Dean Moor

Solar Farm

Environmental Statement: Appendix 7.9 –Glint and Glare Assessment (1 of 2)

on behalf of **FVS Dean Moor Limited**

March 2025
Prepared by: Pager Power
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DEAN MOOR SOLAR FARM

ENVIRONMENTAL STATEMENT

APPENDIX 7.9 – GLINT AND GLARE ASSESSMENT

PLANNING INSPECTORATE REFERENCE EN010155

PREPARED ON BEHALF OF FVS DEAN MOOR LIMITED

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, Regulation 5(2)(a)

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1 Introduction

1.1 Report Purpose

1.1.1 This report has been provided to assess the possible effects of glint and glare from the Dean Moor Solar Farm (the 'Proposed Development'). The Proposed Development is a solar photovoltaic ('PV') energy generating station with a total capacity exceeding 50 Megawatts ('MW') comprising solar PV arrays, grid connection infrastructure, associated infrastructure, and green infrastructure.

1.1.2 The Proposed Development will be located on approximately 276.5ha of land located between the villages of Gilgarran and Branthwaite in West Cumbria (the 'Site') (ES Figure 1.1) [**REF: 6.2**], which is situated within the administrative area of Cumberland Council (the 'Council').

1.1.3 This assessment pertains to the possible impacts upon road safety, residential amenity, and aviation activity associated with a temporary / seasonal aerodrome at Gilgarran (referred to herein as Gilgarran Airfield).

1.1.4 No significant impacts are predicted upon road safety, residential amenity, and aviation activity associated with Gilgarran Airfield. Mitigation is therefore not required.

1.1.5 This assessment forms Appendix 7.9 of ES Chapter 7 – Landscape and Visual [**REF: 6.1**].

1.2 Overview

1.2.1 Pager Power has been retained to assess the possible effects of glint and glare from the Proposed Development located between the villages of Gilgarran and Branthwaite in West Cumbria. This assessment pertains to the possible impacts upon road safety, residential amenity, and aviation activity associated with Gilgarran Airfield.

1.2.2 This report contains the following:

- Solar development details;
- Explanation of glint and glare;
- Overview of relevant guidance and studies;
- Overview of Sun movement;
- Assessment methodology;
- Identification of receptors;
- Glint and glare assessment for identified receptors;
- Results discussion;
- Overall conclusions and recommendations.

1.3 Pager Power

1.3.1 Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 60 countries within Europe, Africa, America, Asia, and Australasia.

1.3.2 The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

1.3.3 Pager Power prides itself on providing comprehensive, understandable and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

1.3.4 Pager Power has undertaken over 1,500 Glint and Glare assessments in the UK and internationally. The studies have included assessment of civil and military aerodromes, railway infrastructure, and other ground-based receptors including roads and dwellings.

1.4 Glint and Glare definition

1.4.1 The definition[1] of glint and glare is as follows:

- **Glint** – '*a momentary flash of bright light typically received by moving receptors or from moving reflectors*'; and
- **Glare** – '*a continuous source of bright light typically received by static receptors or from large reflective surfaces*'.

1.4.2 The term 'solar reflection' is used in this report to refer to both reflection types i.e. glint and glare.

[1] These definitions are aligned with those presented within the NPS Renewable Energy Infrastructure (EN-3) – published by the Department for Energy Security and Net Zero in (January 2024) and the FAA Administration in the USA.

2 Solar Development Location and Details

2.1 Overview

2.1.1 The following sections present key details pertaining to the Proposed Development and this assessment.

2.2 Proposed Development Parameter Plan

2.2.1 Figures 2.1 and 2.2 show an exert of the Parameter Plan for the Proposed Development, which is provided in full in ES Figure 3.4 [**REF: 6.2**].

Figure 2.1: Parameter Plan

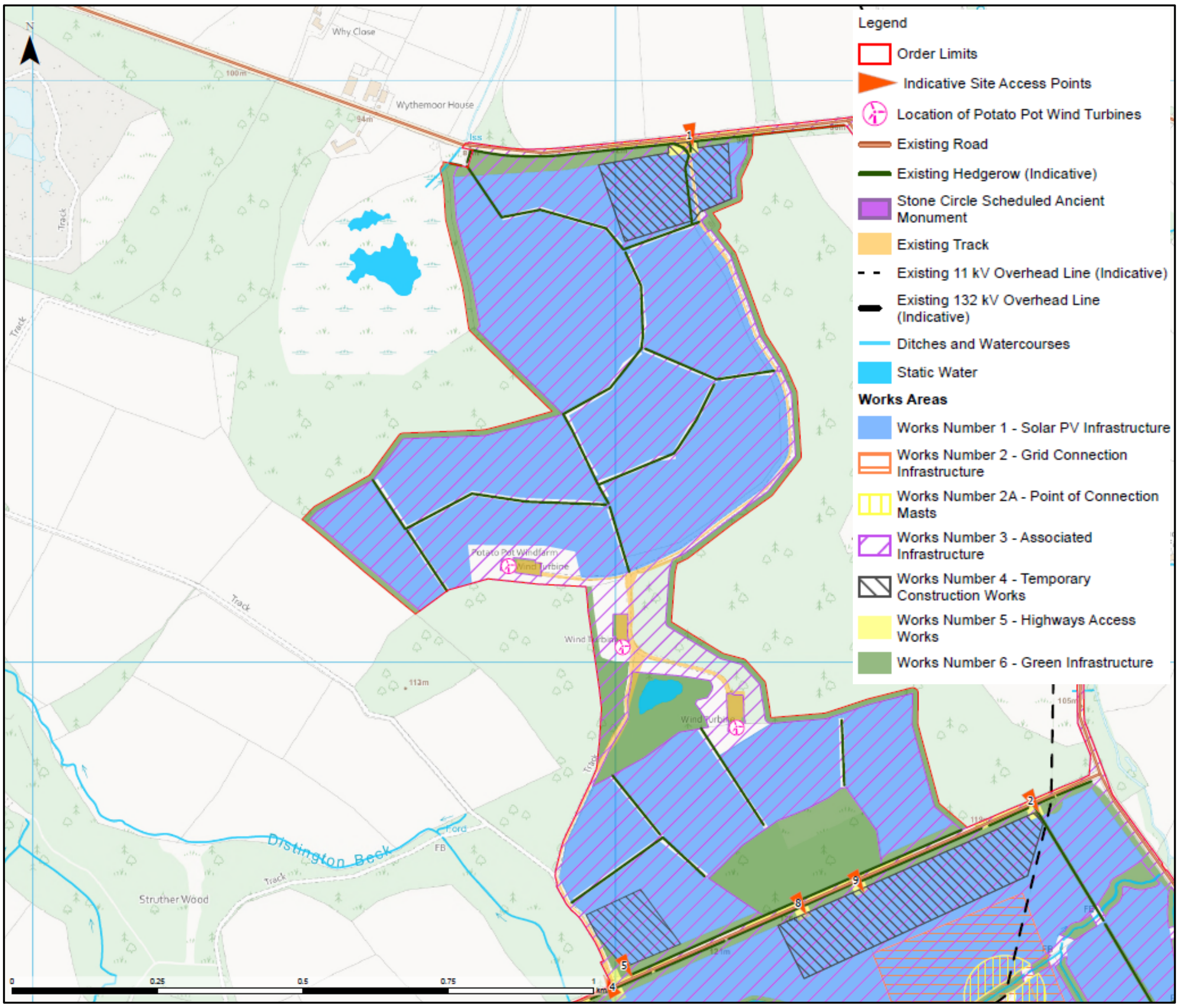
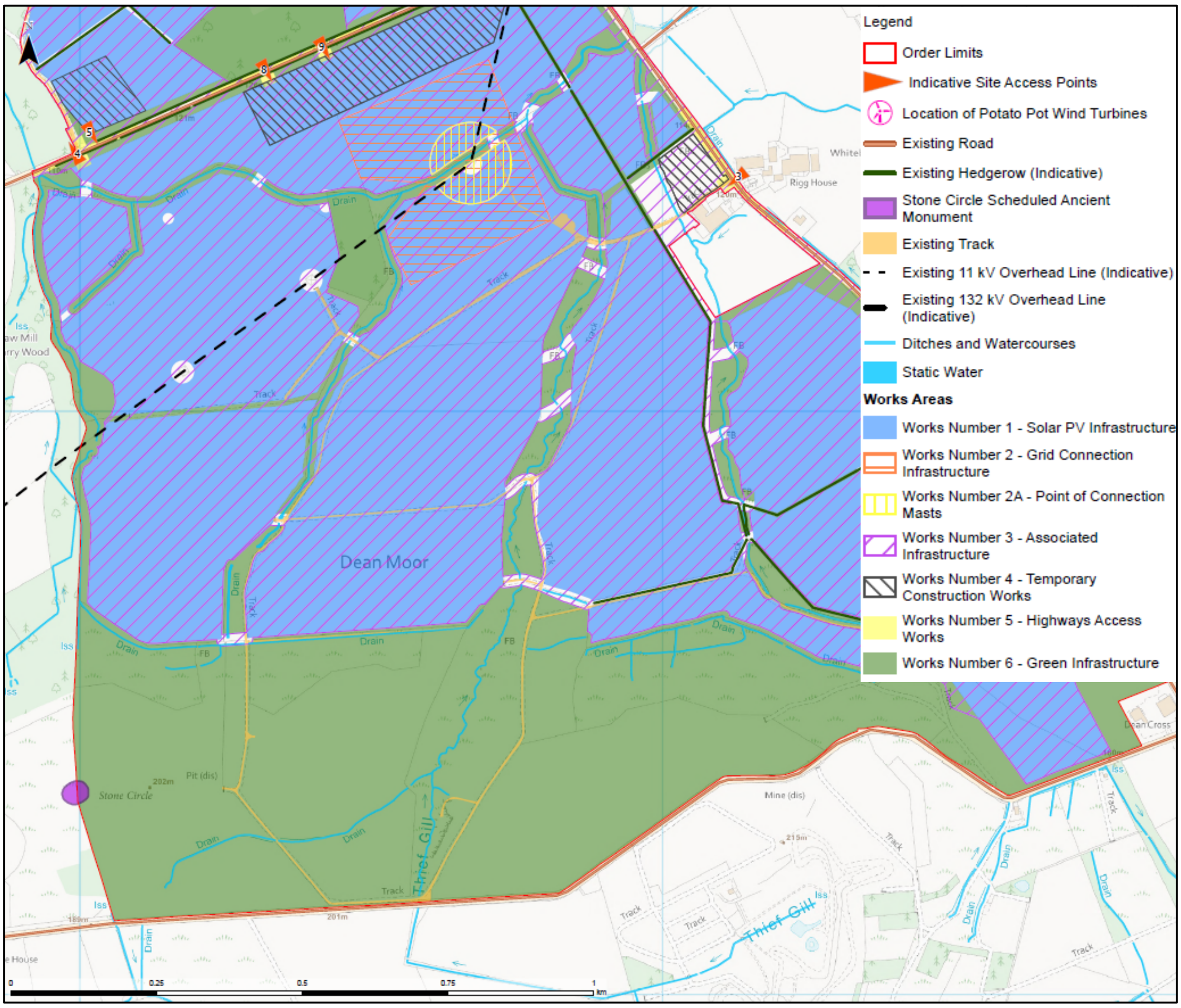
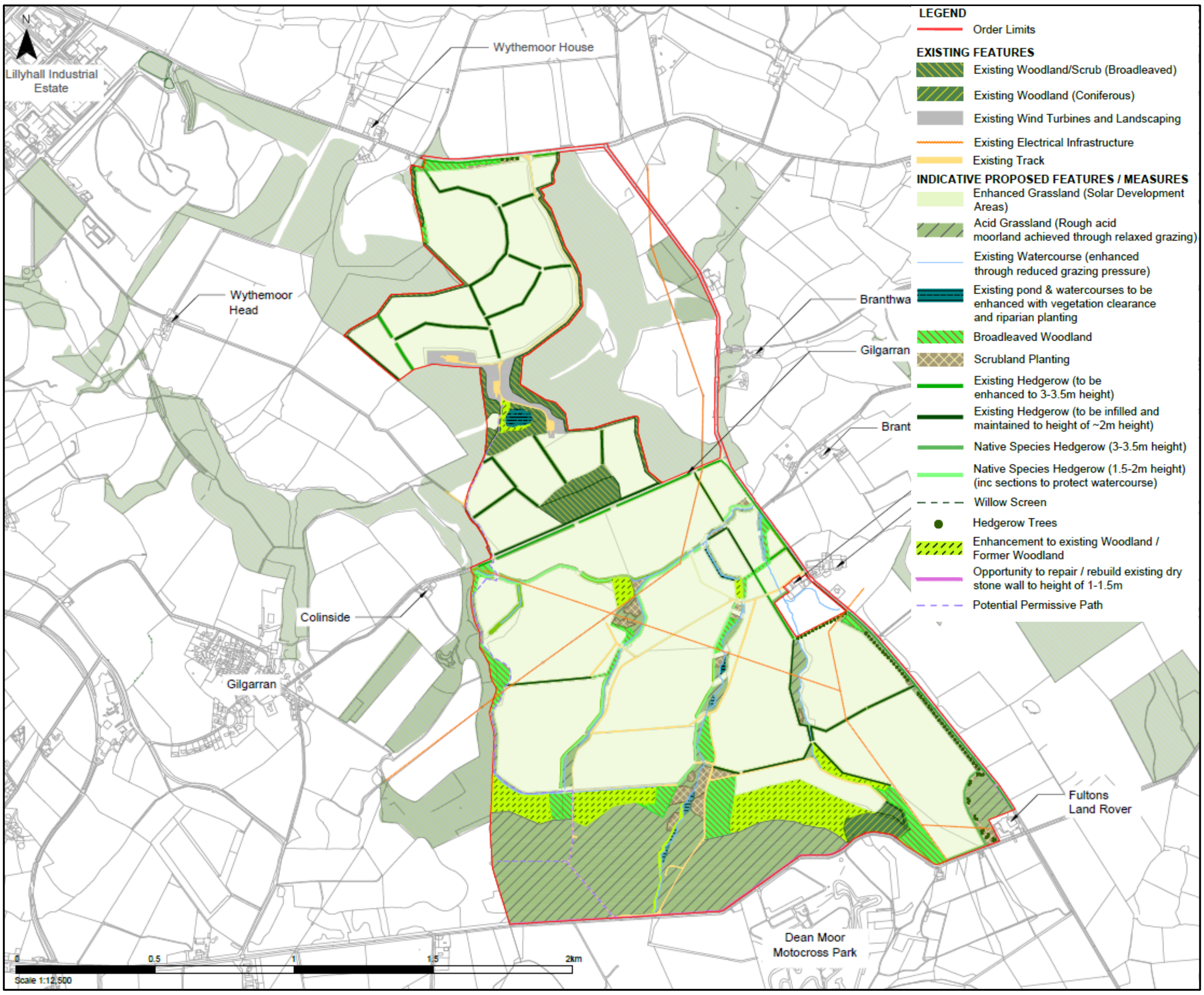


Figure 2.2: Parameter Plan



2.2.2 Figure 2.3 shows the outline Landscape Strategy Plan ('LSP') which is provided in ES Chapter 7 – Landscape and Visual (ES Figure 7.6.1-7.6.5) **[REF 6.2]**. This Glint and Glare Assessment has considered the existing vegetation to be retained and indicative proposed features when considering the impact upon receptors.

Figure 2.3: Landscape Strategy Plan



2.3 Reflector Areas

2.3.1 The bounding coordinates for the Proposed Development have been extrapolated from the Parameter Plan (Figures 2.1 and 2.2). The data can be found in Appendix G. Figure 2.4 shows the assessed reflector areas that have been used for modelling purposes.

Figure 2.4: Assessed Reflector Areas

2.3.2 The model has used a resolution of 10m has been chosen for this assessment. This means that a geometric calculation is undertaken for each identified receptor every 10m from within the defined areas. This resolution is sufficiently high to maximise the accuracy of the results – increasing the resolution further would not significantly change the modelling output. If a reflection is experienced from an assessed panel location, then it is likely that a reflection will be viewable from similarly located panels within the Site.

2.4 Solar Panel Technical Information

2.4.1 The technical information of the modelled solar panels used in this assessment is summarised as follows:

- Azimuth angle[2]: 180°;
- Elevation angle[3]: 15°; and
- Assessed centre height[4]: 2.0m above ground level.

[2] Direction the panels are facing relative to True North (0°). Relative to an average orientation of (-)4° from south

[3] Pitch above horizontal. Assessed at a midpoint between 10° and 20°. The modelling results are not expected to change significantly for small changes to the elevation angle.

[4] Relative to the lowest (0.7m) and highest (3.3m) points above ground level

3 Glint and Glare Assessment Methodology

3.1 Overview

3.1.1 The following sub-sections provide a general overview with respect to the guidance studies and methodology which informs this report. Pager Power has also produced its own Glint and Glare Guidance[5] which draws on assessment experience, consultation, and industry expertise.

3.2 Guidance and Studies

3.2.1 Guidelines exist in the UK (produced by the CAA)[6] and in the USA (produced by the FAA)[7] with respect to solar developments and aviation activity. The UK CAA guidance is relatively high-level and does not prescribe a formal methodology. There is no formal planning guidance for the assessment of solar reflections from solar panels towards roads and nearby dwellings. Pager Power has however produced guidance for glint and glare and solar photovoltaic developments, with the fourth edition published in 2022[8]. This methodology defines a comprehensive process for determining the impact upon road safety, residential amenity, and aviation activity.

3.2.2 Pager Power's approach is to undertake geometric reflection calculations and, where a solar reflection is predicted, consider the screening (existing and/or proposed) between the receptor and the reflecting solar panels. For aviation activity, where a solar reflection is predicted, solar intensity calculations are undertaken where appropriate in line with the Sandia National Laboratories' FAA methodology[9]. The scenario in which a solar reflection can occur for all receptors is then identified and discussed, and a comparison is made against the available solar panel reflection studies to determine the overall impact.

[5] Pager Power (2022). Solar Photovoltaic and Building Development – Glint and Glare Guidance.

[6] CAA Interim Guidance (presented in Appendix A)

[7] Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports'(presented in Appendix A)

[8] Pager Power Glint and Glare Guidance, Fourth Edition, September 2022.

[9] Formerly mandatory for on-airfield solar developments in the USA under the FAA's interim policy, superseded in 2021 with a policy that effectively requires individual airports to sign off on their on-airfield development as they see fit.

3.2.3 The approach is to identify receptors, undertake geometric reflection calculations, and review the scenario under which a solar reflection can occur, whilst comparing the results against available solar reflection studies.

3.2.4 The available studies have measured the intensity of reflections from solar panels with respect to other naturally occurring and manmade surfaces. The results show that the reflections produced are of intensity similar to or less than those produced from still water and significantly less than reflections from glass and steel[10].

3.2.5 Appendix A and B present a review of relevant guidance and independent studies regarding glint and glare issues from solar panels and glass. The overall conclusions from the available studies are as follows:

- Specular reflections of the sun from solar panels and glass are possible;
- The measured intensity of a reflection from solar panels can vary from 2% to 30% depending on the angle of incidence; and
- Published guidance shows that the intensity of solar reflections from solar panels are equal to or less than those from still water and similar to those from glass. It also shows that reflections from solar panels are significantly less intense than many other reflective surfaces, which are common in an outdoor environment, including steel[11].

3.3 Background

3.3.1 Details of the sun's movements and solar reflections are presented in Appendix C.

3.4 Methodology

3.4.1 Statutory consultation between April and May 2024 did not raise any specific concerns for glint and glare. The assessment methodology for this assessment is outlined in the following sections, in accordance with industry best practice.

3.4.2 Information regarding the methodology is presented in the following sub-sections 3.4.3 and 3.4.6 respectively.

[10] SunPower, 2009, SunPower Solar Module Glare and Reflectance (appendix to Solargen Energy, 2010).

[11] SunPower, 2009, SunPower Solar Module Glare and Reflectance (appendix to Solargen Energy, 2010).

3.4.3 The glint and glare assessment methodology has been derived from the information provided to the author through consultation with stakeholders and by reviewing the available guidance, studies and the authors' practical experience. The methodology for this assessment is as follows:

- Identify receptors in the area surrounding the Proposed Development;
- Consider direct solar reflections from the Proposed Development towards the identified receptors by undertaking geometric calculations;
- Consider the visibility of the reflectors from the receptor's location. If the reflectors are not visible from the receptor then no reflection can occur;
- Based on the results of the geometric calculations, determine whether a reflection can occur, and if so, at what time it will occur;
- Consider the solar reflection intensity, if appropriate;
- Consider both the solar reflection from the Proposed Development and the location of the direct sunlight with respect to the receptor's position;
- Consider the solar reflection with respect to the published studies and guidance; and
- Determine whether a significant detrimental impact is expected in line with Appendix D.

3.4.4 Within the model, the reflector area is defined, as well as the relevant receptor locations. The result is a chart that states whether a reflection can occur, the duration and the panels that can produce the solar reflection towards the receptor. Where a solar reflection is identified for an aviation approach path receptor, intensity calculations are completed in line with the Sandia National Laboratories methodology (section 3.4.2).

3.4.5 Sandia National Laboratories developed the Solar Glare Hazard Analysis Tool ('SGHAT') which is no longer freely available however it is now developed by Forge Solar. The author uses this model where required for aviation receptors. Whilst strictly applicable in the USA and to solar photovoltaic developments only, the methodology is widely used by aviation stakeholders internationally.

3.5 Assessment Methodology and Limitations

3.5.1 Further technical details regarding the methodology of the geometric calculations and limitations are presented in Appendix E and Appendix F.

4 Identification of Receptors

4.1 Overview

4.1.1 The following sections present the relevant receptors assessed within this report. Terrain data has been interpolated based on Ordnance Survey (‘OS’) 50 Digital Terrain Model (‘DTM’) data. The receptor details for all receptors are presented in Appendix G.

4.2 Aviation Receptors

4.2.1 Gilgarran Airfield is an unlicensed general aviation aerodrome (i.e., not a certified and/or licensed aerodrome), and not understood to have an Air Traffic Control (‘ATC’) Tower. The airfield is considered to be active temporarily through the year (i.e. seasonally) for a maximum of 28 days of the year. There are no published details or record of this aerodrome, reiterating that the license (if any) would have lapsed.

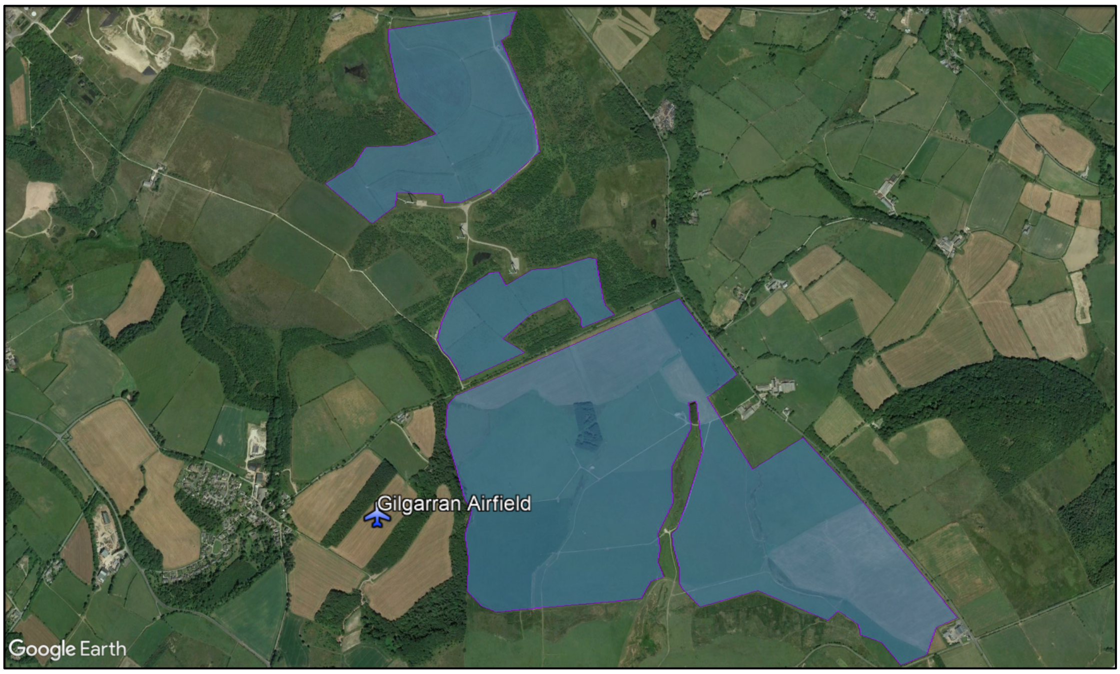
4.2.2 The airfield has one operational runway, the details[12] of which are presented below:

- 04/22 measuring 325 metres by 11 metres (grass).

4.2.3 Gilgarran Airfield is approximately 345m west from the Proposed Development. The location relative to the Proposed Development is shown in Figure 4.1.

[12] Source: As determined from aerial imagery

Figure 4.1: Gilgarran Airfield Relative to Proposed Development



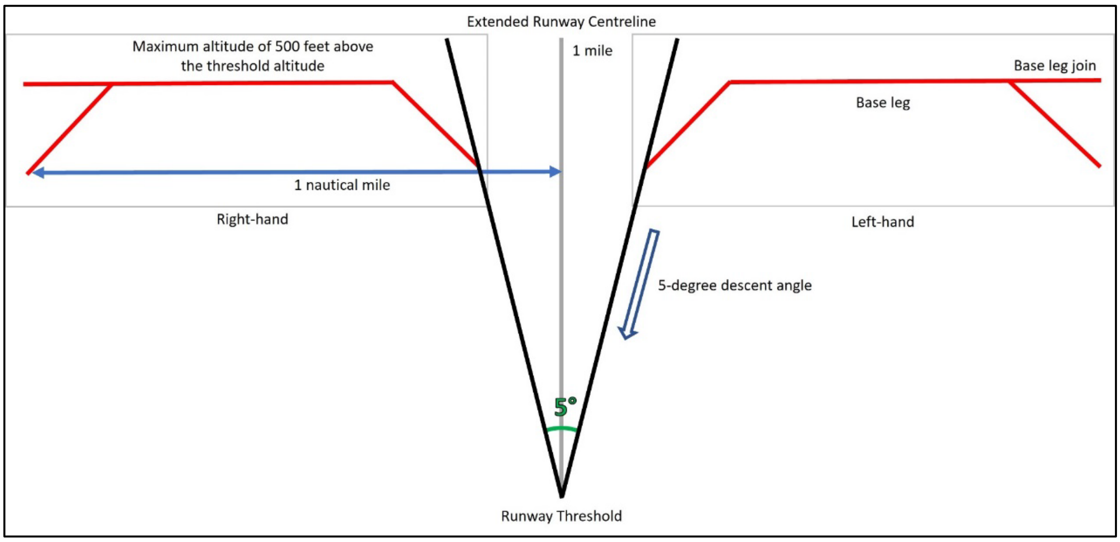
4.2.4 Gilgarran Airfield is a general aviation airfield where aviation activity is dynamic and does not necessarily follow the typical approaches / flight paths of a larger licensed aerodrome or airport. It is not possible to assess every single location of airspace that an aircraft travels in flight around an aerodrome; however, it is possible to assess the most frequently flown flight paths and the most critical stages of flight, which would cover most, or all, of the relevant locations.

4.2.5 As such, the authors' methodology is to assess whether a solar reflection can be experienced on the following characteristics:

- 1-mile approach path with a splay angle of 5 degrees, considering 2.5 degrees either side of the extended runway centreline;
- A descent angle of 5 degrees;
- Circuit width of 1 nautical mile from runway centreline; and
- Maximum altitude of 500 feet above the average threshold altitude.

4.2.6 Figure 4.2 illustrates the splayed approach and final sections of the visual circuits.

Figure 4.2: Splayed Approach and Final Sections of Visual Circuits



4.2.7 Figure 4.3 shows the assessed aircraft receptor points of the splayed approach and final sections of the visual circuits at Gilgarran Airfield.

Figure 4.3: Gilgarran Airfield Receptors

4.3 Ground Based Receptors

4.3.1 There is no formal guidance regarding the maximum distance at which glint and glare should be assessed. From a technical perspective, there is no maximum distance for potential reflections. The significance of a reflection however decreases with distance because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases. Terrain and shielding by vegetation are also more likely to obstruct an observer's view at longer distances.

4.3.2 The above parameters and industry experience over a significant number of glint and glare assessments undertaken, shows that a 1km assessment area from the Proposed Development is considered appropriate for glint and glare effects on road users and dwellings. Reflections towards ground-based receptors located further north than any proposed panel are highly unlikely. Therefore, receptors north of the most northern panel areas have not been modelled. The assessment area has been designed accordingly as 1km from the Proposed Development, disregarding the area to the north of the north-most solar panels.

4.3.3 Potential receptors within the associated assessment area are identified based on mapping and aerial photography of the region. The initial judgement is made based on high-level consideration of aerial photography and mapping i.e. receptors are excluded if it is clear from the outset that no visibility would be possible. A more detailed assessment is made if the modelling reveals a reflection would be geometrically possible.

4.4 Road Receptors

4.4.1 Road types can generally be categorised as:

- Major National – Typically a road with a minimum of two carriageways with a maximum speed limit of up to 70mph. These roads typically have fast moving vehicles with busy traffic;
- National – Typically a road with a one or more carriageways with a maximum speed limit 60mph or 70mph. These roads typically have fast moving vehicles with moderate to busy traffic density;
- Regional – Typically a single carriageway with a maximum speed limit of up to 60mph. The speed of vehicles will vary with a typical traffic density of low to moderate; and
- Local – Typically roads and lanes with the lowest traffic densities. Speed limits vary.

4.4.2 The analysis has considered major national, national, regional, and local roads that:

- Are within the one-kilometre assessment area; and
- Have a potential view of the panels.

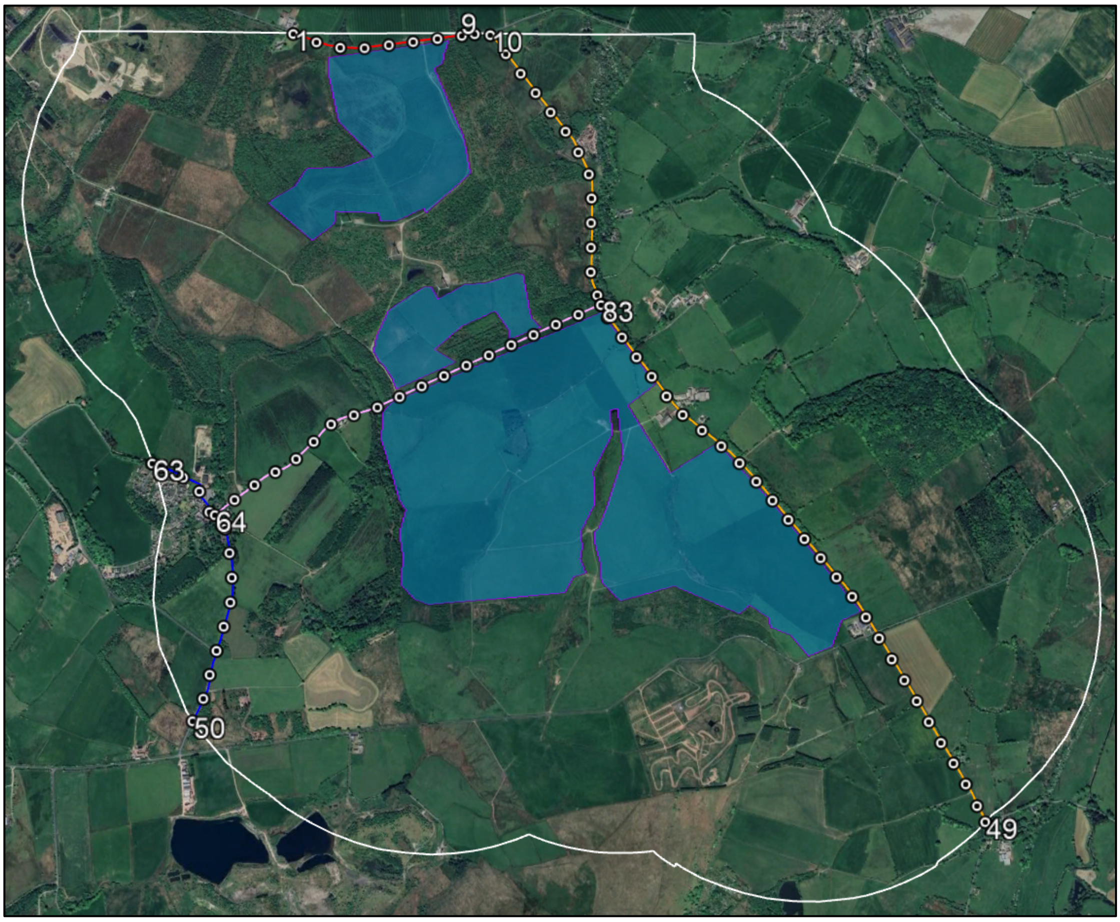
4.4.3 Four local roads have been geometrically modelled in this assessment for completeness. Receptors are placed approximately 100m apart along each section of road. Table 4.1 below summarises the roads, total length assessed, and receptors modelled in this assessment.

Table 4.1: LVIA and Dwelling Receptors

Road	Total length assessed	Receptors
Branthwaite Road	750m	1 – 9
Branthwaite Edge Road	3.88km	10 – 49
3 (unnamed)	1.24km	50 – 63
Gilgarran Road (known locally as Colingate Road)	1.80km	64 – 83

4.4.4 Figure 4.4 on the following page illustrates the assessed roads and modelled receptors.

Figure 4.4: Assessed road receptors



4.5 Dwelling Receptors

4.5.1 The analysis has considered dwellings that:

- Are within the one-kilometre assessment area; and
- Have a potential view of the panels.

4.5.2 In residential areas with multiple layers of dwellings, only the outer dwellings have been considered for assessment. This is because they will mostly obscure views of the solar panels to the dwellings behind them, which will therefore not be impacted by the Proposed Development because line of sight will be removed, or they will experience comparable effects to the closest assessed dwelling.

4.5.3 Additionally, in some cases, a single receptor point may be used to represent a small number of separate addresses. In such cases, the results for the receptor will be representative of the adjacent observer locations, such that the overall level of effect in each area is captured reliably.

4.5.4 The assessed dwelling receptors are shown in Figures 4.5 to 4.7. In total, 35 dwellings have been assessed. An additional 1.8m height above ground is used in the modelling to simulate the typical viewing height of an observer on the ground floor[13].

[13] Small changes to this height are not significant, and views above the ground floor considered are considered where appropriate.

Figure 4.5: Overview of All Dwellings Receptors

Figure 4.6: Dwellings 2 to 20

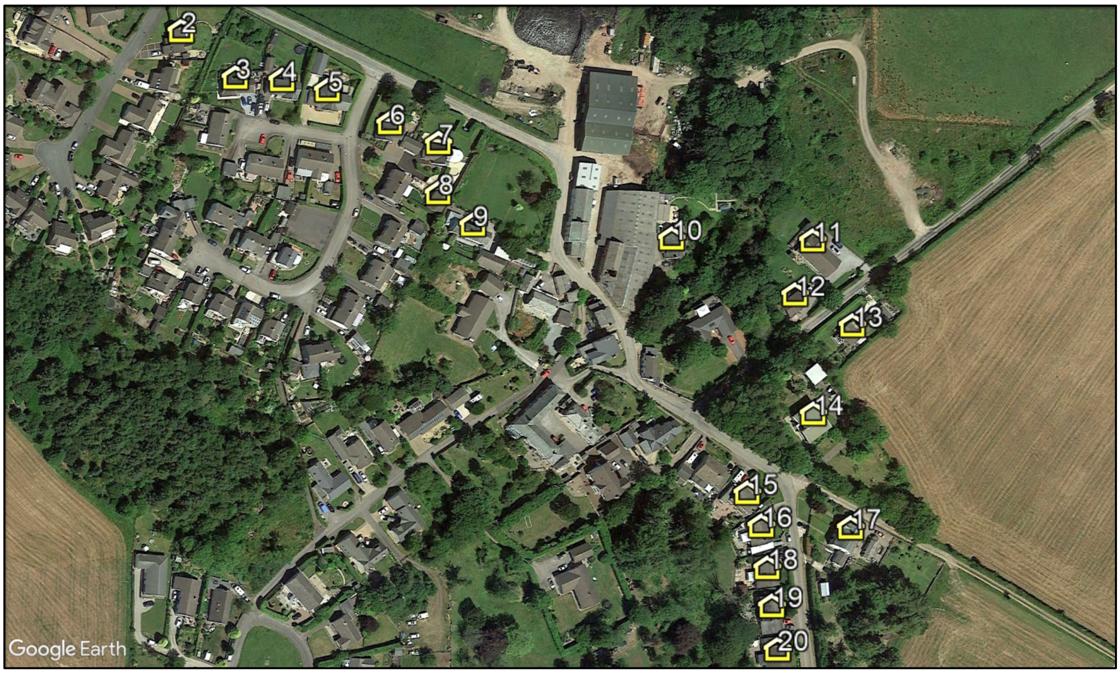


Figure 4.7: Dwellings 24 to 31

4.5.5 ES Chapter 7 – Landscape and Visual considers a number of representative view locations as agreed with relevant stakeholders. These locations are representative of a number of the dwelling receptors identified in this report. Table 4.2 sets the relationship between the two.

Table 4.2: LVIA and Dwelling Receptors

Glint and Glare Dwelling Receptor	Relevant LVIA View Locations	Notes
1	VL 9	View location located adjacent to property entrance on footpath.
2-20	VL 2, 2a and 2b	View Location 2a located approx. 350m south of Gilgarran southern extents, View Location 2 approx. 160m east of Gilgarran eastern extents, and View Location 2b located adjacent to property boundary.
21	VL 3b	View location located near property entrance. View location removed from ES as no visibility of the Proposed Development predicted.
22	VL3b	View Location located approx. 500m north of the dwelling from a publicly accessible location. View location removed from ES as no visibility of the Proposed Development predicted.
23	N/A	No visibility of the Proposed Development predicted from this receptor. Borne out by ZTV findings.

Glint and Glare Dwelling Receptor	Relevant LVIA View Locations	Notes
24-25	VL7	View location located opposite property entrance on western carriageway verge.
26	VL8b	View Location located approx. 500m northwest of the dwelling from a Public Right of Way ('PRoW').
27-28	VL7	View Location located approx. 200m south of the dwelling from a publicly accessible location.
29	VL8b	View Location located approx. 300m northwest of the dwelling from a PRoW.
30-31	VL8b	View Location located approx. 100m north of the dwelling from a PRoW.
32	N/A	Nearest VL 8b, however receptor not considered in LVIA due to intervening vegetation between receptor and Proposed Development.
33	VL1c	View location located approx.160m northwest of receptor from a PRoW.
35	VL6, VL6a	View locations located to west and east of property boundary from publicly accessible location.

5 Geometric Assessment Results and Discussion

5.1 Overview

5.1.1 The following sections present:

- The key considerations for each receptor type. The criteria are determined by the assessment process for each receptor, which are set out in Appendix D;
- Geometric modelling results of the assessment based solely on bare-earth terrain i.e., without consideration of screening in the form of buildings, dwellings, (existing or proposed) vegetation, and/or terrain. The modelling output for receptors, shown in Appendix H, presents the precise predicted times and the reflecting panel areas;
- Whether a reflection will be experienced in practice. When determining the visibility of the reflecting panels for an observer, a conservative review of the available imagery, landscape strategy plan, google earth viewshed (high-level terrain analysis), and/or site photography (if available) is undertaken, whereby it is assumed views of the panels are possible if it cannot be reliably determined that existing and/or proposed screening will remove effects. Detailed screening analysis may be undertaken to determine visibility, where appropriate;
- The impact significance and any mitigation recommendations / requirements; and
- The desk-based review of the available imagery, where appropriate.

5.2 Assessment Results – Aviation Receptors

5.2.1 The models have been used to determine whether reflections are possible for aviation receptors. Intensity calculations (Forge Model) in line with the Sandia National Laboratories methodology have been undertaken. These calculations are routinely required for solar photovoltaic developments on or near aerodromes. The intensity model calculates the expected intensity of a reflection with respect to the potential for an after-image (or worse) occurring. The designation used by the model is presented in Table 5.1 along with the associated colour coding.

Table 5.1: Glare Intensity Designation

Coding Used	Intensity Key
Glare beyond 50°	Glare outside a pilot's field-of-view
'Green glare'	'Low potential for temporary after-image'
'Yellow glare'	'Potential for temporary after-image'
'Red glare'	'Potential for permanent eye damage'

5.2.2 This coding has been used in the table where a reflection has been calculated and is in accordance with Sandia National Laboratories' methodology.

5.2.3 In addition, the intensity model allows for the assessment of a variety of solar panel surface materials. In the first instance, a surface material of '*smooth glass with an anti-reflective coating'* is assessed. It is understood that this is the most common surface for panels. Other surfaces that could be modelled include:

- Smooth glass without an anti-reflective coating;
- Light textured glass without an anti-reflective coating;
- Light textured glass with an anti-reflective coating; or
- Deeply textured glass.

5.2.4 Appendix H presents the results charts showing specific times and dates.

5.2.5 The process for determining impact significance is defined in Appendix D. For the runway approach paths, the key considerations are:

- Whether a reflection is predicted to be experienced in practice;
- The location of glare relative to a pilot's primary field-of-view (50 degrees either side of the approach bearing);
- The intensity of glare for the solar reflections; and
- Whether a reflection is predicted to be operationally significant in practice or not.

5.2.6 Where no solar reflections are geometrically possible or where solar reflections are predicted to be significantly screened, no impact is predicted, and mitigation is not required.

5.2.7 Where solar reflections are of an intensity no greater than '*low potential for temporary after-image*' ('green' glare) or occur outside of a pilot's primary field-of-view, the impact significance is low, and mitigation is not required.

5.2.8 Glare with '*potential for a temporary after-image'* ('yellow' glare) was formerly not permissible under the interim guidance provided by the FAA in the USA[14] for on-airfield solar. Whilst this guidance was never formally applicable outside of the USA, it has been a common point of reference internationally. Pager Power recommends a pragmatic approach whereby instances of 'yellow' glare are evaluated in a technical and operational context. As per the Pager Power glint and glare guidance document where solar reflections are of an intensity of '*potential for temporary after-image'*, expert assessment of the following relevant factors is required to determine the impact significance[15]:

- The likely traffic volumes and level of safeguarding at the aerodrome – licensed aerodromes typically have higher traffic volumes and are formally safeguarded. Unlicensed aerodromes have greater capacity for operational acceptance;
- The time of day at which glare is predicted and whether the aerodrome will be operational such that pilots can be on the approach at the time of day at which glare is predicted;
- The duration of any predicted glare – glare that occurs for low durations throughout the year is less likely to be experienced than glare that occurs for longer durations throughout a year;
- The location of the source of glare relative to a pilot's primary field-of-view;
- The relative size of the reflecting panel area and whether the reflecting area takes up a large percentage of a pilot's primary field-of-view;
- The location of the source of glare relative to the position of the sun at the times and dates in which solar reflections are geometrically possible – effects that coincide with direct sunlight appear less prominent than those that do not;
- The intensity of the predicted glare; and
- The level of predicted effect relative to existing sources of glare – a solar reflection is less noticeable by pilots when there are existing reflective surfaces in the surrounding environment.

[14] This FAA guidance from 2013 has since been superseded by the FAA guidance in 2021 whereby airports are tasked with determining safety requirements themselves.

[15] This approach taken is reflective of the changes made in the 2021 FAA guidance; however, it should be noted that this guidance states that it is up to the airport to determine the safety requirements themselves. Therefore, an airport may not accept any yellow glare towards approach paths.

5.2.9 Following consideration of these relevant factors, where the solar reflection is deemed not significant, a low impact is predicted, and mitigation is not recommended; however, consultation with the aerodrome is recommended to understand their position along with any feedback or comments regarding the Proposed Development. Where the solar reflection is deemed significant, the impact significance is moderate, and mitigation is recommended.

5.2.10 Where solar reflections are of an intensity greater than '*potential for temporary after-image'*, the impact significance is high, and mitigation is required.

5.2.11 In all cases, however, consultation with the aerodrome is recommended to understand their position along with any feedback or comments regarding the Proposed Development.

5.2.12 Table 5.2 on the following page presents geometric modelling results and predicted impact significance for Gilgarran Airfield.

Table 5.2: Geometric Modelling Results – Gilgarran Airfield

Receptor	Geometric Modelling Result	Glare Intensity	Predicted Impact Significance
Threshold 04 Splayed Approach	Solar reflections are geometrically possible towards the entire 1.0-mile splayed approach	Yellow	Low impact Glare scenario considered in an operational context in section 5.3.
Threshold 22 Splayed Approach	Solar reflections are geometrically possible towards the entire 1.0-mile splayed approach	Yellow	Low impact Glare scenario considered in an operational context in section 5.3.
Threshold 04 Final Sections of Visual Circuits	Solar reflections are geometrically possible towards sections of the base legs and associated base leg joins	Glare beyond 50°	Solar reflections occur outside a pilot's field-of-view and therefore not considered significant in accordance with the associated guidance (Appendix D) and industry best practice.
Threshold 22 Final Sections	Solar reflections are geometrically possible towards sections of the	Yellow	Low impact Glare scenario considered in an

Receptor	Geometric Modelling Result	Glare Intensity	Predicted Impact Significance
of Visual Circuits	base legs and associated base leg joins		operational context in section 5.3.

5.3 Glare Scenario in an Operational Context

5.3.1 Instances of 'yellow' glare require the glare scenario considered in an operational context. The following can be concluded for the 'yellow' glare predicted at Gilgarran Airfield:

- The maximum instance of 'yellow' glare occurs at 0.1 miles (161m) from the threshold for runway 22. At this point, the Proposed Development is behind a pilot on approach towards threshold 22 and therefore not within a pilot's main field-of-view;
- When the Proposed Development is within a pilot's field-of-view, 'yellow' glare occurs the longest duration towards the splayed approaches for threshold 04, and along the left-hand circuit for threshold 22. The duration of 'yellow' glare is predicted for a maximum of 3,380 and 2,255 minutes per year respectively. This represents a very small proportion of time relative to average daylight hours in any given year (1.29% and 0.85% respectively);
- Solar reflections of 'yellow' glare are predicted at times when the sun is low in the sky beyond the reflecting panels. This means that a pilot will likely have a view of the sun within the same viewpoint of the reflecting solar panels (as shown in Figures 5.1 and 5.2 on the following page). The sun is a far more significant source of light, and therefore the glare originating from the Proposed Development will not be significant;
- The 'yellow' glare only marginally exceeds the 'yellow' threshold on the intensity chart. 'Green' glare (or glare with 'low potential for temporary after-image') is considered an acceptable level of glare intensity for aircrafts on approach;
- The weather would have to be clear and sunny at the specific times when the glare was possible to be experienced. A pilot would also have to be on approach/the circuit path at the times when solar reflections are possible;
- The volume of air traffic at Gilgarran Airfield is expected to be very low. The airfield is considered to be active temporarily/seasonally for a maximum of 28 days of the year; and
- Effects would be fleeting due to their short duration along the visual circuits for threshold 22.

5.3.2 It is considered that the instances of ‘yellow’ glare are operationally accommodatable, and a low impact is predicted, and mitigation is not recommended. In addition, operational measures used by pilots to mitigate the effects of direct sunlight will adequately mitigate the effects of solar glare from the panels.

5.3.3 It is recommended that the analysis of this yellow glare scenario is made available to Gilgarran Airfield.

Figure 5.1: Point-of-view for runway threshold 04

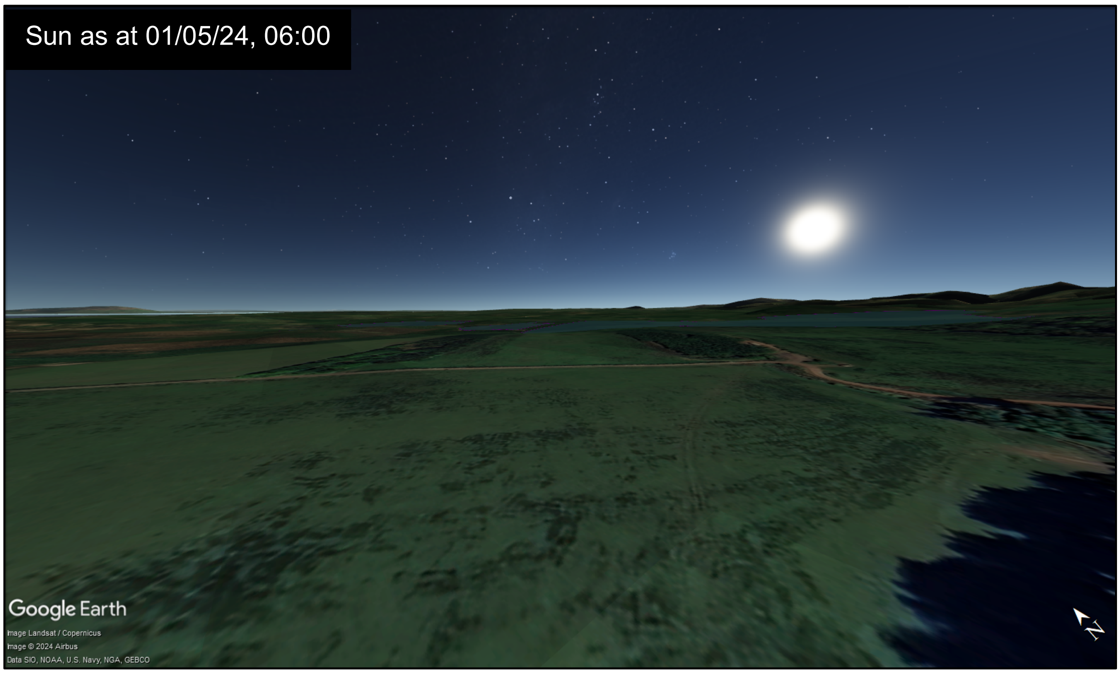
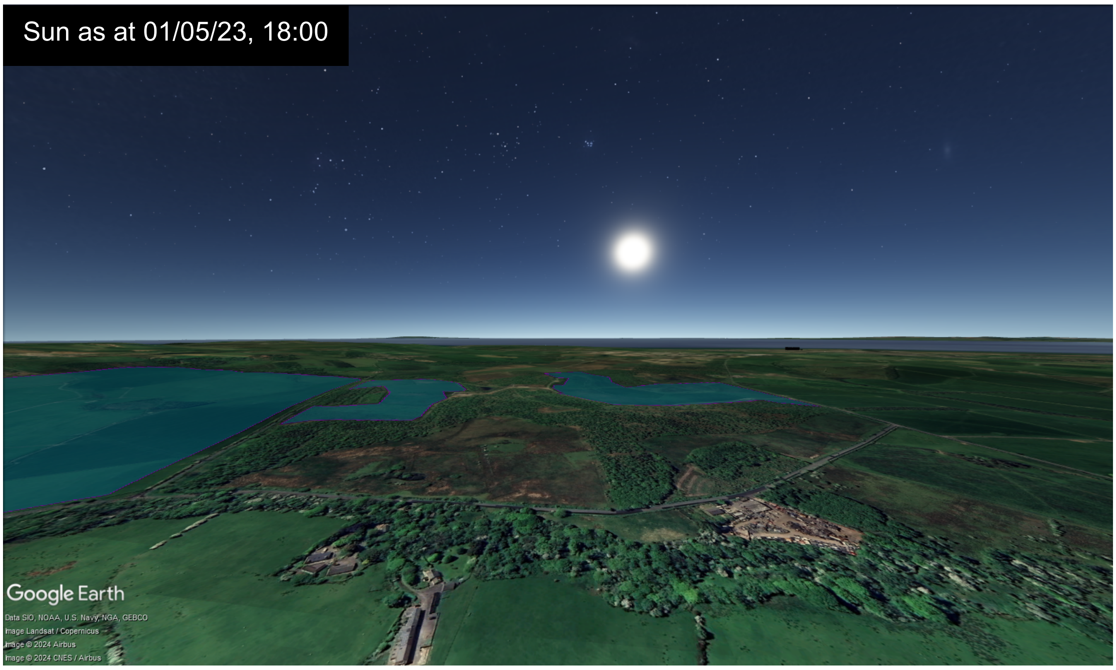


Figure 5.2: Point-of-view for runway threshold 22



5.4 Assessment Results – Road Receptors

5.4.1 The key considerations for road users along major national, national, and regional roads are:

- Whether a reflection is predicted to be experienced in practice; and
- The location of the reflecting panel relative to a road user's direction of travel.

5.4.2 Where solar reflections are not geometrically possible, or the reflecting panels are predicted to be significantly obstructed from view, no impact is predicted, and mitigation is not required.

5.4.3 Where solar reflections originate from outside of a road user's primary horizontal field of view (50 degrees either side relative to the direction of travel), or the closest reflecting panel is over 1km from the road user, the impact significance is low, and mitigation is not recommended.

5.4.4 Where solar reflections are predicted to be experienced from inside of a road user's primary field of view, expert assessment of the following factors is required to determine the impact significance and mitigation requirement:

- Whether the solar reflection originates from directly in front of a road user – a solar reflection that is directly in front of a road user is more hazardous than a solar reflection to one side;
- Whether visibility is likely for elevated drivers (relevant to dual carriageways and motorways[16]);
- The separation distance to the panel area. Larger separation distances reduce the proportion of an observer's field of view that is affected by glare;
- Whether a solar reflection is fleeting in nature. Small gap/s in screening, e.g., an access point to the Site, may not result in a sustained reflection for a road user; and
- The position of the sun. Effects that coincide with direct sunlight appear less prominent than those that do not. The sun is a far more significant source of light.

5.4.5 Following consideration of these mitigating factors, where the solar reflection does not remain significant, a low impact is predicted, and mitigation is not recommended. Where the solar reflection remains significant, the impact significance is moderate, and mitigation is recommended.

5.4.6 Where solar reflections originate from directly in front of a road user and there are no mitigating factors, the impact significance is high, and mitigation is required.

5.4.7 Table 5.3 below and on the following pages presents the geometric modelling results and predicted impacts significance for the assessed dwelling receptors.

Table 5.3: Geometric modelling results and predicted impact classification – road receptors

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening and Predicted Visibility (desk-based review)	Mitigating Factors	Predicted Impact
1 – 10 (Branthwaite Road and Branthwaite Edge Road)	Solar reflections are not geometrically possible.	N/A	N/A	No impact

[16] There is typically a higher density of elevated drivers (such as HGVs) along dual carriageways and motorways compared to other types of road.

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening and Predicted Visibility (desk-based review)	Mitigating Factors	Predicted Impact
11 – 23 (Branthwaite Edge Road)	Solar reflections occur **within** a road user's Field of View ('FOV')	Existing and proposed vegetation, and intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact
24 – 39 (Branthwaite Edge Road)	Solar reflections occur **within** a road user's FOV	Existing and proposed vegetation is predicted to obstruct views of reflecting panels	N/A	No impact
40 – 63 (Branthwaite Edge Road and unnamed)	Solar reflections occur **outside** a road user's FOV	Existing and proposed vegetation, and intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact
64 – 72 (Gilgarran Road)	Solar reflections occur **within** a road user's FOV	Existing and proposed vegetation is predicted to obstruct views of reflecting panels	N/A	No impact
73 – 80 (Gilgarran Road)	Solar reflections occur **within** a road user's FOV	No significant screening identified	Road is a local road	Moderate impact Mitigation recommended
81 – 83 (Gilgarran Road)	Solar reflections occur **within** a road user's FOV	Existing vegetation and intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact

5.4.8 A desk-based review of the available imagery is presented in Figures 5.3 to 5.9. The cumulative reflecting panel areas are indicated by regions of yellow. The identified screening in the form of existing vegetation to be retained and enhanced, is outlined in green.

Figure 5.3: Screening for road receptors 11 to 23

Figure 5.4: Screening for road receptors 24 to 39

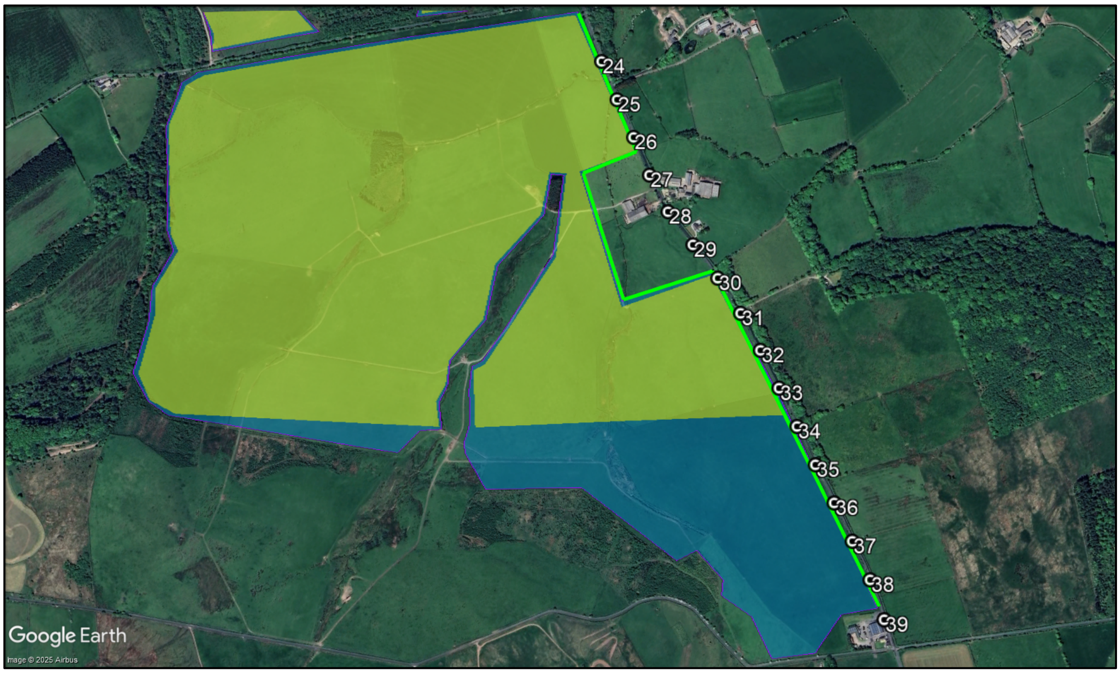


Figure 5.5: Screening for road receptors 40 to 49

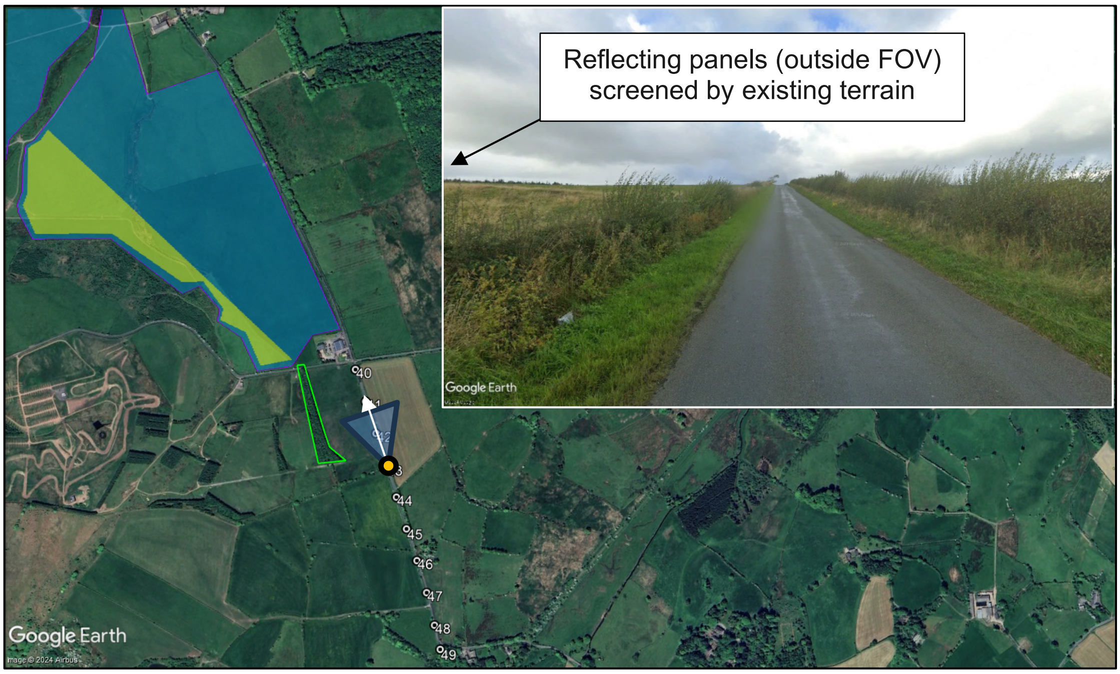


Figure 5.6: Screening for road receptors 50 to 63