

8. Aviation

8.1 Introduction

- 8.1.1 This chapter assesses the potential effects that the Proposed Development may have on identified civilian and military aviation interests and aviation radar safeguarding, and if required, reviews mitigation measures to be implemented to prevent, reduce or offset these where required.
- 8.1.2 The potential effects of wind turbines on aviation interests primarily concern the maintenance of safe aviation operations. There are numerous subtleties in the actual effects but there are two dominant scenarios:
- Physical obstruction: turbines can present a physical obstruction at, or close to, an aerodrome or other aviation activity area; and
 - Radar / Air Traffic Services ('ATS'): turbine clutter appearing on a radar display can affect the safe provision of ATS as it can mask unidentified aircraft from the air traffic controller and / or prevent them from accurately identifying, or maintaining identity of, aircraft under their control. In some cases, radar reflections from the turbines can affect the performance of the radar itself.

8.2 Limitations of this Assessment

- 8.2.1 There are no limitations relating to Aviation that affect the robustness of the assessment of the likely significant effects of the Proposed Development. However, the results of the radar Line of Sight ('LoS') analysis provide theoretical results on signal diffraction and attenuation within a given radar environment, which can influence the probability of a turbine being detected.

8.3 Relevant Legislation, Planning Policy, Technical Guidance

- 8.3.1 All national and Development Plan policies and other considerations of relevance to the Proposed Development are outlined in **Chapter 5 – Planning Policy Context**.
- 8.3.2 Of specific relevance to the technical assessments provided in this EIA Report chapter, Policy 11(e)(iv) of National Planning Framework ('NPF4') (2023) requires that in the determination of applications for energy infrastructure developments the project design and mitigation would demonstrate how 'impacts on aviation and defence interests including seismological recording' are addressed. The Scottish Government's Online Renewables Planning Advice regarding Onshore Wind Turbines (last updated 28th May 2014) includes guidance regarding potential impacts on aviation safeguarding and the need for civil and military aviation authorities to be consulted regarding proposed wind energy developments.
- 8.3.3 Policy RE1: Renewable Energy Developments within the EAC LDP (2017) states that proposals for the generation and utilisation of renewable energy developments in the form of new build development, would be supported in standalone locations and as integral parts of new or existing developments 'where it can be demonstrated that there would be no unacceptable significant adverse impacts on all of the relevant Renewable Energy Assessment Criteria set out in Schedule 1 of the LDP...' and similar policy wording is

included in policy RE3: Wind Energy Proposals over 50 Metres in Height specifically in relation to proposed wind energy developments. Schedule 1 broadly mirrors NPF Policy 11(e) and therefore requires impacts on aviation and defence interests to be assessed.

- 8.3.4 The Onshore Wind Policy Statement 2022 states within Chapter 6 (Onshore Wind and Aviation Considerations) that ‘wind turbines have the potential to impact aviation operations, including, but not limited to impact on aviation radar’. Solutions which have ‘alleviated specific individual objections’ have been agreed however, it is ‘...important that solutions are cognisant of the cost of deploying renewable energy, particularly given the need to focus on both security of supply and low-cost generation, given the current international and economic situation.’

8.4 Data Gathering Methodology

- 8.4.1 Potential aviation stakeholders were identified in accordance with the guidance in Civil Aviation Publication (CAP 764) Policy and Guidelines on Wind Turbines (CAA, 2016), with the suggested anticipated extents of impact utilised as a minimum. It is, however, acknowledged that objections from beyond the Civil Aviation Authority (‘CAA’) recommended aviation stakeholder consultation distances can potentially be sustainable and valid; the threshold used for identifying potential aviation stakeholders is not a definitive limit on the extent of potential impacts arising from the Proposed Development.
- 8.4.2 Consideration is given to any aviation infrastructure where the Proposed Development lies within operational range of that infrastructure. Operational range varies with radar type or operations conducted and therefore the study areas are defined relative to a potential receptor on a case-by-case basis in this respect.
- 8.4.3 The radar LoS analysis has been completed to model the terrain elevation profile between aviation radar systems of interest and the blade tips of the Proposed Development. This is a limited and theoretical desk-based study. In reality there are variable levels of signal diffraction and attenuation within a given radar environment that can influence the probability of an operational turbine being detected. The analysis is designed to give an indication of the likelihood of the turbine being detected such that the operational significance of the wind farm relative to nearby aviation stakeholders can be assessed.
- 8.4.4 The radar LoS analysis has been completed on the two-turbine layout at a blade tip height of 149.9 metres (m) above ground level (agl).

8.5 Overall Baseline

Introduction

- 8.5.1 In the UK Flight Information Region (‘FIR’) and Upper Information Region (‘UIR’), airspace is classified as A, C, D, E and G in accordance with International Civil Aviation Organisation (‘ICAO’) standards (Note: there is no airspace designated as Class B or F in UK airspace). Airspace Classes A to E are variants of Controlled Airspace (‘CAS’) in which aircraft are required to obtain the necessary clearance to operate from Air Traffic Control (‘ATC’). Class G Airspace is designated as uncontrolled airspace in which aircraft can operate autonomously without any clearance required, subject to certain conditions.
- 8.5.2 The airspace within, above and surrounding the Proposed Development site is used by both civil and military aircraft, which observe the following airspace rules dependent on the classification of airspace they are operating in:
- Class G uncontrolled airspace up to 4,000 feet (ft) above mean sea level (amsl); any aircraft can operate in this area of uncontrolled airspace without any requirement to be

in communication with an Air Navigation Service Provider ('ANSP'), although it will be good practice for aircraft operating in the region of the Proposed Development underneath the CAS which forms the Glasgow Prestwick Airport ('GPA') Control Area ('CTA') to inform GPA ATC of their intentions. Pilots of aircraft operating under Visual Flight Rules ('VFR') in Class G airspace are ultimately responsible for seeing and avoiding other aircraft, terrain and obstacles.

- Above 4,000 ft amsl, Class D CAS is established which forms the GPA CTA-6, up to the base of the Scottish Terminal Manoeuvring Area (TMA), this airspace provides greater protection for aircraft operating to and from GPA.
- Above GPA CTA-6, Class D CAS of the Scottish TMA from 5,500 ft amsl up to Flight Level ('FL') 195 (approximately 19,500 ft.); aircraft operating within this airspace must be in receipt of an ATS from NATS Scottish Area Control Centre ('ACC') or GPA, the air traffic controller is responsible for maintaining typically 5 Nautical Miles ('NM') lateral separation between aircraft.
- Class C controlled airspace is established above the Scottish TMA; all aircraft operating in this airspace must be in receipt of an ATS from NATS or Military controllers located at a NATS ACC.

8.5.3 NATS are the main UK ATS provider, utilising several long-range Primary Surveillance Radar ('PSR') and Secondary Surveillance Radar²⁴ ('SSR') systems positioned to provide maximum coverage of UK airspace. Additionally, NATS has a licence obligation to provide radar data to other remote aviation stakeholders (such as the Ministry of Defence (MOD)) to a high quality and performance standard for the benefit of UK aviation as a whole. In the airspace above the Proposed Development, NATS utilises the Lowther Hill PSR and the Cumbernauld PSR systems to support their provision of navigational services to flights into and out of Edinburgh, Glasgow, GPA Airports, aircraft operating between UK airports and mainland Europe and also to those overflying the UK Flight Information Region (FIR).

8.5.4 The military UK Low Flying System ('UKLFS') covers the open airspace of the whole UK and surrounding overseas areas from surface to 2,000 ft agl or amsl. Additionally, there are three areas, known as Tactical Training Areas ('TTA'), which are considered suitable for flying lower than the standard training heights due to their challenging terrain and generally sparse population. This added capability of military low flying training in the TTAs allows aircrews to enhance their skills in preparation for deployment onto operations. Consequently, the addition of significant physical obstructions into the low-level environment has the potential to influence military low-flying training. However, the MOD does permit a degree of wind energy development in these areas.

MOD

8.5.5 The Proposed Development would be located within Low Flying Area ('LFA') 16. This area is located in the south of Scotland, including the Borders Region, Dumfries and Galloway and other counties up to and including those within the central belt of Scotland.

8.5.6 Furthermore, the Proposed Development will be located within TTA 20T which forms a portion of LFA 16. TTA 20T is utilised, when required, for operational low flying to meet operational readiness requirements. Height in the UKLFS can be referred to in terms of Minimum Separation Distance ('MSD'). This is the distance that must be maintained between any part of an aircraft in flight and the ground, the water or any other object. In

²⁴ SSR differs from PSR systems in that it transmits an interrogation requesting a dedicated response. CAA guidance (CAP 764, 2016) states that SSR systems are typically affected when wind turbines are located less than 10 kilometres (km) from the radar position. There are no such SSR systems within a 10 km radius of the Proposed Development and therefore SSR systems are not considered further.

an LFA aircraft can operate down to 250 ft. MSD; however, in a TTA fast-jets can fly at 100 ft. MSD, helicopters may fly to ground level.

NATS

- 8.5.7 The Proposed Development is within the operational range of the NATS Lowther Hill PSR system. Turbine 1 is the closest turbine to the PSR at a bearing and range of 260° / 31.3 Kilometres (km) (16.6 NM) from the PSR and will be theoretically detectable by the Lowther Hill PSR. Analysis conclusions indicate that Turbine 2 is unlikely to be detectable by the Lowther Hill PSR however, occasional detection cannot be ruled out.
- 8.5.8 The Proposed Development is within the operational range of the NATS Cumbernauld PSR system. Turbine 1 is the closest turbine to the PSR at a bearing and range of 189° / 68 km (37 NM) from the PSR. While the LoS analysis presented in **Appendix 8A** cannot rule out theoretical intermittent and occasional detectability of the turbines by the Cumbernauld PSR, it is known that the radar LoS software utilised by Osprey provides conservative results when compared with NATS software and NATS have not objected in relation to the Cumbernauld PSR therefore, the Cumbernauld PSR is not considered further.

GPA

- 8.5.9 GPA is wholly owned by The Scottish Government who see the facility as an important national infrastructure asset. The airport is located approximately 2 km to the northeast of the town of Prestwick, South Ayrshire. GPA currently operates a Marconi S511 Hybrid Watchman Model PSR. However, GPA has procured a Terma Scanter 4002 system²⁵ as a potential technical mitigation solution for the effects of multiple wind farms within its Area of Responsibility ('AOR') for the provision of radar based ATS to aircraft. The S511 PSR will continue to be operated until a time that it is decommissioned and replaced by the Terma PSR. The Proposed Development is within the operational range of the GPA PSR systems, located on an approximate range and bearing of 310° / 29 km (15 NM).

Glasgow Airport

- 8.5.10 Glasgow Airport is located 6 miles west of Glasgow city centre, near the towns of Paisley and Renfrew, Scotland. The Airport handles approximately 8.8 million passengers per year to a variety of worldwide destinations making it the second busiest airport in Scotland after Edinburgh Airport. The Airport is owned by AGS Airports Limited, which also owns and operates Aberdeen and Southampton airports. Air traffic services are supplied under contract by NATS. The Proposed Development is located at a bearing and range of 169° / 62 km (33.7) NM from the location of the Glasgow Airport PSR. Radar LoS analysis results indicate that due to terrain shielding the Glasgow Airport Terma PSR will not theoretically detect the Proposed Development wind turbines at a maximum blade tip height of 149.9 m agl. Therefore, Glasgow Airport is not considered further.

8.6 Consultation

- 8.6.1 **Table 8.1** provides a summary of the issues that have been raised by consultees in respect of the Proposed Development. The EIA Scoping Opinion presented in full in **Appendix 4B** of the EIA Report.

²⁵ <https://www.terma.com/products/radars/radar-mitigation/>

Table 8.1 Summary of Issues Raised during Consultation

Consultee(s)	Response
Defence Infrastructure Organisation (DIO) – MOD (Response to EIA Scoping Report, March 2020)	<p>DIO stated that it has concerns as the Proposed Development would occupy Low Flying Area TTA 20T and would cause a potential obstruction hazard to military low flying training activities. To address these effects, it stated that the Proposed Development should be fitted with MOD accredited 25 candela omni-directional red lighting with an optimised flash pattern of 60 flashes per minute of 200ms to 500ms duration or equivalent infrared lighting on individual turbines.</p> <p>It stated that MOD Safeguarding wishes to be consulted and notified of the progression of planning applications and submissions relating to this proposal to verify that it would not adversely affect defence interests.</p>
Glasgow Prestwick Airport (GPA) (Response to EIA Scoping Report, March 2020)	<p>State that its LoS indicates both turbines will be visible to its PSR and consequently it must object until a suitable mitigation is agreed for the life of the wind farm.</p> <p>State it is willing to engage with the Developer in an effort to establish if mitigation can be achieved and maintained for the life of the wind farm.</p>
NATS (Response to EIA Scoping Report, March 2020)	<p>Stated that it objects to the Proposed Development on the basis that it will be detectable to the Lowther Hill PSR.</p>

8.7 Scope of the Assessment

Potential Effects

- 8.7.1 The assessment would be focused on the evaluation of the following effects identified as being potentially significant.
- Potential effects on MOD Low Flying activities;
 - Potential effects on NATS Lowther Hill PSR; and
 - Potential effects on the GPA PSR.
- 8.7.2 With specific regard to PSRs, it should be noted that these systems cannot presently distinguish between the radar returns from wind turbines and those representing a real aircraft; therefore, the air traffic controller is required to assume that the turbine induced radar returns could obscure a real aircraft. In providing safe air traffic (radar) services, an air traffic controller must maintain standard separation distances between aircraft under control and those that are unknown or not in receipt of a radar service. Flight procedures are said to be potentially affected by the turbine clutter if they pass within 5 NM of a wind farm. In the CAS above the proposed development site, this criterion is the standard separation distance that air traffic controllers must apply between aircraft under their control and unknown aircraft (or clutter that looks like a real aircraft or could be assumed to be masking returns from a real aircraft). Where turbines are detectable by a PSR system, they are likely to appear as aircraft targets and could mask genuine aircraft responses. The radar may also be de-sensitised by clutter processing within the sector

containing turbines, meaning that real aircraft targets may not be detected by the radar system.

MOD

8.7.3 As detailed in **Section 8.5**, the Proposed Development is located within the UKLFS Low Flying Area ('LFA') 16 and, when the airspace is activated, TTA 20T.

Low flying is a demanding but essential skill for military aircrew, gained through progressive training and continuous practice within the UKLFS. The ability to operate effectively at low level by day and night is vital to fast jet, transport aircraft and helicopters as they support forces on the ground, and hence the UKFLS is a high value receptor. Therefore, potential effects on these receptors have been taken into account as part of the aviation assessment.

NATS

8.7.4 As detailed in **Section 8.5**, the Proposed Development is within the operational range of the NATS Lowther Hill PSR system, therefore potential effects on this receptor has been taken into consideration for the assessment.

GPA

8.7.5 As detailed in **Section 8.5**, the Proposed Development is within the operational range of the GPA PSR system. The GPA response to scoping was limited to potential effects to the PSR system, which provide coverage to support the airport's operational tasks in the region of the Proposed Development. Therefore, this issue has been taken forward for the assessment.

Temporal Scope

8.7.6 The assessment of the potentially significant effects on aviation has been undertaken in relation to the construction, operational and decommissioning phase, in line with the general approach to the EIA set up in **Chapter 4 – Approach to Preparing the EIA Report**.

8.8 Environmental Measures Embedded into the Development Proposals

8.8.1 It is good practice to notify Aviation Stakeholders of the location and dimension of any wind energy development and the associated construction activities. Information regarding construction should be passed to the Defence Geographic Centre (DGC) and the General Aviation Awareness Council ('GAAC') at least 10 weeks in advance of the erection of the first turbine with follow up confirmation on the day that the activity has taken place. The data should include:

- Location, height (of all structures) with a maximum height at or above 150 ft agl, date of erection, name of location, an accurate location of the structures in WGS 84 latitude and longitude (degrees minutes and 1/100 second), an accurate maximum height agl/amsl, date of removal and lighting type (none, infra-red or lighting brightness).
- Local aerodromes identified during consultation should be notified, particularly any police helicopter or air ambulance units.

- RenewableUK should be copied-in on the submission of all such information as an independent record and because they might share the information with other relevant official agencies.
- Appropriate information about the site construction and any associated lighting (where applicable), for example, the height and temporary location of construction cranes, should be provided to the UK Aeronautical Information Service (NATS AIS) for promulgation throughout the UK Integrated Aeronautical Information Package ('UKIAIP') (NATS, 2023).

MOD UKLFS

Construction

- 8.8.2 In Visual Meteorological Conditions²⁶ ('VMC'), pilots are ultimately responsible for seeing and avoiding obstructions such as wind turbines and would be aware through notification of construction activities. Pilots would plan their flying activities in advance to be familiar with any en-route obstacles that they may encounter. Appropriate information about the site construction and any associated lighting (where applicable), for example, the height and temporary location of construction cranes, would be provided as per the notification requirements outlined in **Section 8.8.1**.

Operation

- 8.8.3 Pilots plan their flying activities in advance and are familiar with any en-route obstacles that they may encounter. Obstacle information and any associated lighting would be promulgated in the UKIAIP and Military Aeronautical Information Publication ('AIP'). During the flight, weather conditions or air space restrictions may necessitate route adjustments. However, pilots are ultimately responsible for seeing and avoiding tall structures, including wind turbines.
- 8.8.4 The Development Site is in an area where the MOD anticipates the construction of wind turbines is a concern due to an effect on military Low Flying operations.
- 8.8.5 In order to safeguard general use of the area by military aircraft during operation, the Applicant confirms that the Proposed Development turbines would be fitted with MOD accredited aviation safety lighting. The turbines would be fitted with 25 candela omnidirectional infrared lighting with an optimised flash pattern of 60 flashes per minute of 200ms to 500ms duration at the highest practicable point. This can be implemented under a suitably worded planning condition.
- 8.8.6 Agreement in respect of the MOD lighting requirement will be determined once the layout is finalised to confirm the MOD lighting requirements for air safety.
- 8.8.7 Information on the Proposed Development and construction infrastructure will be provided to the UK Aeronautical Information Service ('AIS') and with the DGC such that it can be depicted on appropriate aviation documentation and charts as detailed in **Section 8.8.1**.

Decommissioning

- 8.8.8 In order to safeguard general use of the area by military traffic, the applicant will adhere to the notification requirements outlined in **Section 8.8.1**.

²⁶ Visual Meteorological Conditions (VMC): A flight category which allows flight to be conducted under visual flight rules defined by in flight visibility and clearance from cloud.

GPA

8.8.9 A preliminary agreement has been reached between GPA and the Applicant for the consented Enoch Hill Wind Farm to work together to identify a mitigation solution and this agreement would be amended to apply also to the Proposed Development. As part of this process, GPA has assessed and identified a number of potential solutions likely to mitigate the effects of wind farm development in proximity to the airport as part of a 'regional solution'. In light of progress made in these works, GPA and RWE have entered into an agreement to secure radar mitigation in relation to the consented Enoch Hill Wind Farm and it is considered that this would be extended to also apply to the Proposed Development. GPA would ultimately select the most appropriate mitigation scheme for Enoch Hill Wind Farm and the Proposed Development. However, the solution is expected to be predicated on the removal/suppression or prevention of the unwanted radar returns on the GPA PSR systems, associated with the turbines. GPA have asked that the Applicant accept the planning condition as outlined below to replace Condition 23 of the Consented Enoch Hill Wind Farm and it is expected that a similar condition would also apply to the Proposed Development.

- *No blade shall be fitted to any turbine or turbines forming part of the development and no such turbine shall operate, save as provided for and in accordance with the Testing Protocol, unless and until such time as the Scottish Ministers receive confirmation from the Airport Operator that: (a) all measures required by the Radar Mitigation Scheme prior to operation of any turbine have been implemented; and (b) the Civil Aviation Authority has evidenced its approval to the Airport Operator that the Radar Mitigation Scheme is acceptable mitigation for the development and has been satisfactorily implemented by the Airport Operator.*
- *No turbine shall operate other than in accordance with the terms of the Radar Mitigation Scheme.*

Reason: In the interests of aviation safety.

Definitions:

- *'Airport Operator' means Glasgow Prestwick Airport Limited or any successor as holder of a licence under the Air Navigation Order 2000 from the Civil Aviation Authority to operate Glasgow Prestwick Airport.*
- *'Radar Mitigation Scheme' means such equipment, procedural or technological measures, as the Airport Operator identifies as necessary and sufficient to prevent the operation of the development or of any turbines forming part of the development impacting adversely on radar performance or on the performance of other navigational aids at Glasgow Prestwick Airport or on maintaining safe and efficient air traffic control services or procedures or airspace and which the Airport Operator is willing and able to implement and maintain for the lifetime of the development or for such shorter period as may be agreed in consultation with the Airport Operator as necessary to mitigate any such adverse impact.*
- *'Testing Protocol' means the protocol to control the operation of any turbine or turbines forming part of the development for the purposes of testing of the Radar Mitigation Solution.*

8.8.10 The Applicant confirms agreement to this planning condition being applied to the Proposed Development if consented.

NATS

- 8.8.11 NATS has installed a replacement advanced radar system to replace the extant Lowther Hill PSR²⁷. The 'Indra' radar system is stated to possess inherent windfarm mitigation; however, it is not certain if the solution, that the 'Indra' radar capability provides, will be applicable to the Proposed Development.
- 8.8.12 A Statement of Common Understanding with regard to a potential Primary Radar Mitigation Scheme ('PRMS') has been agreed between the Applicant and NATS for the consented Enoch Hill Wind Farm which would be enforced by planning condition 24. It is expected that the PRMS will also apply to the Proposed Development and would mitigate any potential adverse effects on the Lowther Hill PSR or its replacement radar system.

8.9 Assessment Methodology

Introduction

- 8.9.1 The generic project-wide approach to the assessment methodology is set out in **Chapter 4**, and specifically in **Section 4.5**. However, whilst this has informed the general approach used in this assessment, standard aviation industry guidance has been taken into consideration for this assessment.
- 8.9.2 The methodology used to identify the aviation stakeholders as well as to assess the potential effects of the Proposed Development on the sensitive aviation receptors is summarised below.

Aviation Stakeholder Identification

- 8.9.3 A radar LoS undertaken by Osprey considers the potential for the Proposed Development to have an effect on the aviation interests, in terms of the radar and operations of NATS and airport operations at GPA. MOD low flying operations may be impacted by the creation of an obstruction within the UKLFS. There are no other aviation stakeholders that are considered to have the potential to be affected by the Proposed Development.
- 8.9.4 The analysis was conducted in accordance with CAP 764 (CAA, 2016). Potential aviation stakeholders were identified and for each receptor, the physical obstruction and / or radar impact, and then subsequently the operational effect, were evaluated. The operational effect pays heed to, but is not limited to, consideration of the orientation of airfield approach and departure routes, physical safeguarding of aircraft operations and airspace characteristics.

Radar Performance and Propagation

- 8.9.5 Radar performance and propagation modelling has been undertaken to determine the theoretical detection of operational wind turbines by the region's radar infrastructure. Osprey utilised the Advanced Topographic Development and Images ('ATDI') ICS LT (Version 4.3.3) tool to model the terrain elevation profile between the identified PSR systems and blade tips of the wind turbine positions within the Proposed Development, to provide a graphical representation of the intervening terrain and theoretical direct radar LoS, in order to determine the affected radar systems within the Baseline.

²⁷ <https://www.nats.aero/news/advanced-new-radar-at-lowther-hill-to-enable-more-wind-energy-generation/>

Assessment Guidance

- 8.9.6 The Aviation Industry and the provision of Air Navigation Services are regulated through extensive legislation, with the mechanism for wind development enabled through the consenting system and in accordance with regulatory guidance. The following policy and guidance documents were considered during the baseline definition and assessment activities:
- CAP 393 Air Navigation: The Air Navigation Order 2016 as amended (CAA, 2022);
 - CAP 764: CAA, Policy and Guidance on Wind Turbines (CAA, 2016);
 - CAP 785B: Implementation and Safeguarding of IFPs in the UK;
 - MOD Obstruction Lighting Guidance (MOD, 2020);
 - Other data sources and guidance considered during the baseline definition and assessment activities include the following:
 - CAA Visual Flight Rules Chart (CAA, 2022);
 - Military Aeronautical Information Publication (Mil AIP) (MOD, 2023);
 - MoD UK Low-Flying System (UKLFS) Priority Areas Map (MOD, 2011); and
 - CAA, CAP 032 UK Integrated Aeronautical Information Publication (UK AIP). The UK AIP is the main resource for information and flight procedures at all licensed UK airports as well as airspace, en-route procedures, charts and other air navigation information (NATS, 2023).

Significance Evaluation Methodology

Sensitivity Criteria

- 8.9.7 The sensitivity of a receptor is subjective in aviation terms and therefore difficult to quantify. Whereas an Air Defence Radar ('ADR') system would be an obvious high value and high sensitivity receptor (due to its role in UK national security), the sensitivity of a local aerodrome can also often be rated high if the Planning Authority considers the receptor to be a significant asset to the local area. The identified receptors in this analysis are considered to have a high sensitivity to effects, given their safety critical function.

Magnitude Criteria

- 8.9.8 The assessment of the magnitude of the potential changes on aviation and radar receptors is assessed using the criteria and terminology given in **Table 8.2**.

Table 8.2 Magnitude of Change Criteria

Descriptor/Criteria	Description
High	Receptor unable to continue safe operations or safe provision of air navigation services (radar) in the presence of the wind turbines. Technical and/or operational mitigation of the effect is required.

Descriptor/Criteria	Description
Medium	Receptor able to continue safe operations but with some restrictions or non-standard mitigation measures in place.
Low	Receptor able to continue operations with standard mitigation in place.
Negligible	No impact on this receptor.

Significance of Effects Criteria

- 8.9.9 Significance criteria for aviation effects are typically difficult to establish. They are not strictly based on the sensitivity of the receptor or magnitude of change but on whether the industry regulations for safe obstacle avoidance or radar separation (from radar clutter) can be maintained in the presence of the wind turbines.
- 8.9.10 The assessment of the significance of the effects is summaries in **Table 8.3**.
- 8.9.11 The anticipated effects have been informed by the results of the desktop assessment and additional consultation with reference to the existing evidence base regarding the effects of wind turbines on aviation receptors.

Table 8.3 Significance of Effects Evaluation Matrix

		Magnitude of change			
		High	Medium	Low	Very Low
Sensitivity/importance/value of receptor	High	Major (Significant)	Major (Significant)	Moderate (Probably significant)	Minor (Not significant)
	Medium	Major (Significant)	Moderate (Probably significant)	Minor (Not significant)	Negligible (Not significant)
	Low	Moderate (Probably significant)	Minor (Not significant)	Negligible (Not significant)	Negligible (Not significant)
	Very Low	Minor (Not significant)	Negligible (Not significant)	Negligible (Not significant)	Negligible (Not significant)

Embedded Mitigations

- 8.9.12 An iterative design process has been carried out, and a range of aviation related measures have been embedded into the Proposed Development. These embedded measures have been taken into consideration when assessing the significance of the potential effects.

8.10 Assessment of Effects

- 8.10.1 This section provides an objective assessment of the effects of the Proposed Development on the key aviation issues identified within the area surrounding the Development Site. The assessment is based on a review of the sensitivity of the receptors and the anticipated magnitude of change brought about by the Proposed Development, taking into account industry standard guidelines.
- 8.10.2 Where applicable, any necessary mitigation measures are also discussed.

Effects on MOD Low Flying Activities

- 8.10.3 Generally, the MOD's sensitivity of the Low Flying activities within the UKLFS Low Flying Area ('LFA') 16 and, when required, TTA 20T is determined to be high. However, by virtue of the embedded mitigations detailed in **Section 8.8**, the sensitivity can be appropriately reduced as discussed below.

Construction

- 8.10.4 The construction of the Proposed Development would create a physical obstruction to flight operations in the vicinity of the wind turbines. Construction infrastructure such as cranes and erected wind turbines can be difficult to see from the air, particularly in poor meteorological conditions, leading to potential increased obstacle collision risk. Furthermore, during the construction phase, the presence and movement of construction infrastructure may present a potential obstacle collision risk to low flying aircraft operations.
- 8.10.5 Pilots are obliged to plan their flying activities in advance and to be familiar with any en-route obstacles they may encounter; however, during flight, weather conditions or operational requirements may necessitate route adjustments. In VMC, pilots are ultimately responsible for seeing and avoiding obstructions such as wind turbines and would be aware through notification of construction activities. Furthermore, when flying in Instrumental Meteorological Conditions²⁸ ('IMC') in the vicinity of the construction area, pilots qualified to do so, would be flying above the Minimum Safe Altitude²⁹ ('MSA') and would utilise (if available) on-board radar which detects obstructions and would be under the control of ATC with an appropriate level of radar service.
- 8.10.6 A range of embedded mitigation measures, in the form of appropriate notification to aviation stakeholders of the extent of the Proposed Development, the maximum height of obstructions, the operational period and timings of any maintenance activity, together with the lighting and marking of infrastructure, would minimise effects to aviation flight operations. These measures would comply with current guidelines and be agreed with the appropriate stakeholders. The ability of aviation receptors to continue to operate safely remains as the obstacles are marked, lit and notified. Dependent on specific weather conditions, aircraft may be required to alter tracks or climb to avoid the area.
- 8.10.7 The mitigations, as detailed in **Section 8.8**, would reduce the magnitude of change to Low, the sensitivity of the receptor is considered to be High, resulting in an effect of Moderate significance, which is **Significant** in EIA terms.

²⁸ Instrument Meteorological Conditions (IMC): Weather conditions which would preclude flight by the visual flight rules, i.e., conditions where the aircraft is in, or close to cloud or flying in visibility less than a specified minimum.

²⁹ Minimum Safe Altitude (MSA): Under aviation flight rules, the altitude below which it is unsafe to fly in IMC owing to presence of terrain or obstacles within a specified area.

Operation

- 8.10.8 The Proposed Development would be located within LFA 16 and, when active, within TTA 20T. LFA 16 and TTA 20T are considered by the MOD to be areas of key importance for low flying training.
- 8.10.9 In general terms, structures less than 150 m agl in height outside the vicinity of an aerodrome are not typically fitted with aviation obstruction lighting. The CAA routinely comments to the effect that, in respect to a proposed wind turbine development, there might be a need to install aviation obstruction lighting to some or all of the associated turbines, when specific concerns have been expressed by other elements of the aviation industry. The MOD have requested that specific aviation lighting be fitted to the Proposed Development to mitigate the effect to low flying operations.
- 8.10.10 As outlined in **Section 8.8**, a range of embedded mitigation measures in the form of appropriate notification to aviation stakeholders, lighting and marking to minimise effects to aviation flight operations would apply to the Proposed Development. MOD accredited aviation safety lighting would be fitted for the Proposed Development; with lighting in place and operational, the magnitude of change is Negligible, and the sensitivity of the receptor is determined to be High, resulting in an effect of Minor significance, which is **Not Significant** in EIA terms.

Decommissioning

- 8.10.11 In line with the general approach outlined in **Chapter 4 – Approach to Preparing the EIA Report** of the EIA Report, the aviation assessment assumes that the Proposed Development will be decommissioned at the end of its operational life. The infrastructure required in the process of the turbine decommissioning may present a physical obstruction and affect operations of military Low Flying aircraft. However, during decommissioning, the owner of the Proposed Development will adhere to the notification requirements, as detailed in paragraphs 8.8.1 to 8.8.12. On this basis, the magnitude of change is Negligible (and declining as infrastructure is removed), the sensitivity of the receptor is considered to be High, which will result in an effect of Minor significance, considered **Not Significant** in EIA terms.

Effects on NATS Lowther Hill PSR

Construction

- 8.10.12 The infrastructure required in the process of the construction of the Proposed Development would have no significant effect on the NATS Lowther Hill PSR system. This is because the static nature of the infrastructure is such that it will not be processed and presented onto ATC display screens by the PSR system. Potential static radar returns will be removed through use of well understood, normal, radar system filtering techniques and thus returns below a pre-set vector threshold would not be displayed on the radar display screen. The magnitude of change is Negligible, the sensitivity of the receptor is considered to be High, resulting in an effect of Minor significance, which is **Not Significant** in EIA terms.

Operation

- 8.10.13 The operational wind turbines of the Proposed Development would be theoretically detectable by the NATS Lowther Hill PSR. Wind turbines detectable by an aviation radar surveillance system might degrade the system by creating false targets, reduce system

sensitivity, create radar shadowing behind the wind turbines and saturate the radar receiver leading to clutter potentially concealing real aircraft targets.

- 8.10.14 Air Traffic Controllers are responsible for maintaining typically 5 NM lateral separation between aircraft and unknown radar targets including those that may be result of radar detection of operational wind turbines. Where turbines are detectable by a PSR system, they may appear as aircraft targets and could mask genuine aircraft responses. The radar may also be de-sensitised by clutter processing within the sector containing turbines, meaning that real aircraft targets may not be detected or may disappear from radar. At an anticipated maximum height of 149.9 m to blade tip, the radar LoS analysis indicates that, theoretically, Turbine 1 will be highly likely to be detectable by the Lowther Hill PSR; analysis cannot rule out intermittent detectability of Turbine 2 by the Lowther PSR. This is predicted to create clutter to be presented on NATS displays utilising the Lowther Hill PSR. See the LoS analysis presented as **Appendix 8A**.
- 8.10.15 It is predicted that the impact will affect the receptor directly, which is vulnerable to this effect; therefore, the magnitude of the change is High. All aviation radar stakeholders aim to ensure ‘clutter free’ radar to continue to deliver a safe and effective ATS therefore, the sensitivity of the receptor is considered to be High. This effect has therefore been assessed as Major, which is **Significant** in EIA terms.
- 8.10.16 The Applicant will continue to engage with NATS prior to and during the application process and will continue this engagement and seek to identify and agree mitigation for the Lowther Hill PSR system. On the basis that suitable mitigation is agreed with NATS, the effect created by the Proposed Development would be Minor, which is **Not Significant** in EIA terms.

Decommissioning

- 8.10.17 Agreed mitigation for the effect to the Lowther Hill PSR is required to remain in place until the Proposed Development has been fully decommissioned. Consequently, this phase would have a **Not Significant** effect in in EIA terms on the Lowther Hill PSR system.

Effects on GPA PSR Systems

Construction

- 8.10.18 The infrastructure required in the process of the construction of the Proposed Development would have no significant effect on the GPA PSR systems. This is because the static nature of the infrastructure is such that it would not be processed and presented onto ATC display screens by the PSR systems. Potential static radar returns would be removed through use of well understood, normal, radar system filtering techniques and thus returns below a pre-set vector threshold would not be displayed on the radar display screen. The magnitude of change would be Negligible, the sensitivity of the receptor is considered to be High, resulting in effects of Minor significance, which is **Not Significant** in EIA terms.

Operation

- 8.10.19 GPA requires an accurate PSR system to support their provision of ATS to aircraft operating to and from, or requesting a service in the vicinity of, the Airport.
- 8.10.20 LoS analysis concluded that theoretically both of the turbines are highly likely to be theoretically detectable by the GPA Terma and S511 PSR systems (Osprey, 2020) (**Appendix 8A**) and create clutter to be presented onto controllers displays. The

Development Site is located directly beneath the flight path for aircraft approaching the Airport on Runway 30. In addition, departures from Runway 12 routing towards the Proposed Development would also be affected, resulting in the possibility of increased track miles being flown by aircraft that are vectored by controllers around the wind farm induced clutter.

- 8.10.21 The receptor is predicted to be directly affected, and vulnerable to this effect; therefore, the magnitude of the change is High. All aviation radar stakeholders aim to ensure 'clutter free' radar to continue to deliver a safe and effective ATS therefore, the sensitivity of the receptor is considered to be High. This effect has therefore been assessed as Major, which is **Significant** in EIA terms.
- 8.10.22 The Applicant would continue to engage with GPA prior to and during the application process and would continue this engagement and seek to identify and agree mitigation for the PSR systems. On the basis that suitable mitigation is agreed with GPA, the effect created by the Proposed Development is reduced to Minor, which is **Not Significant** in EIA terms.

Decommissioning

- 8.10.23 Agreed mitigation for the effect to the GPA PSR is required to remain in place until the Proposed Development has been fully decommissioned. Consequently, this phase would have a **Not Significant** effect, in EIA terms, on the GPA PSR system.

8.11 Assessment of Cumulative Effects

- 8.11.1 There are a number of existing and proposed wind farms, including the Proposed Development and the Consented Enoch Hill Wind Farm, located in areas understood to be detectable to the GPA and NATS PSRs. Without mitigation, the Proposed Development would have a cumulative effect on the GPA and NATS radars in combination with these other projects, in terms of the area affected by radar clutter. Discussions are ongoing with NATS and GPA regarding potential mitigation measures as described in **Section 8.8** *et seq.*
- 8.11.2 Following implementation of mitigation, it can be expected that the stand-alone and cumulative effects of the Proposed Development on the GPA and NATS radar would be reduced to a level assessed as being **Not Significant** in EIA terms.
- 8.11.3 While the proliferation of turbines within LFA 16 and TTA 20T is a general concern for the MOD regarding military Low Flying operations in this region, they have not objected. Subject to the lighting requirements in **Table 8.4**, no adverse cumulative effects are predicted as a result of the Proposed Development.

8.12 Conclusions of Significance Evaluation

- 8.12.1 With the embedded mitigation measures outlined within this EIA Report and based on the progress of discussions and agreements made to date with stakeholders, post-mitigation effects as a result of the Proposed Development are predicted to be **Not Significant** for all aviation stakeholders.

8.13 Implementation of Mitigation Measures

- 8.13.1 **Table 8.4** describes the environmental measures embedded within the Proposed Development and the means by which they would be implemented.

Table 8.4 Summary of Mitigation Measures to be Implemented

Effect	Incorporated mitigation / enhancement measure	Extent to which effect mitigated ³⁰	Monitoring requirements (if any)	Means by which mitigation, or enhancement measure may be secured
Operation				
MOD Low Flying Activities	In order to safeguard general use of the area by military traffic during operation, the Applicant can confirm that the Proposed Development would be fitted with MOD accredited aviation safety lighting. The turbines would be fitted with 25 candela omni-directional infrared lighting with an optimised flash pattern of 60 flashes per minute of 200ms to 500ms duration at the highest practicable point.	Fully	None	By Planning Condition.
GPA PSR	Primary Radar Mitigation Scheme	Fully	None	Planning Condition. GPA have asked that the Applicant accept the wording outlined in Section 8.8.9 of this chapter to replace Condition 23 of the consented Enoch Hill Wind Farm. The Applicant confirms agreement to this replacement wording also being used for the Proposed Development.
NATS Lowther Hill PSR	Primary Radar Mitigation Scheme	Fully	None	Planning Condition 24 which applies to the Consented Enoch Hill Wind Farm and requires that a mitigation solution for the Lowther Hill PSR be agreed with NATS would also apply to the Proposed Development.

³⁰ Key to predicted success of mitigation:

Fully - Effect fully mitigated and no effects predicted.

Substantially - Mitigation would be largely successful at reducing effect. Some effects possible.

Partially - Mitigation would be successful at reducing effects, but some effects likely.