Aviation Impact Assessment

ScottishPower Renewables

Earraghail Renewable Energy Development

16 December 2021

CL-5437-RPT-005 V2.0

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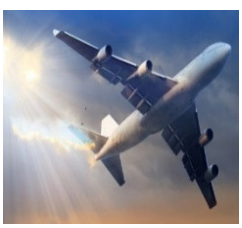

Executive Summary

Cyrrus Limited has been engaged to provide guidance on aviation issues associated with ScottishPower Renewables' proposed Earraghail Renewable Energy Development (the proposed Development) on the Kintyre Peninsula, Argyll and Bute. The proposed Development is anticipated to comprise up to 13 wind turbines with a maximum blade tip height of 180m Above Ground Level (AGL).

Of the aviation stakeholders consulted, Glasgow Prestwick Airport (GPA) stated that any turbine generated clutter would require mitigation, while NATS (En Route) Limited (NERL) indicated that it would object to the proposal due to an unacceptable technical impact on its Primary Surveillance Radar (PSR) at Lowther Hill. The Ministry of Defence (MOD) raised no concerns with the proposal but requested that turbines be fitted with MOD accredited aviation safety lighting.

Initial modelling of the closest NERL PSRs at Lowther Hill and Tiree shows that all 13 turbines are in RLoS of Lowther Hill, while none are in RLoS of Tiree. It can be assumed that Lowther Hill PSR will detect all 13 turbines.

Initial modelling of the S511 and Terma PSRs at GPA show that all 13 of the proposed turbines are in Radar Line of Sight (RLoS) of these radars. It can be assumed that both the S511 and Terma PSRs will also detect all 13 turbines.

The proposed Development is on the edge of GPA's Radar Consultation Zone and, as stated in 2012 by GPA in a response to the planning application for the nearby Freasdail Windfarm, in an area 'rarely used' by the Airport for vectoring aircraft. Any clutter associated with the proposed Development is therefore unlikely to have a negative impact on GPA's ability to provide an Air Traffic Service (ATS).

This report acknowledges that clutter will be formed but, as stated in CAP 764, an objection may not be made simply on the grounds of clutter alone. The Air Navigation Service Providers (ANSPs) must determine an impact on ATS. This report clearly evidences little to no impact on ATS for either GPA or NERL and recommends that both ANSPs provide evidence as to how the proposed Development will impact their ATS.

In the event that impact on ATS can be demonstrated, mitigations are possible and described within this report.

Abbreviations

ACP	Airspace Change Proposal
AGL	Above Ground Level
AIP	Aeronautical Information Publication
AMSL	Above Mean Sea Level
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATS	Air Traffic Service
CAS	Controlled Airspace
CNS	Communication, Navigation and Surveillance
DTM	Digital Terrain Model
DLFS	Day Low Flying System
DRA	Direct Route Airspace
EIA	Environmental Impact Assessment
FIS	Flight Information Service
FL	Flight Level
GA	General Aviation
GIS	Geographic Information System
GPA	Glasgow Prestwick Airport
LFA	Low Flying Area
MOD	Ministry of Defence
NERL	NATS (En Route) Limited
NLFS	Night Low Flying System
NM	Nautical Miles
PD	Probability of Detection
PSR	Primary Surveillance Radar
RLoS	Radar Line of Sight
RMZ	Radio Mandatory Zone
SAR	Search and Rescue
SPR	ScottishPower Renewables
SSR	Secondary Surveillance Radar
TCP	Transfer of Control point
TOPA	Technical and Operational Assessment
TRA	Temporary Reserved Area

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1. Introduction

1.1. Background

1.1.1. ScottishPower Renewables (SPR) is proposing to develop Earraghail Renewable Energy Development (the proposed Development) on the Kintyre Peninsula, Argyll and Bute. The proposed Development is anticipated to comprise up to 13 turbines with a blade tip height of up to 180m Above Ground Level (AGL).

1.1.2. The location of the proposed Development is indicated in Figure 1.

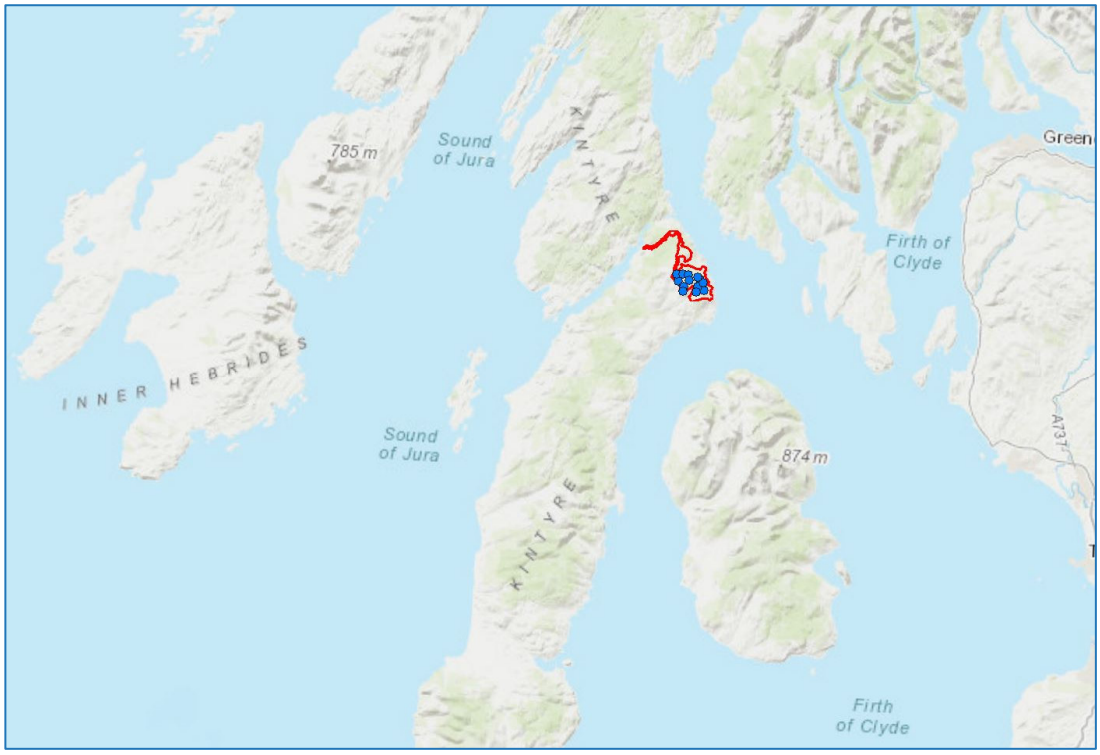

Figure 1: Earraghail Renewable Energy Development location

1.1.1. Cyrrus Limited has been engaged to provide guidance on aviation issues to support the Environmental Impact Assessment (EIA) process for the proposed Development.

1.2. Effects of Wind Turbines on Aviation

1.2.1. Wind turbines are an issue for aviation Primary Surveillance Radars (PSRs) as the characteristics of a moving wind turbine blade are similar to that of an aircraft. The PSR is unable to differentiate between wanted aircraft targets and unwanted clutter targets introduced by the presence of turbines.

1.2.2. The significance of any radar impact depends on airspace usage in the vicinity of the windfarm site and the nature of the Air Traffic Service (ATS) provided in that airspace.

1.3. Scoping Responses

1.3.1. Following publication of the Scoping Report[1] and requests for pre-application advice, responses have been received from the following aviation stakeholders:

- Glasgow Prestwick Airport (GPA);
- Ministry of Defence (MOD); and
- NATS (En Route) Limited (NERL).

1.3.2. In GPA's response on 25 June 2020 it notes that the proposed Development is in an area where Air Traffic Control (ATC) regularly hand military aircraft over to military controllers and vice versa during military exercises and that any turbine generated clutter would hence require mitigation.

1.3.3. The MOD response on 27 May 2020 states that they have no concerns with the proposal but requests that the proposed Development be fitted with MOD accredited aviation safety lighting.

1.3.4. In NERL's response on 25 June 2020 it objects to the proposal. A NATS Technical and Operational Assessment (TOPA)[2] issued for the proposed Development anticipates an unacceptable technical impact on Lowther Hill radar.

1.4. Aviation Modelling Tasks

1.4.1. The aviation modelling tasks identified are:

- Determine the radar visibility of the proposed Development to GPA's PSRs;
- Determine the radar visibility of the proposed Development to NERL's PSRs; and
- Review the nature of the airspace in the vicinity of the proposed Development to determine any potential impact on aviation.

[1] Earraghail Renewable Energy Development EIA Scoping Report, April 2020

[2] TOPA for Earraghail Renewable Energy Development, NATS ref: SG29685, Issue 1, June 2020

2. Data

2.1. Earraghail Renewable Energy Development

2.1.1. A design freeze turbine layout for the proposed Development was finalised on 15 December 2021.

2.1.2. The Ordnance Survey National Grid coordinates for this proposed turbine layout, as used in the assessment, are listed in **Table 1**.

Turbine	Easting	Northing
1	187956	662033
2	190341	662135
3	190737	660952
4	190110	661402
5	189898	660807
6	190711	661790
7	187801	662725
8	188481	662728
9	189075	662686
11	190073	662403
12	189156	662083
13	188515	661414
14	188473	660921

Table 1: Earraghail Renewable Energy Development turbine coordinates

2.1.3. The 13 turbines are planned to have a blade (rotor) diameter of around 155m and a maximum blade tip height of 180m AGL.

2.1.4. The proposed turbine layout used for the modelling is shown in **Figure 2**.

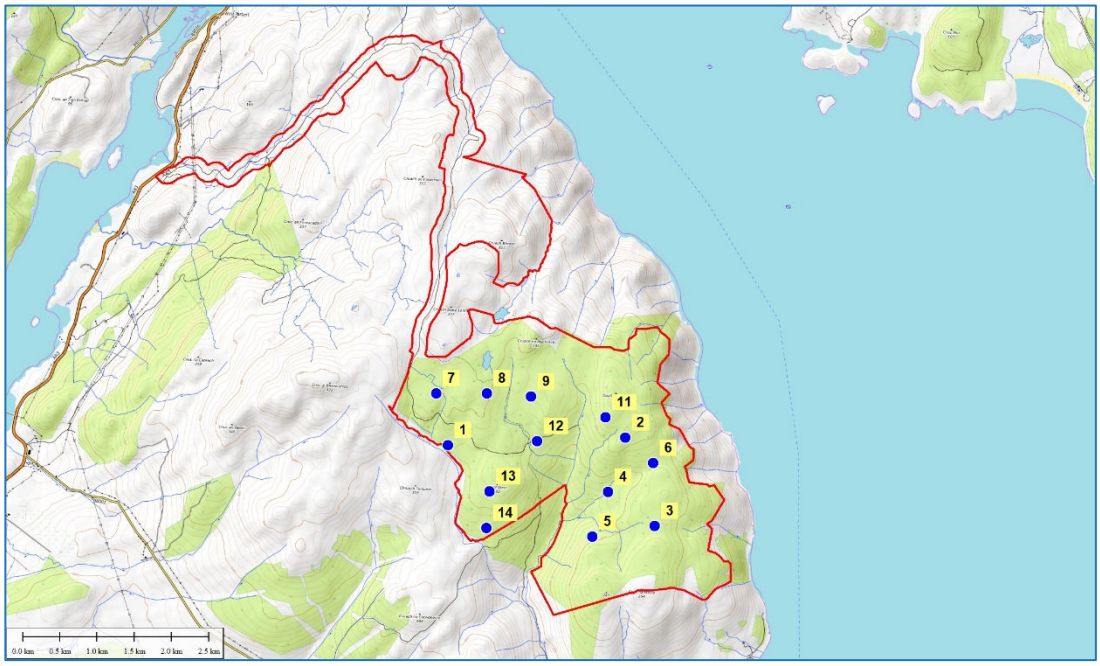

Figure 2: Earraghail Renewable Energy Development turbine layout

2.2. Radar Data

2.2.1. Radar parameters used in the assessment have been taken from data held on file by Cyrrus.

2.3. Analysis Tools

- ATDI HTZ communications v23.2.5 x64 radio network analysis tool;
- Global Mapper v21.1.1 Geographic Information System data processing utility;
- ZWCAD+ 2015 SP2 Pro v2015.05.26(27086) Computer Aided Design software.

2.4. Terrain Data

- 20m Digital Terrain Model (DTM)

2.4.1. A 3D view of the turbines and the terrain model is shown in **Figure 3**.

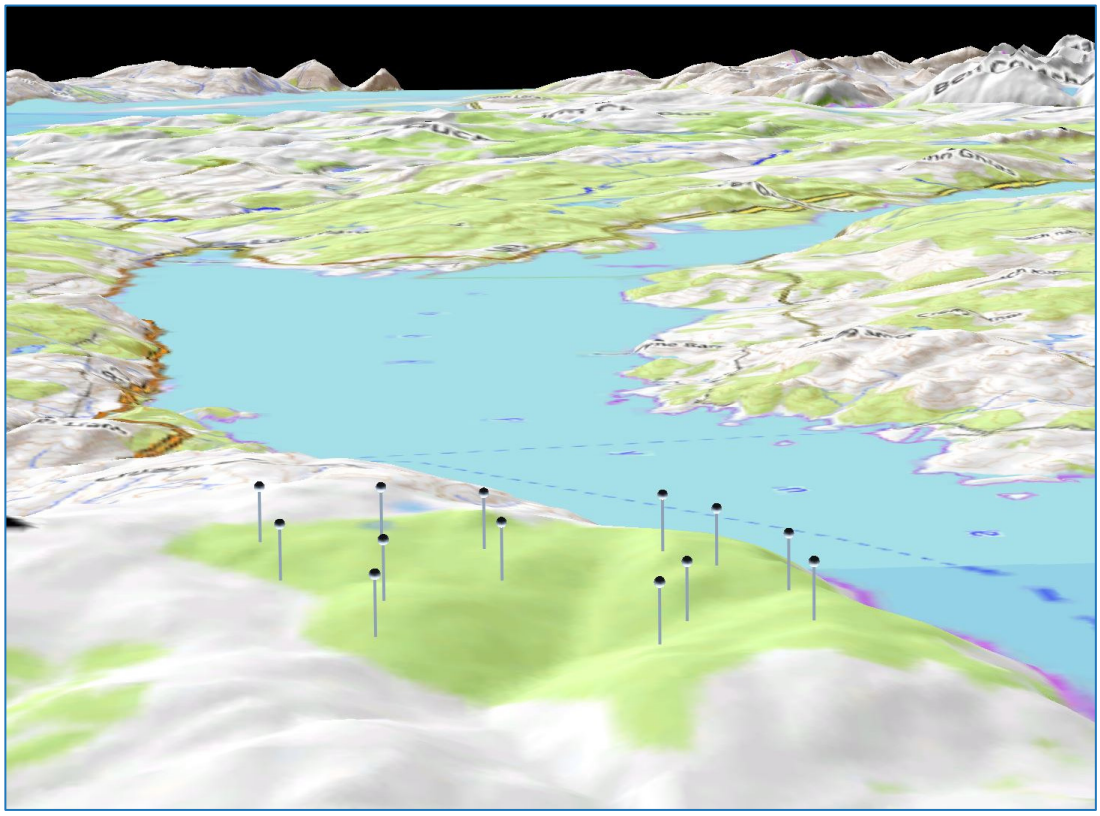

Figure 3: 3D view of turbines and terrain from south

3. GPA Modelling

3.1. Radar Locations

3.1.1. There are two PSR facilities at GPA: a Marconi S511 radar used for planning purposes while a Terma Scanter 4002 radar is used for approach control. In addition, GPA is fed with Secondary Surveillance Radar (SSR) data from Lowther Hill radar. GPA is authorised to use SSR only in the event of PSR failure.

3.1.2. The locations of the two GPA PSRs are shown in **Figure 4**.

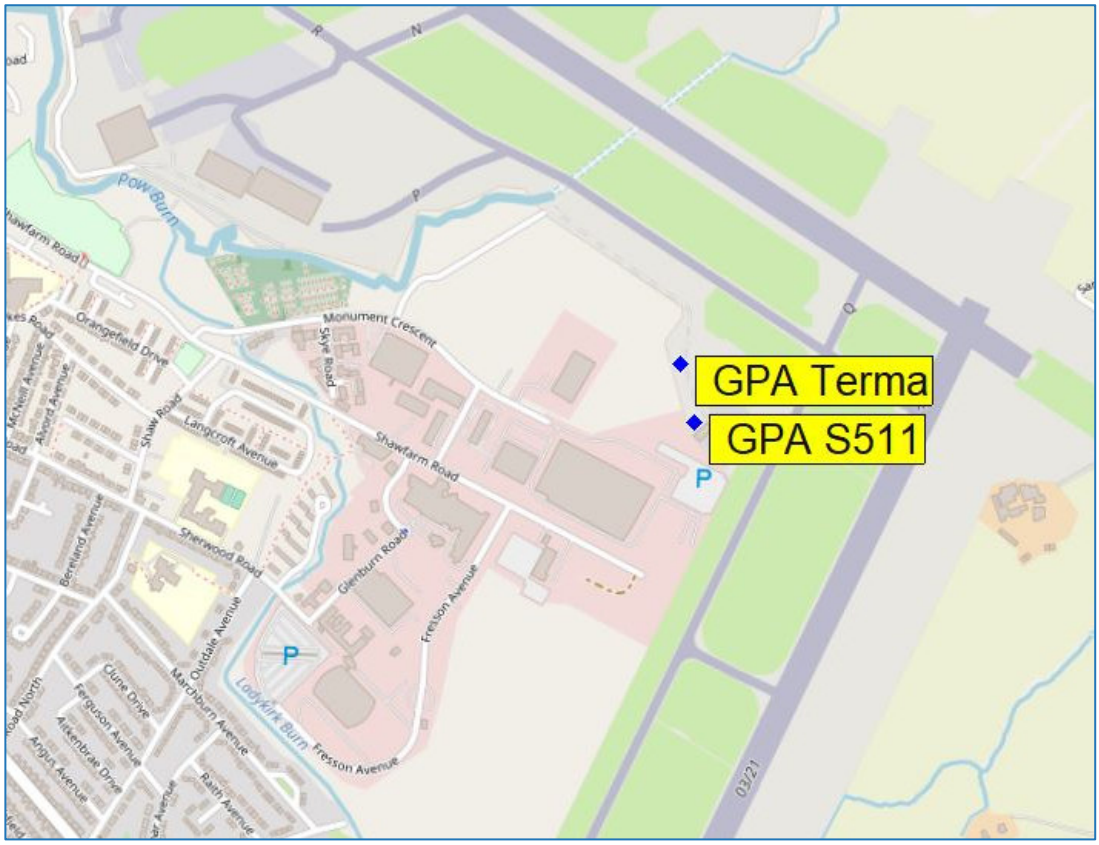

Figure 4: Locations of GPA Terma PSR and S511 PSR

3.1.3. The nearest turbine within the proposed Development area is approximately 57.8 km northwest of the GPA PSRs, as shown in **Figure 5**.

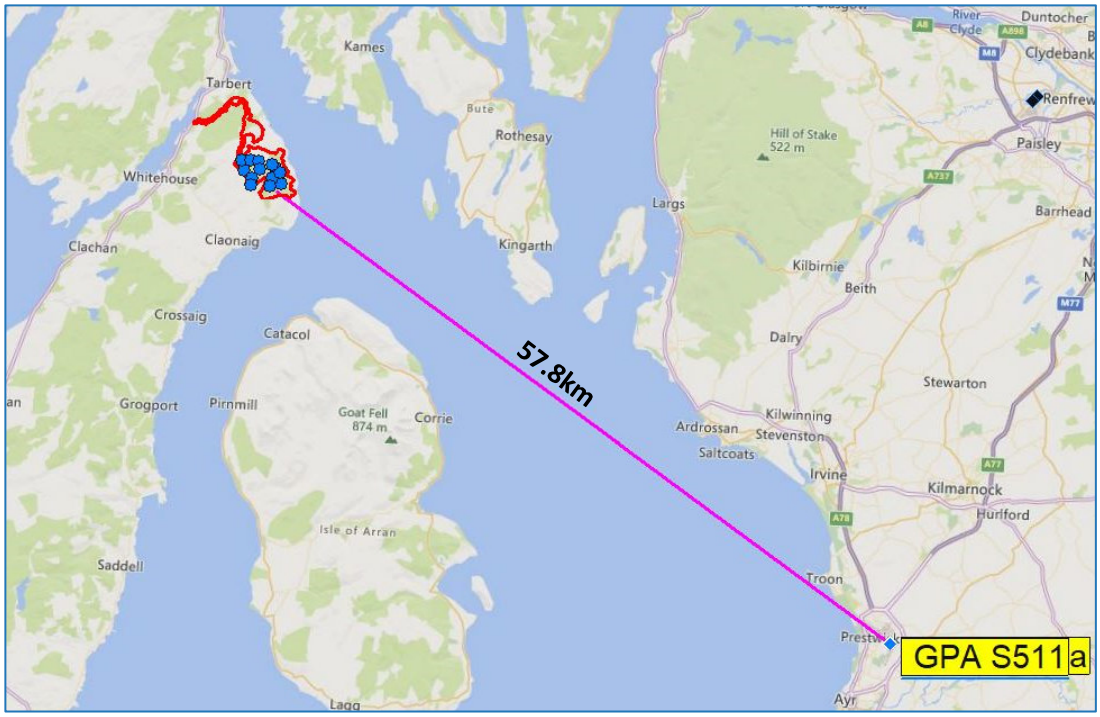

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Figure 5: Location of GPA PSRs and Earraghail Renewable Energy Development

3.2. Radar Line of Sight

3.2.1. Radar Line of Sight (RLoS) is determined from a radar propagation model (ATDI HTZ communications) using 3D DTM data with 20 m horizontal resolution. Radar data is entered into the model and RLoS to the turbines from the radar is calculated.

3.2.2. Note that by using a DTM no account is taken of possible further shielding of the proposed turbines due to the presence of structures or vegetation that may lie between the radars and the turbines. Thus, the RLoS assessments are worst-case results.

3.2.3. For PSR, the principal sources of adverse windfarm effects are the turbine blades, so RLoS is calculated for the maximum tip height of the turbines, i.e. 180 m AGL.

3.3. RLoS – GPA S511 PSR

3.3.1. The magenta shading in Figure 6 illustrates the RLoS coverage from the GPA S511 PSR to turbines with a blade tip height of 180 m AGL.

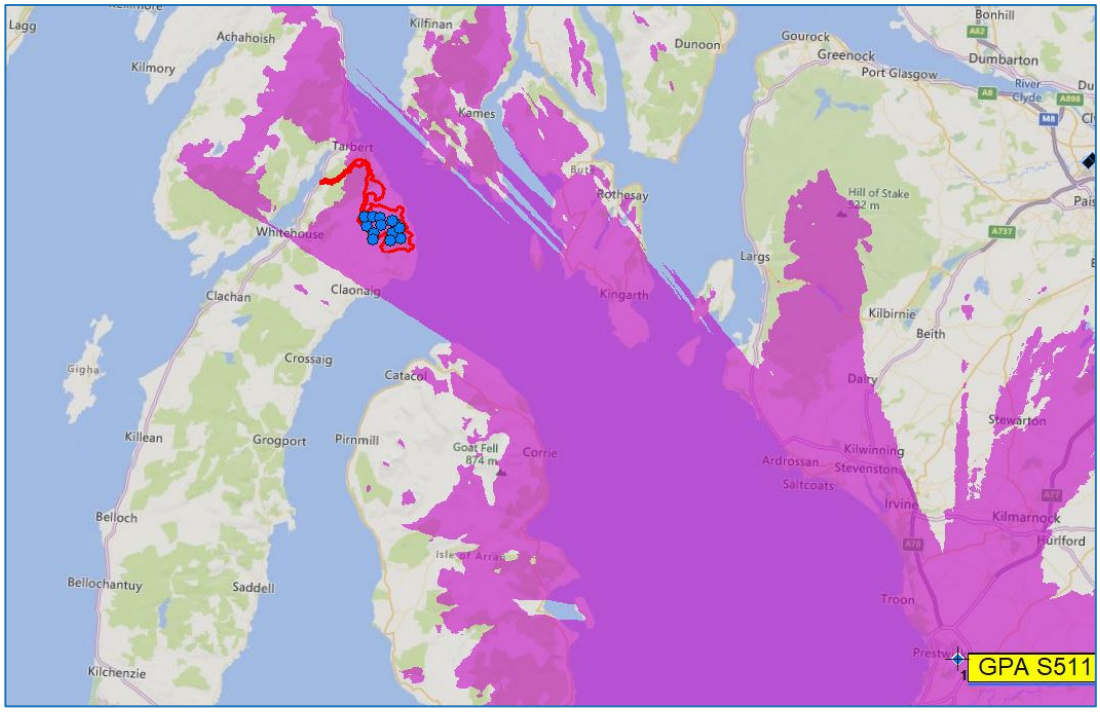

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Figure 6: GPA S511 PSR RLoS to 180m AGL

3.3.2. The zoomed view of the proposed Development in **Figure 7** confirms that RLoS exists between the S511 PSR and the blade tips of all the turbines.

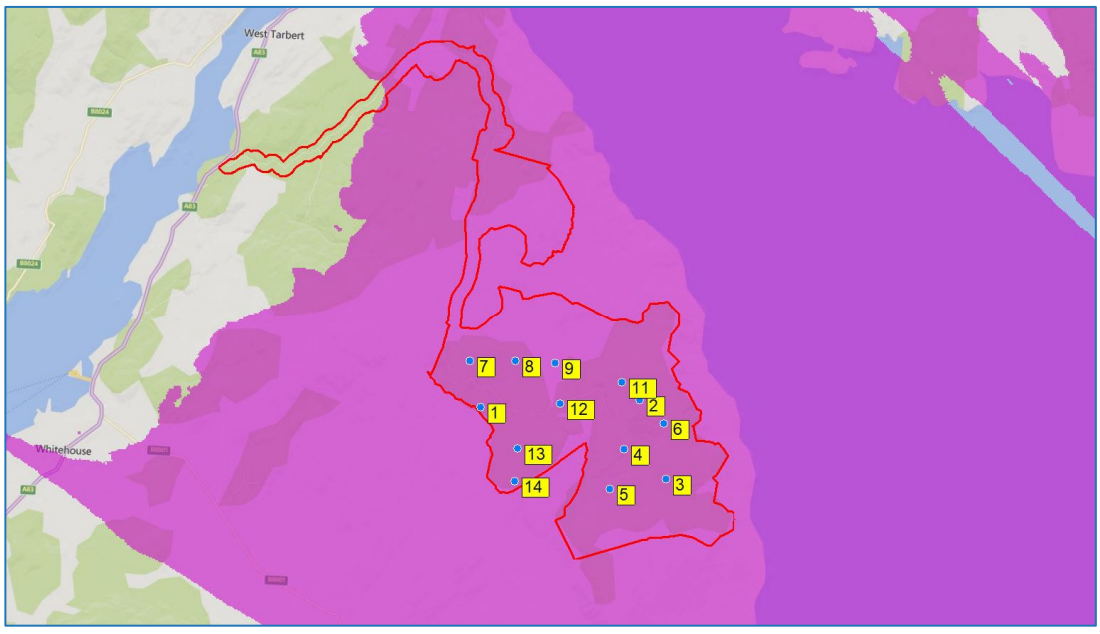

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Figure 7: GPA S511 PSR RLoS to 180m AGL – zoomed

3.3.3. Given that RLoS exists to all the turbines, it can be assumed that the GPA S511 PSR will also detect all the turbines in the proposed Development.

3.4. RLoS – GPA Terma PSR

3.4.1. The magenta shading in **Figure 8** illustrates the RLoS coverage from the GPA Terma PSR to turbines with a blade tip height of 180 m AGL.

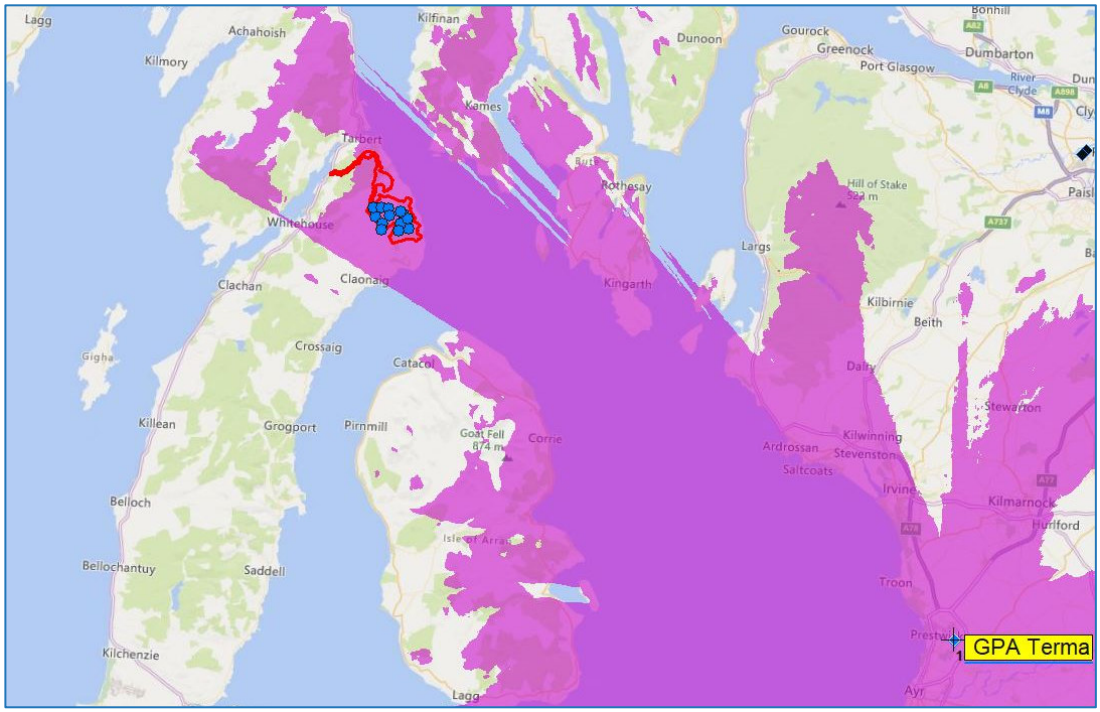

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Figure 8: GPA Terma PSR RLoS to 180m AGL

3.4.2. The zoomed view of the proposed Development in **Figure 9** confirms that, as with the S511 PSR, RLoS exists between the Terma PSR and the blade tips of all of the turbines.

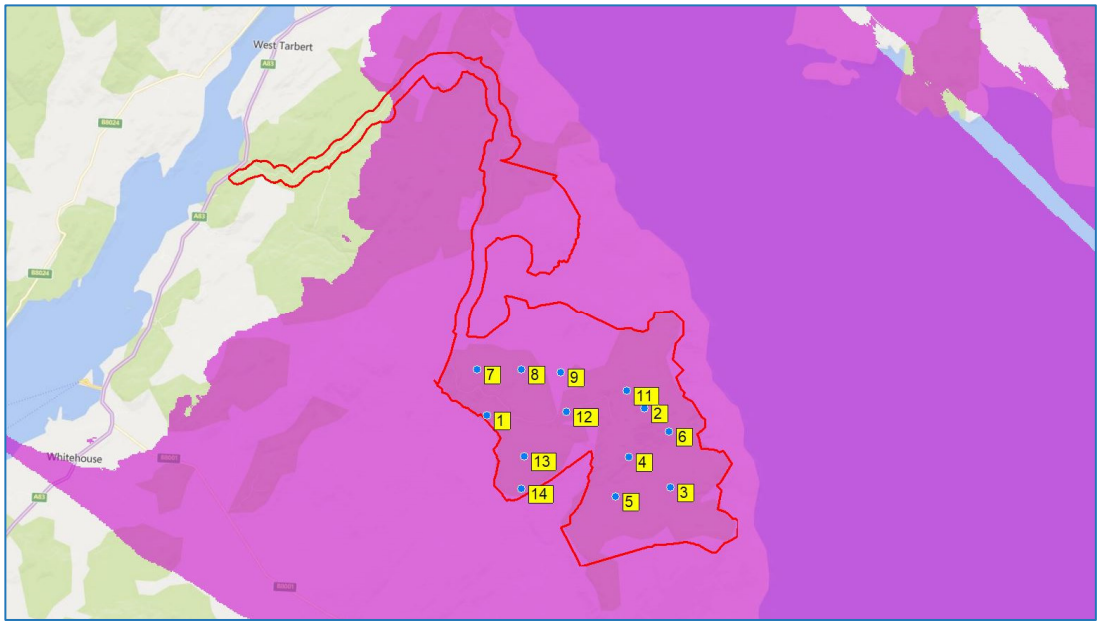

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Figure 9: GPA Terma PSR RLoS to 180m AGL – zoomed

3.4.3. Given that RLoS exists to all the turbines, it can be assumed that the GPA Terma PSR will also detect all the turbines of the proposed Development.

4. NERL Modelling

4.1. Radar Locations

4.1.1. The closest NERL facilities to the proposed Development are the PSRs at Lowther Hill and Tiree.

4.1.2. The nearest turbine of the proposed Development is approximately 110.5 km northwest of Lowther Hill PSR, as shown in **Figure 10**.

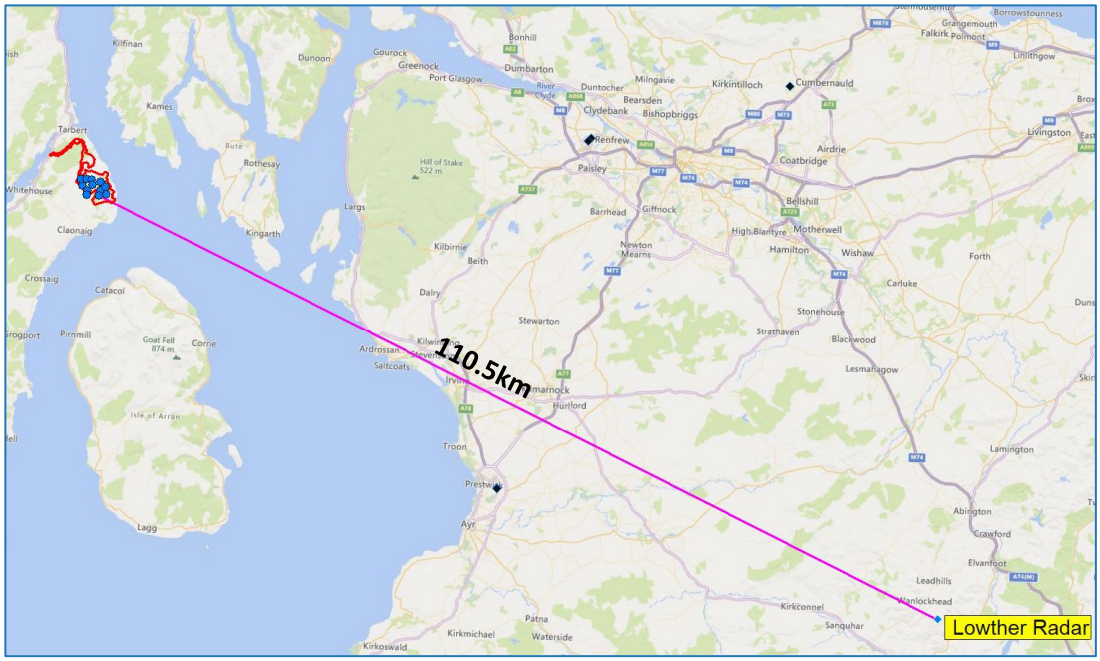

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Figure 10: Location of Lowther Hill PSR and Earraghail Renewable Energy Development

4.1.3. The nearest turbine of the proposed Development is approximately 119.3 km southeast of Tiree PSR, as shown in **Figure 11**.

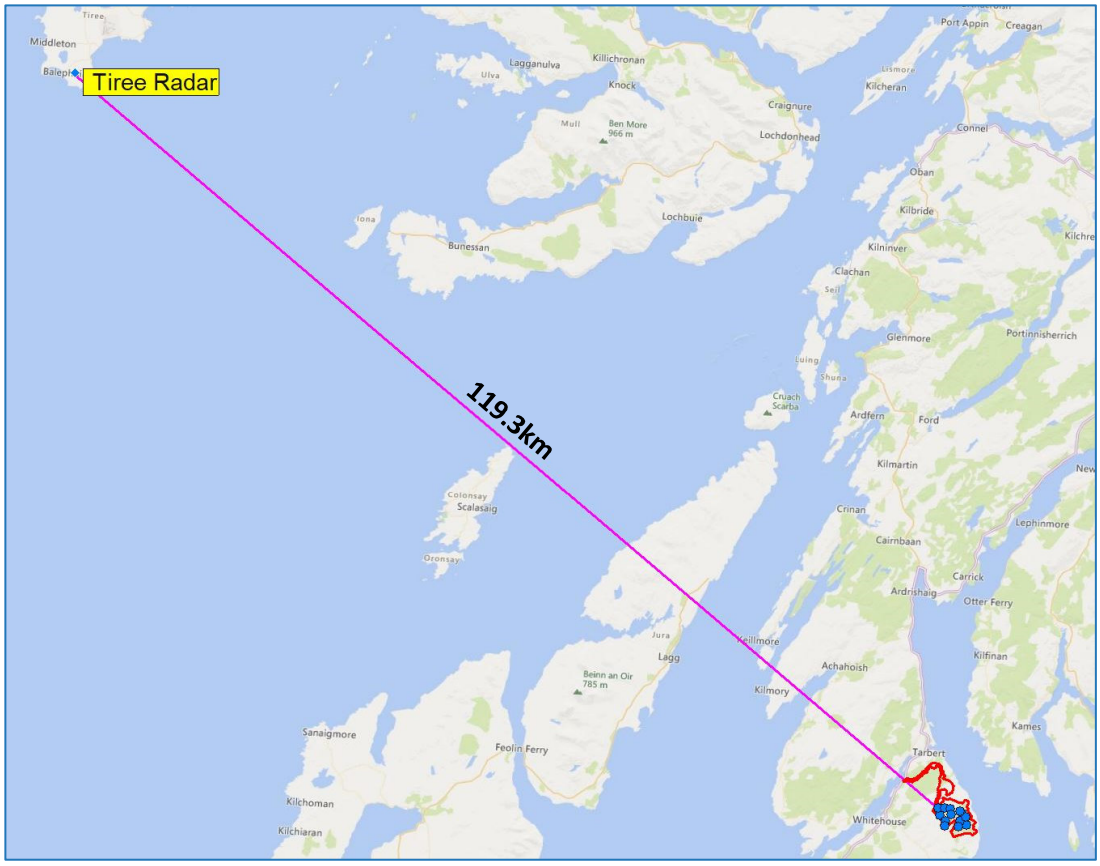

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Figure 11: Location of Tiree PSR and Earraghail Renewable Energy Development

4.2. Radar Line of Sight

4.2.1. RLoS is determined from a radar propagation model (ATDI HTZ communications) using 3D DTM data with 20m horizontal resolution. Radar data is entered into the model and RLoS to the turbines from the radar is calculated.

4.2.2. Note that by using a DTM no account is taken of possible further shielding of the turbines due to the presence of structures or vegetation that may lie between the radars and the turbines. Thus, the RLoS assessments are worst-case results.

4.2.3. For PSR, the principal sources of adverse windfarm effects are the turbine blades, so RLoS is calculated for the maximum tip height of the turbines, i.e. 180 m to blade tip.

4.3. RLoS – Lowther Hill PSR

4.3.1. The magenta shading in Figure 12 illustrates the RLoS coverage from Lowther Hill PSR to turbines with a blade tip height of 180 m AGL.

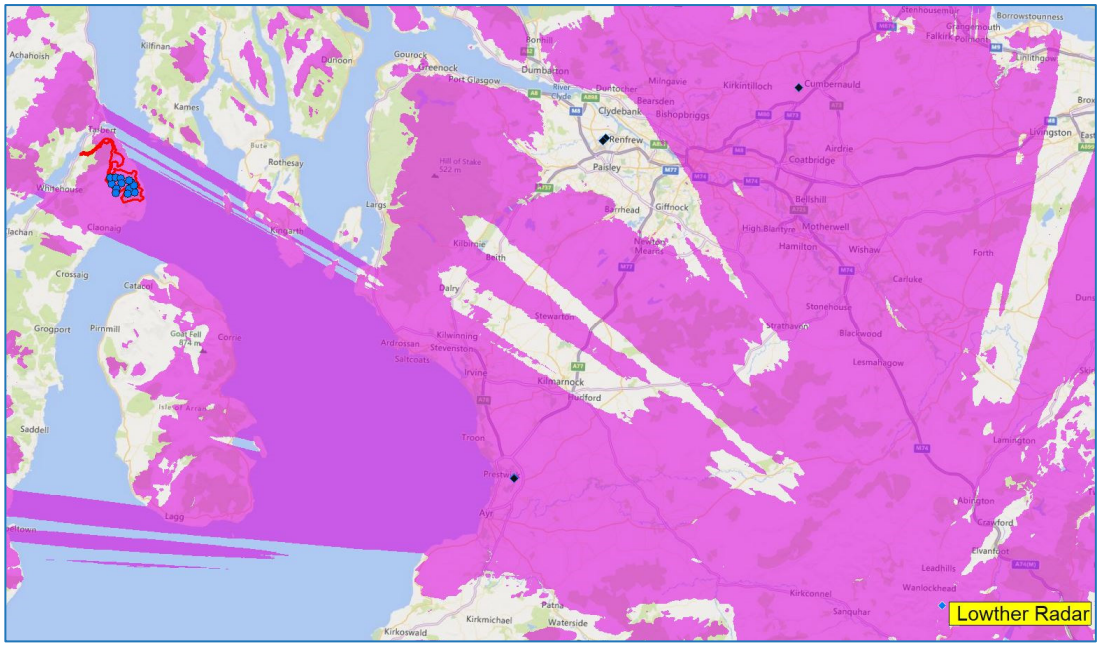

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Figure 12: Lowther Hill PSR RLoS to 180m AGL

4.3.2. The zoomed view of the proposed Development in **Figure 13** shows that RLoS exists between Lowther PSR and all 13 turbines.

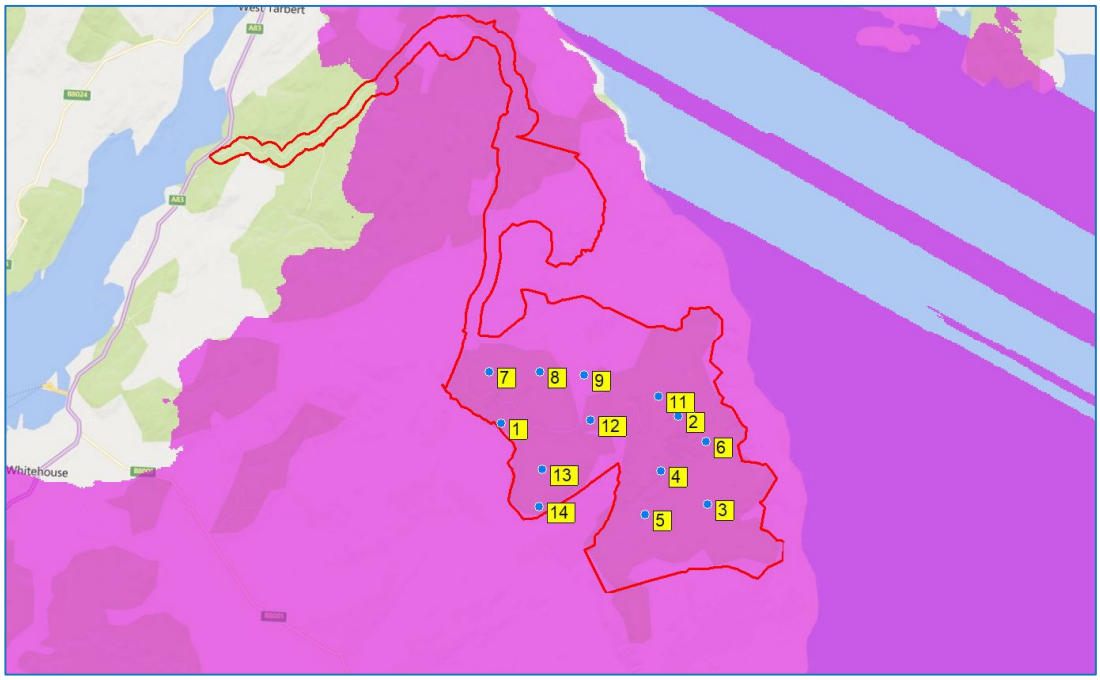

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Figure 13: Lowther Hill PSR RLoS to 180m AGL – zoomed

4.3.3. Given that RLoS exists to all the turbines, it can be assumed that Lowther Hill PSR will also detect all 13 turbines.

4.4. RLoS – Tiree PSR

4.4.1. The magenta shading in Figure 14 illustrates the RLoS coverage from Tiree PSR to turbines with a blade tip height of 180 m AGL.

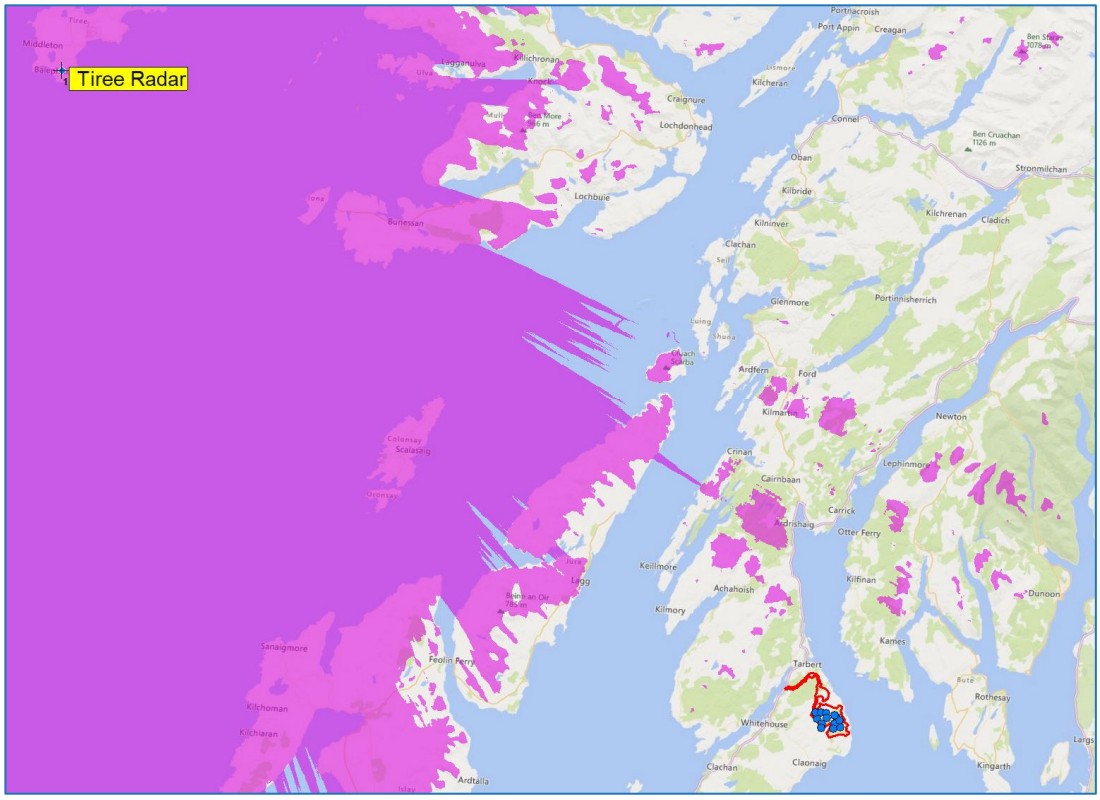

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Figure 14: Tiree PSR RLoS to 180m AGL

4.4.2. The zoomed view of the proposed Development in **Figure 15** confirms that RLoS does not exist between Tiree PSR and any of the turbines.

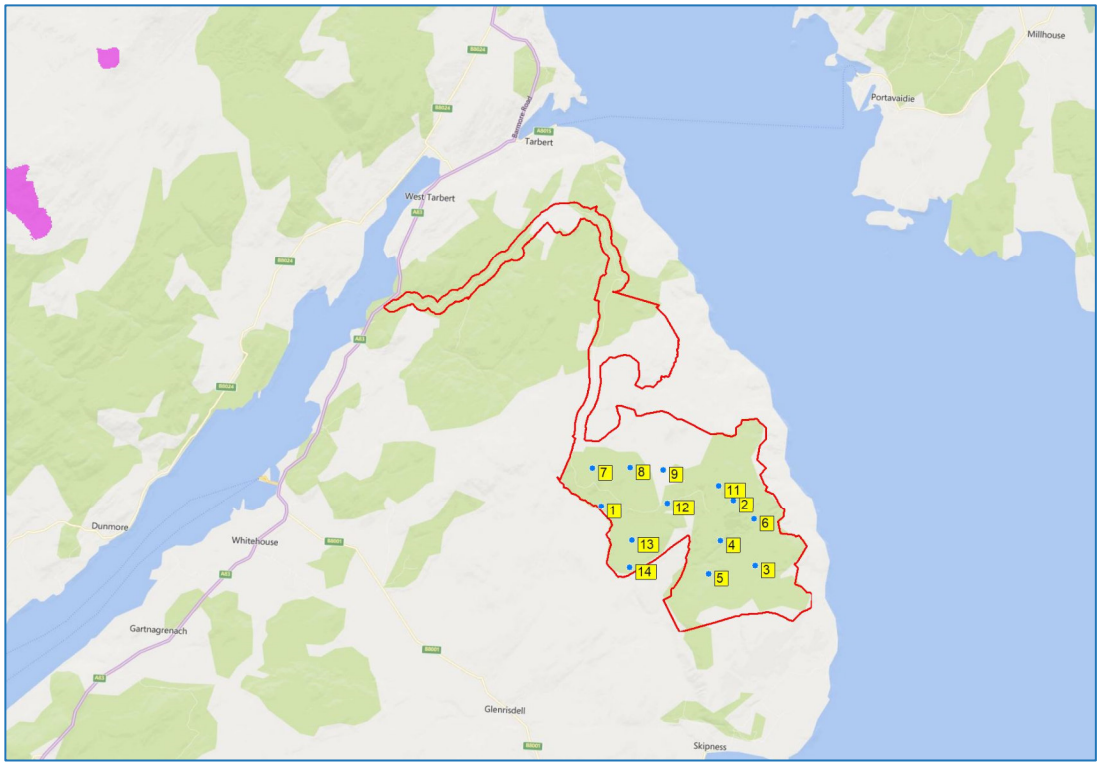

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Figure 15: Tiree PSR RLoS to 180m AGL – zoomed

4.4.3. Given that RLoS does not exist, it can be assumed that Tiree PSR is unlikely to detect the turbines of the proposed Development.

5. Airspace Analysis

5.1. Overview

5.1.1. The significance of any radar impact depends on airspace usage in the vicinity of a windfarm site and the nature of the ATS provided in that airspace.

5.1.2. The airspace surrounding the proposed Development is contained in the UK Aeronautical Information Publication (AIP). The type (airspace classification), usage and dimensions are contained within various sections of the En-Route (ENR) section of the AIP.

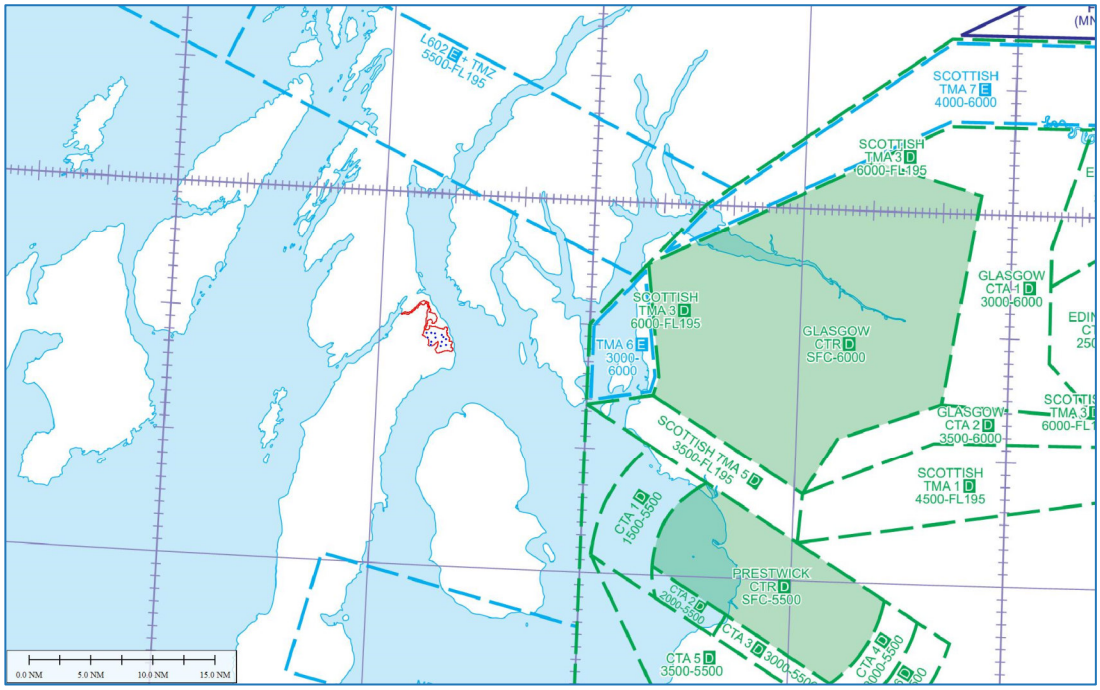

Figure 16: Extract from Chart of UK ATS Airspace Classification – SFC-FL195 ENR 6-7, 20 May 21

5.1.3. The airspace immediately above the proposed Development consists of two types of airspace. The first portion is classified as Class G and extends from ground level to Flight Level (FL) 195 (approximately 19,500ft AMSL).

5.1.4. Class G airspace is commonly referred to as 'uncontrolled airspace' and is predominantly used by General Aviation (GA) and military aircraft.

5.1.5. The closest aerodrome used by GA is Campbeltown Airport, approximately 40 km to the south-west. Campbeltown is only open during daytime hours. The ENR chart depicting the UK Night Low Flying System shows that the proposed Development is within Night Low Flying Area (LFA) 1A and that an area used by Search and Rescue (SAR) helicopters, known as Arran SAR, is in the immediate vicinity.

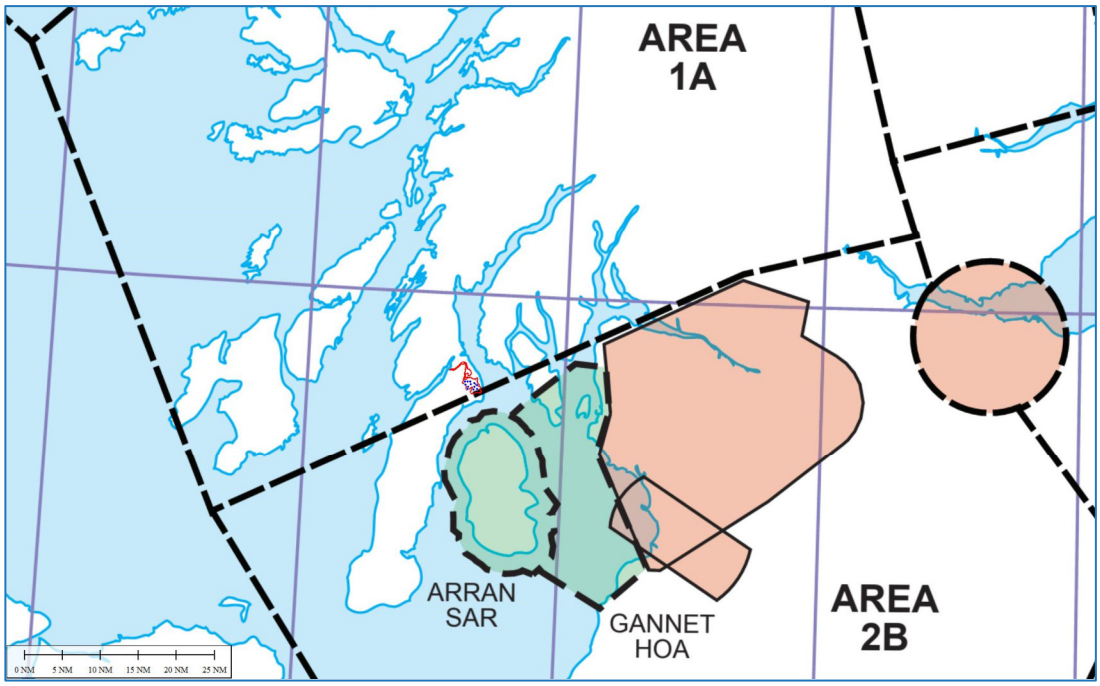

Figure 17: Extract from UK Night Low Flying System (NLFS) ENR 6-21, 2 Jan 20

5.1.6. The UK Day Low Flying System chart indicates that the proposed Development is within LFA 14 (PINS 14E), as shown in **Figure 18**.

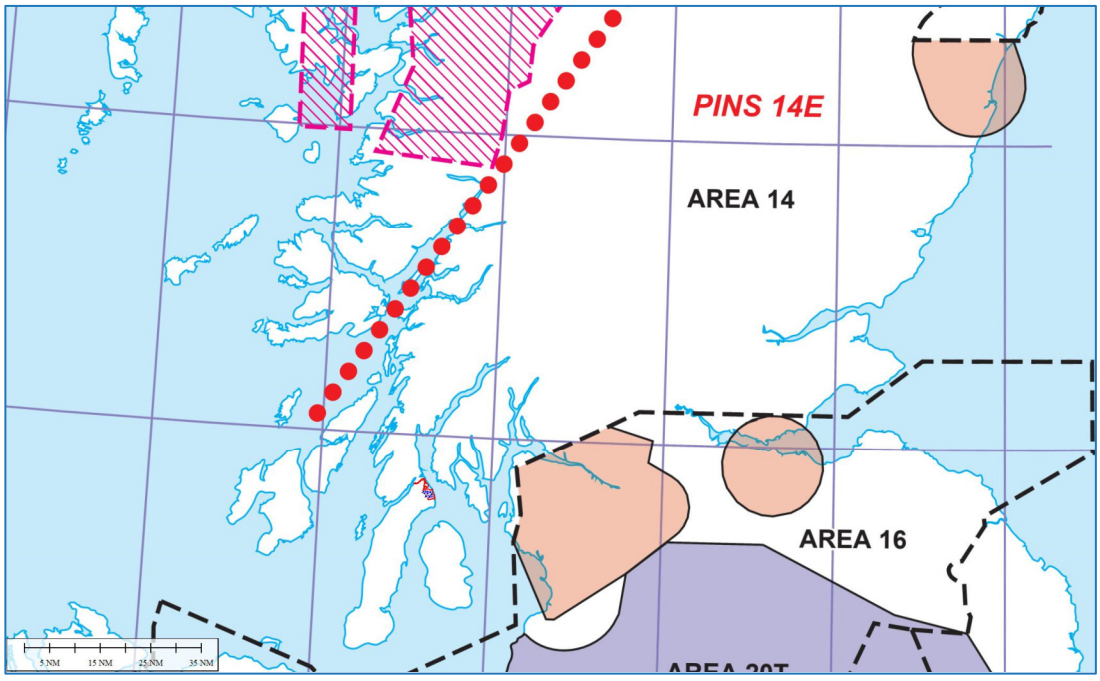

Figure 18: Extract from PINS Areas and UK Day Low Flying System (DLFS) ENR 6-20, 2 Jan 20

5.1.7. The higher portion of airspace, above FL195, is Class C 'controlled airspace' and is located within a Temporary Reserved Area (namely TRA 08C), as shown in **Figure 19**.

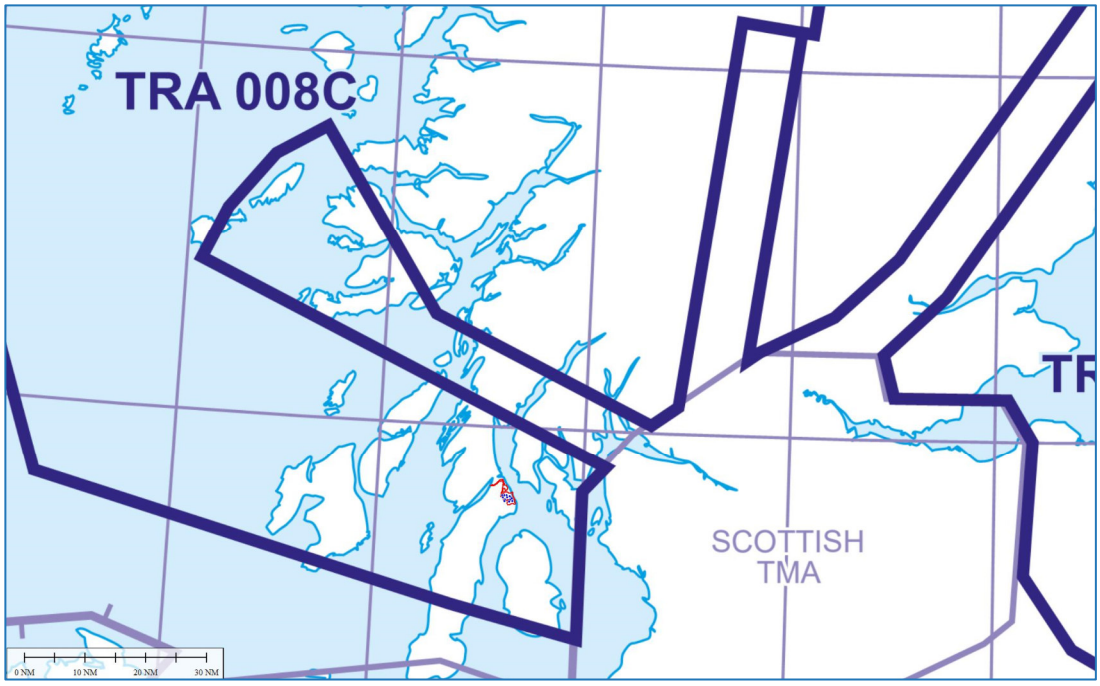

Figure 19: Extract from Temporary Reserved Areas (TRA) ENR 6-13, 25 Feb 21

5.1.8. The elevation of the highest proposed turbine extends to less than 1,700 ft AMSL, and as such does not penetrate any controlled airspace. The site is well clear of any of the airspace structures that are in the vicinity.

5.2. Provision of Air Traffic Services

5.2.1. As already stated, the airspace above the proposed Development consists of two types of airspace. The lower portion is Uncontrolled Airspace notified as Class G airspace while the upper airspace is Controlled Airspace (CAS) and notified as either Class A or C.

5.2.2. For the purpose of this analysis both portions of airspace will be reviewed to determine impact on ATS. The first review will consider the Class G airspace followed by the upper airspace and en-route environment.

5.2.3. For the avoidance of doubt, Prestwick Centre (managed by NERL and also referred to as Scottish Centre) and Prestwick Airport (managed by GPA) are separate entities.

5.2.4. **Figure 20** is a map extracted from the AIP, ENR 6-33. This map indicates the Flight Information Services (FIS) Sectors for Scottish Control.

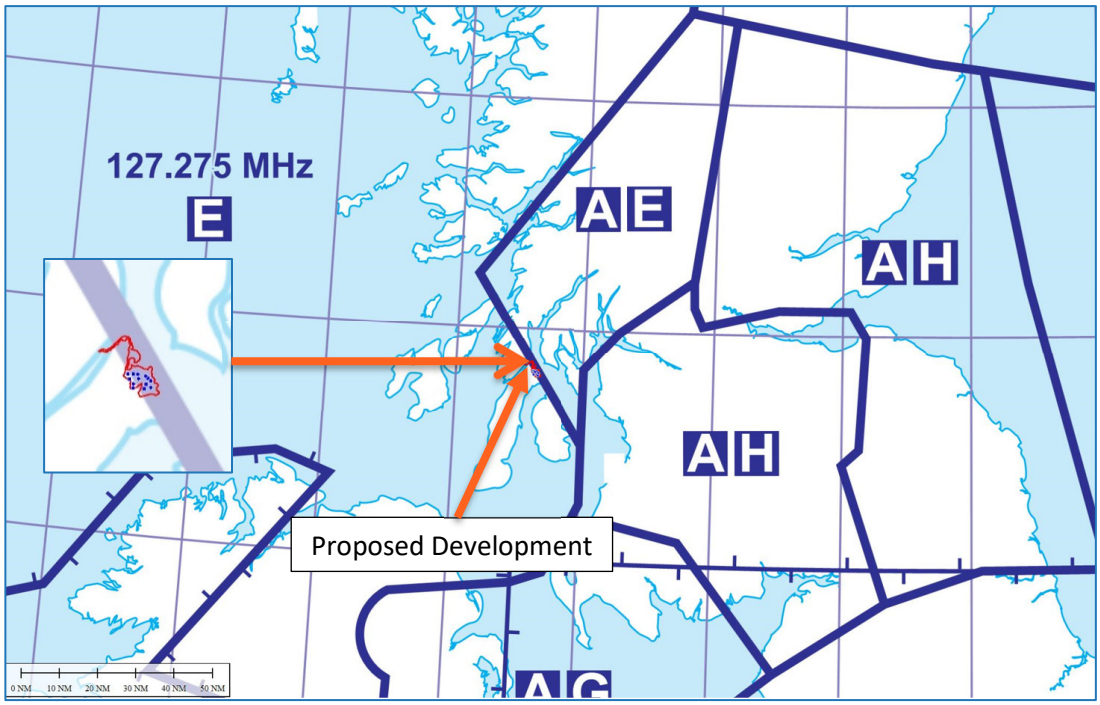

Figure 20: Extract from Scottish Control (Prestwick) - FIS Sectors ENR 6-33, 25 Mar 21

5.2.5. The proposed Development is situated on the border of two FIS Sectors namely Sector A and E. Sector A is only available between 0800-2000 whilst Sector E is operational 24 hours. When Sector A closes, Sector E assumes the services in that sector.

5.2.6. Sector A provides a Basic Service FL55 and below, outside of CAS while a Control/Information FIS is available above FL55. Sector E provides a Control/Information FIS from surface to FL245. The type of FIS is dependent on classification of airspace above FL55.

5.2.7. NERL may provide surveillance-based services in uncontrolled airspace FL55 and below (only a Basic Service is offered), subject to available surveillance coverage (CAP774). Under a Basic Service there is no requirement for the service provider to monitor the flight although controllers may utilise any ATS surveillance system derived information at their disposal in the provision of a Basic Service. However, given that the provider of a Basic Service is not required to monitor the flight, pilots should not expect any form of traffic information from a controller.

5.2.8. It is accepted that where a controller has information that indicates that there is aerial activity in a particular location that may affect a flight, in so far as it is practical, they should provide traffic information in general terms to assist with the pilot's situational awareness. However, whether traffic information has been provided or not, the pilot remains responsible for collision avoidance without assistance from the controller (see CAP 774[3]).

[3] CAP 774: UK Flight Information Services, Version 3, 25 May 2017

5.2.9. Aircraft flying within Class G airspace are not required to contact ATS unless there are conditions associated with that airspace, e.g. Radio Mandatory Zone (RMZ) where aircraft entering a delegated portion of airspace are required to contact and maintain radio contact.

5.2.10. The proposed Development is more than 15NM from any lower airspace routes, as shown in **Figure 21**.

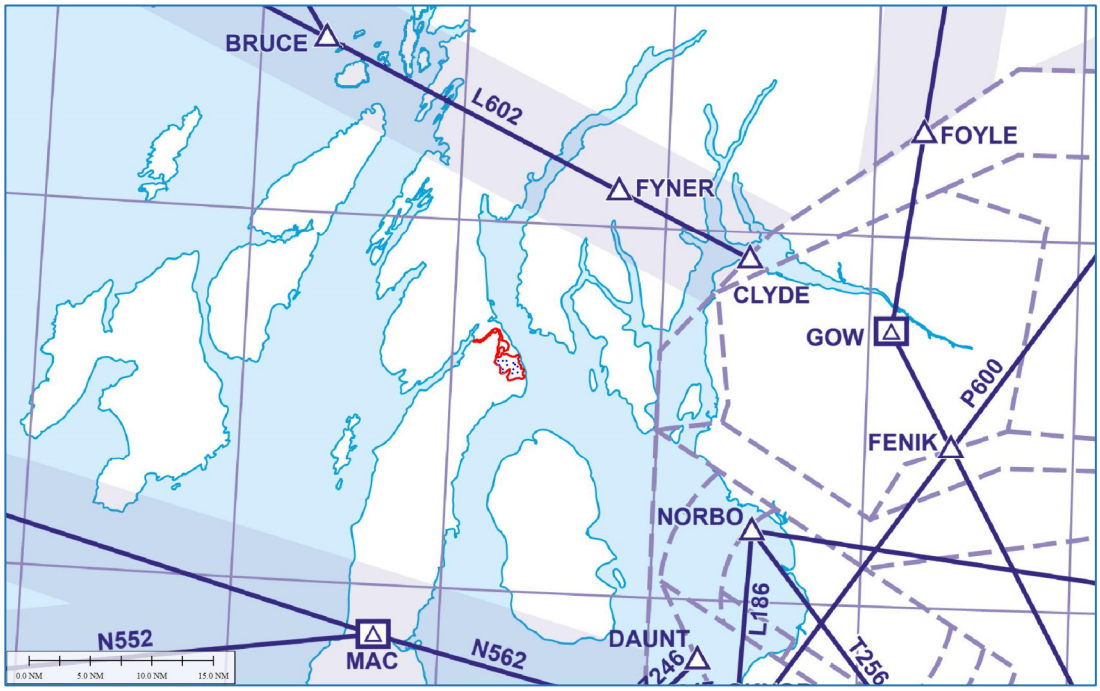

Figure 21: Extract from Lower ATS Routes (North Sheet) ENR 6-69, 25 Feb 21

5.2.11. For all aircraft in UK airspace above FL100 it is mandatory to carry SSR transponder equipment. The ATS provided by NERL above FL195 utilises only SSR therefore any primary radar returns (clutter) associated with the turbines would not impact upon the provision of ATS as they would not be presented to the controller. Note that the rules for the provision of ATS within Class C airspace do not apply within an active TRA, and for large portions of the day this airspace is an active TRA from FL195 to FL245. ATS in an active TRA is provided in accordance with CAP 774.

5.2.12. The airspace above FL255 in the vicinity of the proposed Development is classified as Scottish Direct Route Airspace (DRA), as depicted in **Figure 22**. Within DRA transatlantic traffic can plan more efficient direct routes to cut flying times and save fuel.

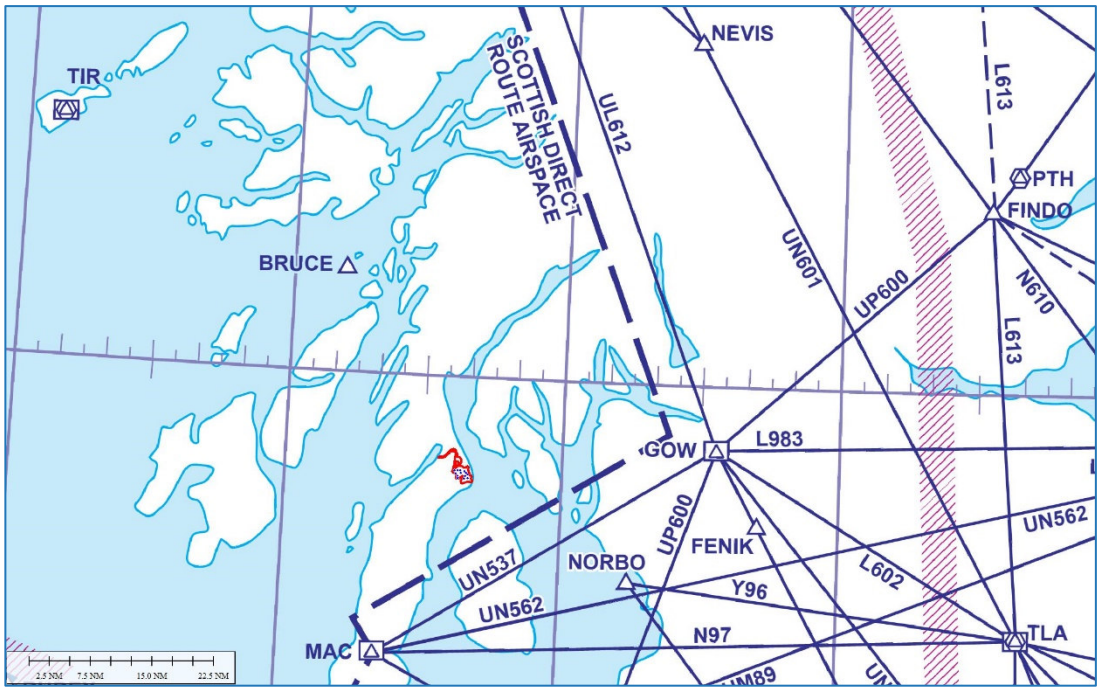

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Figure 22: Extract from Upper Airspace Control Area and Upper ATS Routes (North Sheet) ENR 6-71, 27 Feb 21

5.2.13. CAP 764[4] states that 'Where an ANSP (Air Navigation Service Provider) determines that it is likely that a planned wind turbine development would result in any of the above effects on their CNS (Communication, Navigation and Surveillance) infrastructure, this may not, in itself, be sufficient reason to justify grounds for rejection of the planning application. The ANSP must determine whether the effect on the CNS infrastructure has a negative impact on the provision of the ATS.' As highlighted by the paragraphs above, it is not considered that the clutter associated with the proposed Development will have a negative impact on the provision of the ATS provided by Prestwick Air Traffic Control (NERL).

5.2.14. In 2012 GPA stated in a response to the planning application for the nearby Freasdail Wind Farm that the area is 'rarely used' by the Airport for vectoring aircraft. Any clutter associated with the proposed Development is therefore unlikely to have a negative impact on GPA's ability to provide an ATS.

5.2.15. In addition, GPA do not have any responsibility for aircraft in the vicinity of the proposed Development because Scottish Control is the notified responsible service provider. A single portion of airspace cannot be managed by two separate service providers unless formally notified. This provides airspace users with a single point of contact when a service is required.

5.2.16. GPA airspace is defined in the AIP. Section EGPK AD 2.17 defines the delegated ATS airspace. The AIP makes no mention of any shared airspace delegation and airspace users would expect to call Scottish Control on the notified frequency.

[4] CAP 764: Policy and Guidelines on Wind Turbines, Version 6, February 2016

5.2.17. Aircraft inbound to GPA, from the west, may be released by Scottish Control before the Transfer of Control Point (TCP). A TCP is a fixed position on the boundary between two airspace sectors. Traffic released before the TCP is referred to as Transfer of Communication and may not be assumed as Transfer of Control. Transfer of Control may be conducted through agreement between controllers through direct communication.

5.2.18. If GPA do receive aircraft early it is on the basis the aircraft is 'clean', i.e. there are no other conflicting aircraft identified by the transferring controller to the accepting controller. The accepting controller therefore accepts there are no aircraft to affect the aircraft and therefore radar clutter cannot be considered an impact.

5.2.19. GPA submitted an Airspace Change Proposal (ACP) in October 2017. Within the document submitted to the CAA, the airspace does not expand its considerations as far afield as the proposed Development. The diagrams depicted with the submission also indicate traffic volumes of less than 1 aircraft per day in the area associated with aircraft flying over the proposed Development to the Airport.

5.2.20. The ACP submission, under Section 3.6 Safety, categorically state that "*The proposed routes have not been designed with the intention to alleviate any specific safety issues in the current operation, as none exist.*" Considering an environment within their delegated airspace consisting of multiple windfarm sites that display clutter it is difficult to understand how the proposed Development is considered an impact.

5.2.21. Taking into consideration the points described in **Paragraph 5.2.14**, notified airspace and control of aircraft, the proposed Development does not impact the ATS of GPA and therefore there are no grounds for objection in a portion of airspace managed by another ATS provider.

5.2.22. Furthermore, the ACP was conducted by NATS on behalf of GPA who are the Change Sponsor. The ACP already states that there is very little use of the airspace to the northwest of GPA. If the NERL objection is based on aircraft descending or climbing out of GPA, the statistics provided by GPA and documented by NATS indicate very little use in the area of the proposed Development. If the aircraft impacted are at higher altitudes, then they will be within transponder mandated airspace and therefore not susceptible to clutter.

5.2.23. This report highlights that the proposed Development will be visible to GPA and NERL PSRs. CAP 764 states that an objection may not be made simply on the grounds of clutter alone. The ANSPs must determine an impact to ATS. The assessment conducted indicates there is very little to no impact on ATS for either GPA or NERL and it is recommended that both ANSPs provide evidence as to how the proposed Development will impact their ATS.

6. Mitigation Options – GPA Radars

6.1. Mitigation Requirement

6.1.1. Mitigation may be required where radar clutter generated by the proposed Development's turbines has a detrimental impact on the ATS provided. As was discussed in **Section 5**, it is not considered that the clutter associated with the GPA PSRs will have a negative impact on the ATS provided by GPA, nevertheless this section analyses the mitigation available should it be required.

6.2. Impact of Detected Turbines – GPA S511 PSR

6.2.1. The GPA S511 PSR was installed in 1990, and today is primarily used as a planning radar. The newly installed Terma PSR is effectively a replacement for this legacy radar but is limited to a range of approximately 40 Nautical Miles (NM), so the S511 is used to observe traffic beyond 40NM as the Designated Operational Coverage (DOC) for GPA is 42NM.

6.2.2. In the unlikely event that the Terma approach radar becomes unserviceable then the radar control service would continue using Lowther Hill SSR data only, albeit with a minimum traffic separation increase from 5NM to 10NM.

6.3. Impact of Detected Turbines – GPA Terma PSR

6.3.1. The newly installed GPA Terma Scanter 4002 PSR was introduced as a windfarm tolerant approach radar and was funded through windfarm operators. The Terma PSR operates in the X frequency band (9 GHz), unlike the majority of PSRs providing approach services which operate in the S band (2.8 GHz). This means that the Terma antenna transmits a narrower beam with smaller range resolutions down to approximately 6 m as opposed to 50 m.

6.3.2. The high sensitivity and resolution mean that the Terma PSR is capable of tracking aircraft between turbines in a windfarm, while simultaneously tracking and suppressing the adverse clutter from the turbines.

6.3.3. When new windfarms become operational within the Terma radar coverage area that are in RLoS and detected, then, if necessary, the Terma radar can be re-optimised to filter out any clutter generated by the turbines. Individual turbine positions are manually added to the radar's internal map so that plots originating from turbines are identified as static targets and excluded from the controller's display. Maintaining internal tracks on turbines results in high association likelihood to new plots overlapping the track updated position which helps to consume turbine plots and reduces the risk of track seduction.

6.3.4. The Terma PSR will not detect airborne targets when they overlap with the small areas occupied by wind turbines. This has the consequence of reducing the radar Probability of Detection (PD) within the windfarm area. The expected impact on PD can be modelled by calculating the total area where a wanted target can merge with each turbine and comparing this with the total defined area of a windfarm.

7. Mitigation Options – Lowther Hill PSR

7.1. Mitigation Requirement

7.1.1. Mitigation may be required where radar clutter generated by the proposed Development's turbines has a detrimental impact on the ATS provided. As was discussed in **Section 5**, it is not considered that the clutter associated with Lowther Hill PSR will have a negative impact on the ATS provided by NERL, nevertheless this section analyses the mitigation available should it be required.

7.2. Potential Infill Radars

7.2.1. A potential option for mitigating the impact on Lowther Hill PSR is to use an infill radar feed that does not have RLoS of the turbines but has adequate coverage over the proposed Development site to satisfy ATC requirements. Candidate radars for infill coverage over Earraghail Renewable Energy Development are Tiree PSR, Cumbernauld PSR, Glasgow PSR, and Glasgow Terma PSR.

7.2.2. Historically, there has been a NERL requirement that the base of infill coverage must extend to include a 5NM buffer beyond all the mitigated wind turbines. A 5NM buffer is therefore included in each infill assessment.

7.3. Potential Infill Radars – Tiree PSR

7.3.1. As has already been established, Tiree PSR lies 119 km northwest of the proposed Development and is unlikely to detect the turbines. The magenta shading in **Figure 23** illustrates the RLoS coverage for Tiree PSR at an altitude of 3,500 ft Above Mean Sea Level (AMSL).

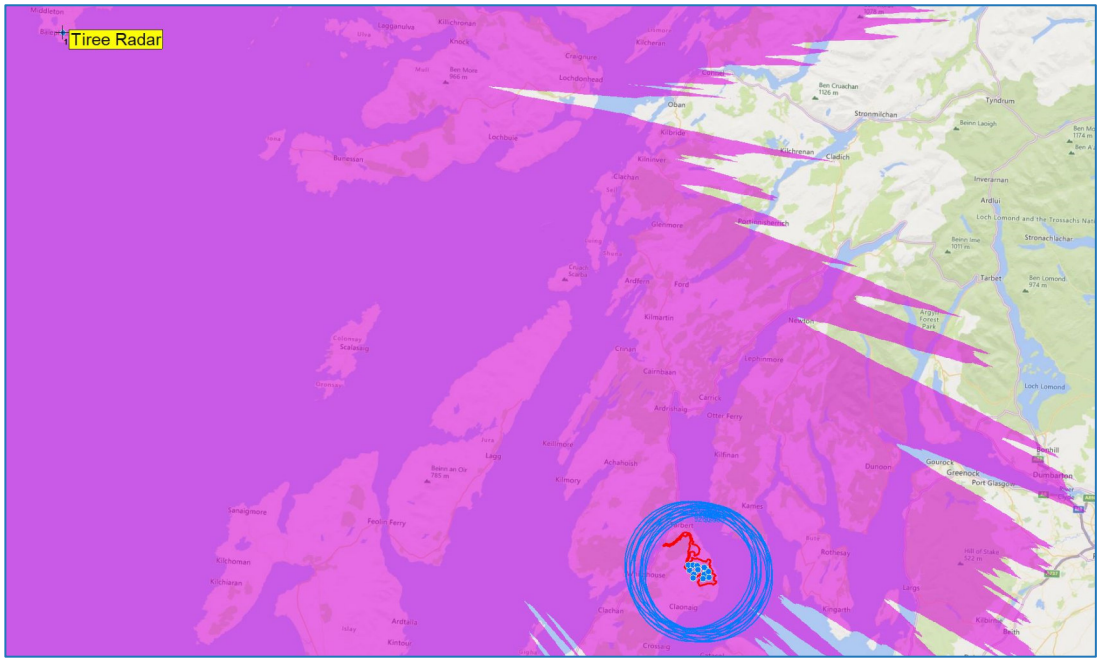

Figure 23: Tiree PSR RLoS at 3,500ft AMSL

7.3.2. The blue rings in Figure 23 are 5NM circles centred on each turbine and show that at a minimum coverage altitude of 3,500 ft AMSL the buffer requirement is satisfied.

7.4. Potential Infill Radars – Cumbernauld PSR

7.4.1. The closest turbine within the proposed Development area is approximately 81.7 km southwest of Cumbernauld PSR. The magenta shading in Figure 24 illustrates the RLoS coverage for Cumbernauld PSR at an altitude of 4,000 ft AMSL.

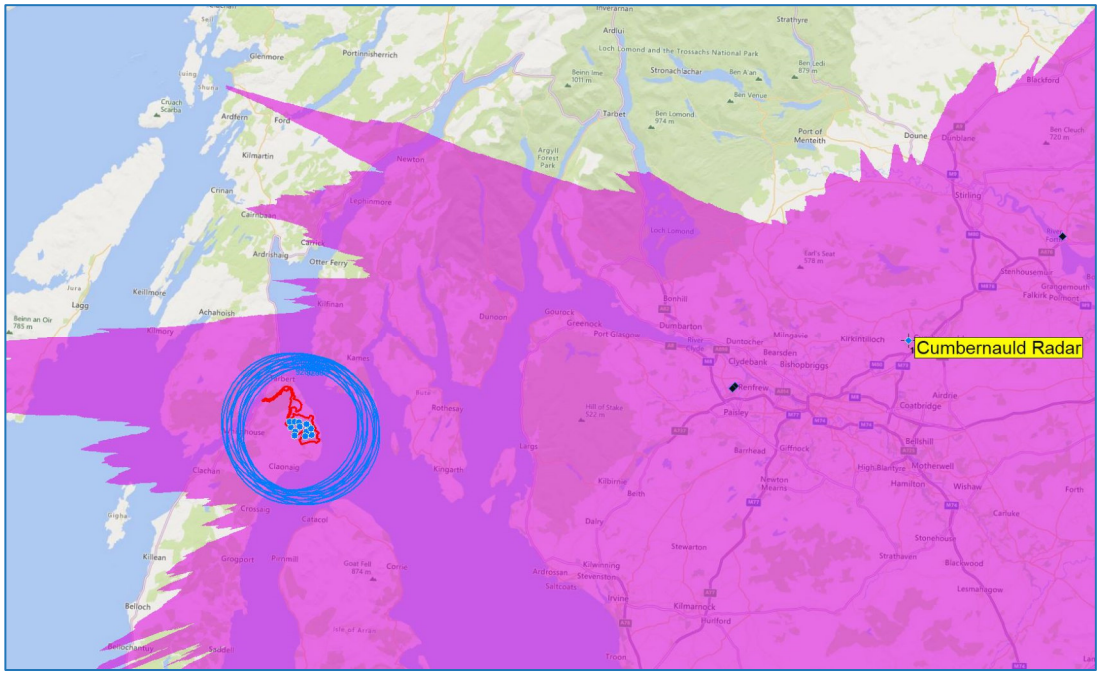

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Figure 24: Cumbernauld PSR RLoS at 4,000ft AMSL

7.4.2. Again, the blue rings in **Figure 24** show that at a minimum coverage altitude of 4,000 ft AMSL the 5NM buffer requirement is satisfied.

7.5. Potential Infill Radars – Glasgow PSR and Glasgow Terma

7.5.1. The locations of the Glasgow PSR and Glasgow Terma are shown in **Figure 25**.

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Figure 25: Locations of Glasgow PSR and Glasgow Terma

7.5.2. The closest turbine within the proposed Development area is approximately 57.2 km west of the Glasgow radars.

7.5.3. The magenta shading in **Figure 26** illustrates the RLoS coverage for Glasgow PSR at an altitude of 6,000 ft AMSL.

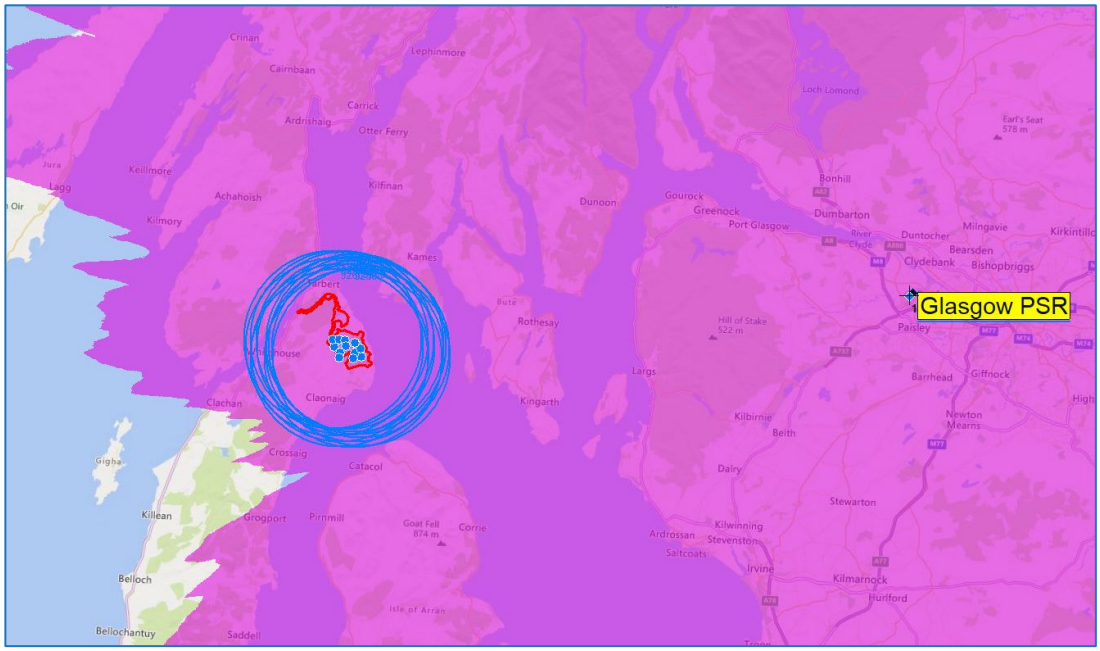

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Figure 26: Glasgow PSR RLoS at 6,000ft AMSL

7.5.4. The Glasgow Terma is sited near the Glasgow PSR and thus has very similar coverage performance. The magenta shading in **Figure 27** illustrates the RLoS coverage for the Glasgow Terma at an altitude of 6,000 ft AMSL.

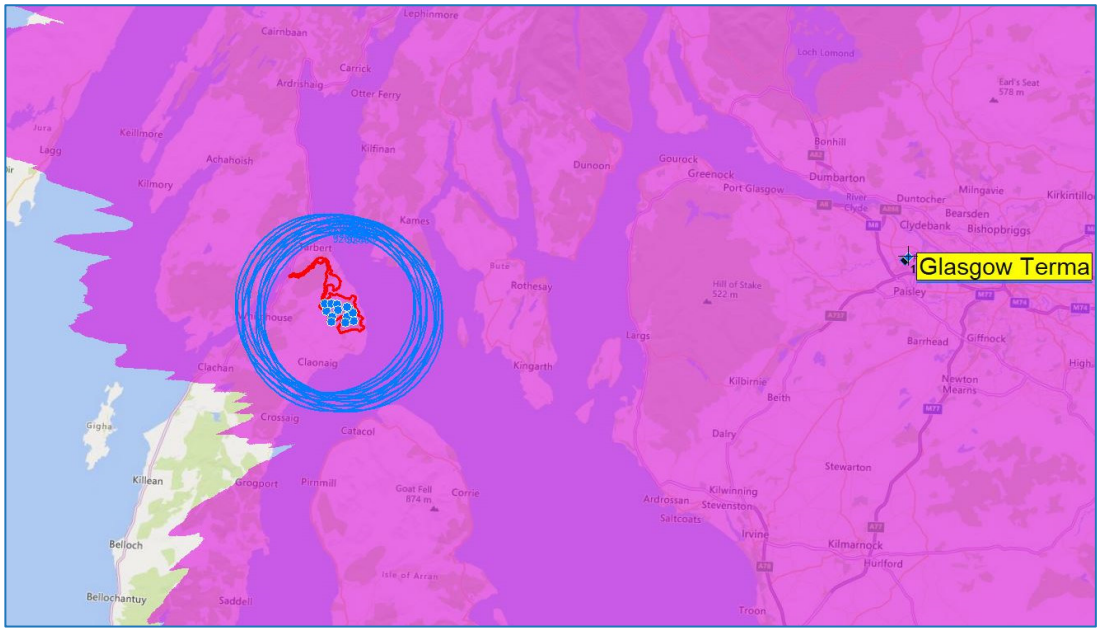

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Figure 27: Glasgow Terma RLoS at 6,000ft AMSL

7.5.5. In both cases the 5NM buffer requirement is satisfied at a minimum coverage altitude of 6,000ft AMSL.

7.6. Potential Infill Radars – Summary

7.6.1. Tiree PSR has the lowest base of radar coverage, 3,500 ft AMSL, in the vicinity of the proposed Development. Cumbernauld PSR can provide a minimum coverage altitude of 4,000 ft AMSL while the Glasgow PSR and Terma facilities can provide a minimum coverage altitude of 6,000 ft AMSL over the turbines.

7.6.2. All four PSRs are integrated into NERL's Multi-Radar Tracking infrastructure.

7.7. Replacement Radar

7.7.1. In September 2020 NATS announced that the existing PSR at Lowther Hill will be replaced by a more advanced radar facility with in-built capability for mitigating the impact of wind turbines. The press release for this replacement radar can be accessed online using the following link: https://www.nats.aero/news/advanced-new-radar-at-lowther-hill-to-enable-more-wind-energy-generation/. The new Lowther Hill radar is expected to be installed and operational by the end of 2021. At the present time the full mitigation capabilities of this radar are not known.

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