

Report



Independent Aviation Review

Ballycar Windfarm Development

F.A Binning

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Contents

1	Introduction	4
1.1	<i>Background</i>	4
1.2	<i>Requirement.....</i>	4
1.3	<i>About Sagentia Aviation.....</i>	4
1.4	<i>Purpose of this Document.....</i>	5
2	Information Reviewed	6
3	Independent Review.....	7
3.1	<i>Approach</i>	7
3.2	<i>Initial Correspondence Timeline: January to November 2022.....</i>	7
3.3	<i>IFP Opinion Ballycar Wind Farm Shannon Airport ({Ref. 1} Appendix B)</i>	11
3.3.1	<i>Report Abstract</i>	11
3.3.2	<i>Sagentia Aviation Summary</i>	11
3.4	<i>Ballycar Wind Farm Aviation Technical Assessment ({Ref. 1} Appendix C)</i>	12
3.4.1	<i>Report Abstract</i>	12
3.4.2	<i>Sagentia Aviation Summary</i>	13
3.5	<i>FCSL Ballycar Wind Farm Impact on ILS Inspection Report ({Ref. 1} Appendix D)</i>	14
3.5.1	<i>Report Abstract</i>	14
3.5.2	<i>AirNav Response</i>	14
3.5.3	<i>Sagentia Aviation Summary</i>	14
3.6	<i>CL-5912-RPT-002 v1.0 Mitigation Options Study ({Ref. 1} Appendix E).....</i>	15
3.6.1	<i>Report Abstract</i>	15
3.6.2	<i>Sagentia Aviation Summary</i>	16
3.7	<i>Ballycar Wind Farm Aviation Impact Assessment & Mitigation Report Review.....</i>	18
3.7.1	<i>Report Abstract</i>	18
3.7.2	<i>Sagentia Aviation Summary</i>	18
3.8	<i>Further Correspondence Timeline: March to July 2024.....</i>	19
3.9	<i>Response to the Request for Further Information from An Bord Pleanála on the Ballycar Green Energy Ltd Strategic Infrastructure Development Application</i>	20
3.9.1	<i>Report Extract</i>	20
3.9.2	<i>Sagentia Aviation Summary</i>	23
3.10	<i>Further Correspondence Timeline: December 2024 to January 2025.....</i>	23
3.11	<i>Response to Observations on Significant Further Information – ABP-318943-24.....</i>	24
3.11.1	<i>Sagentia Aviation Summary</i>	24
4	Overall Synopsis	25
4.1	<i>Overview</i>	25
4.2	<i>Background</i>	25
4.3	<i>IFP.....</i>	25
4.4	<i>ILS.....</i>	25
4.5	<i>Surveillance Systems (Shannon Airport PSR; and Woodcock Hill MSSR)</i>	26
4.6	<i>Final Summary</i>	27

1 Introduction

1.1 Background

The Ballycar Wind Farm Development (the “Development”) consists of 12 Wind Turbine Generators (WTG’s) distributed across a 140-hectare site neighbouring the townlands of Glennagross, Cappateemore East, Ballycannan West, Ballycannan East, Ballycar South, Ballycar North, north of Meelick, in Southeast Clare.

In response to the publication of these plans, Shannon Airport (“the Airport”) and the Irish Aviation Authority (IAA) Air Navigation Service Provider (ANSP) AirNav Ireland (AirNav) raised formal objections to the Development. The primary objections stem from concerns that anticipated aviation issues, most notably interference impacts of the proposed infrastructure on specific Communications Navigations Surveillance (CNS) systems at the Airport and at AirNav Woodcock Hill radar site, are not being adequately addressed or mitigated.

1.2 Requirement

An Bord Pleanála (“the Client”) is the independent body responsible for deciding on direct applications and appeals from planning decisions made by local authorities in Ireland, such as the Ballycar development. The Client have requested Sagentia Aviation conduct and document an independent review of the evidence provided to date that relates to aviation, which will assist ABP with their ability to reach an informed decision regarding the wind farm appeal.

1.3 About Sagentia Aviation

Sagentia Aviation is a leading aviation consultancy specialising in operational and engineering support to both civil and military projects. We are an established, independent aviation consultancy, part of Sagentia, a science and technology business which enables us to deliver a unique blend of operational, engineering and safety capabilities across both the civil and military domains.

Sagentia Aviation’s independence within the aviation sector is relied upon by operators, system suppliers, service providers, government departments and the regulatory community alike. As such we are trusted to consistently deliver the highest quality outputs across this safety-critical sector.

We support UK airports, Windfarm Developers and Platform Operators with complex projects providing innovative technical support and impartial advice on safe operation. We are members of the Airport Operators Association, and a CAA Approved Procedure Design Organisation.

Sagentia Aviation supports Front Line Commands, Defence Equipment and Support (DE&S) and Defence Regulators with specialised safety assurance and procurement advice.

Why Sagentia Aviation?

- Team of aviation experts with blend of military and civilian backgrounds
- Quality of output assured by an established business
- Agility and independence of SME combined with the reassurance of a high-quality level of support and governance as part of a larger group
- 25 years’ experience providing support in the aviation sector
- Breadth of science and technology capabilities through our sister companies in Sagentia

This report provides a comprehensive assessment of the planning application for a proposed windfarm development that has received objections from a nearby airport. The Airport and AirNav has raised concerns about the impact on critical aviation systems including Instrument Flight Procedures (IFP), Instrument Landing Systems (ILS), Primary Surveillance Radar (PSR), and Secondary Surveillance Radar (SSR).

The windfarm developer has responded with evidence of mitigation measures; however, these have been rejected by the Airport and AirNav. This report evaluates the technical concerns, the proposed mitigations, policy implications, and outlines recommendations for further consideration.

1.4 Purpose of this Document

This document aims to provide an independent review of the aviation evidence presented to An Bord Pleanála by the applicants and respondents involved in assessing this application.

2 Information Reviewed

The Client provided the following documents/ information to be the subject of the Independent Review conducted by Sagentia Aviation.

Reference ID.	Title	Reference	Version	Issue Date	Originator
{Ref.1}	Ballycar Wind Farm – Aviation Impact Assessment & Mitigation Report	001/VH202104	Rev 3.0	11/08/2023	Ai Bridges Ltd
{Ref.2}	Shannon Airport Authority DAC March 24 Submission			03/03/2024	Shannon Airport
{Ref.3}	AirNav Ireland March 24 Submission			08/03/2024	AirNav
{Ref.4}	Further Information Request to MWP			26/07/2024	An Bord Pleanála
{Ref.5}	Response to the Request for Further Information from An Bord Pleanála on the Ballycar Green Energy Ltd Strategic Infrastructure Development Application	001/KO070804	Rev 3.0	20/09/2024	Ai Bridges Ltd
{Ref.6}	AirNav - 2nd Submission Dec 24			18/12/2024	AirNav
{Ref.7}	Shannon Airport Authority DAC - 2nd Submission Dec 24			22/12/2024	Shannon Airport
{Ref.8}	Applicant Response to 2nd Subs from Shannon and Air Nav				Malachy Walsh and Partners (MWP)

Table 1 - Client Provided Information

3 Independent Review

3.1 Approach

Sagentia Aviation have conducted thorough review of the information made available by the Client. This review included an analysis of Aviation Impact Assessment and Mitigation Report, produced by Malachy Walsh and Partners (MWP) issued in August 2023 in response to comments received from AirNav.

The review provided Sagentia Aviation with a comprehensive and rounded understanding of the technical and non-technical background for the case.

The reader shall note; that whilst Sagentia Aviation has appraised the information provided, Sagentia Aviation has not assessed the exact methodologies applied and results obtained of technical assessments completed (other than to confirm that the approach, outcomes and conclusions are reasonable in the context applied). Likewise, Sagentia Aviation cannot confirm the accuracy of any statements regarding communications and consultations undertaken, other than as contained within the information provided as listed in Section 2.

Note: To aid context, extracts from reference material may be quoted in this document. For ease of readability, where used, these quotes are formatted in Times New Roman Italic font coloured blue, and enclosed in quotation marks, as shown in the following example: *"I am an example quote extracted from reference material"*.

The review presented in this document has been structured in a logical manner based on the chronological submission of evidence as presented (note, a significant amount of evidence provided to Sagentia Aviation is contained within the Ballycar Wind Farm Aviation Impact Assessment & Mitigation Report {Ref.1}, specifically Appendix B, Appendix C and Appendix D, which were technical reports commissioned by MWP and provided to the Airport and AirNav as individual documents):

The Sections following, provide Extracts, AirNav Responses (where applicable) and Sagentia Aviation summaries for each of the key evidence as follows:

- 3.2 Initial Correspondence Timeline ({Ref.1} Appendix A)
- 3.3 IFP Opinion Ballycar Wind Farm Shannon Airport ({Ref.1} Appendix B)
- 3.4 Ballycar Wind Farm Aviation Technical Assessment ({Ref.1} Appendix C)
- 3.5 FCSL Ballycar Wind Farm Impact on ILS Inspection Report ({Ref.1} Appendix D)
- 3.6 CL-5912-RPT-002 v1.0 Mitigation Options Study ({Ref.1} Appendix E)
- 3.7 Ballycar Wind Farm Aviation Impact Assessment & Mitigation Report ({Ref.1})
- 3.8 Further Correspondence Timeline
- 3.9 Response to the Request for Further Information from An Bord Pleanála on the Ballycar Green Energy Ltd Strategic Infrastructure Development Application({Ref.5})
- 3.10 Further Correspondence Timeline: December 2024 to January 2025
- 3.11 Response to Observations on Significant Further Information – ABP-318943-24

3.2 Initial Correspondence Timeline: January to November 2022

Section 3.2 provides a timeline derived from Appendix A - IAA Consultations published in {Ref.1} as it provides a list of the key correspondence up to November 2022 and is useful as a starting point to assess the responses between MWP and the AirNav in relation the Development.

ID.	Date	Originator	Recipient	Summary
{C1}	05 Jan 22	AirNav	MWP	• RFI for Development Parameters

ID.	Date	Originator	Recipient	Summary
				AirNav recommend MWP <i>“engage with Shannon Airport Authority and the IAA's Air Navigation Service Provider (ANSP) as a matter of urgency to undertake a preliminary screening assessment to confirm that the proposed wind farm and the associated cranes that would be utilised during its construction would have no impact on instrument flight procedures, communication and navigation aids or flight checking at Shannon Airport”</i>
{C2}	13 Jan 22	MWP	AirNav	Development Parameters provided to AirNav
{C3}	13 Jan 22	AirNav	MWP	- Confirmation of receipt of initial Parameters, further data requested. - AirNav notes that the Development <i>“will likely impact the Surveillance Radar at Woodcock Hill and navigation aids for approaches to Shannon Airport”</i> - AirNav notes that <i>“This is not the only wind turbine proposal for this area and to be completely upfront, nearly all are creating issues for the surfaces referenced”</i>
{C4}	13 Jan 22	MWP	AirNav	Further Development Parameters provided to AirNav
{C5}	14 Jan 22	AirNav	MWP	- AirNav as the ANSP outline three areas of concern: - Instrument Flight Procedures (IFPs) surfaces: AirNav states that <i>“IFP assessment to be carried out by a certified IFP designer to assess possible impacts”</i> - Navigation Aids: AirNav states that: <i>“The nearest turbine proposed is c. 16.5 km from Shannon Airport and as such should be outside area of concern for our ground-based navigation aids. This may need to be confirmed by the company who carry out flight checking if these systems”</i> - Surveillance: AirNav states that: <i>“The turbines as proposed are close to our surveillance systems at Woodcock Hill and will need to be considered for an effect on these systems”</i>. AirNav provide MWP with some guidance material and also refer matters to relevant AirNav surveillance team - AirNav requests confirmation that the Development is proceeding with the planning application.
{C6}	25 Feb 22	MWP	AirNav	- MWP confirms that the Development is proceeding with the planning application. - MWP provides two reports they commissioned to Cyrrus. Note: Sagentia Aviation assume that these two reports are: - IFP Opinion Ballycar Wind Farm Shannon Airport, 05 November 2021, CL-5715-RPT-002 V1.0 (Appendix B to {Ref.1}) - Ballycar Wind Farm Aviation Technical Assessment Greensource Limited, 05 November

ID.	Date	Originator	Recipient	Summary
				2021, CL-5715-RPT-002 V1.0 (Appendix C to {Ref.1})
{C7}	25 Feb 22	AirNav	MWP	• {C5} (Point 1 - IFP). Based on the IFP Opinion Report provided {C6.1}, AirNav confirm that they are <i>“happy to accept that the proposed turbines will not affect the Shannon Airport Instrument Flight Procedures and nothing further is required from this perspective.”</i> • {C5} (Point 2 - Navigation Aids). Based on the Technical Assessment {C6.2}, AirNav confirms no issues for Building Restricted Areas (BRA) • {C5} (Point 2 - Navigation Aids). Based on the Technical Assessment {C6.2}, AirNav state: <i>“The report conforms no issues for Airport NAVAIDs: Fergal Doyle copied to confirm this”</i> • {C5} (Point 3 - Surveillance). AirNav state: <i>“The report notes that mitigations are required for the Shannon PSR and the Woodcock Hill MSSR most particularly not prevent false targets and ghost signals respectively. While the report outlines how these mitigations could be applied, this must be assessed by our surveillance team”</i> <i>“This last item will be the main issue for then IAA ANSP in my experience. This proposed development is one of multiple application in the same general area which is all cases is leading to an assessment of Surveillance impacts. While in isolation “filtering” of PSR and /or updates to the reflector file for Woodcock Hill MSSR may seem straightforward, it may be of significant cost to the ANSP and if required for multiple developments, lead to a realistically unusable radar system for aircraft targets between 3500 and 10000 feet, which would be the altitude band serving Shannon Airport. Added to this, such system upgrades have not been planned for in the Surveillance work programme.”</i>
{C8}	9 Mar 22	MWP	AirNav	• MWP follow up, confirming that they have contacted FCSL
{C9}	9 Mar 22	AirNav	MWP	• AirNav confirmation of receipt of {C8}.
{C10}	29 Nov 22	AirNav	MWP	• AirNav Surveillance team response to Technical Assessment {C6}.2. IAA state: <i>“The IAA Surveillance Domain conclusion is that this proposed Ballycar Wind Farm development, would degrade the performance of the Woodcock Hill Radar. As a consequence the IAA would object to a Ballycar Wind Farm development planning application”</i> • AirNav Surveillance team provide a summary to support their conclusion: <i>Reflections and shadowing are also identified in the CYRRUS report but the deflection issue is not.</i> <i>IAA Radars must now meet EU mandated (EU 1207/2011) performance criteria in order to support 5 nautical Mile</i>

ID.	Date	Originator	Recipient	Summary
				separation of aircraft in IAA airspace. Radar performance is assessed on an ongoing periodic basis as well as prior to implementation of any Radar configuration change. From our assessment Woodcock hill radar, without mitigation would not meet the mandated surveillance performance required relating to False Target reports and positional accuracy. The implementation of mitigations for the false target reports will compromise the radars probability of detection requirements and the testing of the mitigations will compromise our availability requirements. We believe there are no credible and implementable mitigations on the Woodcock hill radar itself to eliminate the Radar beam deflections, reflections and shadowing from the proposed turbines. We also note the proposed Ballycar Wind Farm development would introduce false primary targets or clutter on the Shannon Primary radar. Mitigation for the primary clutter would degrade the performance of the Shannon primary radar. Not mitigating for the clutter would be operationally unacceptable and unsafe for Air traffic control. Reflections generate dual aircraft tracks which set off IAA automation system (COOPANS) safety net alarms such as Short-Term Conflict Alert (STCA) and Duplicate (DUPE) alerts. These alerts distract Air Traffic controllers who may attempt to deconflicting real Air traffic tracks from tracks that do not physically exist. Each Safety Net Alarm initiates a safety occurrence report. Reflections occur when an aircraft replies to both a radar interrogation directly and to an interrogation reflected by the Turbine tower or rotor blade; the radar generates both a real aircraft track and a false reflected track in the direction of the turbine. It is possible to reduce the probability of reflections through mitigation. This is normally done at the commissioning phase, where reflection mitigations for existing structures are implemented and tested prior to the operational use of the radar. Mitigating for multiple changing reflections during the construction and operation of wind Turbines within 4km of the woodcock radar, may require the radar to be taken out of service for the duration of the construction phase to implement and test the reflection mitigations. Taking the Woodcock Hill radar out of service for the many months required to mitigate reflections is not acceptable to IAA operations and would compromise the safety of Air Traffic in Irish airspace. Radar reflection mitigations are bypassed when the radar detects aircraft squawking Emergency, Hijack or Comms failure codes. “Deflections also generate dual aircraft tracks which set off COOPANS safety-net alarms such as Short-Term Conflict Alert (STCA) and Duplicate (DUPE) alerts. These alerts distract Air Traffic controllers who may attempt to deconflicting real Air traffic tracks from tracks that do not physically exist.

ID.	Date	Originator	Recipient	Summary
				<i>Each Safety Net Alarm initiates a safety occurrence report.</i> <i>Deflections occur when a Radar interrogation signal is deflected by the Wind Turbine introducing an error in the measured bearing of the Aircraft. This bearing error increases with range of the aircraft from the radar, becoming significant at ranges beyond 100Nautical miles. The radar bearing errors become an issue when the deflected Radar tracks are fused with the track data from other radars which calculate a different position for the aircraft track, and the deflected track is not associated with the true track position and a new Duplicate track is generated. We have mitigated for deflections from individual masts by implementing non-initialisation-areas in our Tracking systems (ARTAS). However, this non-initialisation-area mitigation must be kept to a minimum to avoid introducing holes in radar coverage. Due to the proximity of the proposed Ballycar wind turbine development to Woodcock hill, the scale of the non-initialisation area required to mitigate for the Ballycar generated deflections would in effect remove almost 30-degrees of the radars 360-degree coverage, reducing its performance below mandated requirements.</i> <i>Shadowing from the turbines results in a degradation of the probability of detection of aircraft flying behind the proposed turbines. This may result in the Woodcock hill radar not meeting its mandated Surveillance performance requirements.”</i>

3.3 IFP Opinion Ballycar Wind Farm Shannon Airport ({Ref.1} Appendix B)

Section 3.4 provides an abstract of the report along with key responses and Sagentia Aviation’s summary of the artifact.

3.3.1 Report Abstract

- Executive Summary Extract

“MWP (hereafter referred to as the Client) has requested an Instrument Flight Procedure (IFP) review in respect of a proposed windfarm development (Ballycar) near Shannon Airport.

The process of providing an ‘opinion’ still requires a review of the applicable IFP lateral and horizontal surfaces. This process only determines whether there is a ‘surface penetration’ and not whether the obstacle impacts the IFP. If there is a penetration a full IFP assessment will be noted.”

- Conclusion Extract

“The windfarm does impact to the current published IFPs for Shannon Airport but is only limited to the ATC Surveillance Minimum Altitude Chart. Although a full IFP assessment is normally required for any identified impact, it is recommended to submit this report to the IAA for consideration whether a full assessment is required.

3.3.2 Sagentia Aviation Summary

As a UK Civil Aviation Authority (CAA) and IAA Approved Procedure Design Organisation (APDO), Cyrrus are qualified to assess impacts to IFP and Obstacle Limitation Services (OLS).

The approach, outcomes and conclusions of the IFP Opinion Report are reasonable in the context applied, they have been accepted by the AirNav {C7}.

3.4 Ballycar Wind Farm Aviation Technical Assessment ({Ref.1} Appendix C)

Section 3.4 provides an abstract of the report along with Sagentia Aviation's' summary of the artifact.

3.4.1 Report Abstract

- Introduction Extract

“Cyrrus Limited has been engaged by Malachy Walsh and Partners to undertake an Aviation Study for the proposed Ballycar Wind Farm development in County Clare in the West of Ireland. The proposal comprises 12 wind turbines with a maximum tip height of up to 156.5m Above Ground Level.

An assessment of the Building Restricted Areas associated with the Instrument Landing Systems and Distance Measuring Equipment installed at Shannon Airport shows that the proposed turbines will have no impact on these navigation facilities.

Detailed radar modelling of the indicative layout against the combined Primary Surveillance Radar/Monopulse Secondary Surveillance Radar (PSR/MSSR) facility at Shannon Airport shows the following:

- *Radar Line of Sight (RLoS) exists between Shannon PSR and 11 of the 12 proposed turbines;*
- *There is a high probability that Shannon PSR will detect turbines T1 to T9 and turbines T11 and T12, leading to turbine-induced clutter and false targets, and track seduction of aircraft targets;*
- *It is unlikely that Shannon PSR will detect turbine T10;*
- *Mitigation for Shannon PSR may be required;*
- *The proposed turbine sites are outside the Eurocontrol recommended 16km turbine assessment zone for Shannon MSSR, therefore an impact assessment for the facility was not required;*
- *No mitigation measures are necessary for Shannon MSSR.*

Detailed radar modelling of the indicative layout against the MSSR at Woodcock Hill shows the following:

- *RLoS exists between Woodcock Hill MSSR and all 12 proposed turbine towers;*
- *Aircraft between 5,250m and 10,536m from the proposed turbines may respond to bistatic reflections from these turbine towers, resulting in false targets on the bearings of the turbines;*
- *Provided the MSSR reflector file is updated with the turbine positions, the MSSR should be able to process out false targets caused by reflections from the turbine towers;*
- *The maximum heights of shadow regions from the turbines will be below published Air Traffic Control surveillance minimum altitudes and should therefore be operationally tolerable.*

- Conclusion Extract

“It is recommended that mitigation options are discussed with the Irish Aviation Authority (IAA), specifically Air Traffic Services. It is the surveillance network and operational use that will largely influence a suitable mitigation.

Possible mitigation solutions for Shannon PSR include blanking of PSR transmissions over the wind farm. This can be combined with the application of a Transponder Mandatory Zone in the affected airspace, or with in-fill data from a remote radar source.

Existing remote PSR data can be used as in-fill provided it has suitable airspace coverage and does not have visibility of the turbines. This relies on suitable terrain screening and can be problematic in terms of synchronisation and slant range errors.

In-fill mitigation can be provided using a dedicated 2D radar from a company such as Terma. The mitigation radar must be located in close proximity to the airport PSR and be synchronised with it. Terma radars filter out turbines while continuing to track aircraft.

The Aveillant Holographic Radar™ offers a 3D radar mitigation solution that can discriminate turbines from aircraft without the need for masking. It does not require locating close to the airport PSR and its target output can be coordinate transformed to the PSR origin without slant range errors.

3.4.2 Sagentia Aviation Summary

Cyrrus are a reputable Aviation Consultancy with technical credibility in assessing the impacts that wind farms may have upon Communications Navigation and Surveillance systems. It should be noted that the Aviation Technical Assessment was originally published in 2021, and as some time has passed it is not known if the Design Envelope of the Development has changed at all. If it has, for example changes in location, or changes to proposed maximum tip height of the turbines, then the results presented in this report would require revalidating.

In the Aviation Technical Assessment, Cyrrus conducted two specific and appropriate safeguarding assessments:

- ILS Assessment

Against the respective Building Restricted Areas for the ILS components and against the definitions published by ICAO. The approach, outcomes and conclusions of the ILS assessment are reasonable in the context applied.

- Radar Assessment

Two different radar sites are considered in the report:

- Shannon Airport – Thales STAR 2000PSR/ Thales RSM970 MSSR

The Shannon Radar is two radars combined, a Thales STAR 2000 PSR with a co-mounted Thales RSM970 MSSR. The report states that: *“In accordance with Eurocontrol Guidelines3, the wind turbine assessment zone for MSSR facilities extends to 16km. Beyond this range the impact of a wind turbine is considered to be tolerable. Therefore, an assessment of the impact on the Shannon MSSR is not required.”*

This is a correct and reasonable conclusion, and hence the Shannon Airport Thales RSM 970 MSSR is not considered any further, and only the Shannon Airport STAR 2000 PSR is considered.

A Line of Site assessment against the Shannon Airport STAR 2000 PSR is conducted with an appropriate methodology using industry standard software. The results are reasonable in the context applied, with the conclusion that *“it is unlikely that Shannon PSR will detect turbine T10. However, there is still a high probability that Shannon PSR will detect the rest of the Ballycar turbines”*.

This confirms that there will be an issue to the Shannon STAR 2000 PSR caused by the Development.

The report presents a section on Shannon PSR Mitigation, specifically providing a very high-level overview of potential mitigation approaches including radar blanking coupled with a TMZ (it should be noted that the CAA in the UK see TMZ as a temporary mitigation that must be backed up with a technical mitigation solution in due course) and Infill radar solutions, including a brief overview of the Aveillant Holographic radar. At the time this report was published the Aveillant Holographic Radar had a very limited deployment footprint, with only one example in the UK which was limited to a very specific mitigation case that did not reflect mitigation of a wind farm. The manufacturer of this radar (now Thales) has since withdrawn offering the Aveillant as a solution for wind farm mitigation. No specific mitigation solution is presented, more so, just an overview that technology potentially exists to mitigate. This level of high-level overview of mitigation technologies is however an appropriate level of detail for this type of report, i.e. the reports' main purpose is to confirm whether the Development is likely to cause impacts against the PSR.

- AirNav - Woodcock Hill MSSR

A Line of Site assessment is conducted against the Woodcock Hill MSSR with an appropriate methodology using industry standard software. The results are reasonable in the context applied, with the conclusion that *“that false targets due to bistatic reflections*

from the turbine towers may occur for Woodcock Hill MSSR. Aircraft between 5,250m and 10,536m from the proposed turbines may respond to reflected Woodcock Hill MSSR interrogations, potentially resulting in MSSR 'ghost' targets appearing on the bearings of the turbines”.

A Mitigation is claimed with an argument presented that: *“The Woodcock Hill MSSR has a reflection processing capability which enables the positions of permanent reflecting objects, such as the turbine towers, to be stored in a ‘reflector file’. Once the reflector file is updated it should eliminate any false targets caused by reflections from the turbine towers”.* Again, the level of detail included is appropriate to this type of report, i.e. the reports’ main purpose is to confirm whether the Development is likely to cause impacts against the MSSR.

3.5 FCSL Ballycar Wind Farm Impact on ILS Inspection Report ({Ref.1} Appendix D)

Section 3.5 provides an abstract of the report along with key responses and Sagentia Aviation’s summary of the artifact.

3.5.1 Report Abstract

- Introduction Extract

“The wind farm developer has requested that an assessment be performed to establish any adverse effect the proposed wind farm may have on flight inspection procedures and profiles associated with the Shannon Airport Runway 24 Instrument Landing System (ILS). This report provides an assessment of the impact of terrain and obstacles on ILS flight inspection procedures. It does not provide an assessment of any impact the proposed wind farm may have on the integrity of the Runway 24 ILS guidance signals.”

- Conclusion Extract

“The assessment presented in Section 6 above has shown that a flight inspection aircraft flying centreline, part orbit and bottom edge flight profiles associated with the Shannon Airport Runway 24 ILS will remain sufficiently clear of the proposed Ballycar Wind Farm site.

However, for the slice and left slice 8° profiles, the proposed wind farm will require that these profiles are flown at higher altitudes to provide sufficient clearance above the proposed wind turbines. The flight inspection Glide Path slice and left slice 8° profiles (level runs) will have to be raised to an altitude of 2,400ft in IMC to provide the flight inspection aircraft adequate coverage over the proposed wind turbines.

Section 6.7 above shows that for level runs flown at an altitude of 2,600 ft, Glide Path RF signal levels exceed minimum level of -95 dBW/m2 and sufficient fly-up guidance is achieved below the Glide Path sector.

The proposed Ballycar wind farm will therefore not have any adverse effect on Runway 24 ILS flight inspection procedures and flight profiles. This report provides an assessment of the impact of terrain and obstacles on ILS flight inspection procedures. It does not provide an assessment of any impact the proposed wind farm may have on the integrity of the ILS guidance signals.”

3.5.2 AirNav Response

On the 9 Mar 22, AirNav acknowledge receipt {C9} that MWP have informed them that they would approach FCSL for guidance {C8}. There is no further correspondence on the Airports ILS until {C15} which is dealt with at Section 3.8 of this document.

3.5.3 Sagentia Aviation Summary

FCSL are a reputable organisation who provide navigational aid Flight Inspection and Procedure Validation services worldwide and are along with Thales UK Ltd and Flight Precision Ltd one of only three organisations approved to conduct Flight Inspections of CNS under the UK regulatory framework. FCSL are specifically authorised by the CAA to flight inspect the following CNS systems:

- Instrument Landing Systems (ILS) CAT I, CAT II and CAT III
- Distance Measuring Equipment (DME)

- VHF Marker Beacons
- Non-Directional Beacons
- VHF Omnidirectional Radio Range (VOR)
- Microwave Landing Systems (MLS)

MWP informed AirNav that they would approach FCSL for guidance at {C8}, Sagentia Aviation assume that this report was commissioned by MWP and is the outcome as the FCSL report was issued on the 8th May 2022.

Sagentia Aviation believes that FCSL are the current provider of flight calibration to the IAA and have direct experience and relevant experience of the Instrument Landing Systems at the Airport.

The report comprehensively assesses the impact that the Development would have on the flight inspection procedures required to conduct routine calibration activities for the Airports Runway 24 ILS.

The report presents a reasonable conclusion that the Development will not have any adverse effect on Runway 24 ILS flight inspection procedures and flight profiles other than the potential to increase the height required to fly the Glide Path slice and left slice 8° profiles to 2,400ft in IMC to ensure clearance between the aircraft and the Development. FCSL also confirm that raising the altitude of these profiles will have no impact on calibration activities as the Glide Path RF signal levels exceed minimum level of -95 dBW/m² and sufficient fly-up guidance is achieved below the Glide Path sector.

The report categorically states that it does not *“provide an assessment of any impact the proposed wind farm may have on the integrity of the Runway 24 ILS guidance signals”*.

3.6 CL-5912-RPT-002 v1.0 Mitigation Options Study ({Ref.1} Appendix E)

Section 3.6 provides an abstract of the report along with Sagentia Aviation's' summary of the artifact.

3.6.1 Report Abstract

- Introduction Extract

Cyrrus have been requested by AI Bridges to provide a response to the Irish Aviation Authority email [6] which states “We believe there are no credible and implementable mitigations on the Woodcock hill radar itself to eliminate the Radar beam deflections, reflections and shadowing from the proposed turbines.”

“This report provides a constructive technical view on how both the Woodcock Hill Thales RSM970 Monopulse Secondary Surveillance Radar (MSSR), and the Shannon Airport Thales STAR 2000 Primary Surveillance Radar (PSR) with co-mounted MSSR can operate without disruption to the controlled airspace and allow the development of Ballycar Windfarm.

Cyrrus have engaged with the manufacturer of both radar systems to confirm their capability to operate in the presence of Wind Turbines with minimal intervention. The RSM970 MSSR at Woodcock Hill and STAR 2000 PSR with co-mounted MSSR at Shannon Airport have been developed to allow this capability. The STAR 2000 PSR was designed to work in areas with wind turbines, a continual development cycle has been carried out by Thales to ensure the systems performance is not impacted by Wind Turbines. If required upgrades and enhancements for the STAR 2000 are available. Thales have provided evidence that they are confident that with minor optimisation the proposed wind turbines at Ballycar should have minimal effect on the coverage provided by the radars. This evidence is provided as commercial in confidence. Cyrrus have permission from Thales to reference relevant parts but not provide the Thales documents in full.

- Conclusion Extract

“The development of the Windfarm at Ballycar would require minimal optimisation of the Woodcock Hill and Shannon Airport radars. The systems in place have the capacity to provide a service even if a large number of turbines were developed in the coverage area. Thales can also provide upgrades and enhancements to both systems should they be required in future.

3.6.2 Sagentia Aviation Summary

This brief report presents technical statements made in previous reports and summaries pertinent points against IAA concerns. For clarity we have broken this down into the two key systems being considered as follows:

- AirNav Woodcock Hill Radar - Thales RSM970 MSSR

The following points regarding the Thales RSM970 MSSR have been extracted from the report, with individual Sagentia Aviation comments applied.

“1.3.1. The Woodcock Hill RSM 970 Radar is a tried and tested system used throughout the UK and Europe. The Thales datasheet detailing the systems technical characteristics and ability to meet the Eurocontrol Mode S station Functional Specification (EMS 3.11)[7] and ICAO annex 10 vol IV latest edition standards[8] which have been included for reference.”

“1.3.2. The IAA have raised concerns that reflections, deflections, and shadowing will cause unacceptable issues. Evidence is provided to constructively address each of these concerns, including confirmation from Thales of the System’s ability to address these issues with minimal intervention.”

“1.3.3. To address the issue of reflections, the Thales RSM970 technical submission details how the system can automatically process sporadic reflections, also known as dynamic reflections, to prevent degradation of the radar picture. The system utilises a second stage of reflection processing which is used to address repeated reflections from one area, these are placed in the static reflector file and automatically processed out by the system. A full explanation of how the radar does this is provided in the Thales RSM970 technical description [3].”

“1.3.4. The IAA’s 2nd concern was that Beam deflection can take place on the Woodcock Hill MSSR. Cyrrus investigated the processing used to prevent deflected targets being displayed. The false returns from deflected targets are known as False Returns Uncorrelated in Time (FRUIT). The Surveillance Data Processor (SDP) within the Woodcock Hill MSSR will use a De-FRUITER to remove these false targets. This technique is used in most MSSR systems. A detailed explanation of how this is done is provided in reference [3].”

1.3.5. The IAA’s 3rd concern, that shadowing would degrade the area behind the windfarm. Cyrrus and Thales are confident that any effect would be minimal and have no impact on aeronautical operations.”

Whilst it is recognised that SSR radars are less susceptible to the effects of wind turbines than those experienced by PSR, issues can occur. The report concludes that the issues identified by the IAA can be addressed through minor technical changes to the existing radar, by configuring existing processing capability. The report states that *“Evidence is provided to constructively address each of these concerns, including confirmation from Thales of the System’s ability to address these issues with minimal intervention”*. This statement appears to be conceptual certainty rather than evidence based, as to be so, clear arguments supported by evidence in the form of modelling of the system performance would be provided, whereas the report references the Thales RSM970 technical description which would provide generic detail of how the system is designed to deal with these issues (an argument), rather than supporting this argument with supporting qualitative evidence.

- Shannon Airport - Thales STAR 2000 PSR

The following points regarding the Thales STAR 2000 PSR have been extracted from the report, with individual Sagentia Aviation comments applied.

- Point 1.

“1.4.2. Rotating wind turbine blades will be processed as moving targets by the PSR and will be displayed as clutter. Modern SDP systems can use advanced techniques prevent this clutter from the Wind turbines from being displayed.”

Modern Radars do indeed have advanced processing capabilities designed to reduce the impacts of wind turbines to an acceptable level, however the Thales STAR 2000 PSR has limited capability other than standard radar processing techniques such as blanking or range azimuth gating, unless the radar has undergone software updates to include the Thales Wind Farm Filter. Even then the wind farm processing capabilities are limited. Thales full wind farm mitigation capability is only truly realised when a STAR 2000 is upgraded to the latest variant being offered by Thales, which is a STAR NG PSR. An

upgrade from STAR 2000 to STAR NG is a significant undertaking, whereby fundamentally the majority of the systems electronics are replaced, whilst keeping the core mechanical components of the STAR 2000, such as tower, antenna and turning gear etc. The upgrade can also involve a lengthy period of downtime whereby radar service would not be available. Thales do also offer an option that can reduce downtime, whereby a complete radar cabin is swapped out. The report mentions a list of mitigation options being presented, but it is unclear where these are documented or whether the Airport has had visibility of these.

- Point 2.

“1.4.3. The Thales datasheet [2], confirms the STAR 2000 was designed to operate in areas with wind turbines. Thales have confirmed that the STAR 2000 systems at both Schiphol Airport in the Netherlands and Newcastle Airport in the UK, both operate successfully with multiple windfarms within close proximity of the radars. The Aeronautical Information Service (AIS) for Newcastle Airport [9] has been provided for reference.”

Sagentia Aviation understands that the STAR 2000 PSR's At Schiphol and Newcastle Airports, have had the Wind Farm Filter software updates undertaken, but the radars themselves are not STAR NG variants. Indeed, the full wind farm mitigation capability within the overall surveillance system at Newcastle Airport has only been realised by the addition of a Terma Scanter 4002 X-Band radar as second sensor which provides wind farm mitigated radar data over the majority of wind farms affecting Newcastle Airport. The STAR 2000 at Newcastle does utilise the Wind Farm Filter software update for a small number of individual wind turbines and very small developments, but only in conjunction with an operational mitigation. Clutter is reduced to an acceptable level so as not to cause a distraction, but target detection is also significantly reduced over and around the immediate area of the turbine, such that operational mitigations are also implemented in the form of controller operating procedures to warn of potential degraded performance in the affected areas.

- Point 3.

“1.4.4. The UK MoD have under project Marshall contracted for the supply of a large number of these systems due to their inbuilt capability to operate alongside windfarms.”

Sagentia Aviation believes Project Marshall did not include any requirements for wind farm mitigation in the procurement of a significant number of Thales STAR NG PSR's. Despite having potential wind farm mitigation capability, it is believed to date that no operational wind farms have been mitigated by any sensor deployed under the Project.

- Point 4.

“1.4.5. Thales have undertaken extensive trials documented in their Windfarm Mitigation presentation [4] which concludes the issue of false plots and desensitisation from wind turbines has been solved.”

Thales like other radar manufacturers have indeed undertaken extensive trials of their wind farm mitigation capabilities, from which the majority of data gathered is commercial constrained. Often data presented is limited in context to the actual problem trying to be solved and should only be used to assess likely risk of viability, and not to conclude that “the issue of false plots and desensitisation from wind turbines has been solved” in the context of Ballycar Wind Farm. Such confidence will only be increased by site specific modelling. Confirmation that the problem has been solved will not be realised until after a solution is deployed, implemented and has undergone formal quantitative testing.

The Mitigation Options Study presents a table of IAA Concerns v Impact, detailing ten concerns raised by IAA, providing a ‘Mitigation Measure Solution’ and ‘Residual Impact’ state. It is claimed that all ten concerns have a residual impact of none, thereby claiming a relevant mitigation measure solution exists. The solutions proposed are potentially viable, however at this stage, they are just a claim and an argument each of which in the main reference standard technical datasheets, technical descriptions and generic presentations; indeed, a Thales presentation is referenced, however this is not used as an argument in the table. The presentation is referred to in the text of the document as detailed in Point 4 above, again this is not specific to the Ballycar Wind Farm, other than to provide some context that Thales claim to have wind farm mitigation capability for their PSR.

A list of upgrade options is provided as a reference and used as a claim/ argument. The author of this document has not had visibility of this reference; however, an important factor is that for a 'Mitigation Options Study' of this nature and scope, the claims and arguments are sufficient, the author would expect that from this report, the Developer and Airport and AirNav collaborate to explore the upgrade options further, including providing more detailed and specific evidence (modelling etc.) against the claims/ arguments made.

3.7 Ballycar Wind Farm Aviation Impact Assessment & Mitigation Report Review

Section 3.7 provides an abstract of the report along with key responses and Sagentia Aviation's summary of the artifact.

Ai Bridges Ltd was commissioned by the Environmental Planning Consultants, MWP to produce The Ballycar Wind Farm Aviation Impact Assessment & Mitigation Report {REF.1} following the consultation response {C10} received from the IAA in November 2022.

3.7.1 Report Abstract

- Introduction Extract

Ai Bridges Ltd was commissioned by the Environmental Planning Consultants, Malachy Walsh and Partners (hereafter referred to as MWP) to review a consultation response from the Irish Aviation Authority (hereafter referred to as IAA) received in November 2022 in relation to the possible interference impacts of the proposed Ballycar wind farm on the Surveillance Radar equipment at Shannon Airport and Woodcock Hill."

- Conclusion Extract

"Following the investigation of the mitigation options along with discussions with the manufacturer of the radar equipment, it has been shown that there are viable options available for the mitigation / remediation of the ten concerns raised by the IAA . The Mitigation Options Study report concludes that:

- *The development of the Windfarm at Ballycar would require minimal optimization of the Woodcock Hill and Shannon Airport radars.*
- *The systems in place have the capacity to provide a service even if a large number of turbines were developed in the coverage area.*
- *The manufacturer can also provide upgrades and enhancements to both systems should they be required in future."*

3.7.2 Sagentia Aviation Summary

The Aviation Impact Assessment & Mitigation Report presents the findings of the previously commissioned technical assessments and ties in the conclusions of each against of the concerns raised by the AirNav in relation to IFP, Navigational Aid surfaces and Surveillance Radar systems. The report includes enclosures of each of the technical assessments as appendices as follows:

- Appendix A IAA Consultations
- Appendix B Ballycar Wind Farm IFP Opinion Report
- Appendix C Ballycar Wind Farm Aviation Technical Assessment
- Appendix D Ballycar Wind Farm Impact on ILS Inspection Report
- Appendix E Ballycar Wind Farm Mitigations Options Study.

The reader of this document should identify that each of these appendices has been reviewed as standalone documents based on chronology publication, within the Sections 3.2, 3.3, 3.4, 3.5 and 3.6 respectively. As such the respective Summaries detailed in the respective Sections, apply to this summary of the Aviation Impact Assessment & Mitigation Report and its recommendations which is extracted below:

“From the findings of the Mitigations Options Study Report prepared by Cyrrus the following recommendations have been made to remediate the concerns raised by the IAA ANSP in relation to surveillance radar impacts on the Woodcock Hill MSSR and the Shannon Airport PSR. Below is an extract from this Mitigation Options Study:

- i) The technical documentation provided by the manufacturer (Thales) of the two systems provides assurance that mitigation for the Ballycar Windfarm is possible. Cyrrus would recommend that an onsite condition survey is carried out by Thales on both the Shannon Airport and Woodcock Hill systems to confirm their current operational state and ascertain whether updates or upgrades would be required.*
- ii) A limited operational flight trial may also be prudent at this stage to provide a baseline of the current systems coverage over the area of the proposed Windfarm.*
- iii) Once the windfarm is built, the systems may require minor optimisation by Thales. Once completed, a further Flight Check would be recommended to confirm the systems performance was acceptable over the Windfarm area.”*

Whilst the report does appear to provide clean linkage for mitigations against the Navigational Aid surfaces and Surveillance Radar systems concerns raised by AirNav, the mitigations against the Surveillance Radar systems in particular as summarised in Section 3.6 of this document, still only provide claims and arguments, without substantive evidence. Indeed, the report actually recommends *“that an onsite condition survey is carried out by Thales on both the Shannon Airport and Woodcock Hill systems to confirm their current operational state and ascertain whether updates or upgrades would be required”*.

The author would expect that from the condition survey, Thales as the subject matter experts and system design authority of the radars would be able to provide stakeholders with a clear pathway of technical options, supported by analysis and modelling to underpin the claims and arguments made. However a mitigation programme is complex, to understand all of the implications and to inform a final decision on whether a solution option should be agreed, stakeholders would also have to have a clear understanding of all the implications involved including, timescales, costs, risks, integration, implementation and downtime, validation testing, commissioning and transition, safety programme planning, management and production/ updates of safety assurance artefacts and regulatory assurance compliance.

3.8 Further Correspondence Timeline: March to July 2024

Section 3.8 provides a timeline derived from the information provided to Sagentia Aviation by the client, it provides a list of the key correspondence from March to July 2024 and provides an overview of further concerns lodged by the Airport and AirNav.

ID.	Date	Originator	Recipient	Summary
{C11}	3 Mar 24	The Airport	The Client	- The Airport provide comments against the Development, confirming: <i>“this development will have no impact on the aerodrome OLS”</i> - The Airport shares concern with AirNav <i>“relating to radar systems and notable the Woodcock Hill radar”</i> <i>“it was initially thought that with appropriate mitigation measures and impacts on this critical piece of infrastructure by the Ballycar wind farm development would potentially be negated”</i> <i>“this letter of support also indicated that both the Instrument Flight Procedures (IFP’s and NAVAIDS were un-affected by the proposal”</i> <i>“following recent engagement between the developer” “it became apparent that these impacts could not be mitigated against” “Shannon Airport Authority fully supports the AirNav Ireland position of not being able to support the</i>

				<i>development on the basis that appropriate mitigation measures cannot be deployed to prevent impacts upon the Woodcock Hill radar site and therefore objects”</i>
{C12}	21 Mar 24	AirNav	The Client	- Comments following AirNav review of Technical Assessment {C6}.2 <i>“Due to the proximity and scale of the proposed development, there are no credible and implementable mitigations on the Woodcock Hill Radar itself to eliminate radar beam deflections, reflections, and shadowing from the proposed turbines”</i> <i>The development would compromise the Woodcock Hills radars compliance with EU mandated surveillance performance criteria required to support 5 nautical mile horizontal separation of aircraft en-route Irish airspace and nautical mile horizontal separation of aircraft in Dublin airspace” “The Woodcock radar region impacted sector is over 30 degrees wide”</i>
{C13}	26 Jul 24	The Client	MWP	RFI to MWP to address significant concerns raised by the Airport and AirNav: <i>“Notwithstanding the Applicants response to the observations received, the Applicant is requested to review these submissions further and respond accordingly e.g. through the submission of a technical report. The applicant is advised that their response should demonstrate that sufficient consultation with AirNav and Shannon Airport Authority has been undertaken and all Aviation concerns have been addressed to their satisfaction”</i>
				3.9 Response to the RFI (see Section 3.9 below)

3.9 Response to the Request for Further Information from An Bord Pleanála on the Ballycar Green Energy Ltd Strategic Infrastructure Development Application

Section 3.9 provides an abstract of the report along with key responses and Sagentia Aviation’s summary of the artifact ({Ref.5}).

This document was prepared by the Developer and submitted to the Client in in response to a Request For Information {C13}, where the Developer was *“advised that their response should demonstrate that sufficient consultation with AirNav and Shannon Airport Authority has been undertaken and all Aviation concerns have been addressed to their satisfaction”*.

3.9.1 Report Extract

The response statement comprehensively draws together all pervious correspondence between the parties, including all the technical artefacts produced and submitted at that point in time. It does demonstrate that the Developer has undertaken a significant level of engagement and that the Developer has attempted to address further concerns raised by AirNav and Shannon Airport as documented in Sections 3.2, 3.8 and 3.10.

The response statement summarises and references thirteen appendixes of technical reports. Appendixes 1 to 5 were submitted before issue of the response statement and as such have already been reviewed and commented upon in previous sections of this document as indicated below:

- **Appendix 1** Ballycar Windfarm Aviation Technical Assessment – Cyrrus (**Section 3.4**)
- **Appendix 2** IFP Opinion Ballycar Windfarm – Cyrrus (**Section 3.3**)
- **Appendix 3** Ballycar Windfarm Impact on ILS Inspection Report – FCSL (**Section 3.5**)

- **Appendix 4** Ballycar Wind Farm Aviation Impact Assessment & Mitigation Report – Ai Bridges (**Section 3.7**)
- **Appendix 5** Mitigation Options Study Ballycar Windfarm – Cyrrus (**Section 3.6**)

The remaining appendixes are reviewed below:

- **Appendix 6** AIRNAV Response Statement Ballycar Windfarm – Cyrrus

This document was generated by Cyrrus on behalf of Ai Bridges and was prepared in response to the concerns raised by AirNav in March 2024 {C12}.

Report Extract

The response again provides conceptual certainty, with some technical analysis regarding low-level coverage impacts (but not fully substantiated) on the Woodcock Hill MSSR. The response also goes on to suggest that low-level coverage impacts from shadowing from the Development on the Woodcock Hill MSSR will cause minimal operational impact overall, due to the fact that enroute traffic to which AirNav will generally provide an ATS will be at far higher altitudes. Additionally, the response identifies *“It is unlikely that the Woodcock Hill radar which is > 90NM from the Dublin Airport would be used for maintaining the 3NM Separation when A minimum of four other systems provide closer cover in this area”*

Sagentia Aviation Summary

The claim and arguments presented that the Development would cause minimal issues for the provision of 3NM and 5NM separation as part of enroute ATS provision are reasonable and credible. Further analysis may be required to substantiate these claims past conceptual certainty and to ascertain the exact impacts for inclusion and updates to the respective safety assurance artifacts. This may be in the form of an Operational risk assessment, or part of a more overarching risk assessment. For clarity AirNav could confirm the full extent of how radar data from Woodcock Hill MSSR is used for separation services which they claim will be impacted, in comparison to how radar data from other sensors is utilised for the provision of the same ATS.

- **Appendix 7** Aviation Assessment Methodology

This appendix provides an overview of how the Aviation Assessment Methodology has been undertaken.

Appendix Extract

The appendix summarises the four stages used in preparing the aviation review; these are Consultation, Surveys, Analysis/ Modelling and Aviation Impact Assessment.

Sagentia Aviation Summary

It is Sagentia Aviation’s view that the approach and methodology presented to address the scope of aviation assessments is reasonable in the context of the original application process.

However, despite the Developer’s best efforts to providing a level of conceptual certainty against the identified issues; AirNav and the Airport have maintained their position and, in some cases, raised further previously unidentified impacts.

AirNav and the Airport could have provided clearer expectations to the level of ‘data’, ‘modelling’ and ‘evidence’ required to potentially address the issues raised and that should meet the applicable regulatory requirements. This approach may have allowed the Developer to work with the Aviation stakeholders (including the OEMs of the affected radar systems) to present evidence at the detail required for them to either remove objections or to be comfortable that an agreed course of mitigation actions could be undertaken.

- **Appendix 8** Thales RSM970 Technical Description

A detailed description of the functions and features of the Thales RSM 970S MSSR has been included for reference.

Appendix Extract

The Developer highlights the Thales description of how the RSM 970S has:

“two stage reflection processing to eliminate reflections. The Surveillance Data Processor will mitigate against any reflections, also known as “sporadic” or “dynamic” reflections for buildings, terrain and man-made objects such as wind turbines”

“a well-established processing system to remove deflected targets which are known as False Replies Uncorrelated In Time (FRUIT). The MSSR operated at Woodcock Hill can use one of its own specific inbuilt processing techniques within its Surveillance Data Processor (SDP) to remove these false targets. This process removes the issue of deflections from the system”

Sagentia Aviation Summary

The document provided is a standard Thales description for the capabilities of a RSM 970S MSSR, whilst it provides conceptual certainty that the MSSR has the capability to mitigate temporary (Dynamic) and permanent (Static) reflections, to mitigate FRUIT and to prevent some possible reflection issues, it does not provide specific and contextual evidence of how it would solve the issues claimed by AirNav and the Airport.

- **Appendix 9** Thales Windfarm Mitigation Presentation

A Thales provided generic business development presentation of claimed wind farm mitigation capabilities of the STAR NG PSR.

Sagentia Aviation Summary

This is a generic standard business development presentation (with a link to a marketing video) which provides no evidential value to any claim or argument made, other than that mitigation possibly exists.

- **Appendix 10** Thales Structured List of Upgrades

A Thales provided generic business development presentation of upgrade paths from the STAR 2000 PSR to the STAR NG; and from the RSM 970S MSSR to the 970NG MSSR.

Sagentia Aviation Summary

This is a generic standard business development presentation (which provides no evidential value to any claim or argument made, other than that mitigation possibly exists.

- **Appendix 11** EUROCONTROL Mode S Station Functional Specification (EMS 3.11)

This is the EUROCONTROL Mode S functional specification for SSR/MSSR which is designed to be used as a set of requirements for the purposes of procurement.

Sagentia Aviation Summary

No reference to this document can be found in the Response. It provides no evidential value to any claim or argument made, other than that a standard SSR/ MSSR specification exists.

- **Appendix 12** AIS AIP Newcastle Airport

This is an extract from the UK AIS AIP depicting the Newcastle Airport ATC Surveillance Minimum Altitude Chart (ATCSMAC).

Sagentia Aviation Summary

The Developer references the Newcastle Airport ATCSMAC and claims that as wind farms can be seen within the surveillance volume that viable mitigation with the same type of radar (Newcastle Airport has a Thales STAR 2000 PSR) is possible and has precedence in the UK.

Newcastle Airport have a second radar integrated into their surveillance system, a Terma Scanter 4002 PSR which provides mitigation of wind farms. The Thales STAR 2000 PSR (other than minor blanking) provides limited wind farm mitigation at Newcastle Airport, therefore this reference provides no evidential value to any claim or argument made.

- **Appendix 13** Project Marshall ATC Radar Upgrade

The Developer has provided a list of MOD sites where Thales STAR NG radars have or are scheduled to be deployed.

Sagentia Aviation Summary

The MOD procured numerous instances of the Thales STAR NG PSR and RSM 970NG under Project Marshall, none of which were procured with any form of windfarm mitigation requirement. Whilst the radars have claimed wind farm mitigation capability, none have been optimised against specific operational developments other than for small capability trials; therefore, this reference provides no evidential value to any claim or argument made, other than as an example that there are many instances of the same basic variant of radar in the UK.

3.9.2 Sagentia Aviation Summary

The response statement presents the findings of the previously commissioned technical assessments (Appendixes 1 to 5) and provides additional material (Appendixes 6 to 13) which is generally reference artifacts.

Whilst the response statement is firmly grounded in presenting claims and arguments with supporting conceptual certainty in addressing the issues raised against the Woodcock Hill MSSR, it should be noted that the response statement does also contain superfluous references to Newcastle Airport, the MOD's Project Marshall and to the Thales Wind Farm Filter. These provide no evidential value to any claim or argument made, other than in the case of MSSR, as an example that there are many instances of the same basic variant of radar in the UK.

Overall, though, the Developer has reasonably argued that mitigations are available for the issues raised by AirNav and Shannon Airport regarding the MSSR at Woodcock Hill. The Developer has also highlighted that *“in May 2024, email correspondence was issued from Ballycar Green Energy to AirNav Ireland in relation to a planning condition being placed on the project (should planning permission be received) whereby the wind farm could not commence until all aviation concerns were fully addressed to the satisfaction of AirNav Ireland.*

An acknowledgment of the request was received from AirNav Ireland who outlined that the request was to be assessed by senior management and the legal team. At the time of writing this Response Statement, a reply in relation this request is outstanding from AirNav Ireland.”

In its conclusions the Developer later highlights *“the Applicant is amenable to the Board inserting a planning condition regarding agreement with AirNav Ireland upon the optimisation of Woodcock Hill radar equipment to be undertaken and its financing prior to commencement of the Proposed Development. For example: “Prior to the commencement of development, and following consultations with AirNav Ireland, a detailed aviation mitigation plan which incorporates the commitments set out in the aviation technical report submitted as further information, including details of any required minor optimisations of the Woodcock Hill Radar and the developer’s financial contribution for same, shall be submitted to, and agreed in writing with, the relevant planning authority.”*

This is a totally appropriate approach, whereby the Developer has recognised that there are aviation issues to be addressed, and that the Developer has conducted enough due diligence on appropriate mitigations to be confident enough that viable solutions exists, to the extent that the Developer is willing to accept a significant planning condition that places the financial and operational (renewable revenue) risk upon themselves. The Developer also proposes *“a detailed aviation mitigation plan which incorporates the commitments set”*, again this is an appropriate proposal to make, as in essence this is what would be construed as an Aviation Mitigation Scheme for the Development.

3.10 Further Correspondence Timeline: December 2024 to January 2025

Section 3.10 provides a timeline derived from the information provided to Sagentia Aviation by the client, it provides a list of the key correspondence from December 2024 to January 2025 and provides an overview of further responses lodged by the Airport and AirNav.

ID.	Date	Originator	Recipient	Summary
{C14}	18 Dec 24	AirNav	The Client	• AirNav maintain their position <i>“that we must object in the strongest possible terms to the aforementioned</i>

				<i>proposed windfarm development</i>” “<i>the greatest cause for concern for AirNav is the generation of radar beam deflections that would generate false targets at higher altitudes and at a distance of up to 250nm</i>” • AirNav notes that the original assessment documentation “<i>noted no impacts for the AirNav NAVAIDs facilities. There is however an impact for calibration of the ILS system</i>” “<i>Any amendment to current calibration serials has the potential to affect the safety assurance material of the IL24 Glideslope</i>” <i>“The RFI documentation as lodged has no standing without a full review by the AirNav Ireland Surveillance and NAVAIDs teams including a demonstration of how mitigation measures, if available, could be applied”</i> <i>“the proposed development” “has the potential for the biggest impacts on AirNav Ireland systems, without measurable, evidence-based, demonstrable mitigations being applied”</i>
{C15}	6 Jan 25	The Airport	The Client	• The Airport maintains support for the AirNav position “<i>on the basis that appropriate mitigation measures cannot be deployed (to their satisfaction) to prevent impacts on the Woodcock Hill radar site</i>” • The Airport goes on to propose that “<i>There is, based on information received from AirNav Ireland, an expected impact for calibration of the ILS system</i>” “<i>Any amendment to the current calibration serials has the potential to affect the ILS Glide Slope angle</i>”
				• Response to Observations on Significant Further Information – ABP-318943-24 (see Section 3.11 below)

3.11 Response to Observations on Significant Further Information – ABP-318943-24

Section 3.11 provides an abstract of the report along with key responses and Sagentia Aviation’s summary of the artifact.

This document was prepared by the Developer and submitted to the Client in January 2025. This document sets out the Developers response to the observations received from statutory consultees. In the context of this report, the aviation responses against observations made by AirNav Ireland {C14} and Shannon Airport authority {C15} are detailed in para’s 2.1.5 and 2.1.6 respectively. Additionally at para 2.1.8 the document provides context for statutory bodies obligations regarding the co-existence of windfarms; specifically, regarding EU Regulation 2018 / 1048 and airspace usage requirements concerning Performance Based Navigation (PBN IR), referencing that “*the movement to exclusive use of satellite based navigation systems in Irish airspace is required by the Regulation to take place by June 6th, 2030*”.

3.11.1 Sagentia Aviation Summary

The report provides responses to all of the observations made by AirNav and the Airport throughout the consultation process. Each point is articulated and again demonstrates mitigation for the IFP and ILS concerns with reasoned evidence. For the Surveillance concerns, the report again links to previously commissioned technical reports, and as such the Summaries detailed in the respective Sections of this document apply.

4 Overall Synopsis

4.1 Overview

Sagentia aviation has reviewed the artifacts provided by the Client as listed in Table 1 regarding the proposed Ballycar Wind Farm Development. Individual review summaries are provided at the respective sections of this document.

4.2 Background

AirNav and the Airport raised a number of objections to the Development; these can be categorised as the following key objections:

- IFP
- ILS
- Surveillance Systems (Shannon Airport PSR; and Woodcock Hill MSSR)

During the consultation process, the Developer has commissioned and provided a number of assessments with the intention of providing a level of confidence that mitigations are available to address the concerns raised against each of the key objections. The assessments were conducted by reputable independent aviation consultants and specialists.

The approach, outcomes and conclusions of each assessment are generally reasonable in the context of when they were commissioned in the planning process timeline. However, in the context of increasing confidence sufficiently that the Airport and AirNav may remove objections to the development, very little quantitative evidence has been provided. The Developers reasoning in the main have been supported by claims, arguments and conceptual certainty rather than claims, arguments and evidence based on the actual systems in question and against the development being considered.

Sagentia Aviation's observations to each of the three key objections is presented below:

4.3 IFP

Impacts to IFP were identified as a concern early into the planning engagement. A subsequent report was commissioned and undertaken by FCSL, a Civil Aviation Authority (CAA) and IAA Approved Procedure Design Organisation.

The approach, outcomes and conclusions of the IFP Opinion Report are reasonable in the context applied, they have been accepted by the AirNav {C7}.

4.4 ILS

Initial concerns regarding the Airports Runway 24 ILS were raised. The Developer commissioned Cyrrus to undertake a technical assessment ({Ref.1} Appendix B) and FCSL to undertake an assessment of impact to flight calibration activities ({Ref.1} Appendix D).

Both Cyrrus and FCSL are reputable and competent organisations capable of undertaking the respective assessments.

The Technical Assessment presents a reasonable conclusion that based on conducting a Building Restricted Area's assessment, that the Development will have no impact on the Airports Runway 24 ILS system or associated Distance Measuring Equipment.

The FCSL assessment presents a reasonable conclusion that the Development will not have any adverse effect on Runway 24 ILS flight inspection procedures and flight profiles other than the potential to increase the height required to fly the Glide Path slice and left slice 8° profiles to 2,400ft in IMC to ensure clearance between the aircraft and the Development.

Later into the planning process {C14} AirNav introduced the following response: *“There is however an impact for calibration of the ILS system” “Any amendment to current calibration serials has the potential to affect the safety assurance material of the IL24 Glideslope”*

At a similar time, The Airport {C15} introduced the following response: *“There is, based on information received from AirNav Ireland, an expected impact for calibration of the ILS system” “Any amendment to the current calibration serials has the potential to affect the ILS Glide Slope angle”*.

Sagentia Aviation believes that there is sufficient evidence presented in the FCSL Report to assure the Airport that flight calibration activities can still be conducted satisfactorily to validate current performance requirements of the Glidepath. Several flying serials may need to be increased in height, but FCSL have confirmed that the Glide Path RF signal levels exceed minimum levels and sufficient fly-up guidance is achieved below the Glide Path sector.

Sagentia Aviation notes AirNav concerns that any amendment to current calibration serials has the potential to affect the safety assurance material. The safety assurance material will require a minor update to reflect the change in serials, but as FCSL have already confirmed that this change will not impact calibration activities and that there is sufficient fly-up guidance, then the overall risk to the quality of safety assurance material is very low.

4.5 Surveillance Systems (Shannon Airport PSR; and Woodcock Hill MSSR)

The Developer has presented ‘credible’ mitigation solutions based on technical reports provided by reputable aviation consultants, however the level of evidence detail required to assure the Airport and AirNav of a solutions likelihood of success, and the impacts and costs associated with each undertaking are not present.

Specifically apart from the provision of a recommendation that the Airports PSR and AirNavs MSSR at Woodcock Hill have condition surveys undertaken, and a provision of upgrade options, no further scope has been provided in the form of more detail required to achieve each option; including, timescales, costs, risks, integration, implementation and downtime, validation testing, commissioning and transition, safety programme planning, management and production/ updates of safety assurance artefacts and regulatory assurance compliance.

Whilst it is not unusual that this level of detail is not necessarily available at the point of planning approval, it is usual that where major impacts have been identified, that through collaboration between an aviation objector and a Developer, a form of Aviation Mitigation Scheme has been agreed, and suitable planning conditions are attached to planning permission. The Aviation Mitigation Scheme would also have commercial agreements or heads of terms agreed to establish funding liabilities.

In the case of Ballycar, AirNav and the Airport have continually objected to the Developer, and in some instances has introduced further or new objections quite late into the process. Sagentia Aviation cannot comment on the exact background, relationships, communications and engagement between parties, other than what is contained within the material reviewed in this document. It does appear that both parties have relevant but opposing positions, e.g. from the Airports and AirNavs perspective there are valid aviation impacts; from the Developers perspective there are credible mitigations available.

These mitigations should be explored further collaboratively between the parties with a view to agreeing an Aviation Mitigation Scheme, for example the Developer states:

“From the findings of the Mitigations Options Study Report prepared by Cyrrus the following recommendations have been made to remediate the concerns raised by the IAA ANSP in relation to surveillance radar impacts on the Woodcock Hill MSSR and the Shannon Airport PSR. Below is an extract from this Mitigation Options Study:

- i) The technical documentation provided by the manufacturer (Thales) of the two systems provides assurance that mitigation for the Ballycar Windfarm is possible. Cyrrus would recommend that an onsite condition survey is carried out by Thales on both the Shannon Airport and Woodcock Hill systems to confirm their current operational state and ascertain whether updates or upgrades would be required.*
- ii) A limited operational flight trial may also be prudent at this stage to provide a baseline of the current systems coverage over the area of the proposed Windfarm.*

iii) *Once the windfarm is built, the systems may require minor optimisation by Thales. Once completed, a further Flight Check would be recommended to confirm the systems performance was acceptable over the Windfarm area.*

Point i). above states “*provides assurance that mitigation for the Ballycar Windfarm is possible*”. Sagentia aviation agree mitigation is ‘possible’, but what does that mean to the Airport and AirNav. Are their respective radars going to require relatively low risk optimisation, or as is likely for the Shannon PSR, will it require a costly (circa £3M to £4M) upgrade from a STAR 2000 PSR to a STAR NG variant. As an aviation provider of safety critical Air Traffic Services, both organisations would need further assurance and understanding of the full impact to their operations before removing objections.

Point ii). above states that “*A limited operational flight trial may also be prudent at this stage*”. Sagentia aviation agree that at some point in time a crucial activity is required, but the level of assessment required is proportional to the mitigation solution agreed. For example, if the STAR 2000 was required then a full commissioning flight trial will need to be undertaken, this is a far greater scope than a “*limited operational flight trial*”. Again, the costs and implications involved with this is not insignificant. The flight trial requires designing against an agreed set of requirements. The flight trial needs to be planned, and roles agreed. The flight trial needs to have an approved plan, the actual activity needs to be managed, and data recorded and analysed. A resultant flight trial report needs to be published as it forms a key safety assurance evidence artifact.

Point iii). Above states that the “*the systems may require minor optimisation*” and “*a further Flight Check would be recommended to confirm the systems performance was acceptable over the Windfarm area*”. These are potentially understatement as it is conjecture that the systems may require minor works. The minor works alluded to are still significant undertakings involving cost, time, downtime and impacts to operations, along with supporting safety assurance. If the PSR requires an upgrade then as discussed previously a complex and costly programme of work including system integration, implementation and downtime, validation testing, commissioning and transition, safety programme planning, management and production/ updates of safety assurance artefacts and regulatory assurance compliance is required.

4.6 Final Summary

The Developer should be lauded for engagement early in the planning process circa 2022 with the Airport and AirNav, specifically in commissioning an IFP Assessment ({Ref.1} Appendix B) and an initial Technical Assessment ({Ref.1} Appendix C) which identified the potential impacts to the Airports PSR, assessed no technical impacts to the Airports MSSR and NavAids (including assessing the ILS against the ICAO Building Rested Areas) and also which assessed and identified the impacts to the AirNav MSSR at Woodcock Hill. Further engagement with AirNav and the Airport identified concerns regarding impacts to calibration activities required for the Airports runway 24 ILS Glidepath; again, the Developer engaged with a reputable consultancy to specifically assess ({Ref.1} Appendix D) these concerns.

It should be noted that the original surveillance mitigation options presented in the Technical Assessment ({Ref.1} Appendix C) date back to 2021. Whilst at a high level they give an indication of potential capability, the reference to Aveillant technology, is flawed and outdated.

Further dialog was undertaken between the parties, with AirNav and the Airport maintaining their position that the residual impacts in particular to the Surveillance Systems were unacceptable. AirNav provided a comprehensive response {C.10} in Nov 22 to the Developer, that outlined their main areas of concern.

In 2023 the Developer acted appropriately and commissioned a Mitigation Options Study ({Ref.1} Appendix E)), which aimed to address each of the stated concerns. The study was again produced by a reputable and credible aviation consultancy. The report provided claims and arguments, but not tangible outcomes in the form of ‘measurable evidence’, however Sagentia Aviation believe this to be appropriate at this point in planning process.

Additionally, it should also be noted that as summarised in Section 3.6.2 the mitigation options presented in the Mitigation Options Study ({Ref.1} Appendix E)) give an indication of high-level potential capability only, the references to Newcastle Airport and Project Marshall are flawed and could be misconstrued.

It is Sagentia Aviation's view, that whilst the report did present credible claims and arguments for the point in time, the results and conclusions, could be misinterpreted as 'solutions', and this appears to be what has happened in follow on engagements to date.

In August 2023 the Developer commissioned a further report, the Ballycar Wind Farm Aviation Impact Assessment & Mitigation Report {Ref.1}. This document captured all the previous assessments conducted and aligned their conclusions and recommendations to all of AirNav's and the Airports stated issues captured to that date. Whilst at the planning stage, it is more normal to have agreements in principle in place rather than exacting detail of solutions, as the report still linked back to the claims and arguments and conceptual certainty made in the previous assessments, AirNav and the Airport again objected. In simple terms, the Aviation Impact Assessment & Mitigation Report {Ref.1} contained viable mitigation options but still without detail of actually how they would be applied, how long will it take, what is the cost, how they will be assured and how they would impact the provision of a safe Air Traffic Service.

At the request of the Client {C13}, a further response statement ({Ref.5}) was produced by the Developer which presented the findings of the previously commissioned technical assessments (Appendixes 1 to 5) and provided additional material (Appendixes 6 to 13) which is generally reference artifacts. Overall, though, the Developer has reasonably argued that credible mitigations are available for the issues raised by AirNav and Shannon Airport regarding the MSSR at Woodcock Hill.

An important note is that the Developer referenced that "in May 2024, email correspondence was issued from Ballycar Green Energy to AirNav Ireland in relation to a planning condition being placed whereby the wind farm could not commence until all aviation concerns were fully addressed to the satisfaction of AirNav Ireland. This is a totally appropriate approach, whereby the Developer has recognised that there are aviation issues to be addressed, and that the Developer has conducted enough due diligence on appropriate mitigations to be confident enough that viable solutions exists, to the extent that the Developer is willing to accept a significant planning condition that places the financial and operational (renewable revenue) risk upon themselves. This is fundamentally the Developer proposing that Aviation Mitigation Scheme is negotiated.

It is not known if a reply in relation this request has been received."

A further comprehensive report {Ref.8} was also submitted, this covered all planning aspects of the Development. As summarised at Section 3.11.1, for the aviation concerns, the report again links to previously commissioned technical reports, and as such the Summaries detailed in the respective Sections of this document apply.

In terms of aviation safety, it is AirNav and the Airports legal responsibility as the respective Air Navigations Service Providers to ensure the safety of the services they provide.

The Developer has provided suitable evidence ({Ref.1} Appendix C) that the System Integrity of the ILS would be unaffected and that the calibration flying serials ({Ref.1} Appendix D) could be modified without impact to calibration activities (other than for potentially more flying time, to which the Developer has committed covering additional costs {Ref.8}). Despite this, AirNav {C14} and the Airport {C15} still object to this point. It is Sagentia Aviation's view that the required update to Safety Assurance (the system Safety Case) is minor in nature and will only need to reflect a change in flying serials with a supporting argument (as already evidenced in ({Ref.1} Appendix D)) that this can be achieved to maintain the existing 3° glidepath as sufficient fly up signal strength is available.

At this point in time, it is Sagentia Aviation's view that despite significant engagement, the aviation concerns have not been addressed to the satisfaction of AirNav and the Airport.

It is also Sagentia Aviation's view, that credible surveillance mitigation options do exist, but further collaborative engagement is required to establish how a state of 'conceptual certainty' could be improved to a state of measurable evidence being provided by the Developer at a level that would satisfy the Airports and AirNavs concerns to allow the project to move forward.

This could be through the development of an Aviation Mitigation Scheme, which provides enough detail, commercial certainty and stipulates residual obligations sufficiently enough for the objections to be replaced with planning conditions.

About Sagentia Aviation

Osprey Consulting Services Ltd (t/a Sagentia Aviation) specialises in delivering innovative technical and engineering consultancy services in civil and military aviation environments. It serves government agencies, regulatory authorities, equipment providers, and airport and spaceport operators to enable change and solve critical aviation challenges.

info@sagentiaaviation.com
www.sagentia.com/aviation

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info@sciencegroup.com
www.sciencegroup.com