of the TMZ will ensure that the continued surveillance of aircraft is effective such that separation between aircraft can be maintained
d	Air traffic control procedures are to ensure required separation between traffic inside a new airspace structure and traffic within existing adjacent or other new airspace structures	No change to ATC procedures
e	Within the constraints of safety and efficiency, the airspace classification should permit access to as many classes of user as practicable	No change to airspace classification. The Transponder Mandatory restriction is designed to permit access to as many classes of airspace user as practicable
f	There must be assurance, as far as practicable, against unauthorised incursions. This is usually done through the classification and promulgation	The addition of the 2 NM buffer is designed to identify and act against any infringing aircraft. Section 6.2
g	Pilots shall be notified of any failure of navigational facilities and of any suitable alternative facilities available and the method of identifying failure and notification should be specified	Existing contingency procedures would continue to apply
h	The notification of the implementation of new airspace structures or withdrawal of redundant airspace structures shall be adequate to allow interested parties sufficient time to comply with user requirements. This is normally done through the AIRAC cycle	This change will be promulgated by AIRAC as per the typical cycle schedule
i	There must be sufficient R/T coverage to support the Air Traffic Management system within the totality of proposed controlled airspace	Traffic uses the same regions as today in a similar manner from a communications infrastructure point of view. Demonstrably adequate for the region. See item 12 c
j	If the new structure lies close to another airspace structure or overlaps an associated airspace structure, the need for operating agreements shall be considered	Existing LoAs are given in References 15 - 16
k	Should there be any other aviation activity (low flying, gliding, parachuting, microlight site, etc) in the vicinity of the new airspace structure and no suitable operating agreements or air traffic control procedures can be devised, the change sponsor shall act to resolve any conflicting interests	N/A there are no relevant airspace structures in the vicinity of this airspace change

	Terminal airspace requirements	Evidence of compliance/ proposed mitigation
a	The airspace structure shall be of sufficient dimensions to contain appropriate procedures, holding patterns and their associated protected areas	At the date of the application no procedures within the proposed area
b	There shall be effective integration of departure and arrival routes associated with the airspace structure and linking to designated runways and published instrument approach procedures (IAPs)	At the date of the Application no proposed changes affecting departure and arrival routes and published IAPs
c	Where possible, there shall be suitable linking routes between the proposed terminal airspace and existing en-route airspace structure	At the date of the Application no changes proposed
d	The airspace structure shall be designed to ensure that adequate and appropriate terrain clearance can be readily applied within and adjacent to the proposed airspace	At the date of the Application no change to the airspace structure
e	Suitable arrangements for the control of all classes of aircraft (including transits) operating within or adjacent to the airspace in question, in all meteorological conditions and under all flight rules, shall be in place or will be put into effect by the change sponsor upon implementation of the change in question (if these do not already exist)	No change to the classification of airspace (remains Class G). Extant procedures for Air Traffic Services Outside of Controlled Airspace (ATSOCAS) apply
f	The change sponsor shall ensure that sufficient visual reference points are established within or adjacent to the subject airspace to facilitate the effective integration of VFR arrivals, departures and transits of the airspace with IFR traffic	The WTGs will be distinctive and recognisable visual reference points creating an easily identifiable visual reference to identify the TMZ area
g	There shall be suitable availability of radar control facilities	At the date of the Application no change to radar control facilities
h	The change sponsor shall, upon implementation of any airspace change, devise the means of gathering (if these do not already exist) and of maintaining statistics on the number of aircraft transiting the airspace in question. Similarly, the change sponsor shall maintain records on the numbers of aircraft refused permission to transit the airspace in question, and the reasons why. The change sponsor should note that such records would enable ATS managers to plan staffing requirements necessary to effectively manage the airspace under their control	This will be undertaken as part of the Post Implementation Review (PIR) under CAP 1616
i	All new procedures should, wherever possible, incorporate Continuous Descent Approach (CDA) profiles after aircraft leave the holding facility associated with that procedure	At the date of the Application no new procedures

	ATS route requirements	Evidence
a	There must be sufficient accurate navigational guidance based on in-line VOR/DME or NDB or by approved RNAV derived sources, to contain the aircraft within the route to the published RNP value in accordance with ICAO/ Eurocontrol standards	N/A
b	Where ATS routes adjoin terminal airspace there shall be suitable link routes as necessary for the ATM task	At the date of the application there are no new link routes required as part of this proposal
c	All new routes should be designed to accommodate P-RNAV navigational requirements	N/A – no new routes

	Off – route airspace requirements	Evidence of compliance/proposed mitigation
a	If the new structure lies close to another airspace structure or overlaps an associated airspace structure, the need for operating agreements shall be considered	Existing LoAs are given in References 15 - 16

<p>Should there be any other aviation activity (military low flying, gliding, parachuting, microlight site etc) in the vicinity of the new airspace structure and no suitable operating agreements or air traffic control procedures can be devised, the change sponsor shall act to resolve any conflicting interests</p>	<p>N/A there are no relevant airspace structures in the vicinity of this airspace change</p>
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14. Environmental Assessment

	Theme	Content	Evidence of compliance/ proposed mitigation
a	WebTAG analysis	Output and conclusions of the analysis (if not already provided elsewhere in the proposal)	Not required due to negligible impact. See section 3.7 in stage 3 Full Options Appraisal (Ref 9)
b	Assessment of noise impacts (Level 1/M1 proposals only)	Consideration of noise impacts, and where appropriate the related qualitative and/or quantitative analysis If the change sponsor expects that there will be no noise impacts, the rationale must be explained	N/A - environmental analysis requirements scaled equivalent to a Level 2B change, see Section 7.12
c	Assessment of CO ₂ emissions	Consideration of the impacts on CO ₂ emissions, and where appropriate the related qualitative and/or quantitative analysis If the change sponsor expects that there will be no impact on CO ₂ emissions impacts, the rationale must be explained	See Section 7.10
d	Assessment of local air quality (Level 1/M1 proposals only)	Consideration of the impacts on local air quality, and where appropriate the related qualitative and/or quantitative analysis If the change sponsor expects that there will be no impact on local air quality, the rationale must be explained	N/A - environmental analysis requirements scaled equivalent to a Level 2B change, see Section 7.12
e	Assessment of impacts upon tranquillity (Level 1/M1 proposals only)	Consideration of any impact upon tranquillity, notably on Areas of Outstanding Natural Beauty or National Parks, and where appropriate the related qualitative and/or quantitative analysis If the change sponsor expects that there will be no tranquillity impacts, the rationale must be explained	N/A - environmental analysis requirements scaled equivalent to a Level 2B change, see Section 7.12
f	Operational diagrams	Any operational diagrams that have been used in the consultation to illustrate and aid understanding of environmental impacts must be provided	N/A
g	Traffic forecasts	10-year traffic forecasts, from the anticipated date of implementation, must be provided (if not already provided elsewhere in the proposal)	N/A
h	Summary of environmental impacts and conclusions	A summary of all of the environmental impacts detailed above plus the change sponsor's conclusions on those impacts	See Sections 7.4, 7.10 and 7.12

15. Annexes

15.1 References

Ref No	Description	Hyperlinks
1	Norfolk Vanguard and Boreas Wind Farms Phase 1 CAA web page –progress through CAP1616	Link
2	Stage 1 Assessment Meeting Presentation	Link
3	Stage 1 Assessment Meeting Minutes	Link
4	Stage 1 Design Principles	Link
5	Stage 2 Design Options	Link
6	Stage 2 Design Principle Evaluation	Link
7	Stage 2 Options Appraisal (Initial) & Safety Assessment	Link
8	Stage 3 Consultation Strategy	Link
9	Stage 3 Full Options Appraisal	Link
10	Stage 3 Consultation Document	Link
11	Stage 3 Collate and Review Responses Document (Incorporating Stage 4A Update Design)	Link
12	Technical Definition Document WGS84	Supplied as part of ACP
13	ACP Assurance Report	Supplied as part of ACP
14	AIP Changes in support of change	Supplied as part of ACP
15	LoA Anglia Radar and Swanwick Mil	Supplied as part of ACP
16	LoA Swanwick Mil and Amsterdam ATC	Supplied as part of ACP

15.2 List of Stakeholders

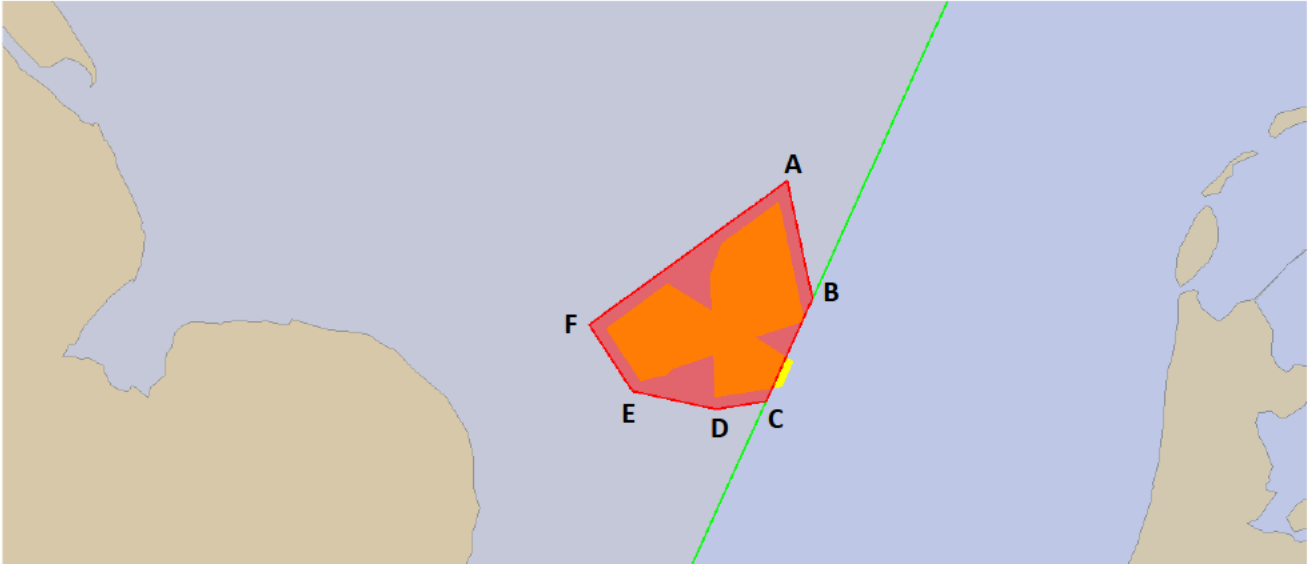
The consultation was considered most relevant to the targeted stakeholders listed below but was not exclusive to this list.

Type	Stakeholder
NATMAC	Aircraft Owners and Pilots Association (AOPA)
	Airfields Operators Group (AOG)
	Airlines UK
	Airport Operators Association (AOA)
	ARPAS - Association of Remotely Piloted Aircraft Systems
	Aviation Environment Federation (AEF)
	B Ae Systems
	BBAC - British Balloon & Airship Club
	BHPA - British Hang gliding & Paragliding Association
	BMAA - British Microlight Aircraft Association
	BMFA - British Model Flying Association
	British Sky Diving (formally BPA)
	British Airline Pilots Association (BALPA)
	British Airways (BA)
	British Business and General Aviation Association (BBGA)
	British Helicopter Association (BHA)
	BGA- British Gliding Association
	GAA- General Aviation Alliance
	General Aviation Safety Council (GASCo)
	Guild of Air Traffic Control Officers (GATCO)
	Heavy Airlines
	Helicopter Club of Great Britain (HCGB)
	Light Aircraft Association (LAA)
	Light Airlines
Low Fare Airlines	
MOD DAATM	
PPL/IR (Europe)	
British Airways (BA)	
Helicopter Operators	Babcock Helicopters ⁶
	Bristow Helicopters
	CHC Scotia
	Heli Holland
	NHV Helicopters
	Maritime and Coastguard Agency (MCA)
ATC	Aberdeen ATC
	NATS En Route Limited (NERL)
	Luchtverkeersleiding Nederland (LVNL)
	Maastricht UAC
Airports	Humberside Airport
	Norwich Airport

⁶ Babcock Helicopters informed us during Stage 2 engagement that they no longer operate in the affected area and wished to be removed from the stakeholder list.

15.3 Coordinates of Proposed TMZ Perimeter- Option C (Preferred)

These coordinates are WGS84 presented in Decimal Degrees (DD) and Degrees Minutes Seconds (DMS). Each row corresponds to the same location. The coordinates below include the TMZ in contained within the UK FIR. The portion within the Dutch FIR is already categorised as a TMZ.



Point	Decimal Degrees		Degrees° Minutes' Seconds.dec'	
	Latitude (DD)	Longitude (DD)	Latitude (DMS)	Longitude (DMS)
A	53.29759851	003.09908850	53° 17' 51.35" N	003° 05' 56.72" E
B	52.96888446	003.19192592	52° 58' 07.98" N	003° 11' 30.93" E
C	52.73570268	002.99669090	52° 44' 08.53" N	002° 59' 48.09" E
D	52.71918836	002.75570865	52° 43' 09.08" N	002° 45' 20.55" E
E	52.77190552	002.40831542	52° 46' 18.86" N	002° 24' 29.94" E
F	52.94552018	002.23506887	52° 56' 43.87" N	002° 14' 06.25" E

15.4 Draft AIP Entry

AIP Section GEN 1.5- 5.3.2.2 Notified 'Transponder Mandatory Zone' Airspace

Add the following to the list:

The vertical and lateral boundaries of the Norfolk TMZ as detailed in ENR 2.2 Paragraph 4.

AIP section ENR 2.2

4 EN-ROUTE TRANSPONDER MANDATORY ZONES

Designation and Lateral Limits	Vertical Limits and Classification	Controlling Authority
Norfolk TMZ (Area A)– the area bounded by: 531751.35N 0030556.72E - 525807.98N 0031130.93E - 524408.53N 0025948.09E - 524309.08N 0024520.55E - 524618.86N 0022429.94E - 525643.87N 00214'06.25E - 531751.35N 0030556.72E.	FL 100 <hr style="width: 50%; margin: auto;"/> FL 65 (Class G)	Swanwick Military (135.325 MHz), - H24.
Norfolk TMZ (Area B)– the area bounded by: 531655.82N 0030338.17E – 525551.00N 0030936.00E - 524408.53N 0025948.09E - 524309.08N 0024520.55E - 524618.86N 0022429.94E - 525643.87N 00214'06.25E - 531655.82N 0030338.17E.	FL 65 <hr style="width: 50%; margin: auto;"/> SFC (Class G)	Anglia Radar (125.275 MHz (backup 128.925 MHz)) - from SFC up to and including FL 65, between 0630-2200 (0530-2100). Swanwick Military (135.325 MHz) - above FL 65 to FL 100, H24. Additionally from SFC up to and including FL 65 between 2200- 0630 (2100-0530).
Norfolk TMZ (Area C)– the area bounded by: 531751.35N 0030556.72E – 52.5807.98N 0031130.93E – 525551.00N 0030936.00E – 531655.82N 0030338.17E – 531751.35N 0030556.72E	FL 65 <hr style="width: 50%; margin: auto;"/> SFC (Class G)	Amsterdam Information (119.175 MHz), H24, from SFC to FL55. Anglia Radar (125.275 MHz (backup 128.925 MHz)) - from FL 55 up to and including FL 65, between 0630-2200 (0530-2100). Swanwick Military (135.325 MHz) - from FL 55 up to and including FL 65 between 2200-0630 (2100- 0530).
<p><i>Note: For aircraft equipped with and operating SSR equipment, as defined in GEN 1.5 paragraph 5.3, access to the Norfolk TMZ is not subject to ATC approval. Access to the Norfolk TMZ without serviceable transponder equipment, as defined in GEN 1.5 paragraph 5.3, is subject to specific approval of the Controlling Authority.</i></p>		

AIP CHART ENR 6-25

Add Norfolk TMZ with coordinates approved by the CAA to chart 6-25.

15.5 Glossary

ACP	Airspace Change Proposal
AIP	Aeronautical Information Package
AIRAC	Aeronautical Information Regulation And Control
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATS	Air Traffic Service
ATSOCAS	Air Traffic Services Outside Controlled Airspace
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAP1616	Civil Aviation Publication 1616- Airspace change: Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information
CAS	Controlled Air Space
CO ₂	Carbon Dioxide
DAATM	Defence Airspace Air Traffic Management
DD	Decimal Degrees
DMS	Degrees Minutes Seconds
DP	Design Principle
EFIS	Electronic Flight Information System
FLXXX	Flight Level XXX
GA	General Aviation
GW	Giga Watt
H24	24 Hours
HIAL	Highlands and Islands Airports Ltd.
HMR	Helicopter Main Route
ICAO	International Civil Aviation Organization
km	Kilometre
kt	Knot
LoA	Letter of Agreement
MHz	Mega Hertz
MOD	Ministry of Defence
MT	Mega Tonne (1 000 000 kg)
NATMAC	National Air Traffic Management Advisory Committee
NERL	NATS En-Route Ltd.
NM	Nautical Mile

NSIP	Nationally Significant Infrastructure Project
NSL	NATS Services Ltd.
PIR	Post Implementation Review
PRMS	Primary Radar Mitigation Scheme
PSR	Primary Surveillance Radar
RAG	Range and Azimuth Gating
SARG	Safety and Airspace Regulations Group
SARP	Standards and Recommended Practices
SSR	Secondary Surveillance Radar
TMZ	Transponder Mandatory Zone
VFR	Visual Flight Rules
WGS	World Geodetic Survey
WTG	Wind Turbine Generator

End of document