Light Valley Solar

Environmental Statement Volume 3

Appendix 16.4: Glint and Glare Assessment

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APFP Regulation 5(2)(a)

Light Valley
Solar

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning
(Applications: Prescribed Forms and Procedure) Regulations 2009

Light Valley Solar

DCO Submission

Glint and Glare Assessment

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Solar Photovoltaic Glint and Glare Study

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February 2026

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the possible effects of glint and glare from a ground-mounted solar photovoltaic development, located in North Yorkshire, UK. It has not yet been determined whether a fixed south facing or single axis tracking layout will be progressed, and therefore both options are assessed in this report.

This assessment pertains to the potential impact upon road safety, residential amenity, railway safety, and aviation activity.

Guidance and Studies

Guidelines exist in the UK (produced by the Civil Aviation Authority) and in the USA (produced by the Federal Aviation Administration) with respect to solar developments and aviation activity. The UK CAA guidance is relatively high-level and does not prescribe a formal methodology.

A national policy for determining the impact of glint and glare on road safety, residential amenity and railway infrastructure and operations has not been produced to date. Therefore, in the absence of this, Pager Power reviewed more general existing planning guidelines and available studies and experience from other projects in the process of defining its own glint and glare assessment guidance and methodology[1]. This methodology defines the process for determining the impact upon road safety, residential amenity, railway infrastructure and operations, and aviation activity.

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. 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.

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

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

steel[2]. Reflections from solar panels are less intense than those from glass or steel because solar panels are designed in order to absorb light, rather than reflect it, as panels are more efficient when they reflect less light.

Assessment Conclusions – Aviation

Leeds East Airport

Glare with ‘low potential for temporary after-image’ (green) is predicted towards the approach paths and visual circuits associated with Leeds East Airport, for both fixed south facing panels and single axis tracking panels.

A low impact is predicted and no mitigation is required.

Sherburn-In-Elmet Airfield

For ‘yellow’ glare towards the visual circuits associated with runways 01/19 and 06/24, solar reflections would occur from outside a pilot’s primary field-of-view for pilots on approach to the runway thresholds. Any possible glare would occur from behind the pilot whilst they are approaching the thresholds and is therefore unlikely to be experienced by pilots in practice. A low impact is predicted but consultation is being undertaken with Sherburn-In-Elmet Airfield to understand their position towards the Proposed Development and their operations.

For visual circuits associated with runways 10/28 and 10G/28G, ‘yellow’ glare is predicted which would occur within a pilot’s primary field-of-view, while they are on final approach. A moderate impact is predicted, and the development of mitigation measures is recommended (see Section 6.7.1) by this study on the basis of the modelling work undertaken.

Burn Airfield

Glare with ‘potential for a temporary after-image’ (yellow) is predicted towards the visual circuits associated with Burn Airfield. Glare is predicted from both fixed south facing panels and single axis tracking panels.

For fixed south facing panels, ‘yellow’ glare will occur towards the visual circuits for runways 01, 25 and 33. For runway 25, ‘yellow’ glare will only occur from outside of a pilot’s primary field-of-view when on approach to the runway, and therefore a low impact is predicted and no mitigation is required. A moderate impact is predicted towards visual circuits associated with runway thresholds 01 and 33, and mitigation is recommended.

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

For single axis tracking panels, 'yellow' glare is predicted towards visual circuits associated with all runway thresholds. A moderate impact is predicted and the development of mitigation measures is recommended (see Section 6.7.1) by this study on the basis of the modelling work undertaken.

Redmoor Farm Airfield (understood not to be operational post 2015)

Glare with 'potential for a temporary after-image' (yellow) is predicted towards the visual circuits associated with Redmoor Farm Airfield. 'Yellow' glare is predicted to be possible towards the visual circuits for runway 09 from fixed south facing panels, but no reflections are predicted towards the approach paths.

For single axis tracking panels, 'yellow' glare is predicted towards the approach path for runway 27 and visual circuits for runway 09/27. Yellow glare towards the approach path is possible only for a very short duration (115 minutes per year) and will coincide with direct sunlight.

'Yellow' glare is predicted to occur for no more than 60 minutes on any given day at a particular location. Solar reflections with yellow glare are predicted to occur within 2 hours of sunset and therefore will occur 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. The Sun is a far more significant source of light.

Overall, it is judged that the effects can be operationally accommodated subject to notifying the airport of the dates/times in which yellow glare can occur, as secured via the Outline Operational Environmental Management Plan (oOEMP) [**EN0110012/APP/LVS/07.03**].

Gilrudding Grange Airfield

Glare with 'potential for a temporary after-image' (yellow) is predicted towards the visual circuits associated with Gilrudding Grange Airfield. 'Yellow' glare is predicted to be possible towards the visual circuits for runway 27 from fixed south facing panels, but no reflections are predicted towards the approach paths.

For single axis tracking panels, 'yellow' glare is predicted towards the approach path for runway 09 and visual circuits for runway 09/27. Yellow glare towards the approach path is possible only for a very short duration (105 minutes per year) and will coincide with direct sunlight.

'Yellow' glare is predicted to occur for no more than 60 minutes on any given day at a particular location. Solar reflections with yellow glare are predicted to occur within 1 hour of sunrise and therefore will occur 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. The Sun is a far more significant source of light.

Overall, it is judged that the effects can be operationally accommodated subject to notifying the airport of the dates/times in which yellow glare can occur, as secured via the oOEMP [**EN0110012/APP/LVS/07.03**].

Bridge Cottage Airfield

No significant impacts are predicted towards Bridge Cottage Airfield from either fixed south facing panels or single axis tracking panels. No impact is predicted and no mitigation is required.

Elvington Airfield

Glare with ‘potential for a temporary after-image’ (yellow) is predicted towards the visual circuits associated with Elvington Airfield from single axis tracking panels only. ‘Yellow’ glare is predicted to be possible towards the visual circuits for runway 08, for a total duration of 115 minutes per year.

Solar reflections with yellow glare are predicted to occur within 1 hour of sunrise in mid-winter and therefore will occur 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. The Sun is a far more significant source of light.

Overall, it is judged that the effects can be operationally accommodated subject to notifying the airport of the dates/times in which yellow glare can occur, as secured via the oOEMP [**EN0110012/APP/LVS/07.03**].

No solar reflections are predicted from fixed south facing panels. No impact is predicted and no mitigation is required.

Birchwood Lodge Airfield

No significant impacts are predicted towards Birchwood Lodge Airfield from either fixed south facing panels or single axis tracking panels. No impact is predicted and no mitigation is required.

Acaster Malbis Airfield

Any solar reflections towards Acaster Malbis Airfield are predicted to be acceptable in accordance with the associated guidance and industry best practice.

Any possible solar reflections towards the approach paths for runways 04, 15 and 22 and the visual circuits for runways 04/22 and 15/33 would have an intensity no greater than 'low potential for temporary after-image'. Solar reflections would be outside a pilot's primary field-of-view (50 degrees either side of the approach bearing) for pilots on approach to runway 33.

No significant impacts are predicted upon aviation activity at Acaster Malbis Airfield and detailed modelling is not recommended.

Garforth Airfield

Any solar reflections towards Garforth Airfield are predicted to be acceptable in accordance with the associated guidance and industry best practice.

Any possible solar reflections towards the approach path for runways 09 and 17 and the visual circuits for runways 09/27 and 17/35 would have an intensity no greater than 'low potential for temporary after-image'. Solar reflections would be outside a pilot's primary field-of-view (50 degrees either side of the approach bearing) for pilots on approach to runways 27 and 35.

No significant impacts are predicted upon aviation activity at Garforth Airfield and detailed modelling is not recommended.

Cliffe Airfield

Any solar reflections towards Cliffe Airfield are predicted to be acceptable in accordance with the associated guidance and industry best practice.

Any possible solar reflections towards the approach paths for runway 28 and the visual circuits for runway 10/28 would have an intensity no greater than 'low potential for temporary after-image'. Solar reflections would be outside a pilot's primary field-of-view (50 degrees either side of the approach bearing) for pilots on approach to runway 10.

No significant impacts are predicted upon aviation activity at Cliffe Airfield and detailed modelling is not recommended.

Breighton Airfield

Any solar reflections towards Breighton Airfield are predicted to be acceptable in accordance with the associated guidance and industry best practice.

Any possible solar reflections towards the approach paths for runway 28 and the visual circuits for runway 10/28 would have an intensity no greater than 'low potential for temporary after-image'. Solar reflections would be outside a pilot's primary field-of-view (50 degrees either side of the approach bearing) for pilots on approach to runway 10.

No significant impacts are predicted upon aviation activity at Breighton Airfield and detailed modelling is not recommended.

Melrose Farm Airfield

Any solar reflections towards Melrose Farm Airfield are predicted to be acceptable in accordance with the associated guidance and industry best practice.

Any possible solar reflections towards the approach paths for runway 23 and the visual circuits for runway 05/23 would have an intensity no greater than 'low potential for temporary after-image'. Solar reflections would be outside a pilot's primary field-of-view (50 degrees either side of the approach bearing) for pilots on approach to runway 05.

No significant impacts are predicted upon aviation activity at Melrose Farm Airfield and detailed modelling is not recommended.

Assessment Conclusions – Roads

For both panel configurations, prior to additional mitigation, a significant (temporary) impact is currently predicted towards some sections of road, where there is no or insufficient existing vegetation screening. It is recommended that further mitigation is implemented in the form of advance planting at these locations, in order that new vegetation will be at a sufficient height to significantly obstruct views of reflecting panels once operational (see Section 6.7.2). The need for, and details of, the proposed advanced planting will be subject to re-assessment at detailed design and this is secured through the outline Construction Environmental Management Plan (oCEMP) **[EN0110012/APP/LVS/07.02]** and outline Landscape Environmental Management Plan (oLEMP) **[EN0110012/APP/LVS/07.05].** For other receptors where glare is geometrically possible, screening will be present in the form of existing and/or proposed vegetation or reflections occur in the presence of significant mitigating factors. No further mitigation is required and there will be no significant residual impacts.

Assessment Conclusions – Dwellings

For both panel configurations, prior to additional mitigation, a significant (temporary) impact is predicted towards a small number of dwellings, where there is no or insufficient existing vegetation screening. For dwellings where impacts are predicted from both fixed and tracking panels, it is recommended that further mitigation is implemented in the form of advance planting at these locations, in order that new vegetation will be at a sufficient height to significantly obstruct views of reflecting panels in Year 1 of operation (see Section 6.7.2). The need for, and details of, the proposed advanced planting will be subject to re-assessment at detailed design and this is secured through the oCEMP **[EN0110012/APP/LVS/07.02]** and oLEMP **[EN0110012/APP/LVS/07.05].** For dwellings where impacts are predicted for only one of the panel configurations, impacts would be considered further at detailed design.

For other receptors where glare is geometrically possible, screening will be present in the form of existing and/or proposed vegetation or reflections occur in the presence of significant mitigating factors. No further mitigation is required and there will be no significant residual impacts.

Assessment Conclusions – Railway

For both panel configurations, prior to additional mitigation, a significant (temporary) impact is predicted towards some sections of railway, where there is no or insufficient existing vegetation screening. It is recommended that further mitigation is implemented in the form of advance planting at these locations, in order that new vegetation will be at a sufficient height to significantly obstruct views of reflecting panels in Year 1 of operation (see Section 6.7.2). The need for, and details of, the proposed advanced planting will be subject to re-assessment at detailed design and this is secured through the oCEMP **[EN0110012/APP/LVS/07.02]** and oLEMP **[EN0110012/APP/LVS/07.05].** For other receptors where glare is geometrically possible, screening will be present in the form of existing and/or proposed vegetation. No further mitigation is required and there will be no significant residual impacts.

Assessment Conclusions – Waterways

Solar reflections are geometrically possible towards a section of the River Aire. Views are expected to be screened by existing vegetation and intervening terrain, but the extent to which partial views may be possible has yet to be confirmed. A low impact is predicted in the worst-case, and no mitigation is recommended.

Assessment Conclusions – Public Rights of Way

No significant impacts are predicted upon public rights of way. No mitigation is required.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 63 countries within Europe, Africa, America, Asia and Oceania.

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

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems. Over the years, the company has expanded into numerous fields including:

1) Renewable energy projects;
2) Building developments;
3) Aviation and telecommunication systems.

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.

Pager Power's assessments withstand legal scrutiny, and the company can provide support for a project at any stage.

1 INTRODUCTION

1.1 Overview

Pager Power has been retained to assess the possible effects of glint and glare from a ground-mounted solar photovoltaic development, located in North Yorkshire, UK. It has not yet been determined whether a fixed south facing or single axis tracking layout will be progressed, and therefore both options are assessed in this report.

This assessment pertains to the potential impact upon road safety, residential amenity, railway safety, and aviation activity.

This report contains the following:

1) Solar development Site details;
2) Explanation of glint and glare;
3) Overview of relevant guidance and relevant studies;
4) Overview of Sun movement;
5) Assessment methodology;
6) Identification of receptors;
7) Glint and glare assessment for identified receptors;
8) High-level assessment of aviation considerations;
9) Results discussion.

The relevant technical analysis is presented in each section. Following the assessment, conclusions and recommendations are made.

1.2 Pager Power's Experience

Pager Power has undertaken over 1,700 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.

1.3 Glint and Glare Definition

The definition[3] of glint and glare is as follows:

[3] These definitions are aligned with those of the National Policy Statement for Renewable Energy Infrastructure (EN-3) – published by the Department for Energy Security & Net Zero in January 2024, and the Federal Aviation Administration (FAA) in the United States of America.

1) Glint – a momentary flash of bright light typically received by moving receptors or from moving reflectors;
2) Glare – a continuous source of bright light typically received by static receptors or from large reflective surfaces.

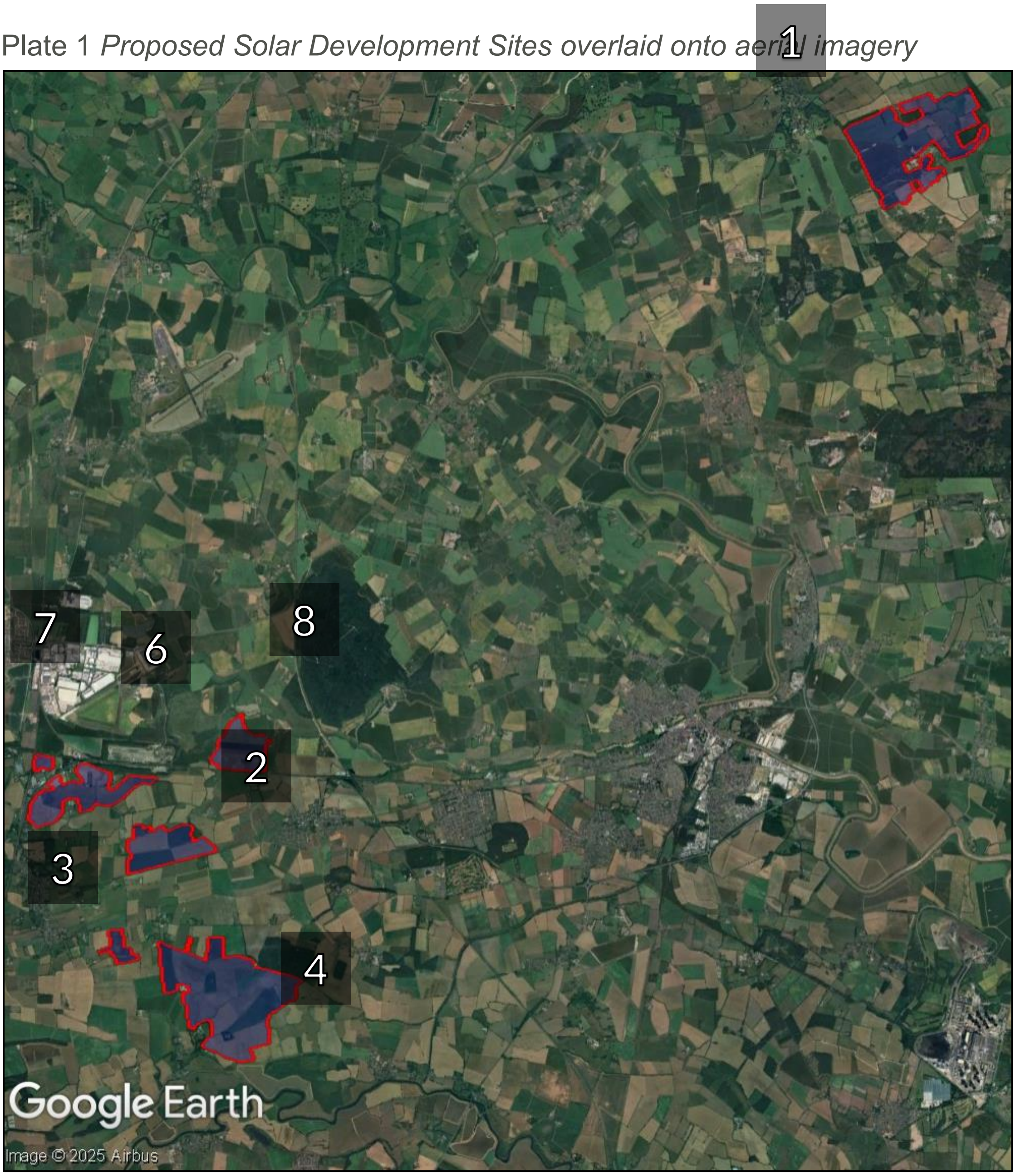
The term 'solar reflection' is used in this report to refer to both reflection types i.e. glint and glare.

2 SOLAR DEVELOPMENT SITES - LOCATION AND DETAILS

2.1 Proposed Solar Development Sites Illustrative Layout

Plate 1 below shows the proposed solar panel areas within Solar Development Sites 1 – 8 overlaid onto aerial imagery as the blue areas. The area modelled is based upon the maximum possible extent of solar panels, to provide a worst-case assessment. The labels indicate the different sites within the development.

Plate 1 *Proposed Solar Development Sites overlaid onto aerial imagery*



2.2 Solar Panel Technical Information

The Proposed development may comprise of either fixed south facing panels or single axis tracking panels. The technical information for both options is outlined in this section, and both options are assessed in this report.

2.2.1 Fixed South Facing Panels

Table 1 below summarises the technical information of the fixed south facing solar panels used in the assessment.

Panel Information	
Azimuth angle[4]	180° (south-facing)
Elevation angle[5]	25°[6]
Assessed centre height[7]	1.95m agl[8]

Table 1 *Solar panel technical information – fixed south facing panels*

2.2.2 Single Axis Tracking Panels

Table 2 below summarises the technical information of the single axis tracking solar panels used in the assessment.

Solar Panel Technical Information	
Assessed centre-height[9]	2.45m agl
Tracking	Horizontal Single Axis tracks Sun East to West
Tilt of tracking axis (°)	0
Orientation of tracking axis (°)	180
Offset angle of module (°)	0

[4] Relative to true north
[5] Inclination above the horizontal
[6] This is the midpoint of 15° and 35° which is the envelope. Small changes to the elevation angle would not be expected to have a significant impact on the report conclusions
[7] This is the midpoint of 0.4m (minimum height) and 3.5m (maximum height)
[8] Above ground level
[9] This is the midpoint of 0.4m (minimum height) and 4.5m (maximum height) and is the height of the tracking axis

Solar Panel Technical Information	
Tracker Range of Motion (º)	±60.0
Resting angle (º)	0
Backtracking Method	Instant (for modelling purposes). Further discussed in the following subsection

Table 2 Solar panel technical information – single axis tracking panels

2.2.3 Solar Panel Backtracking

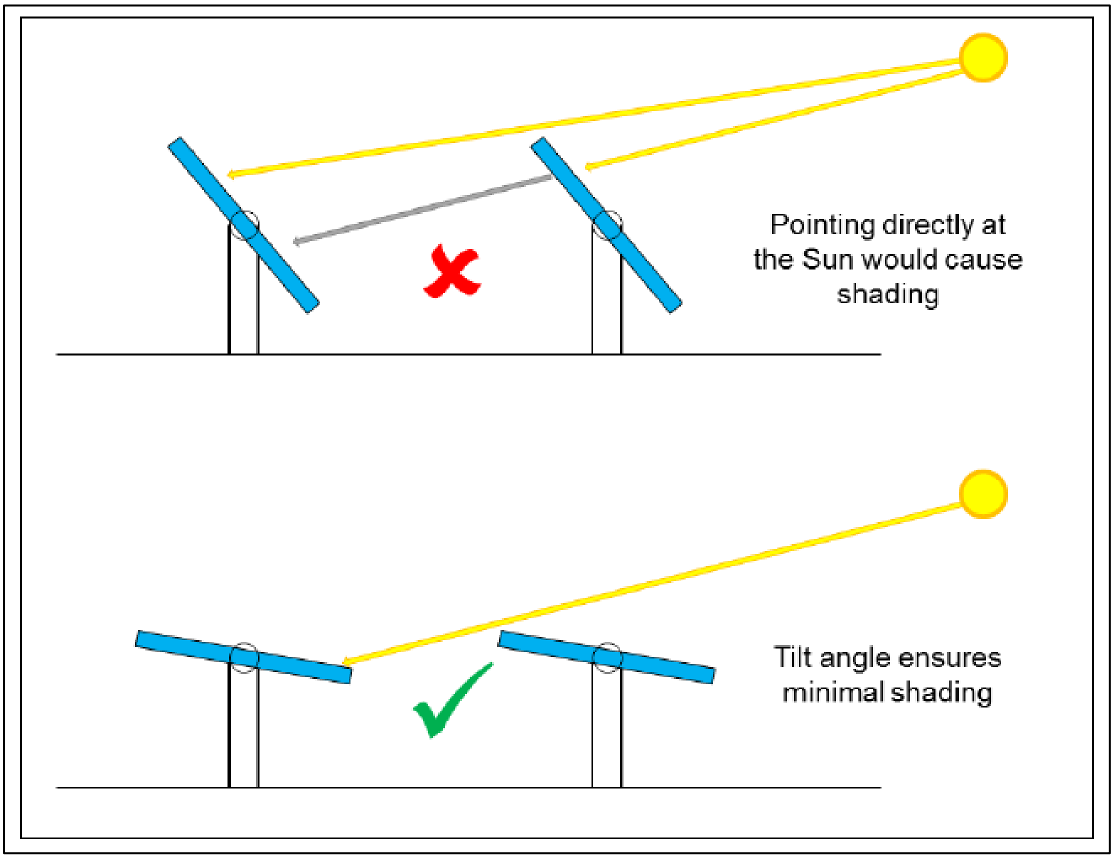
Shading considerations dictate the panel tilt of the single-axis tracking panels. This is affected by:

1) The elevation angle of the Sun;
2) The vertical tilt of the panels;
3) The spacing between the panel rows.

This means that early in the morning and late in the evening, the panels will not be directed exactly towards the Sun, as the loss from shading of the panels (caused by facing the sun directly when the Sun is low in the horizon), would be greater than the loss from lowering the panels to a less direct angle in order to avoid the shading; Plate 2 below illustrates this.

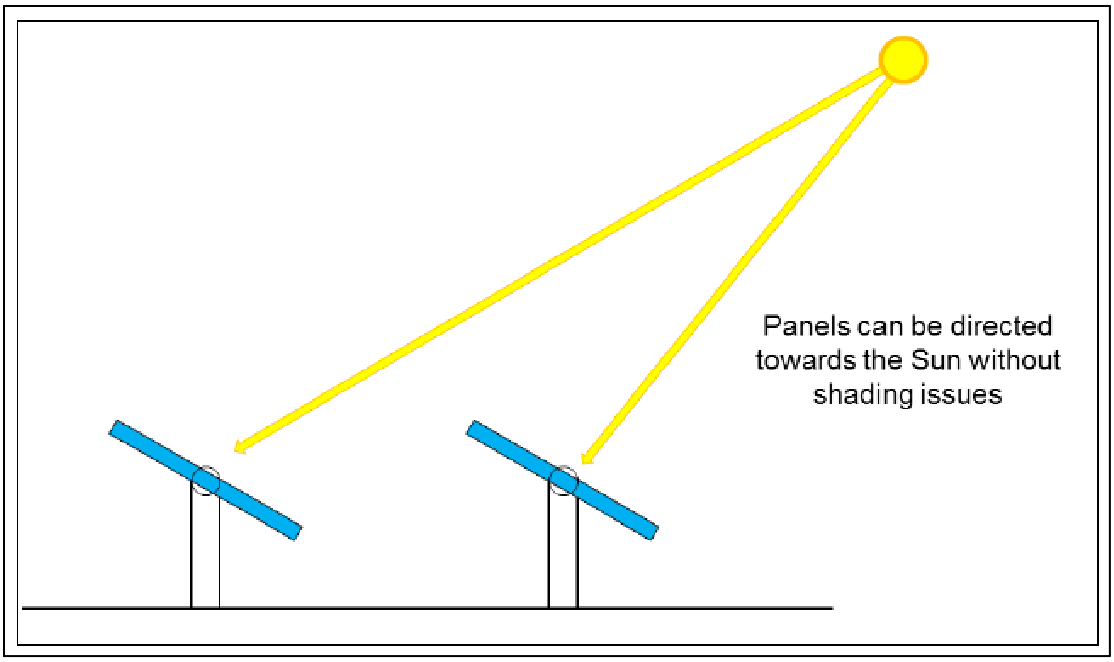
The graphics in Plate 2 show two lines illustrating the paths of light from the Sun towards the solar panels. In reality, the lines from the Sun to each panel would be effectively parallel due to the large separation distance. The plate is for illustrative purposes only.

Plate 2 *Shading considerations*



Later in the day, the panels can be directed towards the Sun without any shading issues. This is illustrated in Plate 3 on the following page.

Plate 3 *Panel alignment at high solar angles*



The solar panels backtrack (where the panel angle gradually declines to prevent shading) by reverting to 0 degrees (flat) once the maximum elevation angle of the panels (60 degrees) becomes ineffective due to the low height of the Sun above the horizon and to avoid shading.

2.2.4 Back Tracking Solar Panel Model

Back tracking systems are sensitive to panel length, row spacing, topography and the level of shading which varies throughout the year. The Forge Solar model used in this assessment is a widely accepted model within this area. The model approximates a backtracking system by assuming the panels instantaneously revert to its resting angle of 0 degrees whenever the sun is outside the rotation range (60 degrees in this instance). Panels with a maximum tracking angle of 60 degrees and resting angle of 0 degrees would therefore lie horizontally from sunrise until the Sun enters the rotation range, and immediately after the sun leaves the rotation range until sunset daily. This definition is taken from Forge (see Annex E – Reflection Calculations Methodology) and by rotation range it is assumed the panels remain at 0 degrees until the Sun reaches 30 degrees above the horizon – when the Sun is at right angles to the panels at 60 degrees. It is understood that this option was created specifically to account for backtracking to the greatest extent possible.

Whilst this model simplifies the backtracking process to be used by the solar panels within the Solar Development Sites, panels that revert back to their resting angle immediately in many cases present a worst-case scenario for reflectors. This is because flatter panels can produce solar reflections in a much greater range of azimuth angles at ground level. The results would in most cases be more conservative than modelling a detailed back tracking system.

3 GLINT AND GLARE ASSESSMENT METHODOLOGY

3.1 Guidance and Studies

Annexes Annex A – Overview of Glint and Glare Guidance and Annex B – Overview of Glint and Glare Studies present a review of relevant guidance and independent studies with regard to glint and glare issues from solar panels. The overall conclusions from the available studies are as follows:

1) Specular reflections of the Sun from solar panels are possible;
2) The measured intensity of a reflection from solar panels can vary from 2% to 30% depending on the angle of incidence;
3) Published guidance shows that the intensity of solar reflections from solar panels are equal to or less than those from water. It also shows that reflections from solar panels are significantly less intense than many other reflective surfaces, which are common in an outdoor environment.

3.2 Background

Details of the Sun's movements and solar reflections are presented in Annex Annex C – Overview of Sun Movements and Relative Reflections.

3.3 Methodology

3.3.1 Pager Power's Methodology

The glint and glare assessment methodology has been derived from the information provided to Pager Power through consultation with stakeholders and by reviewing the available guidance and studies. The methodology for this glint and glare assessment is as follows:

1) Identify receptors in the area surrounding the Solar Development Sites;
2) Consider direct solar reflections from the Solar Development Sites towards the identified receptors by undertaking geometric calculations;
3) Consider the visibility of the panels from the receptor's location. If the panels are not visible from the receptor, then no reflection can occur;
4) Based on the results of the geometric calculations, determine whether a reflection can occur, and if so, at what time it will occur;
5) Consider both the solar reflection from the Solar Development Sites and the location of the direct sunlight with respect to the receptor's position;
6) Consider the solar reflection with respect to the published studies and guidance - including intensity calculations where appropriate;

7) Determine whether a significant detrimental impact is expected in line with the process presented in Annex Annex D – Glint and Glare Impact Significance.

Further technical details regarding the methodology of the geometric calculations are presented in Annex Annex E – Reflection Calculations Methodology.

3.3.2 Sandia National Laboratories' Methodology

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. Pager Power 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.

3.4 Assessment Limitations

3.4.1 Pager Power's Model

The models consider 100% sunlight during daylight hours which is highly conservative. In Yorkshire, there are typically approximately 1,400 annual probable sunlight hours, which is approximately 32% of daylight hours.

The model does not account for terrain between the reflecting solar panels and the assessed receptor where a solar reflection is geometrically possible, which is a conservative approach.

The model considers terrain between the reflecting solar panels and the visible horizon (where the sun may be obstructed from view of the panels)[10].

It is assumed that the panel elevation angle assessed represents the elevation angle for all of the panels within each solar panel area defined.

It is assumed that the panel azimuth angle assessed represents the azimuth angle for all of the panels within each solar panel area defined.

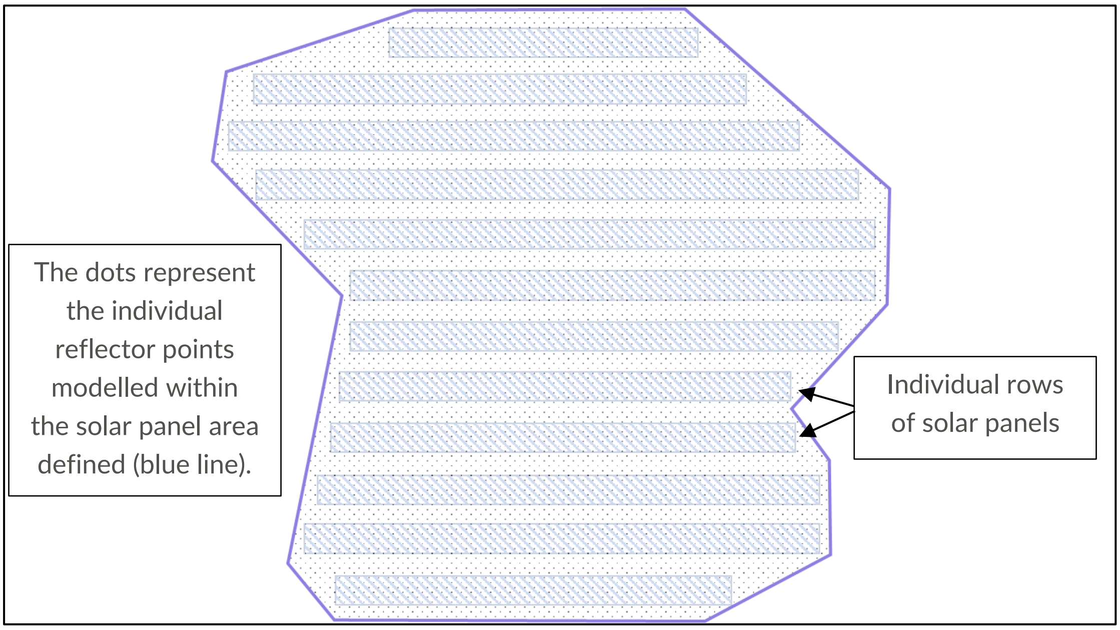
Only a reflection from the face of the panel has been considered. The frame or the reverse or frame of the solar panel has not been considered.

The model assumes that a receptor can view the face of every panel (point, defined in the following paragraph) within the development area whilst in reality this, in the majority of cases, will not occur. Therefore, any predicted solar

[10] UK only.

reflection from the face of a solar panel that is not visible to a receptor will not occur in practice.

A finite number of points within each solar panel area defined is chosen based on an assessment resolution so that a comprehensive understanding of the entire development can be formed. This determines whether a solar reflection could ever occur at a chosen receptor. The model does not consider the specific panel rows or the entire face of the solar panel within the development outline, rather a single point is defined every ‘x’ metres (based on the assessment resolution) with the geometric characteristics of the panel. A panel area is however defined to encapsulate all possible panel locations. See the plate below which illustrates this process.



Solar panel area modelling overview

A single reflection point is chosen for the geometric calculations. This suitably determines whether a solar reflection can be experienced at a receptor location and the time of year and duration of the solar reflection. Increased accuracy could be achieved by increasing the number of heights assessed however this would only marginally change the results and is not considered significant.

The available street view imagery, satellite mapping, terrain and any site imagery provided by the developer has been used to assess line of sight from the assessed receptors to the modelled solar panel area, unless stated otherwise. In some cases, this imagery may not be up to date and may not give the full perspective of the installation from the location of the assessed receptor.

Any screening in the form of trees, buildings etc. that may obstruct the Sun from view of the solar panels is not within the modelling unless stated otherwise. The terrain profile at the horizon is considered if stated.

3.4.2 Forge's Sandia National Laboratories' (SGHAT) Model

The following text is taken from Forge[11] and is presented for reference.

Summary of assumptions and abstractions required by the SGHAT/ForgeSolar analysis methodology

1. Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
2. Result data files and plots are now retained for two years after analysis completion. Files should be downloaded and saved if additional persistence is required.
3. The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
4. Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects analyses of path receptors.
5. Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
6. The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
7. The algorithm assumes that the PV array is aligned with a plane defined by the total heights of the coordinates outlined in the Google map. For more accuracy, the user should perform runs using minimum and maximum values for the vertex heights to bound the height of the plane containing the solar array. Doing so will expand the range of observed solar glare when compared to results using a single height value.
8. The algorithm does not consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
9. The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
10. The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
11. The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
12. Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
13. Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
14. Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
15. PV array tracking assumes the modules move instantly when tracking the sun, and when reverting to the rest position.

[11] Source: [redacted]

4 IDENTIFICATION OF RECEPTORS

4.1 Aviation Receptors

Airfields within 10km of the Solar Development Sites were identified for assessment. The following subsections present the relevant data and receptors associated with the assessed airfields. The locations of the airfields relative to the proposed solar panel areas are shown in Plates 5 to 10, and summarised below:

1) Leeds East Airport: approximately 5.1km north of the nearest solar panel area;
2) Sherburn-In-Elmet Airfield: approximately 0.7km north of the nearest solar panel area;
3) Redmoor Farm Airfield: approximately 2.6km south-east of the nearest solar panel area;
4) Gilrudding Grange Airfield: approximately 2.9km north-west of the nearest solar panel area;
5) Elvington Airfield: approximately 4.3km north of the nearest solar panel area;
6) Birchwood Lodge Airfield: approximately 4.5km south of the nearest solar panel area;
7) Burn Airfield: approximately 5.0km east of the nearest solar panel area;
8) Bridge Cottage Airfield: approximately 7.8km south-east of the nearest solar panel area.

Five further airfields have been identified to be assessed at a high-level. It is considered due to their distance from the Proposed Development (over 5km), and their runway configurations, that no more than a low impact is possible. See Section 7 for further details of these airfields.

4.1.1 Leeds East Airport Information

Leeds East Airport is a licenced aerodrome which is used for private flights and general aviation (GA) flying. It has one operational runway, the details[12] of which are presented below:

1) 06/24 measuring 1,826m by 45m (asphalt).

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[12] NATS AIP

4.1.2 Sherburn-In-Elmet Airfield Information

Sherburn-In-Elmet Airfield is a licensed GA aerodrome and is understood not to have an ATC Tower. It has four operational runways, the details[11] of which are presented below:

1) 01/19 measuring 581m by 21m (grass);
2) 06/24 measuring 771m by 21m (grass);
3) 10/28 measuring 828m by 18m (macadam);
4) 10G/28G measuring 622m by 21m (grass).

4.1.3 Burn Airfield Information

Burn Airfield is an unlicensed GA aerodrome which is primarily used for gliding operations and is understood not to have an ATC Tower. It has three operational runways, the details[13] of which are presented below:

1) 01/19 measuring 1,100m by 46m (asphalt);
2) 07/25 measuring 1,300m by 46m (asphalt);
3) 15/33 measuring 950m by 46m (asphalt).

4.1.4 Redmoor Farm Airfield Information

Redmoor Farm Airfield is an unlicenced GA aerodrome and is understood not to have an ATC Tower. In the past, it has had one operational runway, though it is thought that this airfield may have ceased operations in 2015. To provide a worst-case assessment, the previously active runway has been modelled, the details[14] of which are presented below:

1) 10/28 measuring 550m by 15m (grass).

4.1.5 Gilrudding Grange Airfield Information

Gilrudding Grange Airfield is an unlicenced GA aerodrome and is understood not to have an ATC Tower. It has one operational runway, the details[13] of which are presented below:

1) 09/27 measuring 500m by 25m (grass).

4.1.6 Bridge Cottage Airfield Information

Bridge Cottage Airfield is an unlicenced GA aerodrome and is understood not to have an ATC Tower. It has two operational runways, the details[13] of which are presented below:

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[13] Pooleys Flight Guide, 63rd Edition
[14] As determined by available aerial imagery

1) 01/19 measuring 430m by 18m (grass);
2) 18/36 measuring 400m by 16m (grass).

4.1.7 Elvington Airfield Information

Elvington Airfield is an unlicenced GA aerodrome and is understood not to have an ATC Tower. It has one operational runway, the details[12] of which are presented below:

1) 08/26 measuring 1,810m by 60m (asphalt/concrete).

4.1.8 Birchwood Lodge Airfield Information

Birchwood Lodge Airfield is an unlicenced GA aerodrome and is understood not to have an ATC Tower. It has one operational runway, the details[13] of which are presented below:

1) 08/26 measuring 545m by 18m (grass).

4.1.9 Runway Approach Paths and Visual Circuits

All of the assessed airfields are general aviation (GA) airfields 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.

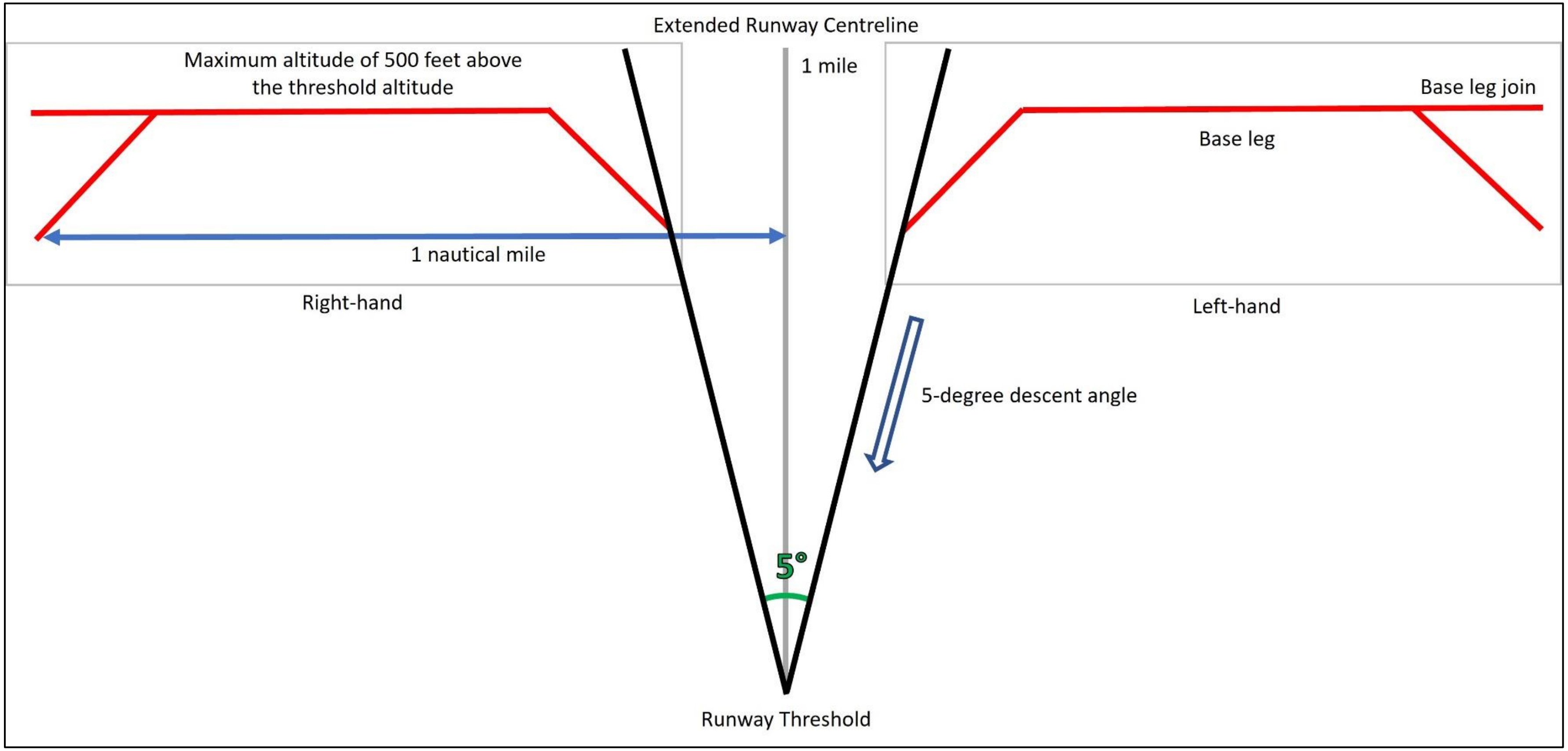
As such, Pager Power's methodology is to assess whether a solar reflection can be experienced on a 5-degree splayed approach path based on the extended runway centreline, and the final sections of the visual circuits and joins on approach to the corresponding runway thresholds. This method has been followed for all airfields other than Sherburn-In-Elmet Airfield and Burn Airfield, which have previously provided Pager Power with specific flight data which has been used to design custom aviation receptors.

The assessed receptors are based on the following characteristics:

1) 1 mile approach paths with a splay angle of 5 degrees, considering 2.5 degrees either side of the extended runway centreline;
2) A descent angle of 5 degrees;
3) Circuit width of 1 nautical mile from runway centreline;
4) Maximum altitude of 500 feet above the aerodrome threshold altitude.

Plate 4 on the following page illustrates the splayed approach and final sections of the visual circuits.

Plate 4 *Splayed approach and final sections of visual circuits*



Plates 5 to 10 on the following pages shows the assessed aircraft receptor points of the splayed approach and final sections of the visual circuits at the assessed airfields. Further receptor details are presented in Annex Annex G – Detailled Modelling Results.

Plate 5 *General aviation splayed approach and visual circuit receptors for Leeds East Airport, Redmoor Farm Airfield, Gilrudding Grange Airfield, Elvington Airfield, and Birchwood Lodge Airfield*

Plate 6 General aviation splayed approach and visual circuit receptors for Bridge Cottage Airfield

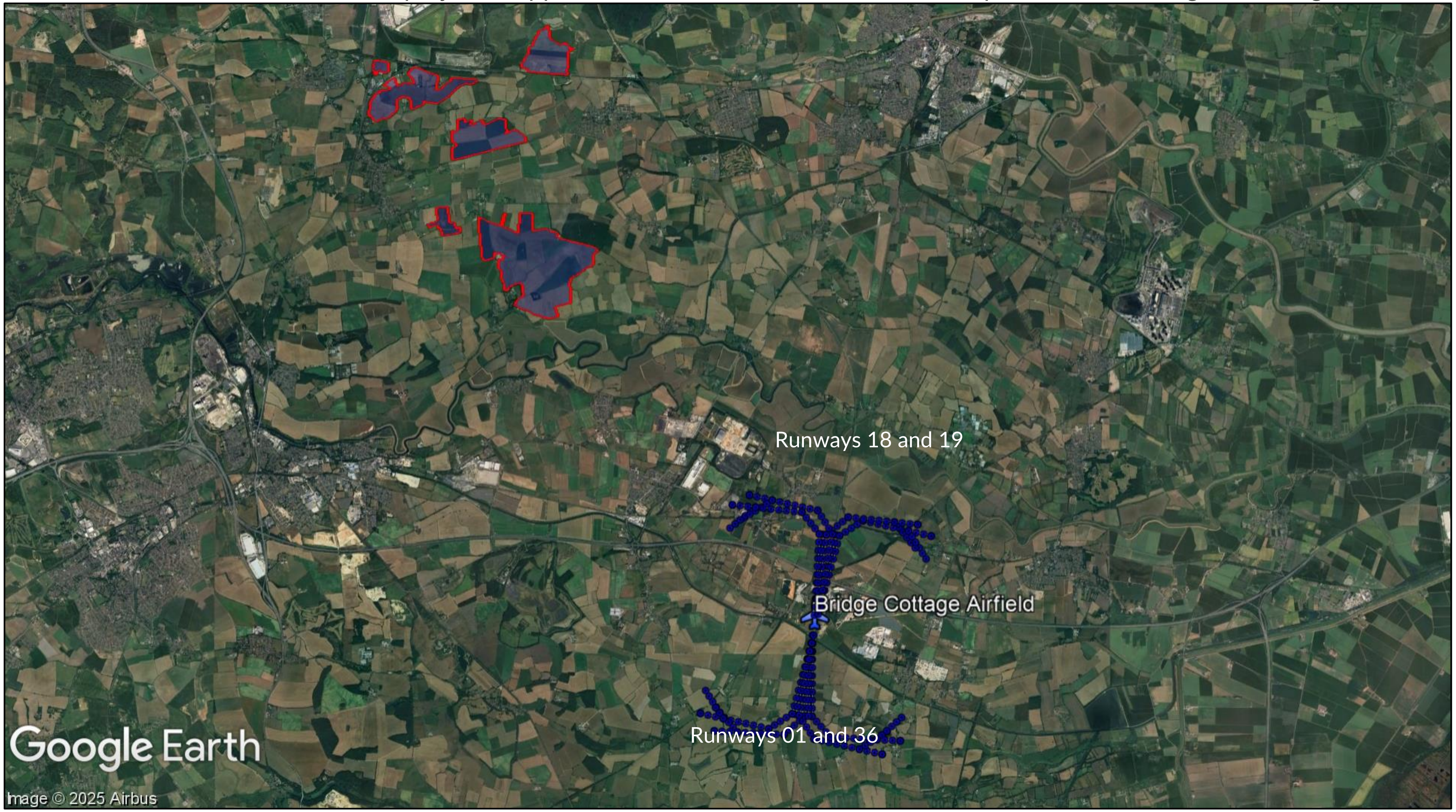


Plate 7 Custom approach and visual circuit receptors for Sherburn-In-Elmet Airfield

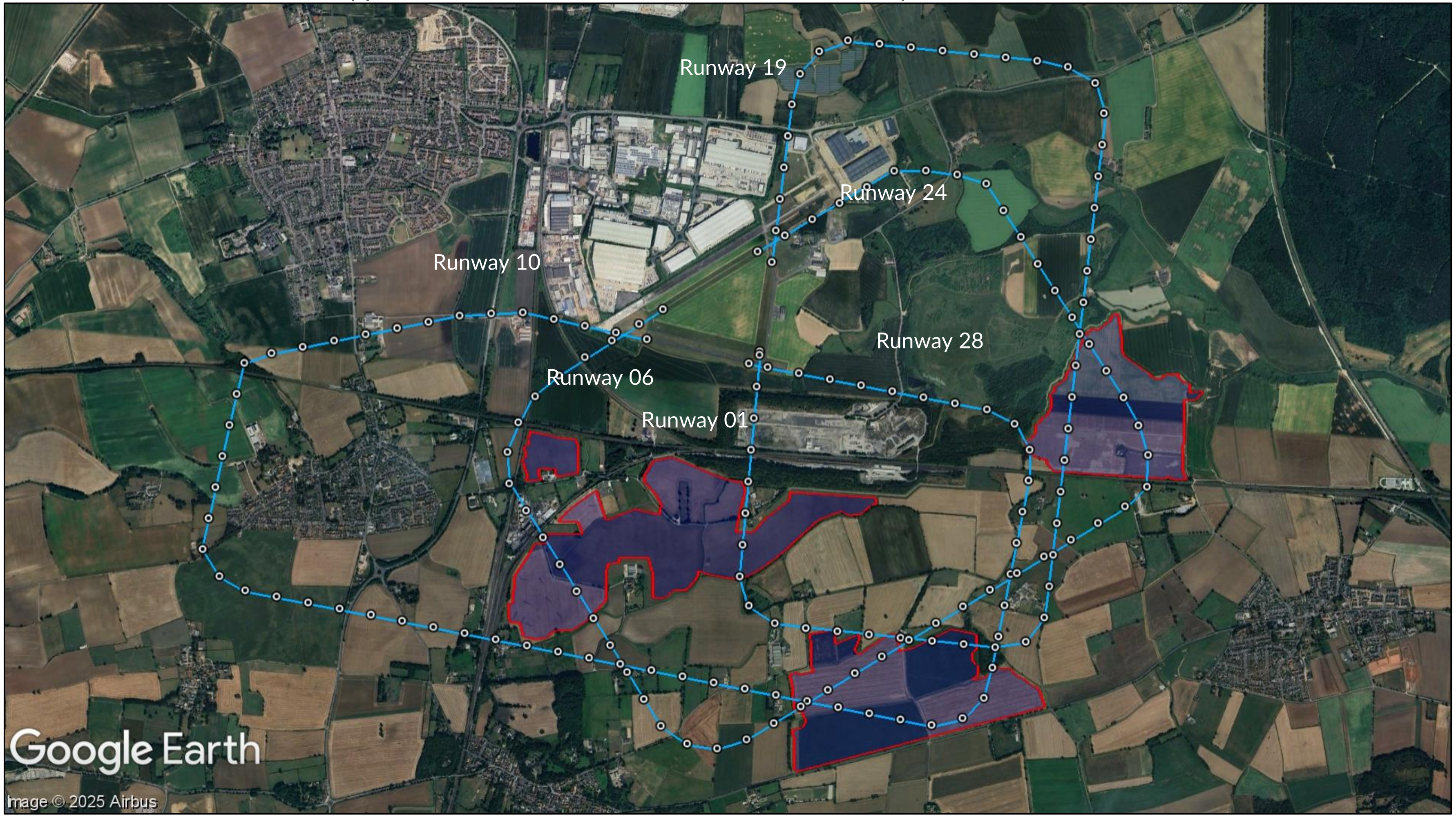


Plate 8 Custom approach and visual circuit receptors for Burn Airfield (Runway 01/19)

Plate 9 *Custom approach and visual circuit receptors for Burn Airfield (Runway 25)*

Plate 10 *Custom approach and visual circuit receptors for Burn Airfield (Runway 33)*

4.2 Ground-Based Receptors Overview

There is no formal guidance with regard to 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.

A 1km assessment area from the periphery of the solar panel areas within each of the Solar Development Sites is considered appropriate for glint and glare effects on ground-based receptors. Receptors within this distance are identified based on mapping and aerial photography of the region. The assessment areas are bounded by the orange outlines in Plates 11 and 12 below and on the following page.

The receptor details are presented in Annex Annex F – Receptor and Reflector Area Details and the terrain elevations have been interpolated based on OS Terrain 50 DTM[15] and SRTM data.

[15] Digital Terrain Model

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Plate 11 *Assessment area (North)*

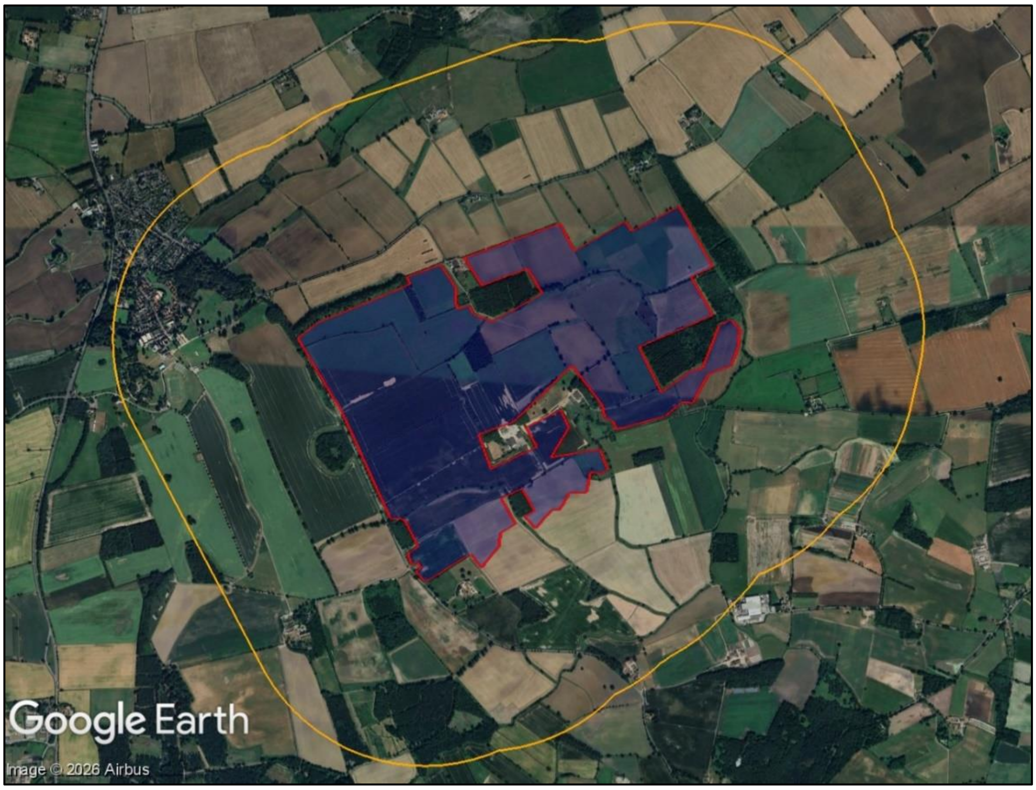
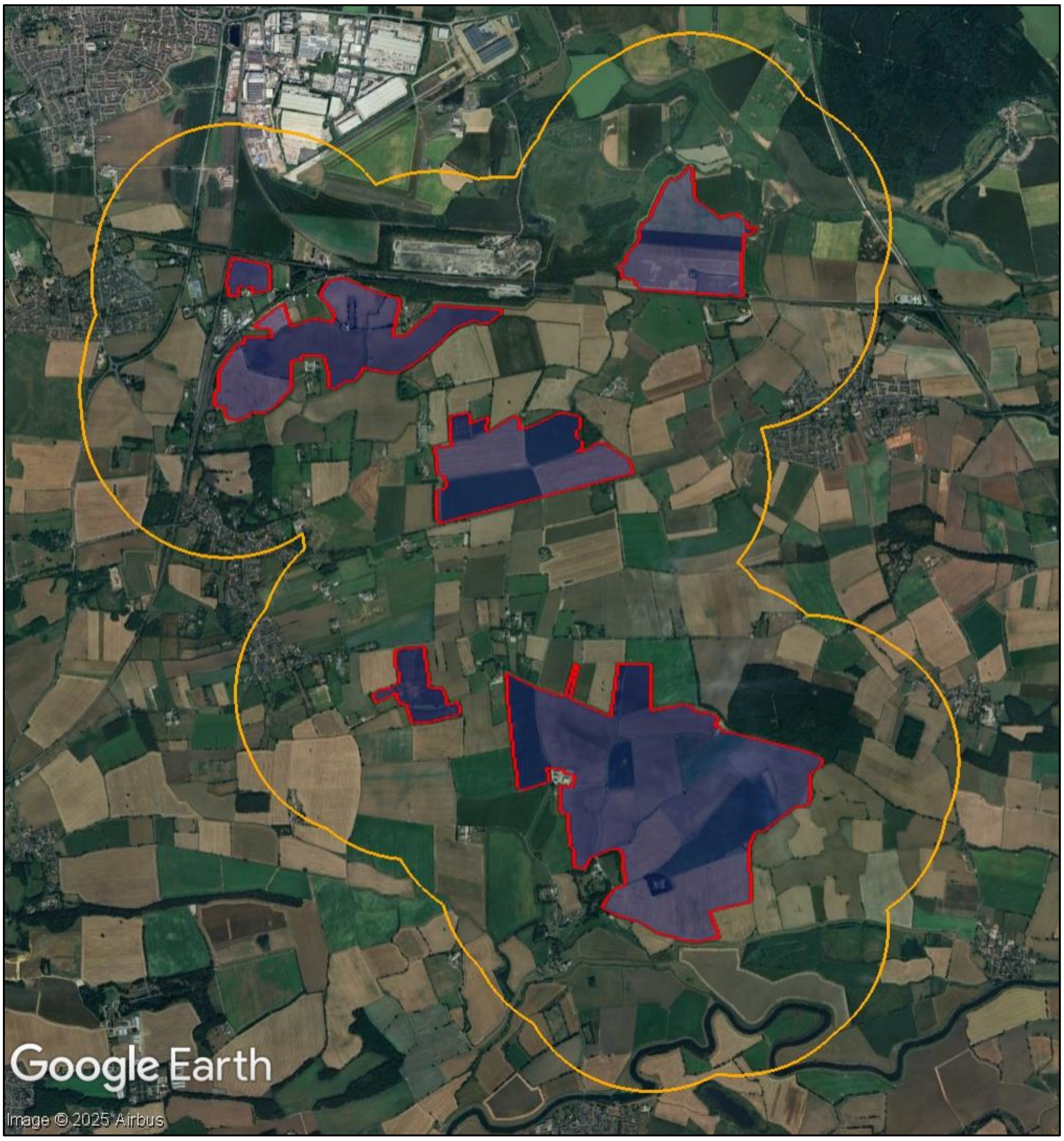


Plate 12 *Assessment area (West)*



4.3 Road Receptors

4.3.1 Road Receptors Overview

Road types can generally be categorised as:

1) 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;
2) National – Typically a road with 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;
3) 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;
4) Local – Typically roads and lanes with the lowest traffic densities. Speed limits vary.

Technical modelling is not recommended for local roads, where traffic densities are likely to be relatively low. Any solar reflections from the Proposed Development that are experienced by a road user along a local road would be considered low impact in the worst case in accordance with the guidance presented in Annex Annex D – Glint and Glare Impact Significance. The analysis has therefore considered major national, national, and regional roads that:

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

4.3.2 Identified Road Receptors

Table 3 below shows a summary of the roads identified within the 1km assessment areas. The receptors are placed circa 100m apart and a height of 1.5 metres above ground level has been taken as the typical eye level of a road user[16]. Plates 13 to 15, on the following pages show the assessed road receptors.

Road	Receptors
Skipwith Road	N1 – N38

[16] This fixed height for the road receptors is for modelling purposes. Changes to the modelling height by a few metres is not expected to significantly change the modelling results. Views for elevated drivers are also considered in the results discussion, where appropriate.

Road	Receptors
A162	W1 – W27
Main Street	W28 – W39
A63	W40 – W81
Hillam Lane	W82 – W89
Hillam Common Lane	W90 – W144
Roe Lane	W145 – W171
Haddlesey Road	W172 – W198

Table 3 *Summary of identified road receptors*

Plate 13 Road receptors – North

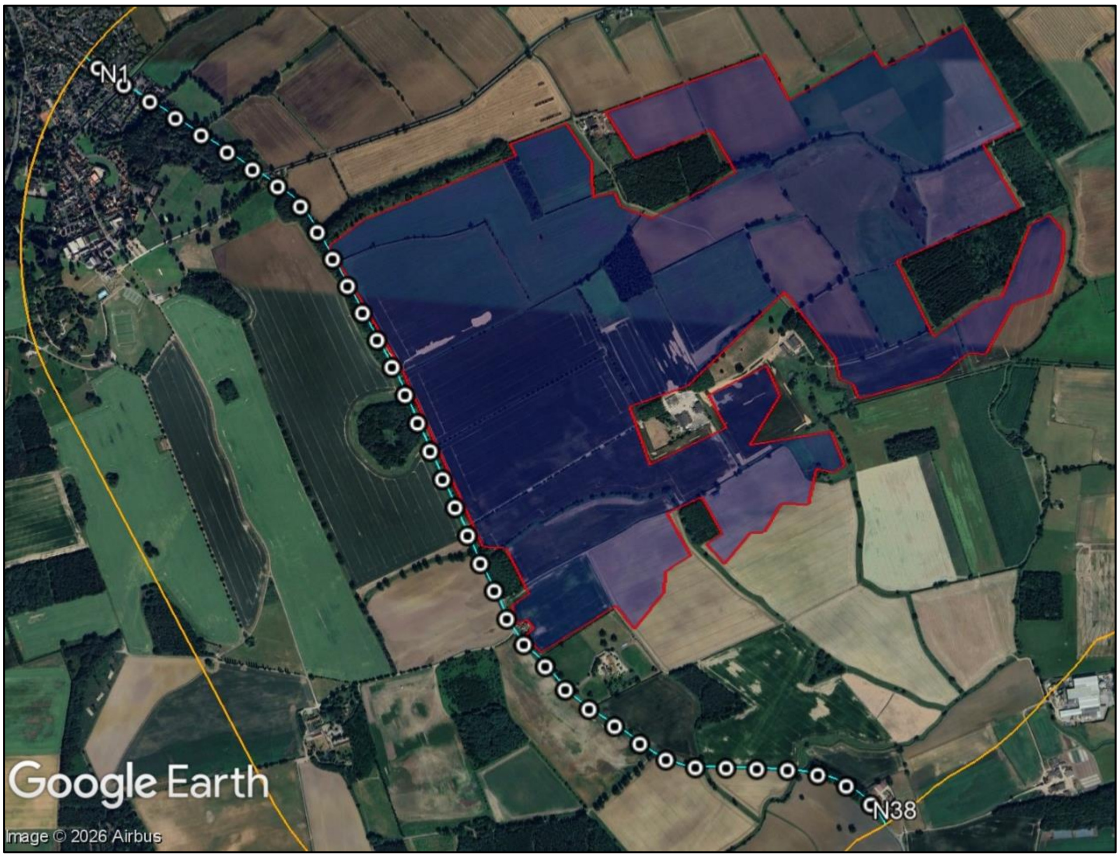
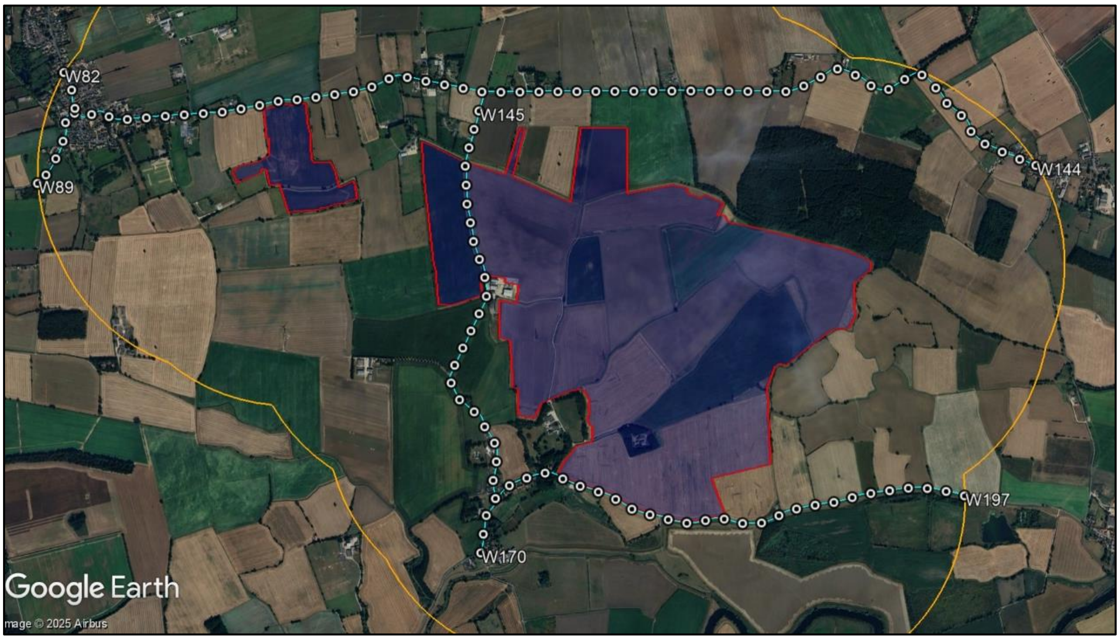


Plate 14 Road receptors – West 1 to 81

Plate 15 Road receptors – West 82 to 197



4.4 Dwelling Receptors

4.4.1 Dwelling Receptors Overview

The analysis has considered dwellings that:

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

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.

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.

4.4.2 Identified Dwelling Receptors

The assessed dwelling receptors are shown in Plates 16 and 17, on the following pages. 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[17].

[17] This fixed height for the dwelling receptors is for modelling purposes. Changes to the modelling height by a few metres is not expected to significantly change the modelling results. Views above ground floor are considered in the results discussion where necessary.

Plate 16 Overview of dwelling receptors – North

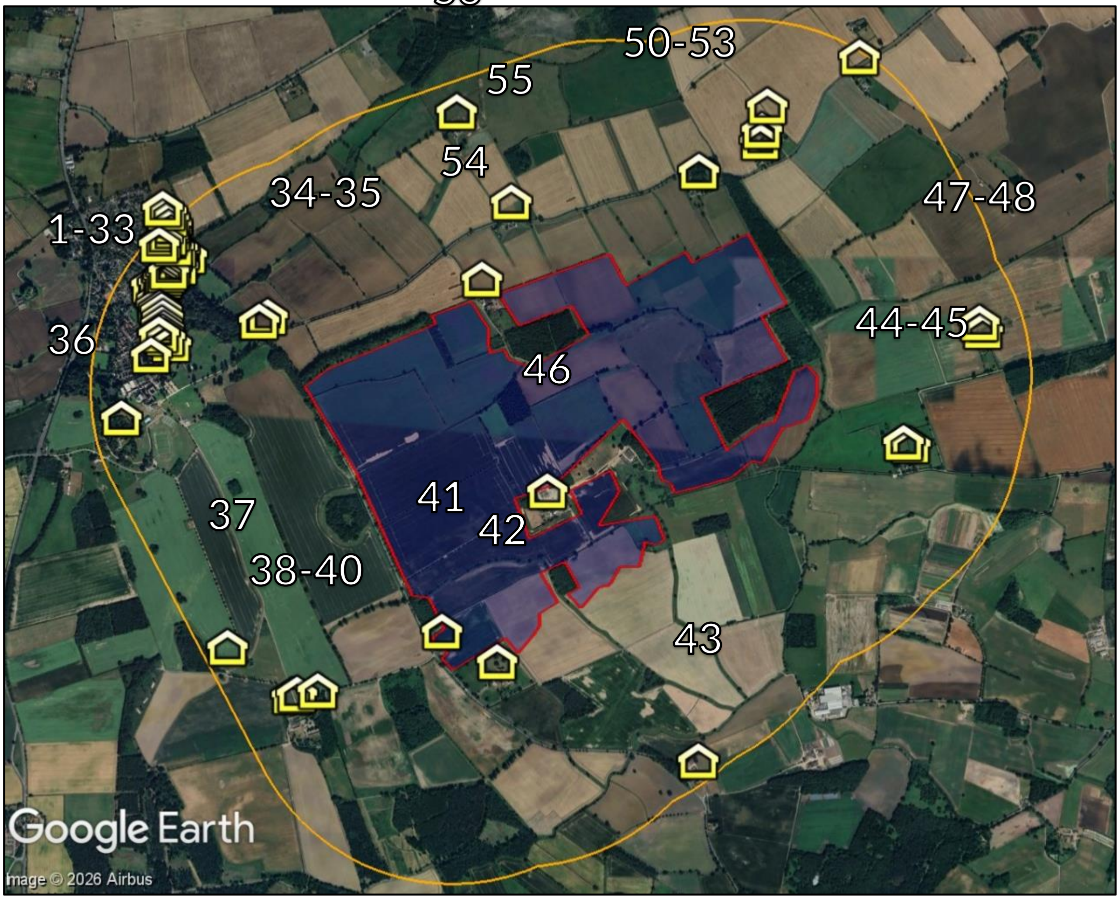
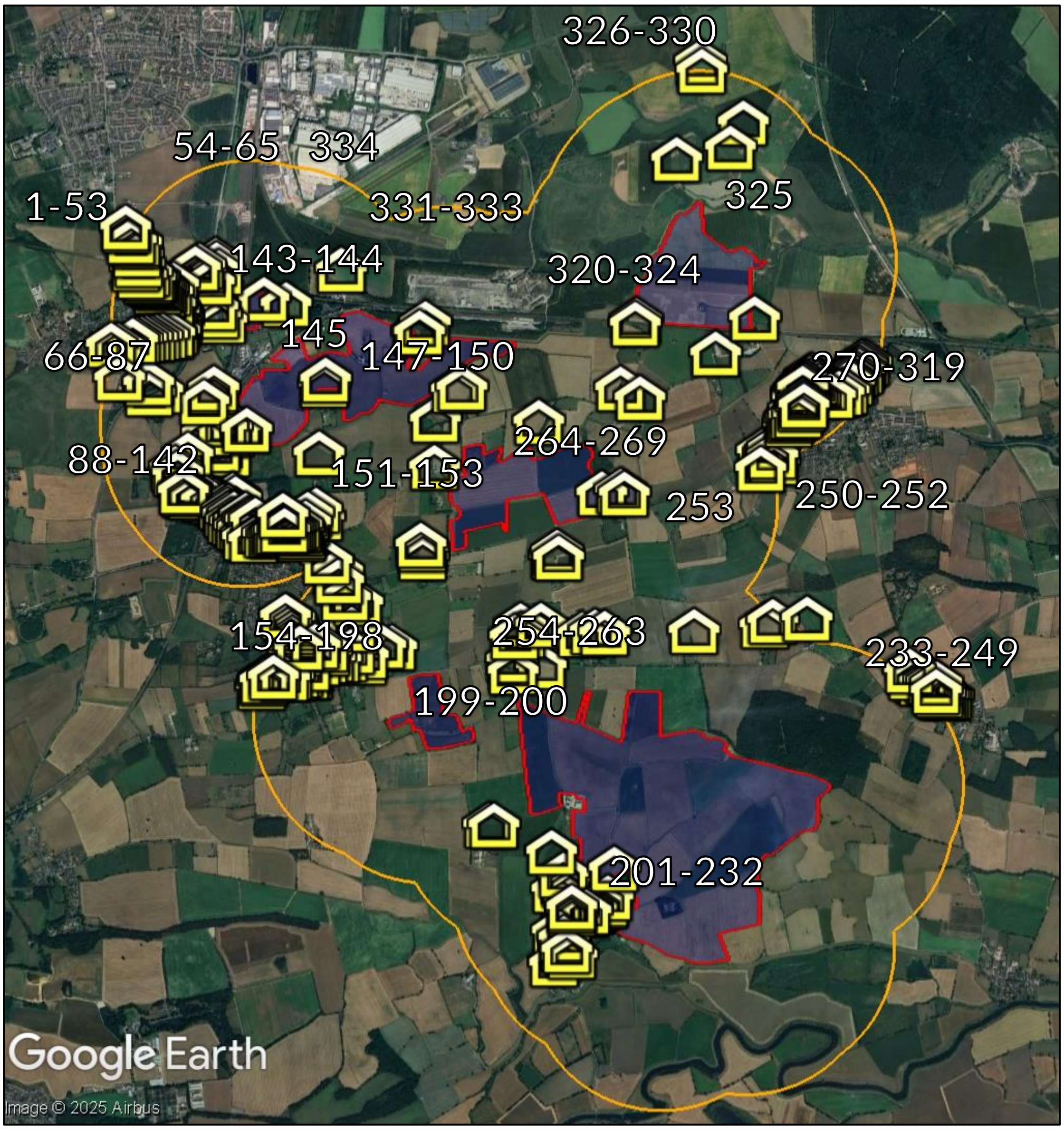


Plate 17 Overview of dwelling receptors – West



4.5 Railway Receptors

4.5.1 Overview

Typical reasons stated by a railway stakeholder for requesting a glint and glare assessment often relate to the following:

1) The development producing solar reflections towards train drivers.
2) The development producing solar reflections, which causes a train driver to take action.
3) The development producing solar reflections that affect railway signals.

With respect to point 1, a reflective panel could produce solar reflections towards a train driver. If this reflection occurs where a railway signal, crossing etc., is present, or where the driver's workload is particularly high, the solar reflection may affect operations. This is deemed to be the most concern with respect to solar reflections.

Following from point 1, point 2 identifies whether a modelled solar reflection could be significant by determining its intensity. Only where a solar reflection occurs under certain conditions and is of a particular intensity may it cause a reaction from a train driver and thus potentially affect safe operations. Therefore, intensity calculations are undertaken where a solar reflection is identified and where its presence could potentially affect the safety of operations. Points 1 and 2 are completed in a 2-step approach.

With respect to all points, railway lines use light signals to manage trains on approach towards particular sections of track. If a signal is passed when not permitted, a SPAD (Signal Passed At Danger) is issued. The concerns will relate specifically to the possibility of the reflections appearing to illuminate signals that are not switched on (known as a phantom aspect illusion) or a distraction caused by the glare itself, both of which could lead to a SPAD. The definition is presented below:

'Light emitted from a Signal lens assembly that has originated from an external source (usually the sun) and has been internally reflected within the Signal Head in such a way that the lens assembly gives the appearance of being lit.[18]'

4.5.2 Disability Glare

As well as the glint and glare definition presented in Section 1.3, glare can also be categorised as causing visual discomfort whereby an observer would

[18] Source: Glossary of Signalling Terms, Railway Group Guidance Note GK/GN0802. Issue One. Date April 2004.

instinctively look away, or cause disability whereby objects become difficult to see. The guidance produced by the Commission Internationale de L'Eclairage (CIE)[19] describes disability glare as:

'Disability glare is glare that impairs vision. It is caused by scattering of light inside the eye…The veiling luminance of scattered light will have a significant effect on visibility when intense light sources are present in the peripheral visual field and contrast of objects is seen to be low.'

'Disability glare is most often of importance at night when contrast sensitivity is low and there may well be one or more bright light sources near to the line of sight, such as car headlights, streetlights or floodlights. But even in daylight conditions disability glare may be of practical significance: think of traffic lights when the sun is close to them, or the difficulty viewing paintings hanging next to windows.'

These types of glare are of particular importance in the context of railway operations as they may cause a distraction to a train driver (discomfort) or may cause railway signals to be difficult to see (disability).

4.5.3 Railway Signal Receptors

The analysis has considered railway signal receptors that:

1) Are within 500 metres of the Proposed Development; and
2) Have a potential view of the panels.

No signals have been assessed as none have been identified in this Study Area.

4.5.4 Train Driver Receptors

The analysis has considered train driver receptors that:

1) Are within 500 metres of the Proposed Development; and
2) Have a potential view of the panels.

Receptors have been placed circa 100m along the identified sections of railway line, as shown in Plate 18, on the following page.

Receptors are placed approximately every 100m along the identified sections of railway and a height of 2.75 metres above ground level has been taken as the typical viewing height of a train operator[20].

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[19] CIE 146:2002 & CIE 147:2002 Collection on glare (2002).
[20] Confirmed by Network Rail during previous consultation

Plate 18 *Railway receptors – West*

4.6 Waterway Receptors

4.6.1 Waterway Receptors Overview

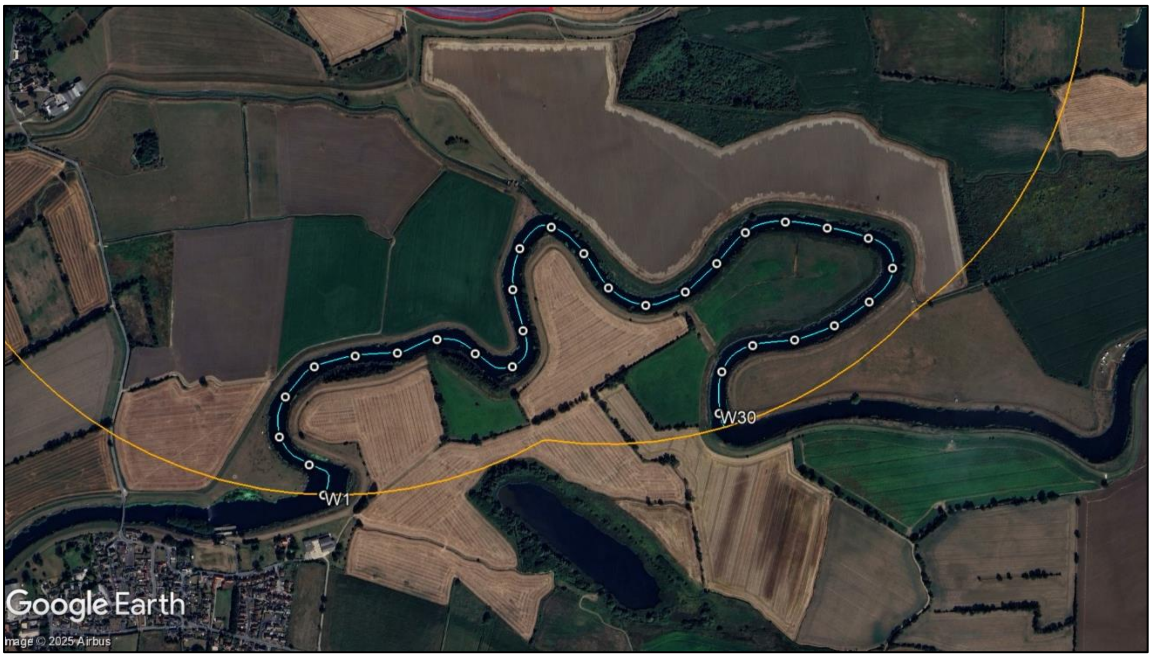
Waterway receptors have been assessed along navigable waterways where they:

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

4.6.2 Identified Waterway Receptors

The receptors are placed circa 100m apart and a height of 1.5 metres above water level has been taken as the typical eye level of a waterway user[21]. Plate19 below shows the assessed waterway receptors located along the River Aire.

Plate 19 *Waterway receptors – West*



[21] This fixed height for the road receptors is for modelling purposes. Changes to the modelling height by a few metres is not expected to significantly change the modelling results.

5 ASSESSED REFLECTOR AREAS

5.1 Reflector Areas

The bounding coordinates for the Proposed Development have been extrapolated from the Solar Development Site plans. The full data can be provided on request.

The Pager Power model has used a resolution of 20m for this assessment.[22] This means that a geometric calculation is undertaken for each identified receptor every 20m 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 proposed Solar Development Sites.

[22] 20m was used for all receptors other than aviation, where 50m was used

6 GEOMETRIC ASSESSMENT RESULTS AND DISCUSSION

6.1 Overview

The following sub-section presents the results of the assessment and the significance of any predicted impact in the context of existing screening and the relevant criteria set out in each sub-section. The criteria are determined by the assessment process for each receptor, which are set out in Annex Annex D – Glint and Glare Impact Significance.

When determining the visibility of the reflecting panels for an observer, a conservative review of the available imagery has been undertaken, whereby it is assumed views of the panels are possible if it cannot be reliably determined that existing screening will remove effects.

The tables in the following subsections summarise the results of the assessment. The predicted glare time modelling is based solely on bare-earth terrain i.e. without consideration of screening from buildings and vegetation. The final column summarises the predicted impact considering the level of predicted screening based on a desk-based review of the available imagery. The significance of any predicted impact is discussed in the subsequent report sections.

The modelling output showing the precise predicted times are shown in Annex Annex G – Detailled Modelling Results.

6.2 Aviation Results

6.2.1 Glare Intensity Categorisation

The Pager Power and Forge models will be used to determine whether reflections are possible. Intensity calculations in line with the Sandia National Laboratories methodology will be undertaken for aviation receptors. 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 4 below along with the associated colour coding.

Coding Used	Intensity Key
Glare beyond 50°	'Glare outside of a pilot's primary field-of-view (50 degrees horizontally either side of the direction of travel)'
'Green' glare	'Low potential for temporary after-image'
'Yellow' glare	'Potential for temporary after-image'
'Red' glare	'Potential for permanent eye damage'

Table 4 Glare intensity designation

This coding will be used in the results tables where a reflection has been calculated and is in accordance with Sandia National Laboratories' methodology. In addition, the intensity model allows for the assessment of a variety of solar panel surface materials. This assessment will considered solar panels with a surface material of 'smooth glass with an anti-reflective coating' as this is committed to by the Proposed Development.

If significant glare is predicted, modelling of less reflective surfaces could be undertaken.

6.2.2 Impact Significance Determination – Approach Paths and Visual Circuits

The process for quantifying impact significance is defined in the report appendices. For the runway approach paths and visual circuits, the key considerations are:

1) Whether a reflection is predicted to be experienced in practice.
2) The location of glare relative to a pilot's primary field-of-view (50 degrees either side of the approach bearing).
3) The intensity of glare for the solar reflections:
    a) Glare with 'low potential for temporary after-image' (green glare);
    b) Glare with 'potential for temporary after-image' (yellow glare);
    c) Glare with 'potential for permanent eye damage' (red glare).
4) Whether a reflection is predicted to be operationally significant in practice or not.

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.

Where solar reflections are of an intensity of 'low potential for temporary after-image' (green glare) or occur outside of a pilot's primary field of view (50 degrees either side of the approach bearing), the impact significance is low, and mitigation is not recommended.

Glare with 'potential for a temporary after-image' (yellow glare) was formerly not permissible under the interim guidance provided by the Federal Aviation Administration in the USA[23] 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 Pager Power's glint and glare guidance document[24], 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[25]:

1) The likely traffic volumes and level of safeguarding at the aerodrome – licensed aerodromes typically have higher traffic volumes and are formally safeguarded;
2) 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 these times;
3) 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 the year;
4) The location and size of the reflecting panel area relative to a pilot's primary field-of-view;
5) 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;
6) 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.

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

[24] Pager Power (2022) https://www.pagerpower.com/news/glint-and-glare-guidance-fourth-edition-now-available/. Fourth Edition, September 2022.

[25] 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.

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

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

Further to this methodology, Annex Annex H – Empirical Evidence on Glint & Glare from Solar PV Installations Near UK Aerodromes sets out an empirical review of evidence regarding glint and glare and establishes that there is no evidence of adverse glint and glare effects impacting pilots at UK aerodromes with existing solar installations in their vicinity. There have also been no instances of reported incidents in the UK or US where glare from solar PV was cited as a factor.

6.2.3 Results Discussion – Leeds East Airport

The results of the geometric calculation for aviation receptors at Leeds East Airport are presented in Table 5 (fixed panels) and Table 6 (tracking panels) below and on the following page.

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 06 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards this approach path	Low impact	No
Runway 24 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Outside 50°'	Any solar reflections would be outside of a pilot's primary field-of-view	Low impact	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 04 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards these circuits	Low impact	No
Runway 22 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards these circuits	Low impact	No

Table 5 *Geometric analysis results – Leeds East Airport – fixed south facing panels*

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 06 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards this approach path	Low impact	No
Runway 24 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Outside 50°'	Any solar reflections would be outside of a pilot's primary field-of-view	Low impact	No
Runway 04 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards these circuits	Low impact	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 22 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards these circuits	Low impact	No

Table 6 *Geometric analysis results – Leeds East Airport – single axis tracking panels*

6.2.4 Results Discussion – Sherburn-In-Elmet Airfield

The results of the geometric calculation for aviation receptors at Sherburn-In-Elmet Airfield are presented in Table 7 (fixed panels) and Table 8 (tracking panels) below and on the following page.

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 10/28 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Moderate impact	Yes
Runway 10G/28G Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Moderate impact	Yes
Runway 01/19 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.11)	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 06/24 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.11)	No

Table 7 *Geometric analysis results – Sherburn-In-Elmet Airfield – fixed south facing panels*

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 10/28 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Moderate impact	Yes
Runway 10G/28G Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Moderate impact	Yes
Runway 01/19 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.11)	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 06/24 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.11)	No

Table 8 *Geometric analysis results – Sherburn-In-Elmet Airfield – single axis tracking panels*

6.2.5 Results Discussion – Burn Airfield

The results of the geometric calculation for aviation receptors at Burn Airfield are presented in Table 9 (fixed panels) and Table 10 (tracking panels) below and on the following page.

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 01 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Moderate impact	Yes
Runway 19 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards these circuits	Low impact	No
Runway 25 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.12)	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 33 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Moderate impact	Yes

Table 9 *Geometric analysis results – Burn Airfield – fixed south facing panels*

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 01 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Moderate impact	Yes
Runway 19 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Moderate impact	Yes
Runway 25 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Moderate impact	Yes

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 33 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Moderate impact	Yes

Table 10 *Geometric analysis results – Burn Airfield – fixed south facing panels*

6.2.6 Results Discussion – Redmoor Farm Airfield

The results of the geometric calculation for aviation receptors at Redmoor Farm Airfield are presented in Table 11 (fixed panels) and Table 12 (tracking panels) below and on the following page.

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 10 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 28 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards this approach path	Low impact	No
Runway 10 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.13)	No
Runway 28	Solar reflections are geometrically possible	'Green'	Solar reflections with intensities of 'low potential	Low impact	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Visual Circuits	towards final sections of the visual circuits		for temporary after-image' are predicted towards these circuits		

Table 11 *Geometric analysis results – Redmoor Farm Airfield – fixed south facing panels*

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 10 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Outside 50°'	Any solar reflections would be outside of a pilot's primary field-of-view	Low impact	No
Runway 28 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards this approach path	Low impact (see Section 6.2.13)	No
Runway 10 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.13)	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 28 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.13)	No

Table 12 *Geometric analysis results – Redmoor Farm Airfield – single axis tracking panels*

6.2.7 Results Discussion – Gilrudding Grange Airfield

The results of the geometric calculation for aviation receptors at Gilrudding Grange Airfield are presented in Table 13 (fixed panels) and Table 14 (tracking panels) below and on the following page.

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 09 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 27 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 09 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 27 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.14)	No

Table 13 *Geometric analysis results – Gilrudding Grange Airfield – fixed south facing panels*

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 09 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards this approach path	Low impact (see Section 6.2.14)	No
Runway 27 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Outside 50°'	Any solar reflections would be outside of a pilot's primary field-of-view	Low impact	No
Runway 09 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.14)	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 27 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.14)	No

Table 14 *Geometric analysis results – Gilrudding Grange Airfield – single axis tracking panels*

6.2.8 Results Discussion – Bridge Cottage Airfield

The results of the geometric calculation for aviation receptors at Bridge Cottage Airfield are presented in Table 15 (fixed panels) and Table 16 (tracking panels) below and on the following page.

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 01 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 19 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 18 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 36 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 01 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 19 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 18 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 36 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No

Table 15 *Geometric analysis results – Bridge Cottage Airfield – fixed south facing panels*

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 01 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 19 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Outside 50°'	Any solar reflections would be outside of a pilot's primary field-of-view	Low impact	No
Runway 18 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Outside 50°'	Any solar reflections would be outside of a pilot's primary field-of-view	Low impact	No
Runway 36 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 01 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 19 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards these circuits	Low impact	No
Runway 18 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards these circuits	Low impact	No
Runway 36 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No

Table 16 *Geometric analysis results – Bridge Cottage Airfield – single axis tracking panels*

6.2.9 Results Discussion – Elvington Airfield

The results of the geometric calculation for aviation receptors at Elvington Airfield are presented in Table 17 (fixed panels) and Table 18 (tracking panels) below and on the following page.

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 08 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 26 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 08 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 26 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No

Table 17 *Geometric analysis results – Elvington Airfield – fixed south facing panels*

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 08 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Outside 50°'	Any solar reflections would be outside of a pilot's primary field-of-view	Low impact	No
Runway 26 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 08 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Yellow'	Solar reflections with intensities of 'potential for temporary after-image' are predicted towards these circuits	Low impact (see Section 6.2.16)	No
Runway 26 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards these circuits	Low impact	No

Table 18 *Geometric analysis results – Elvington Airfield – single axis tracking panels*

6.2.10 Results Discussion – Birchwood Lodge Airfield

The results of the geometric calculation for aviation receptors at Birchwood Lodge Airfield are presented in Table 19 (fixed panels) and Table 20 (tracking panels) below and on the following page.

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 08 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 26 Approach Path	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 08 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No
Runway 26 Visual Circuits	No solar reflections are geometrically possible	N/A	N/A	No impact	No

Table 19 *Geometric analysis results – Birchwood Lodge Airfield – fixed south facing panels*

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
Runway 08 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards this approach path	Low impact	No
Runway 26 Approach Path	Solar reflections are geometrically possible between the threshold and 1-mile from the threshold	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards this approach path	Low impact	No
Runway 08 Visual Circuits	Solar reflections are geometrically possible towards final sections of the visual circuits	'Green'	Solar reflections with intensities of 'low potential for temporary after-image' are predicted towards these circuits	Low impact	No
Runway 26 Visual Circuits	Solar reflections are geometrically possible	'Green'	Solar reflections with intensities of 'low potential for temporary after-image'	Low impact	No

Receptor/Runway	Geometric Modelling Result	Glare Intensity	Comment	Impact Classification	Mitigation Recommended?
	towards final sections of the visual circuits		are predicted towards these circuits		

Table 20 Geometric analysis results – Birchwood Lodge Airfield – single axis tracking panels

6.2.11 Further Results Discussion – Sherburn-In-Elmet Airfield

Glare with ‘potential for temporary after-image’ (yellow) is predicted towards the visual circuits associated with Sherburn-In-Elmet Airfield. Yellow glare was formerly not permissible under the interim guidance provided by the Federal Aviation Administration in the USA[26] for on-airfield solar, which applied to approach paths. Whilst this guidance was never formally applicable outside of the USA, it has been a common point of reference internationally and is useful from a technical context. Pager Power recommends a pragmatic approach whereby instances of ‘yellow’ glare are evaluated in a technical and operational context. This approach is supported by Annex Annex H – Empirical Evidence on Glint & Glare from Solar PV Installations Near UK Aerodromes which sets out an empirical review of evidence regarding glint and glare and establishes that there is no evidence of adverse glint and glare effects impacting pilots at UK aerodromes.

In cases where glare with ‘potential for a temporary after-image’ is predicted, effects must be evaluated in an operational context. This includes consideration of:

1) The type of airfield and the likely air traffic volumes.
2) The impact of direct sunlight on pilots approaching the airfield.
3) The extent to which glint and glare effects and direct sunlight are similar.
4) Whether the measures pilots use to mitigate direct sunlight will also mitigate glint and glare.

For ‘yellow’ glare towards the visual circuits associated with runways 01/19 and 06/24, solar reflections would occur from outside a pilot’s primary field-of-view for pilots on approach to the runway thresholds for both panel types (fixed and tracking). Any possible glare would occur from behind the pilot whilst they are approaching the thresholds and is therefore unlikely to be experienced by pilots in practice. A low impact is predicted but on-going consultation is being undertaken with Sherburn-In-Elmet Airfield to understand their position towards the Proposed Development and their operations.

For visual circuits associated with runways 10/28 and 10G/28G, ‘yellow’ glare is predicted which would occur within a pilot’s primary field-of-view, while they are on final approach. A moderate impact is predicted, and the development of

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

mitigation measures is recommended (see Section 6.7.1) by this study on the basis of the modelling work undertaken.

6.2.12 Further Results Discussion – Burn Airfield

Glare with 'potential for a temporary after-image' (yellow) is predicted towards the visual circuits associated with Burn Airfield. Glare is predicted from both fixed south facing panels and single axis tracking panels.

For fixed south facing panels, 'yellow' glare will occur towards the visual circuits for runways 01, 25 and 33 in evenings throughout Spring and Autumn. A moderate impact is predicted towards visual circuits associated with runway thresholds 01 and 33, and the development of mitigation measures is recommended (see Section 6.7.1) by this study on the basis of the modelling work undertaken. For runway 25, 'yellow' glare will only occur from outside of a pilot's primary field-of-view when on approach to the runway, and therefore a low impact is predicted and no mitigation is required. For runway 19, 'green' glare is predicted, which is deemed acceptable in line with the associated guidance and industry best practice, a low impact is predicted and no mitigation is required.

For single axis tracking panels, 'yellow' glare is predicted towards visual circuits associated with all runway thresholds predominately during evenings in Spring. A moderate impact is predicted, and mitigation is recommended (see Section 6.7.1).

6.2.13 Further Results Discussion – Redmoor Farm Airfield

Due diligence research indicates that Redmoor Farm Airfield has not been operational after 2015, however the runway has been assessed on a precautionary basis. Glare with 'potential for a temporary after-image' (yellow) is predicted towards the visual circuits associated with Redmoor Farm Airfield. 'Yellow' glare is predicted to be possible towards the visual circuits for runway 09 from fixed south facing panels, but no reflections are predicted towards the approach paths.

For single axis tracking panels, 'yellow' glare is predicted towards the approach path for runway 27 and visual circuits for runway 09/27. Yellow glare towards the approach path is possible only for a very short duration (115 minutes per year) and will coincide with direct sunlight.

'Yellow' glare is predicted to occur for no more than 60 minutes on any given day at a particular location and will be possible towards approach paths for approximately 1 month per year. Solar reflections with yellow glare are predicted to occur within 2 hours of sunset and therefore will occur 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. The Sun is a far more significant source of light.

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 the approach path at the specific times and dates when solar reflections are geometrically possible.

Overall, should operations at the airfield recommence, it is judged that the effects can be operationally accommodated subject to notifying the airport of the dates/times in which yellow glare can occur to enable them to make informed decisions about the airfield operation and awareness for pilots as secured via the oOEMP [**EN0110012/APP/LVS/07.03**].

6.2.14 Further Results Discussion – Gilrudding Grange Airfield

Glare with 'potential for a temporary after-image' (yellow) is predicted towards the visual circuits associated with Gilrudding Grange Airfield. 'Yellow' glare is predicted to be possible towards the visual circuits for runway 27 from fixed south facing panels, but no reflections are predicted towards the approach paths.

For single axis tracking panels, 'yellow' glare is predicted towards the approach path for runway 09 and visual circuits for runway 09/27. Yellow glare towards the approach path is possible only for a very short duration (105 minutes per year) and will coincide with direct sunlight.

'Yellow' glare is predicted to occur for no more than 60 minutes on any given day at a particular location and will be possible towards approach paths during spring and autumn. Solar reflections with yellow glare are predicted to occur within 1 hour of sunrise and therefore will occur 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. The Sun is a far more significant source of light.

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 the approach path at the specific times and dates when solar reflections are geometrically possible.

Overall, it is judged that the effects can be operationally accommodated subject to notifying the airport of the dates/times in which yellow glare can occur as secured via the oOEMP [**EN0110012/APP/LVS/07.03**].

6.2.15 Further Results Discussion – Bridge Cottage Airfield

No solar reflections are geometrically possible towards receptors associated with Bridge Cottage Airfield from fixed south facing panels. No impact is predicted and no mitigation is required.

For single axis tracking panels, solar reflections are predicted to occur towards the approach paths for runways 18 and 19 from outside a pilot's primary field-of-view. This is deemed acceptable in line with the associated guidance and industry best practice, a low impact is predicted and no mitigation is required. Glare with 'low potential for a temporary after-image' (green) is predicted towards the visual circuits associated with runways 18 and 19. This is deemed acceptable in line with the associated guidance and industry best practice, a low impact is predicted and no mitigation is required.

6.2.16 Further Results Discussion – Elvington Airfield

Glare with 'potential for a temporary after-image' (yellow) is predicted towards the visual circuits associated with Elvington Airfield from single axis tracking panels only. 'Yellow' glare is predicted to be possible towards the visual circuits for runway 08, for a total duration of 115 minutes per year.

Solar reflections with yellow glare are predicted to occur within 1 hour of sunrise in mid-winter and therefore will occur 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. The Sun is a far more significant source of light.

The weather would have to be clear and sunny at the specific times when the glare was possible to be experienced.

Overall, it is judged that the effects can be operationally accommodated subject to notifying the airport of the dates/times in which yellow glare can occur as secured via the oOEMP [**EN0110012/APP/LVS/07.03**].

6.2.17 Further Results Discussion – Birchwood Lodge Airfield

No solar reflections are geometrically possible towards receptors associated with Birchwood Lodge Airfield from fixed south facing panels. No impact is predicted and no mitigation is required.

For single axis tracking panels, solar reflections are predicted to occur towards the approach paths and visual circuits for runway 08/26 with 'low potential for a temporary after-image' (green). This is deemed acceptable in line with the associated guidance and industry best practice, a low impact is predicted and no mitigation is required.

6.3 Road Results

6.3.1 Impact Significance Determination

The process for quantifying the impact significance concerning road safety is outlined in Annex Annex D – Glint and Glare Impact Significance. The key considerations for road users along major national, national, and regional roads are:

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

Where reflections are geometrically possible but expected to be screened, no impact is predicted, and mitigation is not required.

Where reflections originate from outside of a road user's primary horizontal field-of-view (50 degrees either side of 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.

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

1) Whether visibility is likely for elevated drivers (relevant to dual carriageways and motorways[27]);
2) Whether the solar reflection originates from directly in front of a road user. Solar reflections that are directly in front of a road user are more hazardous;
3) The separation distance to the reflecting panel area. Larger separation distances reduce the proportion of an observer's field-of-view that is affected by glare;

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

4) 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.

Following consideration of these relevant factors, where the solar reflection is not deemed significant, a low impact is predicted, and mitigation is not recommended. Where the solar reflection is deemed significant, the impact significance is moderate, and mitigation is recommended. Where reflections originate from directly in front of a road user and there are no further mitigating factors, the impact significance is high, and mitigation is required.

6.3.2 Results Discussion – Fixed South Facing Panels

Tables 21 and 22, below and on the following page, summarise the predicted impact towards road receptors for fixed south facing panels.

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N1 – N8	Solar reflections geometrically possible from **inside** a road user's primary field-of-view[28]	Existing vegetation and/or intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

[28] 50 degrees either side of the direction of travel

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N9 – N10, N22 – N23	Solar reflections geometrically possible from **outside** a road user's primary field-of-view	Existing vegetation and/or intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A
N11 – N21, N24	Solar reflections geometrically possible from **outside** a road user's primary field-of-view	No significant screening identified	N/A	Low impact	No	N/A

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N25	Solar reflections geometrically possible from **inside** a road user's primary field-of-view	No significant existing screening identified	N/A	Moderate impact (temporary)	Yes Screening has been proposed in the form of advanced planting at Solar Development Site 1 which would be predicted to significantly screen reflecting areas	Low impact
N26 – N38	No solar reflections geometrically possible	N/A	N/A	No impact	No	N/A

Table 21 *Impact classification – road receptors – north area*

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W1 – W4, W83, W100 – W123	No solar reflections geometrically possible	N/A	N/A	No impact	No	N/A
W5 – W16, W25 – W27, W82, W84 – W86, W145 – W146 W154 – W155 W163 – W170	Solar reflections geometrically possible from **outside** a road user's primary field-of-view	Existing vegetation and/or intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W17 – W24, W28 – W49, W72 – W81, W87 – W96, W124 – W144 W161 W171 – W173 W192 – W197	Solar reflections geometrically possible from **inside** a road user's primary field-of-view	Existing vegetation and/or intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W50 – W71	Solar reflections geometrically possible from **inside** a road user's primary field-of-view	Existing vegetation and/or intervening terrain is predicted to partially obstruct views of reflecting panels	N/A	Moderate impact (temporary)	Yes Screening has been proposed in the form of advanced planting at Solar Development Site 2 which would be predicted to significantly screen reflecting areas	Low Impact
W97 – W99, W156 – W160 W162, W174 – W191	Solar reflections geometrically possible from **inside** a road user's primary field-of-view	No significant existing screening identified	N/A	Moderate impact (temporary)	Yes Screening has been proposed in the form of advanced planting at Solar Development Sites 3 and 4 which would be predicted to significantly screen reflecting areas	Low impact

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W147 – W153	Solar reflections geometrically possible from **<u>outside</u>** a road user's primary field-of-view	No significant screening identified	N/A	Low impact	No	N/A

Table 22 *Impact classification – road receptors – west area*

6.3.3 Results Discussion – Single Axis Tracking Panels

Tables 23 and 24, below and on the following page, summarise the predicted impact towards road receptors for fixed south facing panels.

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N1 – N8	Solar reflections geometrically possible from **inside** a road user's primary field-of-view	Existing vegetation and/or intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A
N9 – N10, N22 – N23	Solar reflections geometrically possible from **outside** a road user's primary field-of-view[29]	Existing vegetation and/or intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

[29] 50 degrees either side of the direction of travel

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N11 – N21, N24	Solar reflections geometrically possible from **outside** a road user's primary field-of-view	No significant screening identified	N/A	Low impact	No	N/A
N25	Solar reflections geometrically possible from **inside** a road user's primary field-of-view	No significant existing screening identified	N/A	Moderate impact	Yes Screening has been proposed in the form of advance planting at Solar Development Site 1 which would be predicted to significantly screen reflecting areas	Low impact

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N26 – N38	No solar reflections geometrically possible	N/A	N/A	No impact	No	

Table 23 *Impact classification – road receptors – north area*

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W1 – W16, W25 – W27, W82 – W86, W145 – W146 W154 – W155 W163 – W170	Solar reflections geometrically possible from **outside** a road user's primary field-of-view	Existing vegetation and/or intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W17 – W24, W28 – W49, W72 – W81, W87 – W96, W124 – W144 W161 W171 – W173 W192 – W197	Solar reflections geometrically possible from **inside** a road user's primary field-of-view	Existing vegetation and/or intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W50 – W71	Solar reflections geometrically possible from **inside** a road user's primary field-of-view	Existing vegetation and/or intervening terrain is predicted to partially obstruct views of reflecting panels	N/A	Moderate impact	Yes Screening has been proposed in the form of advanced planting at Solar Development Site 2 which would be predicted to significantly screen reflecting areas	Low impact
W97 – W99, W156 – W160 W162, W174 – W191	Solar reflections geometrically possible from **inside** a road user's primary field-of-view	No significant existing screening identified	N/A	Moderate impact	Yes Screening has been proposed in the form of advanced planting at Solar Development Sites 3 and 4 which would be predicted to significantly screen reflecting areas	Low impact

Road Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W100 – W123	No solar reflections geometrically possible	N/A	N/A	No impact	No	N/A
W147 – W153	Solar reflections geometrically possible from **outside** a road user's primary field-of-view	No significant screening identified	N/A	Low impact	No	N/A

Table 24 *Impact classification – road receptors – west area*

6.4 Dwelling Results

6.4.1 Impact Significance Determination

The process for quantifying the impact significance concerning residential amenity is outlined in Annex Annex D – Glint and Glare Impact Significance. There are no known safety issues associated with glint and glare towards dwellings. The key considerations for residential dwellings are:

1) Whether a reflection is predicted to be experienced in practice;
2) The duration of the predicted effects, relative to thresholds of:
    a) 3 months per year;
    b) 60 minutes on any given day.

Where reflections are geometrically possible but expected to be screened, no impact is predicted, and mitigation is not required.

Where effects occur for less than 3 months per year and less than 60 minutes on any given day, or the closest reflecting panel is over 1km from the dwelling[30], the impact significance is low, and mitigation is not recommended.

Where reflections are predicted to be experienced for more than 3 months per year **and/or** for more than 60 minutes on any given day, expert assessment of the following relevant factors is required to determine the impact significance and mitigation requirement:

1) The separation distance to the reflecting panel area[31]. Larger separation distances reduce the proportion of an observer's field-of-view that is affected by glare;
2) 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;
3) Whether solar reflections will be experienced from all storeys. The ground floor is typically considered the main living space and therefore has a greater significance with respect to residential amenity;
4) Whether the dwelling appears to have windows facing the reflecting areas. An observer may need to look at an acute angle to observe the reflecting areas.

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[30] The assessment area is constructed out to 1km from the Solar Development Sites, but the reflecting panels may not be the closest panels to the receptor and may therefore be beyond 1km from the receptor

[31] Which is often greater than the nearest panel boundary, because not all areas of the site cause specular reflections towards particular receptor locations.

Following consideration of these relevant factors, where the solar reflection is not deemed significant, a low impact is predicted, and mitigation is not recommended. Where the solar reflection is deemed significant, the impact significance is moderate, and mitigation is recommended.

If there are no mitigating factors and the effects last for more than 3 months per year **and** for more than 60 minutes on any given day, the impact significance is high, and mitigation is required.

6.4.2 Results Discussion – Fixed South Facing Panels

Tables 25 and 26, below and on the following pages, summarise the predicted impact towards dwelling receptors for fixed south facing panels.

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N1 – N12, N50 – N52 N63 – N68 N70 – N71	No solar reflections geometrically possible	N/A	N/A	No impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N13 – N40, N42	Solar reflections geometrically possible for **less** than 3 months per year and **less** than 60 minutes on any given day	Existing vegetation and intervening terrain are predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A
N41	Solar reflections geometrically possible for **less** than 3 months per year and **less** than 60 minutes on any given day	Existing vegetation is predicted to partially obstruct views of reflecting panels	N/A	Low impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N43, N45 – N47, N54 – N62 N69	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	Existing vegetation and/or buildings are predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A
N44	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	Existing vegetation is predicted to partially obstruct views of reflecting panels	The dwelling is over 920m from the nearest reflecting panel area	Low impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N48	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	No significant existing screening identified	N/A	Moderate impact	Yes Screening has been proposed in the form of advanced planting at Solar Development Site 1 which would be predicted to significantly screen reflecting areas	Low impact
N49	Solar reflections geometrically possible for **less** than 3 months per year and **less** than 60 minutes on any given day	No significant relevant screening identified	N/A	Low impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N53	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	Existing vegetation is predicted to partially obstruct views of reflecting panels	The dwelling is over 390m from the nearest reflecting panel area	Low impact	No	N/A

Table 25 *Impact classification – dwelling receptors – north area*

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation

W1 – W21, W54 – W59, W151 – W153 W155 – W157 W162 – W165 W173 – W198 W252 W257 – W259 W264 – W265 W287 – W310 W324	Solar reflections geometrically possible for **less** than 3 months per year and **less** than 60 minutes on any given day	Existing vegetation and intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A
W22 – W53, W60 – W63, W66 – W142,	Solar reflections geometrically possible for **more** than 3	Existing vegetation and/or intervening	N/A	No impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W144 – W147 W149 – W150 W154 W199 – W200 W202 – W251 W266 – W286 W311 – W323 W325 W331 – W334	months per year but **less** than 60 minutes on any given day	terrain is predicted to significantly obstruct views of reflecting panels				

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W64 – W65, W143	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	Existing vegetation and/or buildings are predicted to partially obstruct views of reflecting panels	The duration of solar reflections is predicted to be reduced to less than 3 months per year	Low impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W148, W201, W331 – W333	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	Existing vegetation is predicted to partially obstruct views of reflecting panels	N/A	Moderate impact	Yes Screening has been proposed in the form of advanced planting at Solar Development Sites 2, 4 and 6 which would be predicted to significantly screen reflecting areas	Low impact

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W158 – W161 W166 – W172 W253 – W256 W260 – W263 W326 – W330	No solar reflections geometrically possible	N/A	N/A	No impact	No	N/A

Table 26 *Impact classification – dwelling receptors – west area*

6.4.3 Results Discussion – Single Axis Tracking Panels

Tables 30 to 32, below and on the following pages, summarise the predicted impact towards dwelling receptors for single axis tracking panels.

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N1 – N2, N26 – N36, N38 – N40, N43, N46, N49, N50 – N55	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	Existing vegetation and/or buildings are predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N3 – N6, N9, N23 – N25, N38 – N40, N44 – N45 N47 – N48 N56	Solar reflections geometrically possible for **less** than 3 months per year and **less** than 60 minutes on any given day	Existing vegetation is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A
N7 – N8, N10 – N22	No solar reflections geometrically possible	N/A	N/A	No impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N34	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	Existing vegetation is predicted to partially obstruct views of reflecting panels	Partial vegetation screening is predicted to predominately limit views of reflecting panels to above the ground floor	Low impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N37	Solar reflections geometrically possible for **less** than 3 months per year and **less** than 60 minutes on any given day	Existing vegetation is predicted to partially obstruct views of reflecting panels	N/A	Low impact	No	N/A
N41 – N42	Solar reflections geometrically possible for **less** than 3 months per year and **less** than 60 minutes on any given day	No significant relevant screening identified	N/A	Low impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
N53, N55	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	No significant relevant screening identified	N/A	Moderate impact (temporary)	Yes Screening has been proposed at Solar Development Site 1 which would be predicted to significantly screen reflecting areas once mature	Low impact

Table 27 *Impact classification – dwelling receptors – north area*

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W1 – W21, W54 – W59, W151 – W153 W155 – W157 W162 – W165 W173 – W198 W252 W257 – W259 W264 – W265 W287 – W310 W324	Solar reflections geometrically possible for **less** than 3 months per year and **less** than 60 minutes on any given day	Existing vegetation and intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W22 – W53, W60 – W63, W66 – W142, W144 – W147 W149 – W150 W154 W199 – W200 W202 – W251 W266 – W286 W311 – W323 W325 W331 – W334	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	Existing vegetation and/or intervening terrain is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W64 – W65, W143	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	Existing vegetation is predicted to partially obstruct views of reflecting panels	N/A	Moderate impact	Yes Screening has been proposed at Solar Development Sites 4 and 6 which would be predicted to significantly screen reflecting areas once matured	Low impact

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W148, W201, W331 – W333	Solar reflections geometrically possible for **more** than 3 months per year but **less** than 60 minutes on any given day	Existing vegetation is predicted to partially obstruct views of reflecting panels	N/A	Moderate impact	Yes Screening has been proposed in the form of advanced planting at Solar Development Sites 4 and 6 which would be predicted to significantly screen reflecting areas	Low impact

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Relevant Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W158 – W161 W166 – W172 W253 – W256 W260 – W263 W326 – W330	No solar reflections geometrically possible	N/A	N/A	No impact	No	N/A

Table 28 Impact classification – dwelling receptors – single axis tracking

6.5 Railway Results

6.5.1 Impact Significance Determination

The process for quantifying the impact significance concerning railway infrastructure and operations is outlined in Annex Annex D – Glint and Glare Impact Significance. The key considerations for quantifying impact significance for train driver receptors are:

1) Whether a reflection is predicted to be experienced in practice;
2) The location of the reflecting panel relative to a train driver's direction of travel;
3) The workload of a train driver experiencing a solar reflection.

Where reflections are geometrically possible but expected to be screened, no impact is predicted, and mitigation is not required.

Where reflections originate from outside of a train driver's primary horizontal field-of-view (30 degrees either side of the direction of travel), or the closest reflecting panel is over 500m from the railway user, the impact significance is low, and mitigation is not recommended.

Where reflections are predicted to be experienced from inside of a train driver's primary field-of-view, expert assessment of the following relevant factors is required to determine the impact significance and mitigation requirement:

1) Whether the solar reflection originates from directly in front of a train driver. Solar reflections that are directly in front of a train driver are more hazardous;
2) The separation distance to the reflecting panel area. Larger separation distances reduce the proportion of an observer's field-of-view that is affected by glare;
3) 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;
4) The complexity of the railway line. Whether a signal, station, level crossing, or switching point is located within the reflection zone.

Following consideration of these relevant factors, where the solar reflection is not deemed significant, a low impact is predicted, and mitigation is not recommended. Where the solar reflection is deemed significant, the impact significance is moderate, and mitigation is recommended. Where reflections originate from directly in front of a train driver and there are no further mitigating factors, the impact significance is high, and mitigation is required.

6.5.2 Results Discussion – Fixed South Facing Panels

Table 29 below summarises the predicted impact at these receptors.

Railway Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Mitigating Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W1 – W23, W56 – W104	Solar reflections geometrically possible from **inside** a train driver's primary field-of-view[32]	Existing vegetation is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

[32] 30 degrees either side of the direction of travel

Railway Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Mitigating Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W24 – W25	Solar reflections geometrically possible from **inside** a train driver's primary field-of-view	No significant existing screening identified	N/A	Moderate impact	Yes Screening has been proposed in the form of advanced planting which would be predicted to significantly screen reflecting areas	Low impact
W26, W28 – W29, W38 – W42, W48 – W49	Solar reflections geometrically possible from **outside** a train driver's primary field-of-view	No significant screening identified	N/A	Low impact	No	N/A

Railway Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Mitigating Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W27, W30 – W37, W43 – W47, W50 – W55	Solar reflections geometrically possible from **outside** a train driver's primary field-of-view	Existing vegetation is predicted to partially obstruct views of reflecting panels	N/A	Low impact	No	N/A

Table 29 *Impact classification – railway receptors – west area*

6.5.3 Results Discussion – Single Axis Tracking Panels

Table 30 below summarises the predicted impact at these receptors.

Railway Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Mitigating Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W1 – W23, W27, W30 – W31, W56 – W104	Solar reflections geometrically possible from **inside** a train driver's primary field-of-view[33]	Existing vegetation is predicted to significantly obstruct views of reflecting panels	N/A	No impact	No	N/A

[33] 30 degrees either side of the direction of travel

Railway Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Mitigating Factors	Impact Classification	Mitigation Recommended?	Impact Following Mitigation
W24 – W26, W28 – W29	Solar reflections geometrically possible from **inside** a train driver's primary field-of-view	Existing vegetation is predicted to partially obstruct views of reflecting panels	N/A	Moderate impact	Yes Screening has been proposed in the form of advanced planting which would be predicted to significantly screen reflecting areas	Low impact
W32 – W55	Solar reflections geometrically possible from **outside** a train driver's primary field-of-view	Existing vegetation is predicted to partially obstruct views of reflecting panels	N/A	Low impact	No	N/A

Table 30 *Impact classification – railway receptors – west area*

6.6 Waterway Results

6.6.1 Impact Significance Determination

Pager Power does not typically assess waterway receptors for glint and glare; they have been assessed and presented in this section due to specific request in the EIA Scoping Opinion. The key consideration for quantifying impact significance for these receptors is:

1) Whether a reflection is predicted to be experienced in practice for boaters navigating the navigable River Aire.

Where reflections are geometrically possible but expected to be screened, no impact is predicted, and mitigation is not required.

Where reflections are geometrically possible and no screening is identified, a low impact is predicted and mitigation is not recommended. Glare towards waterway receptors is not considered to be a significant safety concern, as it would be for road and railway receptors, due to the comparatively lower speed of waterway users and comparatively low traffic volumes.

Results are presented in the following subsection for reference.

6.6.2 Results Discussion – Fixed South Facing Panels

Table 31 below summarises the predicted impact towards waterway receptors for fixed south facing panels.

Waterway Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Mitigating Factors	Impact Classification	Mitigation Recommended?
W1 – W19, W25 – W30	No solar reflections geometrically possible	N/A	N/A	No impact	No
W20 – W24	Solar reflections are geometrically possible	Existing vegetation and/or intervening terrain is expected to obstruct views of reflecting panels	N/A	Low impact	No

Table 31 Impact classification – waterway receptors – west area

6.6.3 Results Discussion – Single Axis Tracking Panels

Table 32 below summarises the predicted impact towards waterway receptors for single axis tracking panels.

Waterway Receptor	Geometric Modelling Results (screening not considered)	Identified Screening (desk-based review)	Mitigating Factors	Impact Classification	Mitigation Recommended?
W1 – W20, W25 – W30	No solar reflections geometrically possible	N/A	N/A	No impact	No
W21 – W24	Solar reflections are geometrically possible	Existing vegetation and/or intervening terrain is expected to obstruct views of reflecting panels	N/A	Low impact	No

Table 32 Impact classification – waterway receptors – west area

6.7 Mitigation Strategy

6.7.1 Aviation Mitigation

Based on current illustrative site layouts, the development of mitigation measures is recommended by this study on the basis of the modelling work undertaken, in relation to solar reflections towards aviation receptors associated with Sherburn-In-Elmet Airfield and Burn Airfield.

6.7.2 Road and Rail Receptor Mitigation

Additional mitigation is proposed in the form of advanced planting at the commencement of the construction phase. The vegetation would be planted early to allow sufficient time for growth ahead of operation of the Proposed Development, in order to mitigate the impact of glint and glare on road and rail users from the solar panels. Where existing vegetation is available, the Contractor(s) will liaise with landowners to grow up their existing hedgerows.

The locations where advance planting may be implemented is shown in Figure 16.1 Advanced Planting for Glint and Glare Mitigation [**EN0110012/APP/LVS/06.02.16.01].** The need for, and details of, the proposed advanced planting will be subject to re-assessment at detailed design and this is secured through the oCEMP **[EN0110012/APP/LVS/07.02]** and oLEMP **[EN0110012/APP/LVS/07.05].**

6.7.3 Dwellings Receptor Mitigation

For receptors where significant impacts are predicted from both fixed and single-axis tracking panels, additional mitigation is proposed in the form of advanced planting at the commencement of the construction phase. The vegetation would be planted early to allow sufficient time for growth ahead of operation of the Proposed Development, in order to mitigate the impact of glint and glare on dwellings from the solar panels. Where existing vegetation is available, the Contractor(s) will liaise with landowners to grow up their existing hedgerows.

The locations where advance planting may be implemented is shown in Figure 16.1 Advanced Planting for Glint and Glare Mitigation [**EN0110012/APP/LVS/06.02.16.01].** The need for, and details of, the proposed advanced planting will be subject to re-assessment at detailed design and this is secured through the oCEMP **[EN0110012/APP/LVS/07.02]** and oLEMP **[EN0110012/APP/LVS/07.05].**

For dwellings where impacts are only predicted from one panel configuration in Year 1 of operation, there is currently no commitment to advance planting. However, if that panel configuration is taken forward at detailed design, investigations will be undertaken to confirm if the detailed design would lead to the currently assessed impacts and, if an impact is still predicted, the Proposed Development will be designed and/or operated (depending on the chosen technology) to ensure that glint and glare impacts are mitigated until planting has matured to screen glint and glare effects.

7 HIGH-LEVEL AVIATION CONSIDERATIONS

7.1 Overview

The following section presents an overview of the possible effects of glint and glare concerning aviation activity at a high-level. These airfields are all located within 10km of the Proposed Development but have been considered at a high-level due to their distance from and relative position to the Proposed Development.

The locations of the airfields and their 1-mile splayed approach paths relative to the proposed solar panel areas are shown in Plate 20, and summarised below:

1) Acaster Malbis Airfield: approximately 5.7km west of the nearest panel area;
2) Garforth Airfield: approximately 7.6km west of the nearest panel area
3) Cliffe Airfield: approximately 8.0km south and north-east of the nearest panel areas;
4) Breighton Airfield: approximately 8.1km south-east of the nearest panel area;
5) Melrose Farm Airfield: approximately 9.4km east of the nearest panel area.

7.2 Aerodrome Details

7.2.1 Acaster Malbis Airfield Information

Acaster Malbis Airfield is an unlicensed general aviation (GA) aerodrome. A control tower / watch office is present but is understood not to be used operationally[34]. It has three operational runways, the details[35] of which are presented below:

1) 04/22 measuring 360m by 18m (grass);
2) 15L/33R measuring 320m by 25m (grass);
3) 15R/33L measuring 410m by 20m (grass).

[34] The former ATC tower appears to have been renovated as an office building
[35] As determined by available imagery

7.2.2 Garforth Airfield Information

Garforth Airfield is an unlicensed GA aerodrome and is understood not to have an ATC Tower. It has two operational runways, the details[31] of which are presented below:

1) 09/27 measuring 750m by 40m (grass);
2) 17/35 measuring 440m by 30m (grass).

7.2.3 Cliffe Airfield Information

Cliffe Airfield is an unlicensed GA aerodrome and is understood not to have an ATC Tower. It has one operational runway, the details[31] of which are presented below:

1) 10/28 measuring 600m by 15m (grass).

7.2.4 Breighton Airfield Information

Breighton Airfield is an unlicensed GA aerodrome and is understood not to have an ATC Tower. It has one operational runway, the details[36] of which are presented below:

1) 10/28 measuring 802m by 45m (grass).

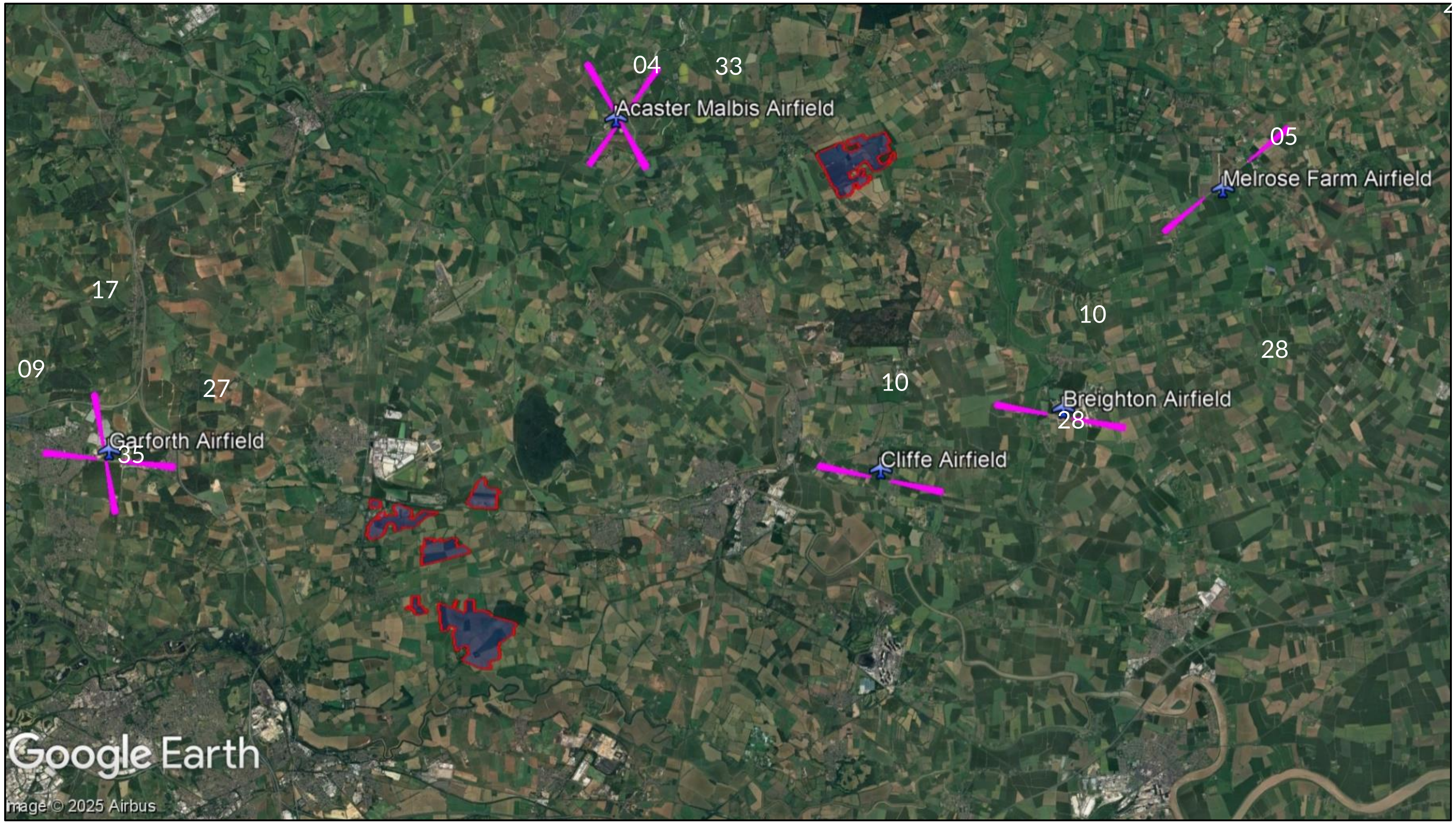
7.2.5 Melrose Farm Airfield Information

Melrose Farm Airfield is an unlicensed GA aerodrome and is understood not to have an ATC Tower. It has one operational runway, the details[31] of which are presented below:

1) 05/23 measuring 1,700m by 35m (concrete).

[36] Pooleys Flight Guide, 63rd Edition

Plate 20 *Locations of Acaster Malbis Airfield, Garforth Airfield, Cliffe Airfield, Breighton Airfield and Melrose Farm Airfield relative to the proposed solar panel areas*



7.3 High-Level Assessment Conclusions

Considerations of the Proposed Development size, distance between the aerodrome and Proposed Development, and previous project experience are made during the assessment.

Reference to a pilot's primary field-of-view is made when determining the predicted impact significance, which is defined as 50 degrees either side of the 1-mile approach path, relative to the runway threshold.

7.3.1 Acaster Malbis Airfield

For aviation activity associated with Acaster Malbis Airfield, the following can be concluded:

1) Any solar reflections towards pilots approaching runway threshold 33 will be outside a pilot's primary field-of-view. This level of glare is acceptable in accordance with the associated guidance and industry best practice;
2) It is also predicted that any solar reflections towards pilots approaching runway thresholds 04, 15 and 22 and pilots on visual circuits for runways 04/22 and 15/33 would have intensities no greater than 'low potential for temporary after-image'. Based upon site size, distance, and previous project experience, this level of glare is acceptable in accordance with the associated guidance and industry best practice.

As a result, no significant impacts are predicted upon aviation activity at Acaster Malbis Airfield and detailed modelling is not recommended.

7.3.2 Garforth Airfield

For aviation activity associated with Garforth Airfield, the following can be concluded:

1) Any solar reflections towards pilots approaching runway thresholds 27 and 35 will be outside a pilot's primary field-of-view. This level of glare is acceptable in accordance with the associated guidance and industry best practice;
2) It is also predicted that any solar reflections towards pilots approaching runway thresholds 09 and 17 and pilots on visual circuits for runways 09/27 and 17/35 would have intensities no greater than 'low potential for temporary after-image'. Based upon site size, distance, and previous project experience, this level of

glare is acceptable in accordance with the associated guidance and industry best practice.

As a result, no significant impacts are predicted upon aviation activity at Garforth Airfield and detailed modelling is not recommended.

7.3.3 Cliffe Airfield

For aviation activity associated with Cliffe Airfield, the following can be concluded:

1) Any solar reflections towards pilots approaching runway threshold 10 will be outside a pilot's primary field-of-view. This level of glare is acceptable in accordance with the associated guidance and industry best practice;
2) It is also predicted that any solar reflections towards pilots approaching runway threshold 28 and pilots on visual circuits for runway 10/28 would have intensities no greater than 'low potential for temporary after-image'. Based upon site size, distance, and previous project experience, this level of glare is acceptable in accordance with the associated guidance and industry best practice.

As a result, no significant impacts are predicted upon aviation activity at Cliffe Airfield and detailed modelling is not recommended.

7.3.4 Breighton Airfield

For aviation activity associated with Breighton Airfield, the following can be concluded:

1) Any solar reflections towards pilots approaching runway threshold 10 will be outside a pilot's primary field-of-view. This level of glare is acceptable in accordance with the associated guidance and industry best practice;
2) It is also predicted that any solar reflections towards pilots approaching runway threshold 28 and pilots on visual circuits for runway 10/28 would have intensities no greater than 'low potential for temporary after-image'. Based upon site size, distance, and previous project experience, this level of glare is acceptable in accordance with the associated guidance and industry best practice.

As a result, no significant impacts are predicted upon aviation activity at Breighton Airfield and detailed modelling is not recommended.

7.3.5 Melrose Farm Airfield

For aviation activity associated with Melrose Farm Airfield, the following can be concluded:

1) Any solar reflections towards pilots approaching runway threshold 05 will be outside a pilot's primary field-of-view. This level of glare is acceptable in accordance with the associated guidance and industry best practice;
2) It is also predicted that any solar reflections towards pilots approaching runway threshold 23 and pilots on visual circuits for runway 05/23 would have intensities no greater than 'low potential for temporary after-image'. Based upon site size, distance, and previous project experience, this level of glare is acceptable in accordance with the associated guidance and industry best practice.

As a result, no significant impacts are predicted upon aviation activity at Melrose Farm Airfield and detailed modelling is not recommended.

8 HIGH-LEVEL ASSESSMENT OF PUBLIC RIGHTS OF WAY

8.1 Overview

Public Rights of Way (PRoW) run through and around the Proposed Development. Reflections towards observers on these PRoW could therefore be experienced under certain conditions (typically coinciding with sunrise/sunset i.e. when the Sun is low in the sky and beyond the panels).

8.2 Assessment

In Pager Power's experience, significant impacts to pedestrians/observers along PRoW are not possible due to glint and glare effects from solar developments. The reasoning is due to the sensitivity of the receptors (in terms of amenity and safety) being concluded to be of low significance because:

1) Effects would typically coincide with direct sunlight. The Sun is a far more significant source of light;
2) The reflection intensity is similar for solar panels and still water (and significantly less than reflections from glass and steel[37]) which is frequently a feature of the outdoor environment surrounding public rights of way. Therefore, the reflections are likely to be comparable to those from common outdoor sources whilst navigating the natural and built environment on a regular basis;
3) The typical density of pedestrians on a PRoW is low in a rural environment (such as the location of the Proposed Development);
4) Any resultant effect is much less serious and has far lesser consequences than, for example, solar reflections experienced towards a road network whereby the resultant impacts of a solar reflection can be much more serious to safety;
5) Glint and glare effects towards receptors on a PRoW are transient, and time and location sensitive whereby a pedestrian could move beyond the solar reflection zone with ease with little impact upon safety or amenity;
6) There is no safety hazard associated with reflections towards an observer on a footpath.

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

Horses may also use bridleways in the vicinity of the Solar Development Sites. Guidance produced by the British Horse Society[38] states with regard to glint and glare that "the incidence of glare or dazzle [from solar panels] is very low compared with glass and will not be uniform throughout a period of sunlight, assuming that the panel is static. Any reflection is unlikely to be a direct problem to horses, riders or carriage-drivers because of the angles and distances involved".

8.3 Conclusions

No significant impacts are predicted upon PRoW. No mitigation is recommended.

[38] British Horse Society, April 2024, Advice on solar farms near routes used by equestrians.

9 OVERALL CONCLUSIONS

9.1 Assessment Conclusions – Aviation

9.1.1 Leeds East Airport

Glare with 'low potential for temporary after-image' (green) is predicted towards the approach paths and visual circuits associated with Leeds East Airport, for both fixed south-facing panels and single axis tracking panels.

A low impact is predicted and no mitigation is required.

9.1.2 Sherburn-In-Elmet Airfield

For 'yellow' glare towards the visual circuits associated with runways 01/19 and 06/24, solar reflections would occur from outside a pilot's primary field-of-view for pilots on approach to the runway thresholds. Any possible glare would occur from behind the pilot whilst they are approaching the thresholds and is therefore unlikely to be experienced by pilots in practice. A low impact is predicted but consultation is being undertaken with Sherburn-In-Elmet Airfield to understand their position towards the Proposed Development and their operations.

For visual circuits associated with runways 10/28 and 10G/28G, 'yellow' glare is predicted which would occur within a pilot's primary field-of-view, while they are on final approach. A moderate impact is predicted, and the development of mitigation measures is recommended (see Section 6.7.1) by this study on the basis of the modelling work undertaken.

9.1.3 Burn Airfield

Glare with 'potential for a temporary after-image' (yellow) is predicted towards the visual circuits associated with Burn Airfield. Glare is predicted from both fixed south facing panels and single axis tracking panels.

For fixed south facing panels, 'yellow' glare will occur towards the visual circuits for runways 01, 25 and 33. For runway 25, 'yellow' glare will only occur from outside of a pilot's primary field-of-view when on approach to the runway, and therefore a low impact is predicted and no mitigation is required. A moderate impact is predicted towards visual circuits associated with runway thresholds 01 and 33, and mitigation is recommended.

For single axis tracking panels, 'yellow' glare is predicted towards visual circuits associated with all runway thresholds. A moderate impact is predicted, and the development of mitigation measures is recommended (see Section 6.7.1) by this study on the basis of the modelling work undertaken.

9.1.4 Redmoor Farm Airfield

Glare with 'potential for a temporary after-image' (yellow) is predicted towards the visual circuits associated with Redmoor Farm Airfield. 'Yellow' glare is predicted to be possible towards the visual circuits for runway 09 from fixed south facing panels, but no reflections are predicted towards the approach paths.

For single axis tracking panels, 'yellow' glare is predicted towards the approach path for runway 27 and visual circuits for runway 09/27. Yellow glare towards the approach path is possible only for a very short duration (115 minutes per year) and will coincide with direct sunlight.

'Yellow' glare is predicted to occur for no more than 60 minutes on any given day at a particular location. Solar reflections with yellow glare are predicted to occur within 2 hours of sunset and therefore will occur 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. The Sun is a far more significant source of light.

Overall, it is judged that the effects can be operationally accommodated subject to notifying the airport of the dates/times in which yellow glare can occur as secured via the oOEMP [**EN0110012/APP/LVS/07.03**]. As noted earlier, it is understood that this airfield was last operational in 2015.

9.1.5 Gilrudding Grange Airfield

Glare with 'potential for a temporary after-image' (yellow) is predicted towards the visual circuits associated with Gilrudding Grange Airfield. 'Yellow' glare is predicted to be possible towards the visual circuits for runway 27 from fixed south facing panels, but no reflections are predicted towards the approach paths.

For single axis tracking panels, 'yellow' glare is predicted towards the approach path for runway 09 and visual circuits for runway 09/27. Yellow glare towards the approach path is possible only for a very short duration (105 minutes per year) and will coincide with direct sunlight.

'Yellow' glare is predicted to occur for no more than 60 minutes on any given day at a particular location. Solar reflections with yellow glare are predicted to occur within 1 hour of sunrise and therefore will occur 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. The Sun is a far more significant source of light.

Overall, it is judged that the effects can be operationally accommodated subject to notifying the airport of the dates/times in which yellow glare can occur as secured via the oOEMP [**EN0110012/APP/LVS/07.03**].

9.1.6 Bridge Cottage Airfield

No significant impacts are predicted towards Bridge Cottage Airfield from either fixed south facing panels or single axis tracking panels. No impact is predicted and no mitigation is required.

9.1.7 Elvington Airfield

Glare with 'potential for a temporary after-image' (yellow) is predicted towards the visual circuits associated with Elvington Airfield from single axis tracking panels only. 'Yellow' glare is predicted to be possible towards the visual circuits for runway 08, for a total duration of 115 minutes per year.

Solar reflections with yellow glare are predicted to occur within 1 hour of sunrise in mid-winter and therefore will occur 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. The Sun is a far more significant source of light.

Overall, it is judged that the effects can be operationally accommodated subject to notifying the airport of the dates/times in which yellow glare can occur as secured via the oOEMP [**EN0110012/APP/LVS/07.03**].

No solar reflections are predicted from fixed south facing panels. No impact is predicted and no mitigation is required.

9.1.8 Birchwood Lodge Airfield

No significant impacts are predicted towards Birchwood Lodge Airfield from either fixed south facing panels or single axis tracking panels. No impact is predicted and no mitigation is required.

9.1.9 Acaster Malbis Airfield

Any solar reflections towards Acaster Malbis Airfield are predicted to be acceptable in accordance with the associated guidance and industry best practice.

Any possible solar reflections towards the approach paths for runways 04, 15 and 22 and the visual circuits for runways 04/22 and 15/33 would have an intensity no greater than 'low potential for temporary after-image'. Solar reflections would be outside a pilot's primary field-of-view (50 degrees either side of the approach bearing) for pilots on approach to runway 33.

No significant impacts are predicted upon aviation activity at Acaster Malbis Airfield and detailed modelling is not recommended.

9.1.10 Garforth Airfield

Any solar reflections towards Garforth Airfield are predicted to be acceptable in accordance with the associated guidance and industry best practice.

Any possible solar reflections towards the approach path for runways 09 and 17 and the visual circuits for runways 09/27 and 17/35 would have an intensity no greater than 'low potential for temporary after-image'. Solar reflections would be outside a pilot's primary field-of-view (50 degrees either side of the approach bearing) for pilots on approach to runways 27 and 35.

No significant impacts are predicted upon aviation activity at Garforth Airfield and detailed modelling is not recommended.

9.1.11 Cliffe Airfield

Any solar reflections towards Cliffe Airfield are predicted to be acceptable in accordance with the associated guidance and industry best practice.

Any possible solar reflections towards the approach paths for runway 28 and the visual circuits for runway 10/28 would have an intensity no greater than 'low potential for temporary after-image'. Solar reflections would be outside a pilot's primary field-of-view (50 degrees either side of the approach bearing) for pilots on approach to runway 10.

No significant impacts are predicted upon aviation activity at Cliffe Airfield and detailed modelling is not recommended.

9.1.12 Breighton Airfield

Any solar reflections towards Breighton Airfield are predicted to be acceptable in accordance with the associated guidance and industry best practice.

Any possible solar reflections towards the approach paths for runway 28 and the visual circuits for runway 10/28 would have an intensity no greater than 'low potential for temporary after-image'. Solar reflections would be outside a pilot's primary field-of-view (50 degrees either side of the approach bearing) for pilots on approach to runway 10.

No significant impacts are predicted upon aviation activity at Breighton Airfield and detailed modelling is not recommended.

9.1.13 Melrose Farm Airfield

Any solar reflections towards Melrose Farm Airfield are predicted to be acceptable in accordance with the associated guidance and industry best practice.

Any possible solar reflections towards the approach paths for runway 23 and the visual circuits for runway 05/23 would have an intensity no greater than 'low potential for temporary after-image'. Solar reflections would be outside a pilot's primary field-of-view (50 degrees either side of the approach bearing) for pilots on approach to runway 05.

No significant impacts are predicted upon aviation activity at Melrose Farm Airfield and detailed modelling is not recommended.

9.2 Assessment Conclusions – Roads

For both panel configurations, prior to additional mitigation a significant (temporary) impact is predicted towards some sections of road, where there is no or insufficient existing vegetation screening. It is recommended that further mitigation is implemented in the form of advance planting at these locations, in order that new vegetation will be at a sufficient height to significantly obstruct views of reflecting panels once operational (see Section 6.7.2). The need for, and details of, the proposed advanced planting will be subject to re-assessment at detailed design and this is secured through the oCEMP **[EN0110012/APP/LVS/07.02]** and oLEMP **[EN0110012/APP/LVS/07.05]**. For other receptors where glare is geometrically possible, screening will be present in the form of existing and/or proposed vegetation or reflections occur in the presence of significant mitigating factors. No further mitigation is required and there will be no significant residual impacts.

9.3 Assessment Conclusions – Dwellings

For both panel configurations, prior to additional mitigation, a significant (temporary)impact is predicted towards a small number of dwellings, where there is no or insufficient existing vegetation screening. For dwellings where impacts are predicted from both fixed and tracking panels, it is recommended that further mitigation is implemented in the form of advance planting at these locations, in order that new vegetation will be at a sufficient height to significantly obstruct views of reflecting panels in Year 1 of operation (see Section 6.7.2). The need for, and details of, the proposed advanced planting will be subject to re-assessment at detailed design and this is secured through the oCEMP **[EN0110012/APP/LVS/07.02]** and oLEMP **[EN0110012/APP/LVS/07.05].** For dwellings where impacts are predicted for only one of the panel configurations, impacts would be considered further at detailed design.

For other receptors where glare is geometrically possible, screening will be present in the form of existing and/or proposed vegetation or reflections occur in the presence of significant mitigating factors. No further mitigation is required and there will be no significant residual impacts.

9.4 Assessment Conclusions – Railway

For both panel configurations, prior to additional mitigation, a significant (temporary) impact is predicted towards some sections of railway, where there is no or insufficient existing vegetation screening. It is recommended that further mitigation is implemented in the form of advance planting at these locations, in order that new vegetation will be at a sufficient height to significantly obstruct views of reflecting panels in Year 1 of operation (see Section 6.7.2). The need for, and details of, the proposed advanced planting will be subject to re-assessment at detailed design and this is secured through the oCEMP **[EN0110012/APP/LVS/07.02]** and oLEMP **[EN0110012/APP/LVS/07.05].** For other receptors where glare is geometrically possible, screening will be present in the form of existing and/or proposed vegetation. No further mitigation is required and there will be no significant residual impacts.

9.5 Assessment Conclusions – Waterways

Solar reflections are geometrically possible towards a section of the River Aire. Views are expected to be screened by existing vegetation and intervening terrain, but the extent to which partial views may be possible has yet to be confirmed. A low impact is predicted in the worst-case, and no mitigation is recommended.

9.6 Assessment Conclusions – Public Rights of Way

No significant impacts are predicted upon public rights of way. No mitigation is required.

ANNEX A – OVERVIEW OF GLINT AND GLARE GUIDANCE

Overview

This section presents details regarding the relevant guidance and studies with respect to the considerations and effects of solar reflections from solar panels, known as 'Glint and Glare'.

This is not a comprehensive review of the data sources, rather it is intended to give an overview of the important parameters and considerations that have informed this assessment and is shown for reference.

UK Planning Policy

Renewable and Low Carbon Energy (2023)

The National Planning Policy Framework (2024) under the planning practice guidance for Renewable and Low Carbon Energy[39] (specifically regarding the consideration of solar farms, paragraph 013) states:

'What are the particular planning considerations that relate to large scale ground-mounted solar photovoltaic Farms?

The deployment of large-scale solar farms can have a negative impact on the rural environment, particularly in undulating landscapes. However, the visual impact of a well-planned and well-screened solar farm can be properly addressed within the landscape if planned sensitively.

Particular factors a local planning authority will need to consider include:

…

1) the proposal's visual impact, the effect on landscape of glint and glare (see guidance on landscape assessment) and on **neighbouring uses and aircraft safety**;
2) the extent to which there may be additional impacts if solar arrays follow the daily movement of the sun;

…

The approach to assessing cumulative landscape and visual impact of large-scale solar farms is likely to be the same as assessing the impact of wind

[39] Renewable and low carbon energy, Ministry of Housing, Communities & Local Government, date: 14 August 2023, accessed on: 28/01/2026

turbines. However, in the case of ground-mounted solar panels it should be noted that with effective screening and appropriate land topography the area of a zone of visual influence could be zero.'

National Policy Statement for Renewable Energy Infrastructure (2025)

The National Policy Statement for Renewable Energy Infrastructure (EN-3)[40] sets out the primary policy for decisions by the Secretary of State for nationally significant renewable energy infrastructure. Sections 2.10.94-98 state:

'2.10.94 Solar panels are specifically designed to absorb, not reflect, irradiation.[41] However, solar panels may reflect the sun's rays at certain angles, causing glint and glare. Glint is defined as a momentary flash of light that may be produced as a direct reflection of the sun in the solar panel. Glare is a continuous source of excessive brightness experienced by a stationary observer located in the path of reflected sunlight from the face of the panel. The effect occurs when the solar panel is stationed between or at an angle of the sun and the receptor.

2.10.95 Applicants should map receptors to qualitatively identify potential glint and glare issues and determine if a glint and glare assessment is necessary as part of the application.

2.10.96 When a quantitative glint and glare assessment is necessary, applicants are expected to consider the geometric possibility of glint and glare affecting nearby receptors and provide an assessment of potential impact and impairment based on the angle and duration of incidence and the intensity of the reflection.

2.10.97 The extent of reflectivity analysis required to assess potential impacts will depend on the specific project site and design. This may need to account for 'tracking' panels if they are proposed as these may cause differential diurnal and/or seasonal impacts.

2.10.98 When a glint and glare assessment is undertaken, the potential for solar PV panels, frames and supports to have a combined reflective quality

[40] National Policy Statement for Renewable Energy Infrastructure (EN-3), Department for Energy Security & Net Zero, date: December 2025, accessed on:28/01/2026.

[41] *'Most commercially available solar panels are designed with anti-reflective glass or are produced with anti-reflective coating and have a reflective capacity that is generally equal to or less hazardous than other objects typically found in the outdoor environment, such as bodies of water or glass buildings.'*

may need to be assessed, although the glint and glare of the frames and supports is likely to be significantly less than the panels.'

The EN-3 does not state which receptors should be considered as part of a quantitative glint and glare assessment. Based on Pager Power's extensive project experience, typical receptors include residential dwellings, road users, aviation infrastructure, and railway infrastructure.

Sections 2.10.126-128 state:

'2.10.126 Applicants should consider using, and in some cases the Secretary of State may require, solar panels to comprise of (or be covered with) anti-glare/anti-reflective coating with a specified angle of maximum reflection attenuation for the lifetime of the permission.

2.10.127 Applicants may consider using screening between potentially affected receptors and the reflecting panels to mitigate the effects.

2.10.128 Applicants may consider adjusting the azimuth alignment of or changing the elevation tilt angle of a solar panel, within the economically viable range, to alter the angle of incidence. In practice this is unlikely to remove the potential impact altogether but in marginal cases may contribute to a mitigation strategy.'

The mitigation strategies listed within the EN-3 are relevant strategies that are frequently utilised to eliminate or reduce glint and glare effects towards surrounding observers. The most common form of mitigation is the implementation of screening along the site boundary.

Sections 2.10.158-159 state:

2.10.158 Solar PV panels are designed to absorb, not reflect, irradiation. However, the Secretary of State should assess the potential impact of glint and glare on nearby homes, motorists, public rights of way, and aviation infrastructure (including aircraft departure and arrival flight paths).

2.10.159 Whilst there is some evidence that glint and glare from solar farms can be experienced by pilots and air traffic controllers in certain conditions, there is no evidence that glint and glare from solar farms results in significant impairment on aircraft safety. Therefore, unless a significant impairment can be demonstrated, the Secretary of State is unlikely to give any more than limited weight to claims of aviation interference because of glint and glare from solar farms.

Assessment Methodology – Ground-Based Receptors

No process for determining and contextualising the effects of glint and glare is provided for assessing the impact of solar reflections upon surrounding roads and dwellings. Therefore, the Pager Power approach is to determine whether a reflection from the proposed Solar Development Sites is geometrically possible and then to compare the results against the relevant guidance/studies to determine whether the reflection is significant.

The Pager Power approach has been informed by the policy presented above, current studies (presented in Annex Annex B – Overview of Glint and Glare Studies) and stakeholder consultation. Further information can be found in Pager Power's Glint and Glare Guidance document[42] which was produced due to the absence of existing guidance and a specific standardised assessment methodology.

[42] Pager Power Glint and Glare Guidance, Fourth Edition (4.0), August 2022.

Assessment Methodology – Railways

Railway operations are not mentioned specifically within the Planning Policy Guidance or the National Policy Statement however it is stated in the Planning Policy Guidance that a developer will need to consider *'the proposal's visual impact, the effect on landscape of glint and glare and on neighbouring uses…'*. Network Rail is a statutory consultee when a development is located in close proximity to its infrastructure.

No process for determining and contextualising the effects of glint and glare are, however, provided. Therefore, the Pager Power approach is to determine whether a reflection from a development is geometrically possible and then to compare the results against the relevant guidance/studies set out below to determine whether the reflection is significant.

Railway Assessment Guidelines

The following section provides an overview of the relevant railway guidance with respect to the siting of signals on railway lines. Network Rail is the stakeholder of the UK's railway infrastructure.

A railway operator's concerns would likely to relate to the following:

1) The development producing solar glare that affects train drivers; and
2) The development producing solar reflections that affect railway signals and create a risk of a phantom aspect signal.

Railway guidelines are presented below. These relate specifically to the sighting distance for railway signals.

Reflections and Glare

The extract below is taken from Section A5 – Reflections and glare (pages 64-65) of the 'Signal Sighting Assessment Requirements'[43] which details the requirement for assessing glare towards railway signals.

Reflections and glare

Rationale

Reflections can alter the appearance of a display so that it appears to be something else.

Guidance

[43] Source: Signal Sighting Assessment Requirements, June 2016. Railway Group Guidance Note. Last accessed 18.10.2016.

A5 is present if direct glare or reflected light is directed into the eyes or into the lineside signalling asset that could make the asset appear to show a different aspect or indication to the one presented.

A5 is relevant to any lineside signalling asset that is capable of presenting a lit signal aspect or indication.

The extent to which excessive illumination could make an asset appear to show a different signal aspect or indication to the one being presented can be influenced by the product being used. Requirements for assessing the phantom display performance of signalling products are set out in GKRT0057 section 4.1.

Problems arising from reflection and glare occur when there is a very large range of luminance, that is, where there are some objects that are far brighter than others. The following types of glare are relevant:

a) *Disability glare, caused by scattering of light in the eye, can make it difficult to read a lit display.*
b) *Discomfort glare, which is often associated with disability glare. While being unpleasant, it does not affect the signal reading time directly but may lead to distraction and fatigue.*

Examples of the adverse effect of disability glare include:

a) *When a colour light signal presenting a lit yellow aspect is viewed at night, but the driver is unable to determine whether the aspect is a single yellow or a double yellow.*
b) *Where a colour light signal is positioned beneath a platform roof painted white and the light reflecting off the roof can make the signal difficult to read.*

Options for militating against A5 include:

a) *Using a product that is specified to achieve high light source: phantom ratio values.*
b) *Alteration to the features causing the glare or reflection.*
c) *Provision of screening.*

Glare is possible and should be assessed when the luminance is much brighter than other light sources. Glare may be unpleasant and therefore cause distraction and fatigue or may make the signal difficult to read and increase the reading time.

Determining the Field of Focus

The extract below is taken from Appendix F - Guidance on Field of Vision (pages 98-101) of the 'Signal Sighting Assessment Requirements'[44] which details the visibility of signals, train drivers' field of vision and the implications with regard to signal positioning.

Asset visibility

The effectiveness of an observer's visual system in detecting the existence of a target asset will depend upon its:

a) Position in the observer's visual field.

b) Contrast with its background.

c) Luminance properties.

d) The observer's adaptation to the illumination level of the environment.

It is also influenced by the processes relating to colour vision, visual accommodation, and visual acuity. Each of these issues is described in the following sections.

Field of vision

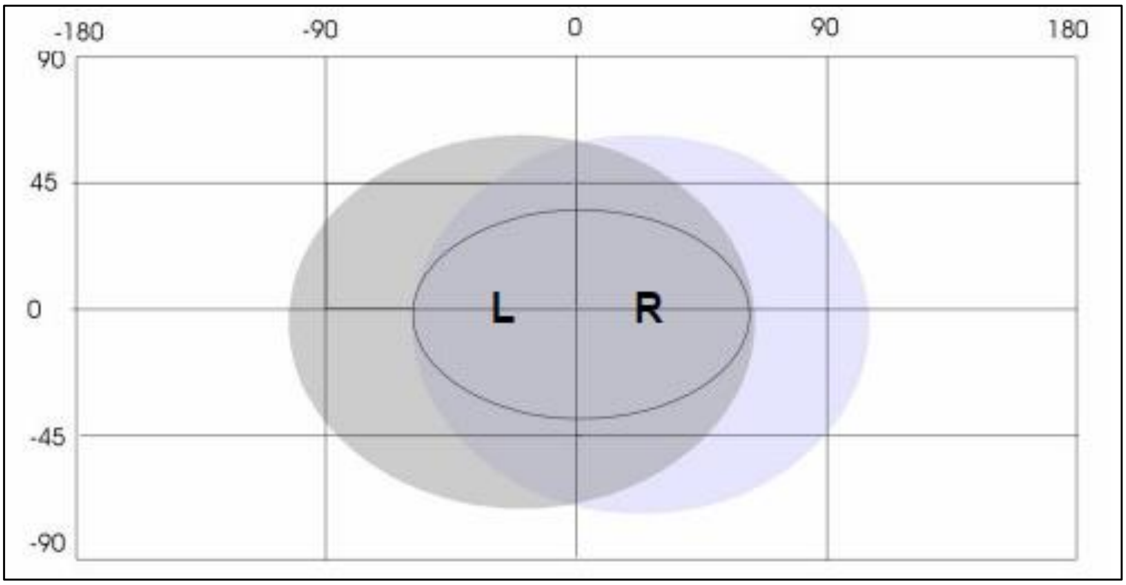
The field of vision, or visual field, is the area of the visual environment that is registered by the eyes when both eyes and head are held still. The normal extent of the visual field is approximately 135o in the vertical plane and 200o in the horizontal plane.

The visual field is usually described in terms of central and peripheral regions: the central field being the area that provides detailed information. This extends from the central point (0^o) to approximately 30^o at each eye. The peripheral field extends from 30o out to the edge of the visual field.

F.6.3 Objects positioned towards the centre of the observer's field of vision are seen more quickly and identified more accurately because this is where our sensitivity to contrast is the highest. Peripheral vision is particularly sensitive to movement and light.

[44] Source: Signal Sighting Assessment Requirements, June 2016. Railway Group Guidance Note. Last accessed 28.08.2020.

Plate G 21 - Field-of-view



In Plate G 21, the two shaded regions represent the view from the left eye (L) and the right eye (R) respectively. The darker shaded region represents the region of binocular overlap. The oval in the centre represents the central field of vision.

Research has shown that drivers search for signs or signals towards the centre of the field of vision.
Signals, indicators and signs should be positioned at a height and distance from the running line that permits them to be viewed towards the centre of the field of vision. This is because:

- *a) As train speed increases, drivers become increasingly dependent on central vision for asset detection. At high speeds, drivers demonstrate a tunnel vision effect and focus only on objects in a field of + 8º from the direction of travel.*
- *b) Sensitivity to movement in the peripheral field, even minor distractions can reduce the visibility of the asset if it is viewed towards the peripheral field of vision. The presence of clutter to the sides of the running line can be highly distracting (for example, fence posts, lamp-posts, traffic, or non-signal lights, such as house, compatibility factors or security lights).*

Plate G 22 and Table G 5 identify the radius of an 8o cone at a range of close-up viewing distances from the driver's eye. This shows that, depending on the lateral position of a stop signal, the optimal (normal) train stopping point could be as far as 25 m back from the signal to ensure that it is sufficiently prominent.

The dimensions quoted in Table G 5 assume that the driver is looking straight ahead. Where driver-only operation (DOO) applies, the drivers' line of sight at the time of starting the train is influenced by the location of DOO monitors and mirrors. In this case it may be appropriate to provide supplementary information alongside the monitors or mirrors using one of the following:

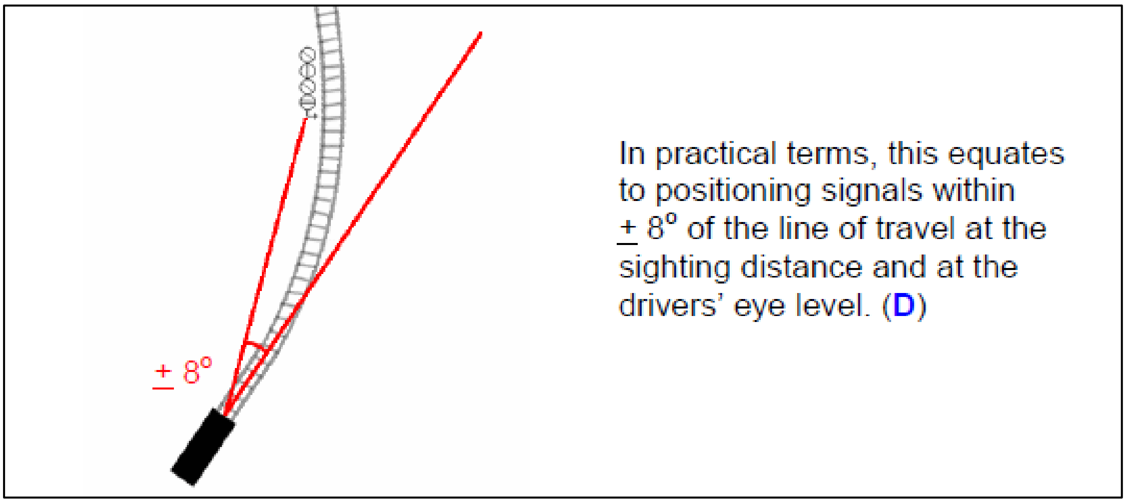
- *a) A co-acting signal.*
- *b) A miniature banner repeater indicator.*
- *c) A right away indicator.*
- *d) A sign to remind the driver to check the signal aspect.*

In order to prevent misreading by trains on adjacent lines, the co-acting signal or miniature banner repeater may be configured so that the aspect or indication is presented only when a train is at the platform to which it applies.

'Car stop' signs should be positioned so that the relevant platform starting signals and / or indicators can be seen in the driver's central field of vision.

If possible, clutter and non-signal lights in a driver's field-of-view should be screened off or removed so that they do not cause distraction.

Plate G 22 - Signal positioning



'A' (m)	'B' (m)	Typical display positions
5	*0.70*	-
6	*0.84*	-
7	*0.98*	-
8	*1.12*	-
9	*1.26*	-
10	*1.41*	-
11	*1.55*	-
12	*1.69*	-
13	*1.83*	-
14	*1.97*	-
15	*2.11*	*A stop aspect positioned 3.3 m above rail level and 2.1 m from the left handrail is within the 8^o cone at 15.44 m in front of the driver*
16	*2.25*	-
17	*2.39*	-
18	*2.53*	*A stop aspect positioned 5.1 m above rail level and 0.9 m from the left handrail is within the 8^o cone at 17.93 m in front of the driver*
19	*2.67*	-
20	*2.81*	-
21	*2.95*	-
22	*3.09*	-

'A' (m)	'B' (m)	Typical display positions
23	*3.23*	-
24	*3.37*	-
25	*3.51*	*A stop aspect positioned 3.3 m above rail level and 2.1 m from the right handrail is within the 8º cone at 25.46 m in front of the driver*

Table G 5 – 8º cone angle co-ordinates for close-up viewing

The distance at which the 8° cone along the track is initiated is dependent on the minimum reading time and distance which is associated to the speed of trains along the track. This is discussed below.

Determining the Assessed Minimum Reading Time

The extracts below are taken from the RIS-0737-CCS-1 of the 'Signal Sighting Assessment Requirements' which details the required minimum reading time for a train driver when approaching a signal.

The following abbreviations are defined within the 'Definitions and Abbreviations':

'Baseline response time

The minimum time value that can be used by the SSC to specify the MRT for a particular signalling asset type.

Supplementary response time

The assessed amount of extra time that the SSC adds to the BRT to determine the MRT value for a specific lineside signalling asset.'

The following extract is taken from page 114 of the RIS-0737-CCS-1:

'Minimum response time (MRT)

The assessed minimum time needed by a driver (or other authorised user) to respond to the information presented by a specific lineside signalling asset, taking account of the following human tasks:

a) Read the display or display combination.

a) Interpret the display or display combination

b) Assimilate all of the available information

c) Decide what action to take (if any), and when it needs to be taken *d) Take the action, where necessary, before the train passes the asset.*

MRT = BRT + SRT'

The distance at which a signal should be clearly viewable is determined by the maximum speed of the trains along the track. If there are multiple signals present at a location, then an additional 0.2 seconds reading time is added to the overall viewing time.

Signal Design and Lighting System

Many railway signals are now LED lights and not filament (incandescent) bulbs. The benefits of an LED signal over a filament bulb signal with respect to possible phantom aspect illuminations are as follows:

1) An LED railway signal produces a more intense light making them more visible to approaching trains when compared to the traditional filament bulb technology[45];
2) Most LED signals do not have a reflective mirror present within the signal itself, unlike a filament bulb. The presence of the reflective surfaces greatly increases the likelihood of incoming light being reflecting out making the signal appear illuminated.

Many LED signal manufacturers[46,47,48] claim that LED signal lights significantly reduce the likelihood of a phantom aspect illumination occurring.

Aviation Assessment Guidance

The UK Civil Aviation Authority (CAA) issued interim guidance relating to Solar Photovoltaic Systems (SPV) on 17 December 2010 and was subject to a CAA information alert 2010/53. The formal policy was cancelled on September 7th, 2012[49] however the advice is still applicable[50] until a formal policy is developed. The relevant aviation guidance from the CAA is presented in the section below.

CAA Interim Guidance

This interim guidance makes the following recommendations (p.2-3):

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45 Source: Wayside LED Signals – Why it's Harder than it Looks, Bill Petit.

46 Source: [redacted] (Last accessed 21.02.18).

47 Source: [redacted]. (Last accessed 21.02.18).

48 Source: Siemens, Sigmaguard LED Tri-Colour L Signal – LED Signal Technology at Incandescent Prices. Datasheet 1A-23. (Last accessed 22.02.18).

49 Archived at Pager Power

50 Reference email from the CAA dated 19/05/2014.

'8. It is recommended that, as part of a planning application, the SPV developer provide safety assurance documentation (including risk assessment) regarding the full potential impact of the SPV installation on aviation interests.

9. Guidance on safeguarding procedures at CAA licensed aerodromes is published within CAP 738 Safeguarding of Aerodromes and advice for unlicensed aerodromes is contained within CAP 793 Safe Operating Practices at Unlicensed Aerodromes.

10. Where proposed developments in the vicinity of aerodromes require an application for planning permission the relevant LPA normally consults aerodrome operators or NATS when aeronautical interests might be affected. This consultation procedure is a statutory obligation in the case of certain major airports and may include military establishments and certain air traffic surveillance technical sites. These arrangements are explained in Department for Transport Circular 1/2003 and for Scotland, Scottish Government Circular 2/2003.

11. In the event of SPV developments proposed under the Electricity Act, the relevant government department should routinely consult with the CAA. There is therefore no requirement for the CAA to be separately consulted for such proposed SPV installations or developments.

12. If an installation of SPV systems is planned on-aerodrome (i.e. within its licensed boundary) then it is recommended that data on the reflectivity of the solar panel material should be included in any assessment before installation approval can be granted. Although approval for installation is the responsibility of the ALH[51], as part of a condition of a CAA Aerodrome Licence, the ALH is required to obtain prior consent from CAA Aerodrome Standards Department before any work is begun or approval to the developer or LPA is granted, in accordance with the procedures set out in CAP 791 Procedures for Changes to Aerodrome Infrastructure.

13. During the installation and associated construction of SPV systems there may also be a need to liaise with nearby aerodromes if cranes are to be used; CAA notification and permission is not required.

[51] Aerodrome Licence Holder.

14. The CAA aims to replace this informal guidance with formal policy in due course and reserves the right to cancel, amend or alter the guidance provided in this document at its discretion upon receipt of new information.

15. Further guidance may be obtained from CAA's Aerodrome Standards Department via aerodromes@caa.co.uk.'

FAA Guidance

The most comprehensive guidelines available for the assessment of solar developments near aerodromes has been produced by the United States Federal Aviation Administration (FAA). The first guidelines were produced initially in November 2010 and updated in 2013. A final policy was released in 2021, which superseded the interim guidance.

The 2010 document is entitled 'Technical Guidance for Evaluating Selected Solar Technologies on Airports'[52], the 2013 update is entitled 'Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports'[53], and the 2021 final policy is entitled 'Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports'[54].

Key excerpts from the final policy are presented below:

Initially, FAA believed that solar energy systems could introduce a novel glint and glare effect to pilots on final approach. FAA has subsequently concluded that in most cases, the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. However, FAA has continued to receive reports of potential glint and glare from on-airport solar energy systems on personnel working in ATCT cabs. Therefore, FAA has determined the scope of agency policy should be focused on the impact of on-airport solar energy systems to federally-obligated towered airports, specifically the airport's ATCT cab.

The policy in this document updates and replaces the previous policy by encouraging airport sponsors to conduct an ocular analysis of potential impacts to ATCT cabs prior to submittal of a Notice of Proposed Construction or

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[52] Archived at Pager Power

[53] Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports, Department of Transportation, Federal Aviation Administration (FAA), date: 10/2013, accessed on: 08/12/2021.

[54] Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports, Federal Aviation Administration, date: May 2021, accessed on: 08/12/2021.

Alteration Form 7460-1 (hereinafter Form 7460-1). Airport sponsors are no longer required to submit the results of an ocular analysis to FAA. Instead, to demonstrate compliance with 14 CFR 77.5(c), FAA will rely on the submittal of Form 7460-1 in which the sponsor confirms that it has analyzed the potential for glint and glare and determined there is no potential for ocular impact to the airport's ATCT cab. This process will enable FAA to evaluate the solar energy system project, with assurance that the system will not impact the ATCT cab.

FAA encourages airport sponsors of federally-obligated towered airports to conduct a sufficient analysis to support their assertion that a proposed solar energy system will not result in ocular impacts. There are several tools available on the open market to airport sponsors that can analyze potential glint and glare to an ATCT cab. For proposed systems that will clearly not impact ATCT cabs (e.g., on-airport solar energy systems that are blocked from the ATCT cab's view by another structure), the use of such tools may not be necessary to support the assertion that a proposed solar energy system will not result in ocular impacts.

The excerpt above states where a solar PV development is to be located on a federally obligated aerodrome with an ATC Tower, it will require a glint and glare assessment to accompany its application. It states that pilots on approach are no longer a specific assessment requirement due to effects from solar energy systems being similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. Ultimately it comes down to the specific aerodrome to ensure it is adequately safeguarded, and it is on this basis that glint and glare assessments are routinely still requested.

The policy also states that several different tools and methodologies can be used to assess the impacts of glint and glare, which was previously required to be undertaken by the Solar Glare Hazard Analysis Tool (SGHAT) using the Sandia National Laboratories methodology.

In 2018, the FAA released the latest version (Version 1.1) of the 'Technical Guidance for Evaluating Selected Solar Technologies on Airports'[55]. Whilst the 2021 final policy also supersedes this guidance, many of the points are still relevant because aerodromes are still safeguarding against glint and glare

[55] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 08/12/2021.

irrespective of the FAA guidance. The key points are presented below for reference:

1) Reflectivity refers to light that is reflected off surfaces. The potential effects of reflectivity are glint (a momentary flash of bright light) and glare (a continuous source of bright light). These two effects are referred to hereinafter as “glare,” which can cause a brief loss of vision, also known as flash blindness[56].
2) The amount of light reflected off a solar panel surface depends on the amount of sunlight hitting the surface, its surface reflectivity, geographic location, time of year, cloud cover, and solar panel orientation.
3) As illustrated on Figure 16[57], flat, smooth surfaces reflect a more concentrated amount of sunlight back to the receiver, which is referred to as specular reflection. The more a surface is polished, the more it shines. Rough or uneven surfaces reflect light in a diffused or scattered manner and, therefore, the light will not be received as bright.
4) Because the FAA has no specific standards for airport solar facilities and potential glare, the type of glare analysis may vary. Depending on site specifics (e.g., existing land uses, location and size of the project) an acceptable evaluation could involve one or more of the following levels of assessment:
    a) A qualitative analysis of potential impact in consultation with the Control Tower, pilots and airport officials;
    b) A demonstration field test with solar panels at the proposed site in coordination with FAA Tower personnel;
    c) A geometric analysis to determine days and times when an impact is predicted.
5) The extent of reflectivity analysis required to assess potential impacts will depend on the specific project site and system design.
6) **Assessing Baseline Reflectivity Conditions** – Reflection in the form of glare is present in current aviation operations. The existing sources of glare come from glass windows, auto surface parking, rooftops, and water bodies. At airports, existing reflecting surfaces may include hangar roofs,

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[56] Flash Blindness, as described in the FAA guidelines, can be described as a temporary visual interference effect that persists after the source of illumination has ceased. This occurs from many reflective materials in the ambient environment.

[57] First figure in Annex B.

surface parking, and glassy office buildings. To minimize unexpected glare, windows of air traffic control towers and airplane cockpits are coated with anti-reflective glazing. Operators also wear polarized eye wear. Potential glare from solar panels should be viewed in this context. Any airport considering a solar PV project should first review existing sources of glare at the airport and the effectiveness of measures used to mitigate that glare.

7) **Tests in the Field** – Potential glare from solar panels can easily be viewed at the airport through a field test. A few airports have coordinated these tests with FAA Air Traffic Controllers to assess the significance of glare impacts. To conduct such a test, a sponsor can take a solar panel out to proposed location of the solar project and tilt the panel in different directions to evaluate the potential for glare onto the air traffic control tower. For the two known cases where a field test was conducted, tower personnel determined the glare was not significant. If there is a significant glare impact, the project can be modified by ensuring panels are not directed in that direction.
8) **Geometric Analysis** – Geometric studies are the most technical approach for reflectivity issues. They are conducted when glare is difficult to assess through other methods. Studies of glare can employ geometry and the known path of the sun to predict when sunlight will reflect off of a fixed surface (like a solar panel) and contact a fixed receptor (e.g., control tower). At any given site, the sun moves across the sky every day and its path in the sky changes throughout year. This in turn alters the destination of the resultant reflections since the angle of reflection for the solar panels will be the same as the angle at which the sun hits the panels. The larger the reflective surface, the greater the likelihood of glare impacts.
9) Facilities placed in remote locations, like the desert, will be far from receptors and therefore potential impacts are limited to passing aircraft. Because the intensity of the light reflected from the solar panel decreases with increasing distance, an appropriate question is how far you need to be from a solar reflected surface to avoid flash blindness. It is known that this distance is directly proportional to the size of the array in question[58] but still requires further research to definitively answer.

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[58] Ho, Clifford, Cheryl Ghanbari, and Richard Diver. 2009. Hazard Analysis of Glint and Glare From Concentrating Solar Power Plants. SolarPACES 2009, Berlin Germany. Sandia National Laboratories.

10) **Experiences of Existing Airport Solar Projects** – Solar installations are presently operating at a number of airports, including megawatt-sized solar facilities covering multiple acres. Air traffic control towers have expressed concern about glint and glare from a small number of solar installations. These were often instances when solar installations were sited between the tower and airfield, or for installations with inadequate or no reflectivity analysis. Adequate reflectivity analysis and alternative siting addressed initial issues at those installations.

Air Navigation Order (ANO) 2016

In some instances, an aviation stakeholder can refer to the ANO 2016[59] with regard to safeguarding. Key points from the document are presented below.

Lights liable to endanger

224. (1) A person must not exhibit in the United Kingdom any light which—

(a) by reason of its glare is liable to endanger aircraft taking off from or landing at an aerodrome; or

(b) by reason of its liability to be mistaken for an aeronautical ground light is liable to endanger aircraft.

(2) If any light which appears to the CAA to be a light described in paragraph (1) is exhibited, the CAA may direct the person who is the occupier of the place where the light is exhibited or who has charge of the light, to take such steps within a reasonable time as are specified in the direction—

(a) to extinguish or screen the light; and

(b) to prevent in the future the exhibition of any other light which may similarly endanger aircraft.

(3) The direction may be served either personally or by post, or by affixing it in some conspicuous place near to the light to which it relates.

(4) In the case of a light which is or may be visible from any waters within the area of a general lighthouse authority, the power of the CAA under this article must not be exercised except with the consent of that authority.

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[59] The Air Navigation Order 2016. [online] Available at: <https://www.legislation.gov.uk/uksi/2016/765/contents/made> [Accessed 4 February 2022].

Lights which dazzle or distract

225. A person must not in the United Kingdom direct or shine any light at any aircraft in flight so as to dazzle or distract the pilot of the aircraft.'

The Order states that no 'light', 'dazzle' or 'glare' should be produced which will create a detrimental impact upon aircraft safety.

Endangering safety of an aircraft

240. A person must not recklessly or negligently act in a manner likely to endanger an aircraft, or any person in an aircraft.

Endangering safety of any person or property

241. A person must not recklessly or negligently cause or permit an aircraft to endanger any person or property

ANNEX B – OVERVIEW OF GLINT AND GLARE STUDIES

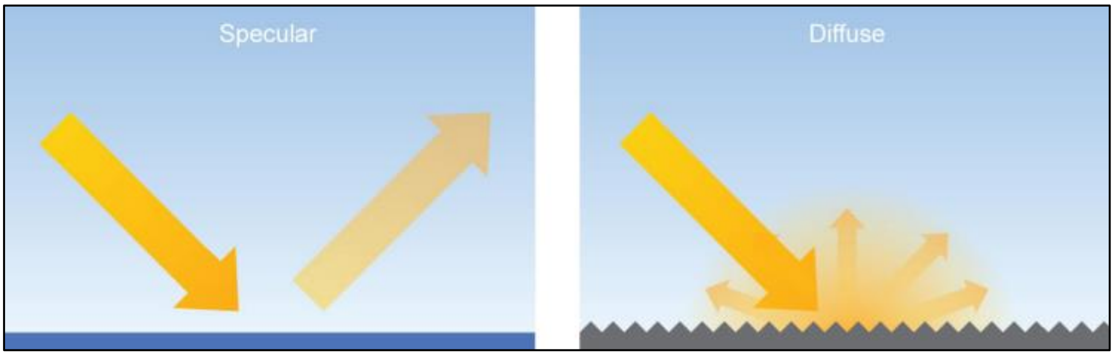
Overview

Studies have been undertaken assessing the type and intensity of solar reflections from various surfaces including solar panels and glass. An overview of these studies is presented below.

The guidelines presented are related to aviation safety. The results are applicable for the purpose of this analysis.

Reflection Type from Solar Panels

Based on the surface conditions reflections from light can be specular and diffuse. A specular reflection has a reflection characteristic similar to that of a mirror; a diffuse will reflect the incoming light and scatter it in many directions. The plate below, taken from the FAA guidance[60], illustrates the difference between the two types of reflections. Because solar panels are flat and have a smooth surface most of the light reflected is specular, which means that incident light from a specific direction is reradiated in a specific direction.



Specular and diffuse reflections

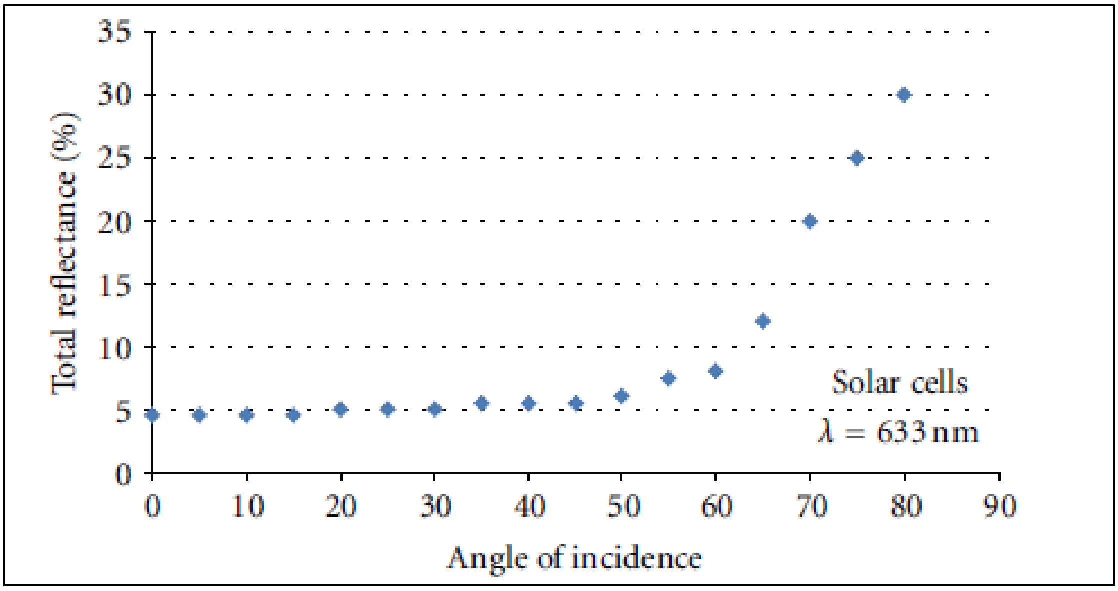
[60] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 20/03/2019.

Solar Reflection Studies

An overview of content from identified solar panel reflectivity studies is presented in the subsections below.

Evan Riley and Scott Olson, "A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems"

Evan Riley and Scott Olson published in 2011 their study titled: A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems[61]". They researched the potential glare that a pilot could experience from a 25-degree fixed tilt PV system located outside of Las Vegas, Nevada. The theoretical glare was estimated using published ocular safety metrics which quantify the potential for a postflash glare after-image. This was then compared to the postflash glare after-image caused by smooth water. The study demonstrated that the reflectance of the solar cell varied with angle of incidence, with maximum values occurring at angles close to 90 degrees. The reflectance values varied from approximately 5% to 30%. This is shown on the plate below.



Total reflectance % when compared to angle of incidence

The conclusions of the research study were:

1) The potential for hazardous glare from flat-plate PV systems is similar to that of smooth water;

[61] Evan Riley and Scott Olson, "A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems," ISRN Renewable Energy, vol. 2011, Article ID 651857, 6 pages, 2011. doi:10.5402/2011/651857

2) Portland white cement concrete (which is a common concrete for runways), snow, and structural glass all have a reflectivity greater than water and flat plate PV modules.

FAA Guidance – "Technical Guidance for Evaluating Selected Solar Technologies on Airports"[62]

The 2010 FAA Guidance included a diagram which illustrates the relative reflectance of solar panels compared to other surfaces. The figure shows the relative reflectance of solar panels compared to other surfaces. Surfaces in this figure produce reflections which are specular and diffuse. A specular reflection (those made by most solar panels) has a reflection characteristic similar to that of a mirror. A diffuse reflection will reflect the incoming light and scatter it in many directions. A table of reflectivity values, sourced from the figure within the FAA guidance, is presented below.

Surface	Approximate Percentage of Light Reflected[63]
Snow	80
White Concrete	77
Bare Aluminium	74
Vegetation	50
Bare Soil	30
Wood Shingle	17
Water	5
Solar Panels	5
Black Asphalt	2

Relative reflectivity of various surfaces

[62] Federal Aviation Administration (FAA), [redacted] 04/2018, accessed on: 20/03/2019.
[63] Extrapolated data, baseline of 1,000 W/m^2 for incoming sunlight.

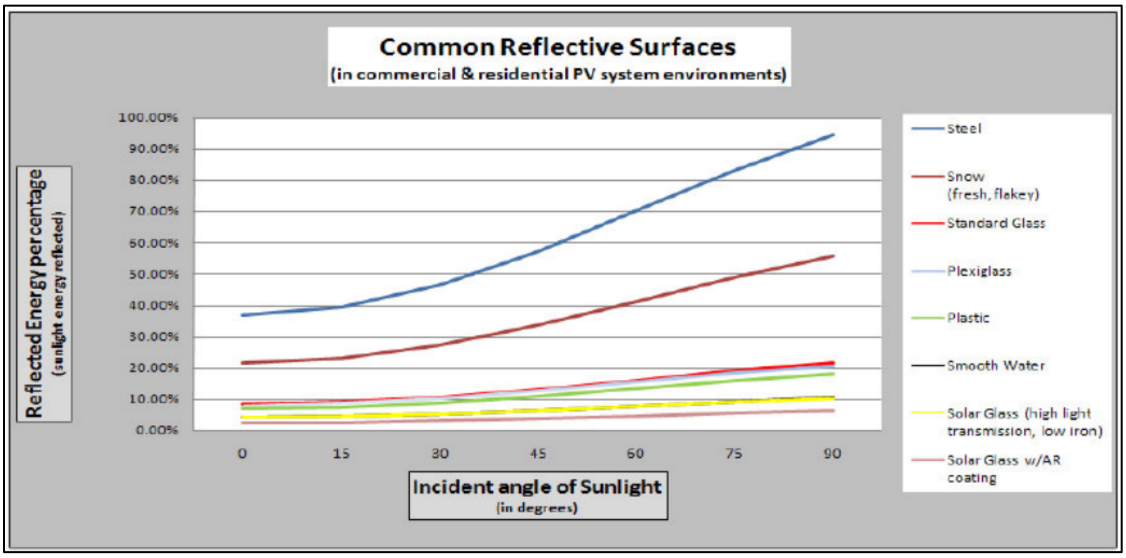
Note that the data above does not appear to consider the reflection type (specular or diffuse).

An important comparison in this table is the reflectivity compared to water which will produce a reflection of very similar intensity when compared to that from a solar panel. The study by Riley and Olsen study (2011) also concludes that still water has a very similar reflectivity to solar panels.

SunPower Technical Notification (2009)

SunPower published a technical notification[64] to 'increase awareness concerning the possible glare and reflectance impact of PV Systems on their surrounding environment'.

The plate presented below shows the relative reflectivity of solar panels compared to other natural and manmade materials including smooth water, standard glass and steel.



Common reflective surfaces

The results, similarly, to those from Riley and Olsen study (2011) and the FAA (2010), show that solar panels produce a reflection that is less intense than those of 'standard glass and other common reflective surfaces'.

With respect to aviation and solar reflections observed from the air, SunPower has developed several large installations near airports or on Air Force bases. It is stated that these developments have all passed FAA or Air Force standards with all developments considered "No Hazard to Air Navigation". The note

[64] Source: Technical Support, 2009. SunPower Technical Notification – Solar Module Glare and Reflectance.

suggests that developers discuss any possible concerns with stakeholders near proposed solar farms.

ANNEX C – OVERVIEW OF SUN MOVEMENTS AND RELATIVE REFLECTIONS

The Sun's position in the sky can be accurately described by its azimuth and elevation. Azimuth is a direction relative to true north (horizontal angle i.e. from left to right) and elevation describes the Sun's angle relative to the horizon (vertical angle i.e. up and down).

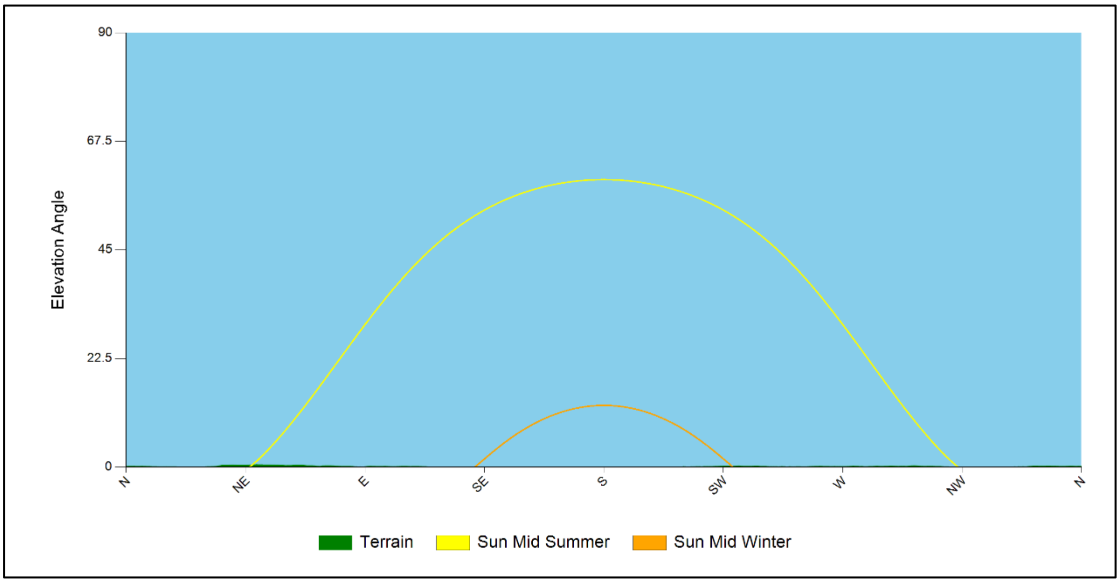
The Sun's position can be accurately calculated for a specific location. The following data being used for the calculation:

1) Time;
2) Date;
3) Latitude;
4) Longitude.

The following is true at the location of the Solar Development Sites:

1) The Sun is at its highest around midday and is to the south at this time;
2) The Sun rises highest on 21 June (longest day);
3) On 21 December, the maximum elevation reached by the Sun is at its lowest (shortest day).

The combination of the Sun's azimuth angle and vertical elevation will affect the direction and angle of the reflection from a reflector. The plate below shows terrain at the horizon from the Proposed Development location as well as the sunrise and sunset curves throughout the year.



Sunrise and sunset curves

ANNEX D – GLINT AND GLARE IMPACT SIGNIFICANCE

Overview

The significance of glint and glare will vary for different receptors. The following section presents a general overview of the significance criteria with respect to experiencing a solar reflection.

Impact Significance Definition

The table below presents the recommended definition of ‘impact significance’ in glint and glare terms and the requirement for mitigation under each.

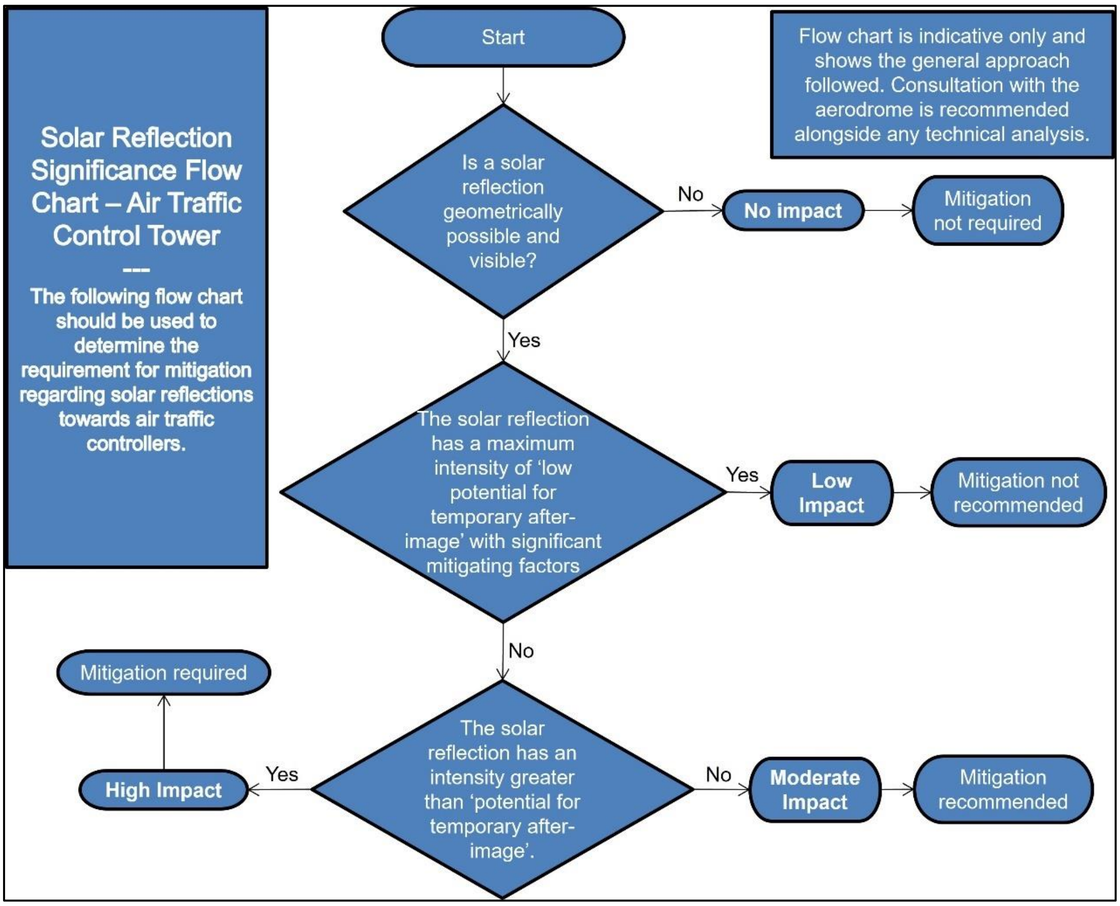
Impact Significance	Definition	Mitigation
No Impact	A solar reflection is not geometrically possible or will not be visible from the assessed receptor.	No mitigation required.
Low	A solar reflection is geometrically possible however any impact is considered to be small such that mitigation is not required e.g. intervening screening will limit the view of the reflecting solar panels significantly.	No mitigation recommended.
Moderate	A solar reflection is geometrically possible and visible however it occurs under conditions that do not represent a worst-case given individual receptor criteria.	Mitigation recommended.
High	A solar reflection is geometrically possible and visible under worst-case	Mitigation will be required if the Proposed

	conditions that will produce a significant impact given individual receptor criteria	Development is to proceed.

Impact significance definition

Impact Significance Determination for ATC Towers

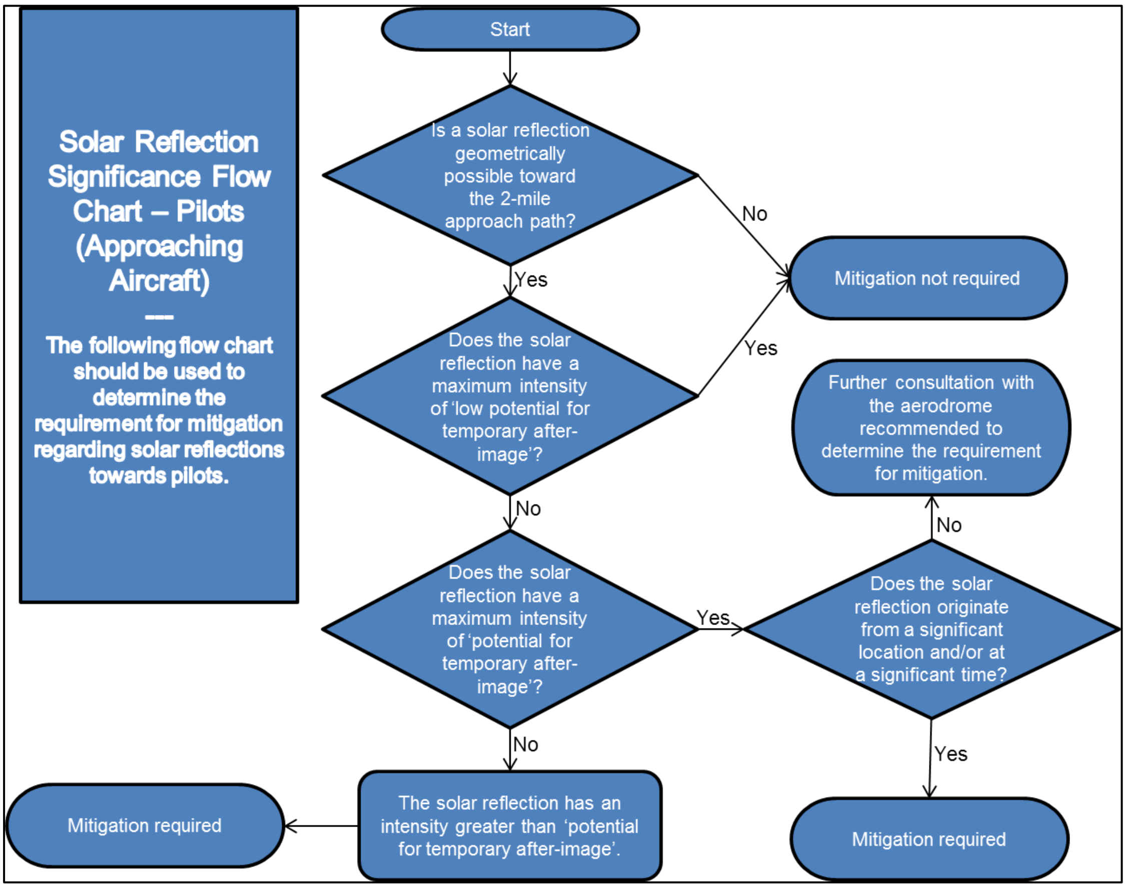
The flow chart presented below has been followed when determining the impact significance and mitigation requirement for ATC Towers.



ATC Tower receptor mitigation requirement flow chart

Impact Significance Determination for Approaching Aircraft

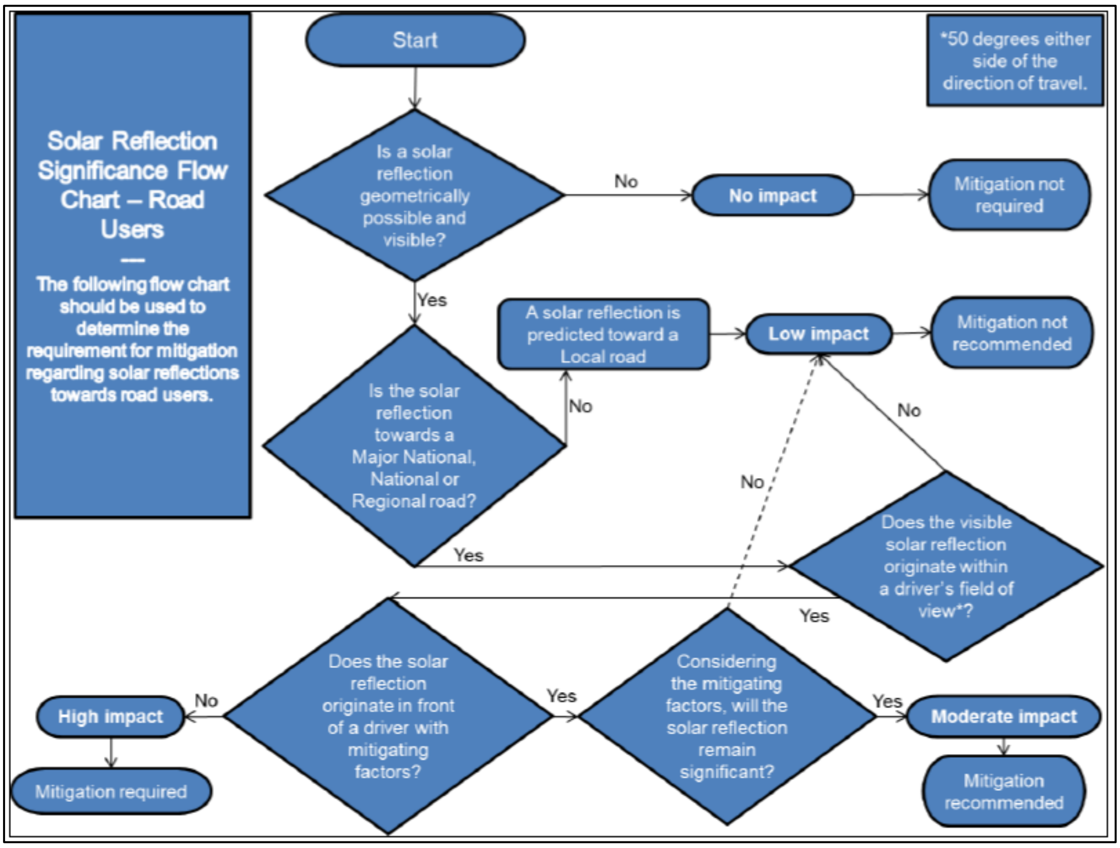
The flow chart presented below has been followed when determining the impact significance and mitigation requirement for approaching aircraft.



Approaching aircraft receptor mitigation requirement flow chart

Impact Significance Determination for Road Receptors

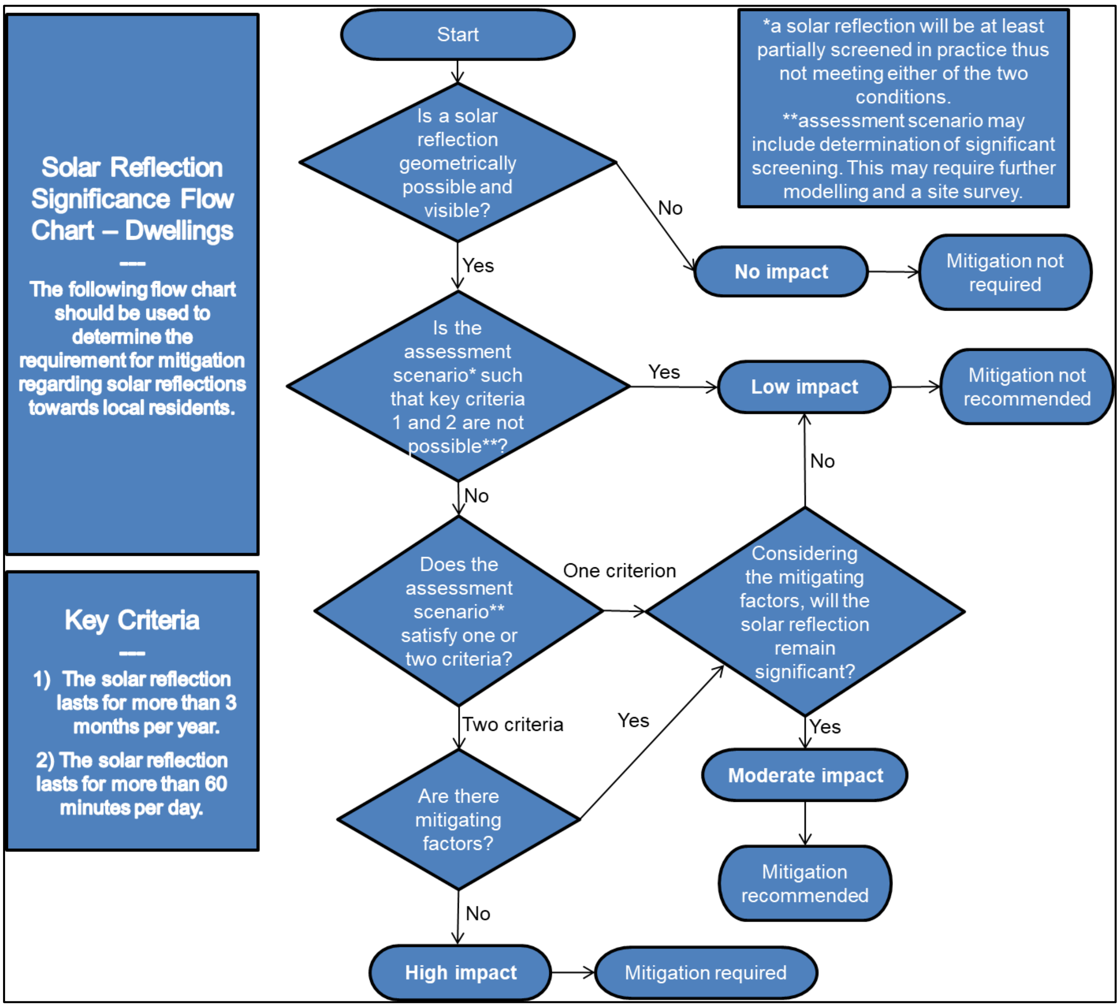
The flow chart presented below has been followed when determining the impact significance and mitigation requirement for road receptors.



Road receptor impact significance flow chart

Impact Significance Determination for Dwelling Receptors

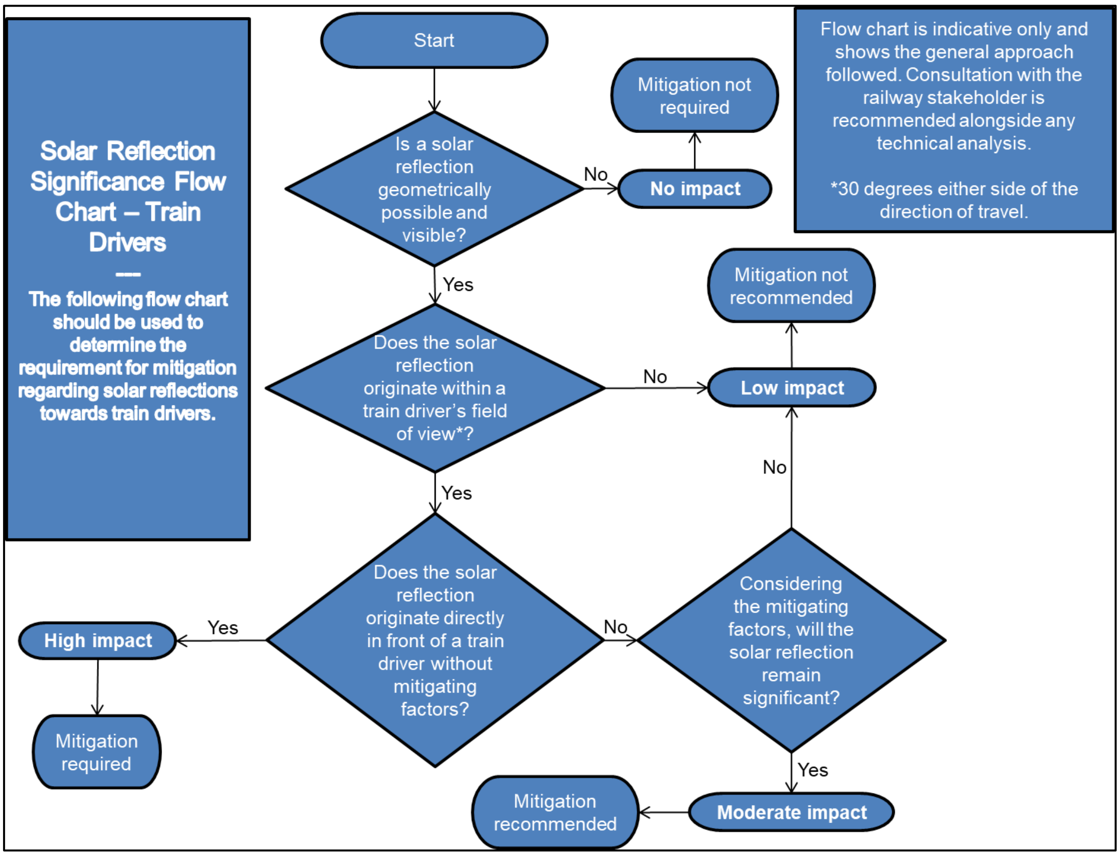
The flow chart presented below has been followed when determining the impact significance and mitigation requirement for dwelling receptors.



Dwelling receptor impact significance flow chart

Impact Significance Determination for Railway Receptors

The flow chart presented below has been followed when determining the impact significance and mitigation requirement for railway receptors.



Train driver impact significance flow chart

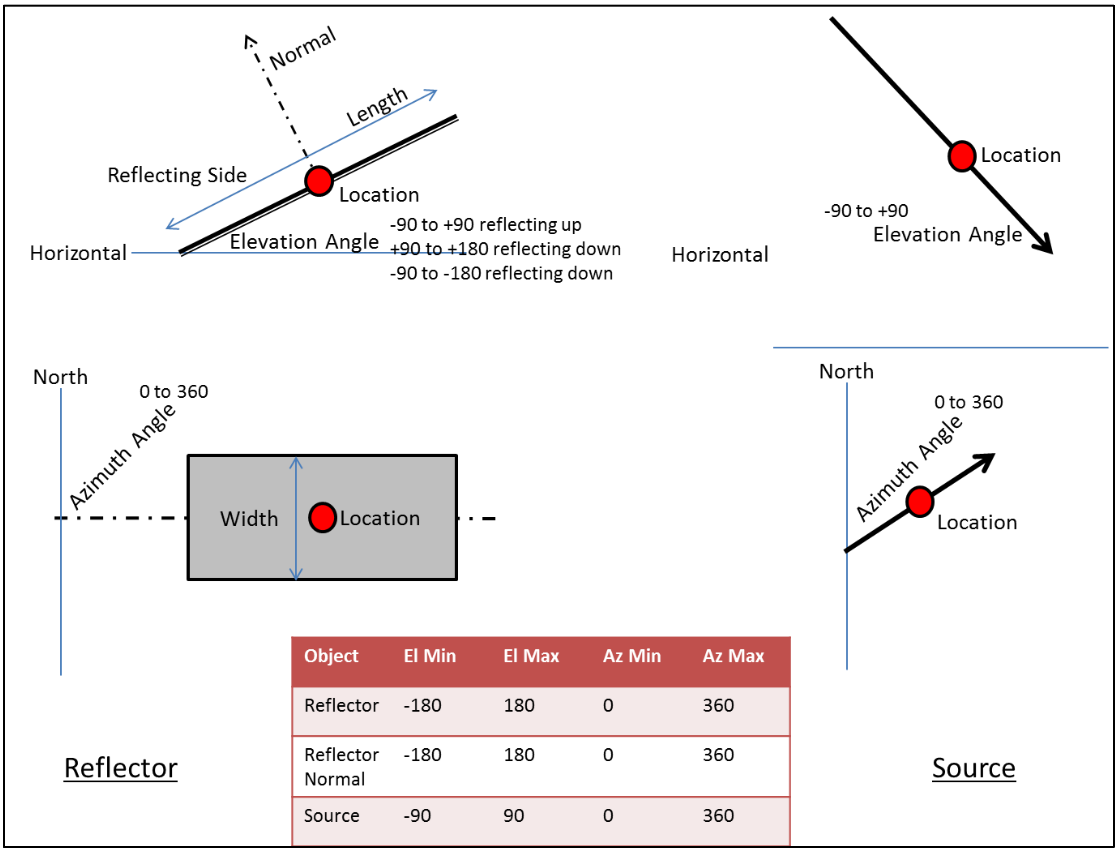
ANNEX E – REFLECTION CALCULATIONS METHODOLOGY

Pager Power Methodology

The calculations are three dimensional and complex, accounting for:

1) The Earth's orbit around the Sun;
2) The Earth's rotation;
3) The Earth's orientation;
4) The reflector's location;
5) The reflector's 3D Orientation.

Reflections from a flat reflector are calculated by considering the normal which is an imaginary line that is perpendicular to the reflective surface and originates from it. The diagram below may be used to aid understanding of the reflection calculation process.



Object	El Min	El Max	Az Min	Az Max
Reflector	-180	180	0	360
Reflector Normal	-180	180	0	360
Source	-90	90	0	360

Reflection calculation process

The following process is used to determine the 3D Azimuth and Elevation of a reflection:

1) Use the Latitude and Longitude of reflector as the reference for calculation purposes;
2) Calculate the Azimuth and Elevation of the normal to the reflector;
3) Calculate the 3D angle between the source and the normal;
4) If this angle is less than 90 degrees a reflection will occur. If it is greater than 90 degrees, no reflection will occur because the source is behind the reflector;
5) Calculate the Azimuth and Elevation of the reflection in accordance with the following:
    a) The angle between source and normal is equal to angle between normal and reflection;
    b) Source, Normal and Reflection are in the same plane.

ANNEX F – RECEPTOR AND REFLECTOR AREA DETAILS

Aerodrome Details

The table below presents the data for the assessed airfields, including runway details. The receptor locations are based on the methodology set out in Section 4.1.

Aerodrome	Threshold	Longitude (°)	Latitude (°)	Threshold Height (m) (amsl)
Leeds East Airport	06	-1.20517	53.83040	9
	24	-1.18396	53.83930	9
Sherburn-In-Elmet Airfield	01	-1.21380	53.78450	7
	19	-1.21268	53.78914	7
	06	-1.22237	53.78666	8
	24	-1.21395	53.78969	8
	10	-1.22379	53.78509	8
	28	-1.21473	53.78382	8
	10G	-1.22301	53.78569	8
	28G	-1.21383	53.78442	7
Burn Airfield	01	-1.08445	53.74148	6
	19	-1.08226	53.75105	6
	07	-1.09731	53.74897	7
	25	-1.07906	53.75164	6
	15	-1.09085	53.74895	6
	33	-1.08182	53.74229	6

Aerodrome	Threshold	Longitude (°)	Latitude (°)	Threshold Height (m) (amsl)
Redmoor Farm Airfield	10	-0.97585	53.84091	10
	28	-0.96774	53.83973	8
Gilrudding Grange Airfield	09	-1.07148	53.89374	9
	27	-1.06382	53.89356	9
Bridge Cottage Airfield	01	-1.10155	53.67792	5
	19	-1.10011	53.68172	8
	18	-1.10129	53.68154	7
	36	-1.10181	53.67797	5
Elvington Airfield	08	-1.00491	53.92074	13
	26	-0.98155	53.92558	14
Birchwood Lodge Airfield	08	-1.01712	53.81767	8
	26	-1.00898	53.81841	8

Assessed aerodrome information

Road Receptor Data

The road receptor data is presented in the tables below. An additional 1.5m height has been added to the elevation to account for the eye-level of a road user.

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
N1	-1.04663	53.87411	N30	-1.02383	53.86691
N2	-1.04603	53.87494	N31	-1.02321	53.86609
N3	-1.04549	53.87578	N32	-1.02259	53.86527

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
N4	-1.04510	53.87665	N33	-1.02196	53.86445
N5	-1.04487	53.87754	N34	-1.02127	53.86365
N6	-1.04470	53.87843	N35	-1.02065	53.86283
N7	-1.04463	53.87933	N36	-1.01981	53.86208
N8	-1.04500	53.88012	N37	-1.01874	53.86144
N9	-1.04458	53.88056	N38	-1.01775	53.86075
N10	-1.04338	53.88001	N39	-1.01657	53.86018
N11	-1.04215	53.87947	N40	-1.01531	53.85968
N12	-1.04091	53.87895	N41	-1.01405	53.85917
N13	-1.03964	53.87845	N42	-1.01276	53.85870
N14	-1.03835	53.87797	N43	-1.01130	53.85847
N15	-1.03707	53.87748	N44	-1.00977	53.85846
N16	-1.03580	53.87698	N45	-1.00825	53.85842
N17	-1.03452	53.87649	N46	-1.00672	53.85839
N18	-1.03326	53.87598	N47	-1.00522	53.85825
N19	-1.03200	53.87548	N48	-1.00380	53.85793
N20	-1.03085	53.87489	N49	-1.00259	53.85739
N21	-1.03002	53.87414	N50	-1.00175	53.85664
N22	-1.02926	53.87335	N51	-1.00097	53.85590
N23	-1.02853	53.87257	N52	-1.00088	53.85500

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
N24	-1.02779	53.87178	N53	-1.00038	53.85415
N25	-1.02706	53.87099	N54	-0.99959	53.85338
N26	-1.02633	53.87020	N55	-0.99877	53.85263
N27	-1.02569	53.86938	N56	-0.99802	53.85185
N28	-1.02507	53.86856	N57	-0.99726	53.85107
N29	-1.02445	53.86774	N58	-0.99669	53.85045

Road receptor data – north area

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W1	-1.23675	53.78907	W100	-1.21587	53.75402
W2	-1.23703	53.78818	W101	-1.21439	53.75421
W3	-1.23732	53.78730	W102	-1.21287	53.75428
W4	-1.23759	53.78641	W103	-1.21136	53.75439
W5	-1.23782	53.78552	W104	-1.20985	53.75452
W6	-1.23803	53.78463	W105	-1.20835	53.75466
W7	-1.23822	53.78374	W106	-1.20688	53.75489
W8	-1.23840	53.78285	W107	-1.20551	53.75527
W9	-1.23856	53.78195	W108	-1.20403	53.75533
W10	-1.23877	53.78106	W109	-1.20254	53.75515
W11	-1.23904	53.78017	W110	-1.20105	53.75498

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W12	-1.23936	53.77929	W111	-1.19955	53.75481
W13	-1.23974	53.77842	W112	-1.19806	53.75465
W14	-1.24019	53.77756	W113	-1.19654	53.75464
W15	-1.24069	53.77671	W114	-1.19501	53.75464
W16	-1.24124	53.77587	W115	-1.19349	53.75465
W17	-1.24194	53.77508	W116	-1.19197	53.75466
W18	-1.24288	53.77437	W117	-1.19045	53.75466
W19	-1.24404	53.77379	W118	-1.18893	53.75467
W20	-1.24535	53.77334	W119	-1.18740	53.75467
W21	-1.24679	53.77304	W120	-1.18588	53.75468
W22	-1.24802	53.77273	W121	-1.18436	53.75468
W23	-1.24902	53.77206	W122	-1.18284	53.75469
W24	-1.24988	53.77132	W123	-1.18132	53.75469
W25	-1.25049	53.77050	W124	-1.17979	53.75468
W26	-1.25082	53.76962	W125	-1.17827	53.75467
W27	-1.25100	53.76872	W126	-1.17675	53.75467
W28	-1.24410	53.76191	W127	-1.17523	53.75465
W29	-1.24261	53.76208	W128	-1.17371	53.75466
W30	-1.24110	53.76219	W129	-1.17227	53.75492
W31	-1.23958	53.76221	W130	-1.17092	53.75534

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W32	-1.23818	53.76255	W131	-1.16957	53.75572
W33	-1.23675	53.76253	W132	-1.16814	53.75543
W34	-1.23539	53.76214	W133	-1.16688	53.75493
W35	-1.23400	53.76179	W134	-1.16548	53.75476
W36	-1.23254	53.76157	W135	-1.16418	53.75523
W37	-1.23123	53.76118	W136	-1.16281	53.75544
W38	-1.22971	53.76108	W137	-1.16170	53.75482
W39	-1.22844	53.76086	W138	-1.16081	53.75409
W40	-1.22636	53.76036	W139	-1.15965	53.75352
W41	-1.22485	53.76034	W140	-1.15887	53.75276
W42	-1.22334	53.76044	W141	-1.15776	53.75216
W43	-1.22183	53.76055	W142	-1.15638	53.75179
W44	-1.22031	53.76065	W143	-1.15498	53.75143
W45	-1.21882	53.76082	W144	-1.15369	53.75114
W46	-1.21736	53.76107	W145	-1.19830	53.75374
W47	-1.21590	53.76134	W146	-1.19869	53.75287
W48	-1.21445	53.76161	W147	-1.19910	53.75201
W49	-1.21298	53.76184	W148	-1.19939	53.75113
W50	-1.21150	53.76206	W149	-1.19933	53.75023
W51	-1.21003	53.76228	W150	-1.19926	53.74933

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W52	-1.20855	53.76250	W151	-1.19898	53.74845
W53	-1.20708	53.76272	W152	-1.19874	53.74756
W54	-1.20560	53.76294	W153	-1.19826	53.74671
W55	-1.20413	53.76317	W154	-1.19784	53.74586
W56	-1.20266	53.76340	W155	-1.19771	53.74496
W57	-1.20118	53.76363	W156	-1.19829	53.74414
W58	-1.19971	53.76385	W157	-1.19895	53.74332
W59	-1.19824	53.76408	W158	-1.19960	53.74251
W60	-1.19676	53.76431	W159	-1.20025	53.74170
W61	-1.19529	53.76454	W160	-1.20053	53.74086
W62	-1.19382	53.76476	W161	-1.19986	53.74006
W63	-1.19234	53.76499	W162	-1.19868	53.73949
W64	-1.19087	53.76521	W163	-1.19785	53.73878
W65	-1.18939	53.76543	W164	-1.19706	53.73801
W66	-1.18791	53.76564	W165	-1.19691	53.73713
W67	-1.18644	53.76588	W166	-1.19716	53.73624
W68	-1.18498	53.76612	W167	-1.19703	53.73535
W69	-1.18351	53.76637	W168	-1.19772	53.73458
W70	-1.18211	53.76671	W169	-1.19795	53.73369
W71	-1.18071	53.76707	W170	-1.19817	53.73280

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W72	-1.17942	53.76754	W171	-1.19698	53.73538
W73	-1.17826	53.76812	W172	-1.19587	53.73599
W74	-1.17709	53.76870	W173	-1.19448	53.73635
W75	-1.17575	53.76912	W174	-1.19301	53.73659
W76	-1.17432	53.76942	W175	-1.19159	53.73631
W77	-1.17287	53.76970	W176	-1.19020	53.73596
W78	-1.17140	53.76992	W177	-1.18875	53.73569
W79	-1.16992	53.77013	W178	-1.18736	53.73534
W80	-1.16842	53.77029	W179	-1.18606	53.73487
W81	-1.16718	53.77039	W180	-1.18461	53.73460
W82	-1.23147	53.75555	W181	-1.18315	53.73437
W83	-1.23088	53.75473	W182	-1.18166	53.73421
W84	-1.23064	53.75386	W183	-1.18017	53.73433
W85	-1.23141	53.75319	W184	-1.17867	53.73440
W86	-1.23161	53.75231	W185	-1.17720	53.73419
W87	-1.23219	53.75148	W186	-1.17568	53.73421
W88	-1.23297	53.75071	W187	-1.17429	53.73456
W89	-1.23365	53.75031	W188	-1.17288	53.73487
W90	-1.23067	53.75363	W189	-1.17139	53.73505
W91	-1.22930	53.75357	W190	-1.16988	53.73518

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W92	-1.22791	53.75347	W191	-1.16841	53.73541
W93	-1.22645	53.75334	W192	-1.16693	53.73561
W94	-1.22494	53.75342	W193	-1.16543	53.73574
W95	-1.22342	53.75350	W194	-1.16392	53.73586
W96	-1.22190	53.75357	W195	-1.16240	53.73584
W97	-1.22038	53.75363	W196	-1.16090	53.73570
W98	-1.21887	53.75370	W197	-1.15943	53.73549

Road receptor data – west area

Dwelling Receptor Data

The dwelling receptor data is presented in the tables below. An additional 1.8m height has been added to the elevation to account for the eye-level of an observer at these dwellings.

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
N1	-1.04097	53.88190	N37	-1.03993	53.87501
N2	-1.04071	53.88176	N38	-1.03950	53.87486
N3	-1.04048	53.88151	N39	-1.03907	53.87460
N4	-1.04048	53.88126	N40	-1.04047	53.87412
N5	-1.04021	53.88095	N41	-1.03221	53.87574
N6	-1.03990	53.88070	N42	-1.03282	53.87555
N7	-1.03996	53.88047	N43	-1.04256	53.87149
N8	-1.03968	53.88028	N44	-1.03507	53.86186

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
N9	-1.03942	53.88013	N45	-1.03048	53.85983
N10	-1.03926	53.87986	N46	-1.03011	53.85990
N11	-1.03907	53.87962	N47	-1.02863	53.86005
N12	-1.03904	53.87947	N48	-1.01980	53.86254
N13	-1.03909	53.87927	N49	-1.01587	53.86126
N14	-1.03934	53.87907	N50	-1.00153	53.85711
N15	-1.03974	53.87892	N51	-1.00072	53.85523
N16	-1.03994	53.87876	N52	-0.99588	53.85209
N17	-1.03893	53.87864	N53	-0.99383	53.85807
N18	-1.03865	53.87859	N54	-0.98912	53.86077
N19	-1.03854	53.87847	N55	-0.98419	53.86044
N20	-1.03798	53.87831	N56	-0.98227	53.86389
N21	-1.03860	53.87784	N57	-0.98232	53.86410
N22	-1.03910	53.87777	N58	-0.98641	53.87036
N23	-1.03926	53.87765	N59	-0.98691	53.87046
N24	-1.03941	53.87753	N60	-1.01228	53.86844
N25	-1.03958	53.87739	N61	-0.98126	53.87515
N26	-1.03968	53.87726	N62	-0.98149	53.87548
N27	-1.03997	53.87715	N63	-0.99003	53.88662
N28	-1.04050	53.87708	N64	-0.99005	53.88875

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
N29	-1.04005	53.87647	N65	-0.99660	53.88457
N30	-1.04009	53.87622	N66	-0.99699	53.88354
N31	-1.03990	53.87608	N67	-0.99710	53.88308
N32	-1.03977	53.87598	N68	-1.00147	53.88183
N33	-1.03967	53.87571	N69	-1.01693	53.87731
N34	-1.03974	53.87543	N70	-1.01483	53.88055
N35	-1.03961	53.87522	N71	-1.01873	53.88435
N36	-1.03969	53.87506			

Dwelling receptor data – north area

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W1	-1.24850	53.78267	W168	-1.22867	53.75477
W2	-1.24838	53.78249	W169	-1.22847	53.75457
W3	-1.24788	53.78174	W170	-1.22825	53.75432
W4	-1.24728	53.78163	W171	-1.22830	53.75393
W5	-1.24729	53.78144	W172	-1.22653	53.75406
W6	-1.24716	53.78083	W173	-1.22587	53.75382
W7	-1.24698	53.78017	W174	-1.22547	53.75388
W8	-1.24732	53.77989	W175	-1.22531	53.75360
W9	-1.24613	53.77955	W176	-1.22641	53.75291

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W10	-1.24671	53.77937	W177	-1.22559	53.75308
W11	-1.24571	53.77920	W178	-1.22487	53.75319
W12	-1.24545	53.77920	W179	-1.22415	53.75314
W13	-1.24529	53.77920	W180	-1.22328	53.75320
W14	-1.24592	53.77905	W181	-1.22241	53.75371
W15	-1.24565	53.77898	W182	-1.22096	53.75338
W16	-1.24535	53.77891	W183	-1.22106	53.75299
W17	-1.24506	53.77882	W184	-1.22757	53.75255
W18	-1.24479	53.77872	W185	-1.22754	53.75226
W19	-1.24455	53.77861	W186	-1.22727	53.75203
W20	-1.24427	53.77850	W187	-1.22773	53.75200
W21	-1.24477	53.77834	W188	-1.22843	53.75213
W22	-1.24438	53.77816	W189	-1.22888	53.75209
W23	-1.24298	53.77877	W190	-1.22915	53.75192
W24	-1.24369	53.77825	W191	-1.22968	53.75195
W25	-1.24349	53.77812	W192	-1.23009	53.75186
W26	-1.24331	53.77797	W193	-1.23083	53.75201
W27	-1.24381	53.77784	W194	-1.23137	53.75194
W28	-1.24364	53.77766	W195	-1.23221	53.75186
W29	-1.24350	53.77751	W196	-1.23234	53.75170

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W30	-1.24339	53.77741	W197	-1.23248	53.75156
W31	-1.24329	53.77733	W198	-1.23273	53.75126
W32	-1.24299	53.77717	W199	-1.20641	53.74181
W33	-1.24294	53.77698	W200	-1.20581	53.74179
W34	-1.24274	53.77687	W201	-1.19913	53.73997
W35	-1.24260	53.77674	W202	-1.19188	53.73883
W36	-1.24258	53.77663	W203	-1.19777	53.73842
W37	-1.24255	53.77652	W204	-1.19744	53.73812
W38	-1.24257	53.77642	W205	-1.19742	53.73776
W39	-1.24259	53.77622	W206	-1.19701	53.73746
W40	-1.24285	53.77613	W207	-1.19851	53.73739
W41	-1.24281	53.77581	W208	-1.19745	53.73675
W42	-1.24289	53.77558	W209	-1.19745	53.73675
W43	-1.24342	53.77542	W210	-1.19742	53.73643
W44	-1.24338	53.77527	W211	-1.19678	53.73620
W45	-1.24425	53.77526	W212	-1.19681	53.73600
W46	-1.24497	53.77519	W213	-1.19675	53.73578
W47	-1.24552	53.77511	W214	-1.19590	53.73584
W48	-1.24613	53.77512	W215	-1.19550	53.73579
W49	-1.24670	53.77506	W216	-1.19514	53.73590

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W50	-1.24725	53.77499	W217	-1.19486	53.73595
W51	-1.24769	53.77496	W218	-1.19452	53.73605
W52	-1.24938	53.77461	W219	-1.19426	53.73616
W53	-1.25017	53.77464	W220	-1.19390	53.73636
W54	-1.24047	53.77991	W221	-1.19385	53.73657
W55	-1.23998	53.78008	W222	-1.19261	53.73686
W56	-1.23988	53.77983	W223	-1.19306	53.73647
W57	-1.23813	53.78046	W224	-1.19313	53.73632
W58	-1.23803	53.78019	W225	-1.19846	53.73453
W59	-1.23779	53.77965	W226	-1.19770	53.73409
W60	-1.23886	53.77893	W227	-1.19765	53.73389
W61	-1.23845	53.77721	W228	-1.19765	53.73371
W62	-1.23815	53.77668	W229	-1.19760	53.73346
W63	-1.23740	53.77631	W230	-1.19737	53.73325
W64	-1.23252	53.77780	W231	-1.19679	53.73287
W65	-1.22997	53.77745	W232	-1.19878	53.73232
W66	-1.24919	53.77235	W233	-1.15325	53.75063
W67	-1.24584	53.77203	W234	-1.15360	53.75064
W68	-1.24479	53.77153	W235	-1.15390	53.75067
W69	-1.24576	53.77133	W236	-1.15423	53.75075

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W70	-1.23830	53.77169	W237	-1.15460	53.75099
W71	-1.23835	53.77148	W238	-1.15423	53.75102
W72	-1.23945	53.77074	W239	-1.15455	53.75153
W73	-1.23906	53.76863	W240	-1.15501	53.75164
W74	-1.23741	53.76900	W241	-1.15535	53.75170
W75	-1.23685	53.76903	W242	-1.15565	53.75176
W76	-1.23661	53.76905	W243	-1.15588	53.75180
W77	-1.23636	53.76903	W244	-1.15614	53.75184
W78	-1.23606	53.76901	W245	-1.15609	53.75158
W79	-1.23577	53.76896	W246	-1.15626	53.75167
W80	-1.23686	53.76870	W247	-1.15658	53.75176
W81	-1.23684	53.76856	W248	-1.15730	53.75196
W82	-1.23450	53.76885	W249	-1.15769	53.75241
W83	-1.23803	53.76752	W250	-1.16955	53.75596
W84	-1.23683	53.76721	W251	-1.17353	53.75579
W85	-1.24131	53.76714	W252	-1.17442	53.75549
W86	-1.24277	53.76622	W253	-1.18265	53.75510
W87	-1.24247	53.76589	W254	-1.19299	53.75498
W88	-1.24158	53.76479	W255	-1.19412	53.75507
W89	-1.24180	53.76464	W256	-1.19562	53.75487

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W90	-1.24161	53.76451	W257	-1.20035	53.75269
W91	-1.24125	53.76437	W258	-1.20360	53.75231
W92	-1.24076	53.76428	W259	-1.20374	53.75313
W93	-1.23914	53.76413	W260	-1.20340	53.75471
W94	-1.23862	53.76415	W261	-1.20271	53.75484
W95	-1.23608	53.76438	W262	-1.20275	53.75550
W96	-1.23575	53.76416	W263	-1.20039	53.75552
W97	-1.23822	53.76397	W264	-1.19834	53.76012
W98	-1.23781	53.76392	W265	-1.19874	53.76023
W99	-1.23751	53.76382	W266	-1.19852	53.76052
W100	-1.23721	53.76360	W267	-1.19335	53.76453
W101	-1.23661	53.76356	W268	-1.19115	53.76471
W102	-1.23667	53.76334	W269	-1.19073	53.76450
W103	-1.23659	53.76307	W270	-1.17491	53.76620
W104	-1.23634	53.76304	W271	-1.17340	53.76668
W105	-1.23593	53.76310	W272	-1.17352	53.76710
W106	-1.23593	53.76310	W273	-1.17394	53.76722
W107	-1.23618	53.76265	W274	-1.17475	53.76739
W108	-1.23571	53.76254	W275	-1.17372	53.76737
W109	-1.23524	53.76266	W276	-1.17345	53.76761

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W110	-1.23467	53.76291	W277	-1.17167	53.76926
W111	-1.23457	53.76302	W278	-1.17152	53.76959
W112	-1.23422	53.76272	W279	-1.17131	53.76975
W113	-1.23396	53.76266	W280	-1.17102	53.76982
W114	-1.23346	53.76268	W281	-1.17055	53.76988
W115	-1.23522	53.76222	W282	-1.17099	53.77022
W116	-1.23482	53.76214	W283	-1.17016	53.77034
W117	-1.23442	53.76169	W284	-1.16993	53.77053
W118	-1.23435	53.76149	W285	-1.16994	53.77068
W119	-1.23362	53.76133	W286	-1.17002	53.77084
W120	-1.23321	53.76149	W287	-1.17064	53.77110
W121	-1.23275	53.76149	W288	-1.17072	53.77134
W122	-1.23235	53.76179	W289	-1.17045	53.77147
W123	-1.23196	53.76169	W290	-1.17027	53.77161
W124	-1.23140	53.76165	W291	-1.17008	53.77175
W125	-1.23111	53.76174	W292	-1.16993	53.77187
W126	-1.23090	53.76187	W293	-1.16976	53.77197
W127	-1.23059	53.76193	W294	-1.16962	53.77209
W128	-1.23010	53.76199	W295	-1.16939	53.77227
W129	-1.22978	53.76207	W296	-1.16923	53.77240

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W130	-1.22952	53.76212	W297	-1.16906	53.77257
W131	-1.22924	53.76216	W298	-1.16868	53.77233
W132	-1.22872	53.76232	W299	-1.16839	53.77204
W133	-1.22856	53.76214	W300	-1.16814	53.77182
W134	-1.22845	53.76200	W301	-1.16781	53.77150
W135	-1.22825	53.76180	W302	-1.16744	53.77128
W136	-1.22808	53.76158	W303	-1.16685	53.77119
W137	-1.22813	53.76141	W304	-1.16643	53.77135
W138	-1.23026	53.76302	W305	-1.16586	53.77140
W139	-1.22766	53.76250	W306	-1.16550	53.77148
W140	-1.22612	53.76285	W307	-1.16528	53.77151
W141	-1.22740	53.76310	W308	-1.16468	53.77212
W142	-1.22642	53.76338	W309	-1.16471	53.77230
W143	-1.22537	53.77229	W310	-1.16478	53.77246
W144	-1.22550	53.77195	W311	-1.16492	53.77261
W145	-1.22612	53.76725	W312	-1.16452	53.77265
W146	-1.21022	53.77159	W313	-1.16452	53.77265
W147	-1.20956	53.77173	W314	-1.16406	53.77276
W148	-1.20065	53.76941	W315	-1.16352	53.77291
W149	-1.21264	53.76955	W316	-1.16346	53.77308

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W150	-1.21274	53.76632	W317	-1.16327	53.77329
W151	-1.21430	53.76099	W318	-1.16325	53.77347
W152	-1.21412	53.76072	W319	-1.16278	53.77349
W153	-1.21409	53.76013	W320	-1.18893	53.77104
W154	-1.22517	53.75984	W321	-1.19119	53.77171
W155	-1.22394	53.75918	W322	-1.18948	53.77613
W156	-1.22383	53.75849	W323	-1.18935	53.77638
W157	-1.22305	53.75733	W324	-1.18016	53.77410
W158	-1.22162	53.75702	W325	-1.17565	53.77651
W159	-1.22232	53.75523	W326	-1.17697	53.78991
W160	-1.21894	53.75406	W327	-1.17847	53.78819
W161	-1.21768	53.75397	W328	-1.18470	53.78741
W162	-1.22996	53.75611	W329	-1.18177	53.79344
W163	-1.22954	53.75595	W330	-1.18193	53.79405
W164	-1.22933	53.75568	W331	-1.21380	53.77617
W165	-1.22919	53.75537	W332	-1.21449	53.77553
W166	-1.22929	53.75508	W333	-1.21470	53.77551
W167	-1.22902	53.75484	W334	-1.22356	53.77982

Dwelling receptor data – west area

Railway Receptor Data

The railway receptor data is presented in the table below. An additional 2.75m height has been added to the elevation to account for the eye-level of a train operator.

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W1	-1.23019	53.78428	W53	-1.23408	53.78319
W2	-1.22928	53.78356	W54	-1.23401	53.78409
W3	-1.22829	53.78288	W55	-1.23396	53.78471
W4	-1.22720	53.78225	W56	-1.24155	53.78136
W5	-1.22605	53.78166	W57	-1.24006	53.78119
W6	-1.22481	53.78113	W58	-1.23856	53.78103
W7	-1.22351	53.78067	W59	-1.23706	53.78087
W8	-1.22220	53.78021	W60	-1.23556	53.78071
W9	-1.22089	53.77975	W61	-1.23406	53.78055
W10	-1.21948	53.77942	W62	-1.23256	53.78039
W11	-1.21880	53.77933	W63	-1.23107	53.78023
W12	-1.21881	53.77923	W64	-1.22957	53.78006
W13	-1.22033	53.77918	W65	-1.22807	53.77990
W14	-1.22184	53.77905	W66	-1.22657	53.77975
W15	-1.22333	53.77886	W67	-1.22506	53.77962
W16	-1.22478	53.77859	W68	-1.22355	53.77950
W17	-1.22619	53.77824	W69	-1.22204	53.77942

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W18	-1.22754	53.77783	W70	-1.22052	53.77935
W19	-1.22884	53.77736	W71	-1.21900	53.77929
W20	-1.23007	53.77683	W72	-1.21748	53.77922
W21	-1.23124	53.77626	W73	-1.21596	53.77916
W22	-1.23235	53.77564	W74	-1.21444	53.77910
W23	-1.23338	53.77498	W75	-1.21292	53.77903
W24	-1.23429	53.77426	W76	-1.21140	53.77896
W25	-1.23515	53.77351	W77	-1.20988	53.77890
W26	-1.23591	53.77274	W78	-1.20837	53.77883
W27	-1.23631	53.77187	W79	-1.20685	53.77876
W28	-1.23664	53.77099	W80	-1.20533	53.77870
W29	-1.23714	53.77014	W81	-1.20381	53.77863
W30	-1.23768	53.76930	W82	-1.20229	53.77857
W31	-1.23819	53.76845	W83	-1.20077	53.77850
W32	-1.23854	53.76775	W84	-1.19925	53.77844
W33	-1.23940	53.76548	W85	-1.19773	53.77838
W34	-1.23911	53.76636	W86	-1.19621	53.77831
W35	-1.23883	53.76725	W87	-1.19469	53.77825
W36	-1.23856	53.76813	W88	-1.19317	53.77819
W37	-1.23829	53.76902	W89	-1.19166	53.77812

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W38	-1.23802	53.76991	W90	-1.19014	53.77805
W39	-1.23775	53.77079	W91	-1.18862	53.77799
W40	-1.23746	53.77168	W92	-1.18710	53.77793
W41	-1.23718	53.77256	W93	-1.18558	53.77787
W42	-1.23687	53.77344	W94	-1.18406	53.77781
W43	-1.23656	53.77432	W95	-1.18254	53.77775
W44	-1.23627	53.77521	W96	-1.18102	53.77769
W45	-1.23599	53.77609	W97	-1.17950	53.77764
W46	-1.23571	53.77697	W98	-1.17798	53.77759
W47	-1.23544	53.77786	W99	-1.17646	53.77754
W48	-1.23513	53.77874	W100	-1.17494	53.77748
W49	-1.23483	53.77962	W101	-1.17342	53.77743
W50	-1.23456	53.78051	W102	-1.17190	53.77738
W51	-1.23434	53.78140	W103	-1.17038	53.77732
W52	-1.23418	53.78229	W104	-1.16886	53.77726

Railway receptor data – west area

Waterway Receptor Data

The waterway receptor data is presented in the table below. An additional 1.5m height has been added to the elevation to account for the eye-level of a waterway user.

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
W1	-1.18677	53.72420	W16	-1.17654	53.72860
W2	-1.18730	53.72484	W17	-1.17520	53.72823
W3	-1.18836	53.72543	W18	-1.17378	53.72852
W4	-1.18815	53.72629	W19	-1.17265	53.72912
W5	-1.18711	53.72693	W20	-1.17162	53.72978
W6	-1.18564	53.72715	W21	-1.17019	53.73000
W7	-1.18413	53.72722	W22	-1.16868	53.72987
W8	-1.18270	53.72751	W23	-1.16721	53.72966
W9	-1.18133	53.72721	W24	-1.16634	53.72902
W10	-1.17999	53.72693	W25	-1.16717	53.72830
W11	-1.17961	53.72769	W26	-1.16843	53.72780
W12	-1.17998	53.72856	W27	-1.16985	53.72750
W13	-1.17973	53.72944	W28	-1.17136	53.72738
W14	-1.17859	53.72989	W29	-1.17247	53.72682
W15	-1.17743	53.72933	W30	-1.17257	53.72593

Waterway receptor data – west area

ANNEX G – DETAILLED MODELLING RESULTS

Overview

An example of Pager Power and Forge charts for receptors are shown on the following pages. Further modelling charts can be provided upon request. Each Pager Power chart shows:

- The receptor (observer) location – top right image. This also shows the azimuth range of the Sun itself at times when reflections are possible. If sunlight is experienced from the same direction as the reflecting panels, the overall impact of the reflection is reduced as discussed within the body of the report;
- The reflection date/time graph – left hand side of image. The blue line indicates the dates and times at which geometric reflections are possible. This relates to reflections from the yellow areas;
- The sunrise and sunset curves throughout the year (red and yellow lines).

The Forge charts for the receptors are shown on the following pages. Each chart shows:

- The annual predicted solar reflections.
- The daily duration of the solar reflections.
- The location of the Proposed Development where glare will originate.
- The calculated intensity of the predicted solar reflections.

Full modelling results can be provided upon request.

Aviation Receptors

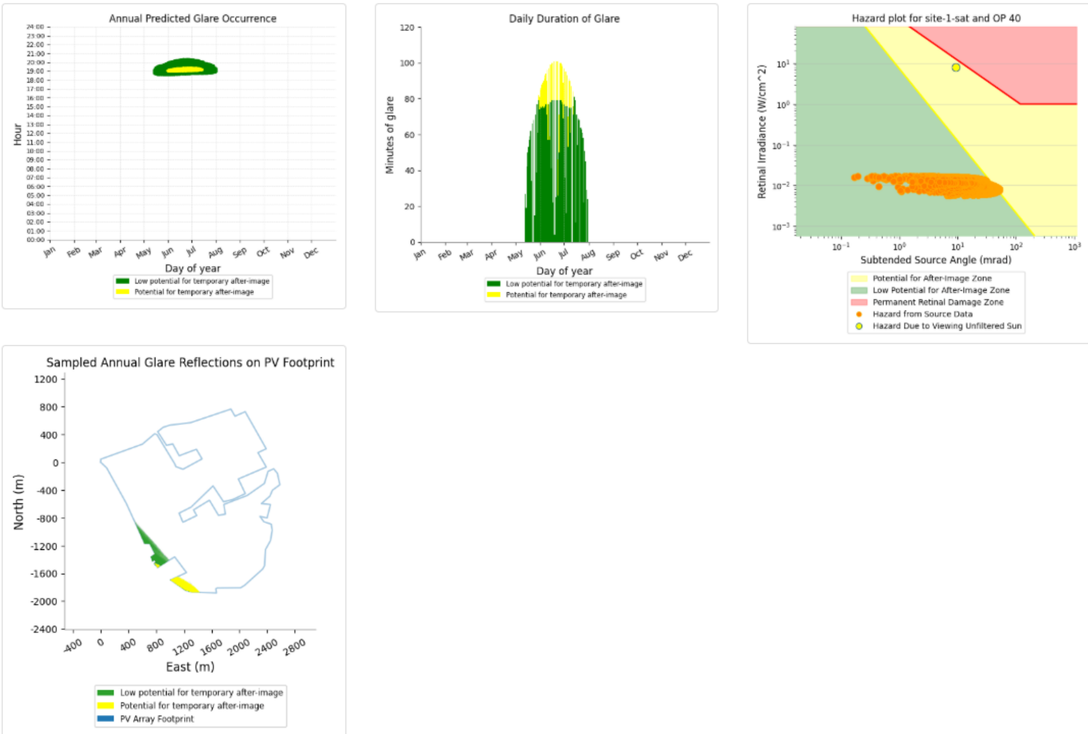
An example results chart has been included. Full modelling charts are available upon request.

Single Axis Tracking Panels

Site 1 - SAT: OP 40

PV array is expected to produce the following glare for this receptor:

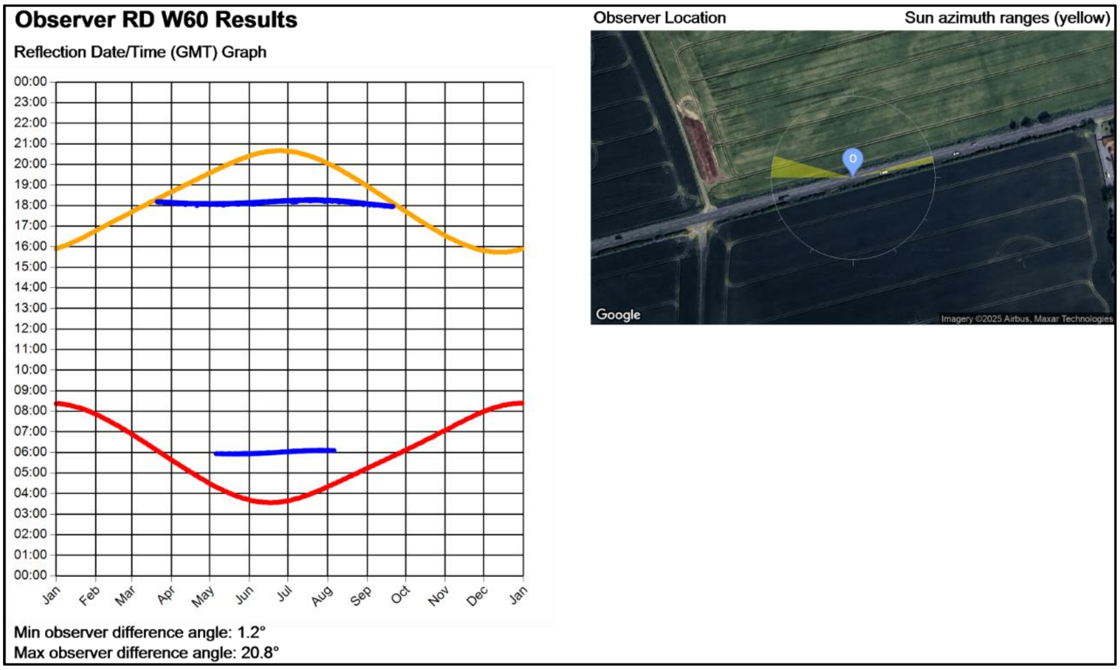
- 4,537 minutes of "green" glare with low potential to cause temporary after-image.
- 618 minutes of "yellow" glare with potential to cause temporary after-image.



Road Receptors

Fixed South Facing Panels

An example results chart has been included. Full modelling charts are available upon request.



ANNEX H – EMPIRICAL EVIDENCE ON GLINT & GLARE FROM SOLAR PV INSTALLATIONS NEAR UK AERODROMES

AVIATICA

LIGHT VALLEY SOLAR: EMPIRICAL EVIDENCE ON GLINT & GLARE FROM SOLAR PV INSTALLATIONS NEAR UK AERODROMES

February 2026

Report No.25/1277/IGP

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1. Introduction

1.1 This report provides information to supplement the assessment of effects of glint and glare on aviation receptors set out in Chapter 16: Other Environmental Matters (ES Volume 1) **[EN0110012/APP/LVS/06.01.16]** and Appendix 16.4: Glint and Glare Assessment (ES Volume 3) **[EN0110012/APP/LVS/06.03.16.04]** of which this study is an Annex.

1.3 In order to test the validity of the ForgeSolar modelling predictions of glare to aviation receptors in the vicinity of the Scheme, research has been carried out to identify aerodromes in the UK that have operational solar PV installations in their vicinity (defined for the purposes of this exercise as being located within one nautical mile (1852m) of the end of any runway).[1] The details of each solar PV installation have been obtained from published planning documents. The published information for each aerodrome sourced from the UK Aeronautical Information Publication, aerodrome websites and pilots' guides, has then been analysed for any reference to the adjacent solar installation(s), advice or warnings to pilots, and mitigation measures in place to address effects of glint and glare. Finally, aerodromes have been consulted through face-to-face meetings, telephone and email to determine whether incidents of adverse effects from glare have been experienced or reported to them by pilots. The latter element of the research exercise is ongoing. So far, 65 UK aerodromes with solar PV installations in their vicinity have been identified; of those, 53 have been contacted; and responses have been received from 33 resulting in a response rate of 62%.

1.4 The research exercise described above is considered to be in keeping with the Civil Aviation Authority (CAA) policy on solar PV glint and glare set out in the October 2020 update to CAP 738 *Safeguarding of Aerodromes*, which states:[2]

> *In the United Kingdom there has been a further increase in SPV cells, including some located close to aerodrome boundaries; to date the CAA has not received any detrimental comments or issues of glare at these established sites. Whilst this early indication is encouraging, those responsible for safeguarding should remain vigilant to the possibility.*

2. Empirical evidence from UK aerodromes

2.1 Research completed by Aviatica has identified 65 UK aerodromes with operational solar farms in their vicinity. The details of these are provided in Annex 1.

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[1] It should be noted that this is significantly less than the minimum 5km radius suggested by the Combined Aerodrome Safeguarding Team – see [Chapter 16: Other Environmental Matters (ES Volume 1) [EN0110012/APP/LVS/06.01.16] Section 16.8]. This shorter distance was selected in order to ensure that only aerodromes with a higher probability of significant impacts were studied.

[2] CAA, *Safeguarding of Aerodromes*, CAP 738, 3rd Edition, October 2020, Appendix C: Solar Photovoltaic Cells, paragraphs 1 and 2.

2.2 Aviatica has consulted the operators of 53 aerodromes with solar farms in their vicinity. Responses have been received from 33 of those aerodrome operators. The results of these consultations are summarised in Table 1. In all cases where a response has been received to Aviatica consultations, the response has been that no adverse glare effects have been experienced or reported.

Table 1: Responses to Aviatica consultations with owners, operators and pilots at UK aerodromes with solar farms in vicinity

Aerodrome	***Consultee***	***Response***
Beccles	Chief Parachute Instructor	No issues for pilots or skydivers. Solar farms have been there 5-6 years and have had no issues with them and not heard of glare being a problem at other sites.
Belfast International	Safeguarding Manager	1. The Airport has had no Reportable Occurrences on the Solar farm and 2. Our Main Carrier has no observations reported within their safety system
Boscombe Down	Operations staff	I can say that with the way it is positioned, it does not effect the pilots at Boscombe Down due to any potential glare being directed away from our runways. We have not received any DASORs [Defence Air Safety Occurrence Reports] or anything alike reference this before.
Cae Mawr	Owner	Nobody’s ever mentioned it. No issues.
Chalgrove	Company spokesperson	We can advise that to our knowledge, there hasn't been any problems reported with glare from solar panels
Coldharbour Farm	Aero Club Chair	Our guys have not reported any problems.
Croft Farm	Owner/instructor	No reports from pilots of adverse glare effects and none experienced personally. On basis of no impact from existing solar farm, aerodrome did not object to larger development to NW and has had no adverse impacts since it was built.
Cromer	Owner	We have a 25 acre solar array almost adjacent to the airfield at Northrepps. We do not get any 'glare' or reflected light from the panels.
Dunkeswell	Manager, parachute school	As both a skydiver and jump pilot I have not noticed any problems over the last 10 years.
Dunsfold	Properties Infrastructure Manager	I can’t think of a single case of anyone ever reporting that or mentioning it to me.
East Midlands	Safeguarding Manager	I can confirm that there have not been any reports from ATC [air traffic control] or pilots concerning glare

Eastchurch	Owner	The two existing solar farms have caused me no problem at all
Fowlmere	Head of Training	We fly over the solar panels all day every day and have never experienced any glare or any difficulties. I have also flown into other airfields with solar panels and have never experienced any glare or even heard of others experiencing this
Freshwater	Owner	With regard to the solar farm, which is about 300m northeast of my airstrip. I have not experienced a problem, and I have just spoken to the group who keep an aircraft here and fly from the airstrip, and they have not had any problems (to date) either.
Harringe Court Farm	Aero Club Chair	Our guys have not reported any problems.
Haverfordwest	Owner	It’s not something we’ve had any reports of so far. No-one’s mentioned it.
Kitty Hawk	Based pilot/former CAA policy officer	No adverse glare effects experienced in eight years of operating from the airfield and none reported by other pilots. Solar farm is “one of the best navigation features you could hope for”, making it significantly easier to identify the airfield when inbound.
Laddingford	Owner	No glare ever reported
Little Staughton	Administrator	No reports from pilots of adverse glare effects. Some pilots comment that the solar farm makes it easier to identify the airfield when approaching.
Membury	Aerodrome manager	No incidents, nor reports from pilots, of adverse effects from glare from the solar farm on the airfield in the nine years since it began operating in 2015.
Newmarket Heath	Helicopter operator	I can’t say we’ve ever had a report or concern raised on panel glare.
Old Hay	Owner	The solar farm is situated south of our air strip and the panels are angled south, so not a factor in departure and landing operations. When approaching the field from the south, you notice glare but nothing that causes an issue due to the angle being quite shallow.
Old Park Farm	Airfield manager	I’m the airfield manager and have been at Old Park Farm since 2007. The solar panels were installed around 2012, and I can honestly say I have had no complaints or observations made by any of our pilots or visiting pilots during this period of time.

		We do approach runway 36 directly over the panels at a height of about 600 to 800 feet and have never had any issues at all.
Peterlee	Chief Skydive Instructor	No glare issues experienced
RNAS Yeovilton	Air Operations Officer	There are no reported incidents from Solar Panel glare.
Shacklewell	Owner	We haven't experienced any glare from the nearby solar farm
Sherburn-in-Elmet	Head of Training	We've never had anything reported and I've never experienced it myself in 7-8 years of being here
Sywell	Owner	No adverse effects experienced or reported
Thruxton	Instructors x3	No glare issues experienced
Tilstock	Chief Skydive Instructor	No glare issues experienced
Turweston	Aerodrome manager	No reports from pilots or Air-Ground Radio Operators of adverse glare effects.
Upwood	Gliding Club CFI	As you know we have 2 blocks of solar panels just off the approach to runway 24, our normal gliding circuit takes us overhead of these. There are no reports of any glare from these, I myself have flown many hundreds of times over these and to be honest they can be a reliable source of lift for glider pilots, so no problems for us at Upwood.
Wadswick	Owner	I've never encountered any issues with glare from the solar installation at Wadswick, and I don't recall anyone ever mentioning it (or it being recorded in any of the visiting pilots notes on SkyDemon for Wadswick).

2.3 The consultations summarised above are in keeping with the CAA's statement in Appendix C of CAP 738 which notes that "*to date the CAA has not received any detrimental comments or issues of glare*" from existing solar PV sites. The consultation responses also support the findings of the Department for Energy Security and Net Zero that there is "*no evidence that glint and glare from solar farms results in significant impairment on aircraft safety*".[3]

2.4 To put these consultations into context, Aviatica has run the ForgeSolar glare prediction model for the final approach paths to the airfields at Beccles, Kitty Hawk, Membury, Thruxton and Turweston to determine whether the lack of adverse

[3] Department for Energy Security & Net Zero (DESNZ), *National Policy Statement for Renewable Energy Infrastructure (EN-3)*, November 2023, paragraph 2.10.159. This text is unchanged in the revised EN-3 laid before Parliament in November 2025 (DESNZ, *National Policy Statement for Renewable Energy Infrastructure (EN-3)*, December 2025, paragraph 2.10.151).

glare reports from pilots at those airfields might be at least in part explained by the model predicting no 'yellow' glare at those airfields. The results are shown in Table 2. Aerial photography imagery of these five aerodromes and their adjacent solar farms is reproduced in Annex 2. It can be seen that the ForgeSolar model does predict significant durations of 'yellow' glare at each of those five airfields. It can be concluded that the lack of pilot reports of glare from those airfields cannot be explained by the ForgeSolar model predicting that the solar farms at those locations would not generate glare towards the approach paths. It also suggests that the ForgeSolar model may be overly conservative in its predictions of the reactions of pilots to particular levels of glare.

Table 2: ForgeSolar glare predictions at Beccles, Kitty Hawk, Membury, Thruxton and Turweston airfields

Airfield	*Runway approach/receptor*	*ForgeSolar predicted minutes of 'yellow' glare per annum*
Beccles	09	9722
	27	198
Kitty Hawk	10	8441
	28	7027
Membury	31	6202
	34	3327
Thruxton	30	231
	Heli North approaches	4364
	Heli South approaches	16534
Turweston	09	22581
	Alternate helicopter	1807
	Control tower	4479

2.5 In the light of these findings, it is clear that sole reliance should not be placed on the outputs of the ForgeSolar model to predict actual adverse glare effects on aircraft safety. Due consideration must also be given to empirical evidence on the effects of glare from solar farms, as the UK Department for Energy Security and Net Zero (DESNZ) and the US Federal Aviation Administration (FAA) have done in the development of their policy on this topic. The DESNZ conclusion in NPS EN-3 that there is "*no evidence that glint and glare from solar farms results in significant impairment on aircraft safety*" is supported by the empirical evidence from airfields across the UK.

3. Accident and incident data

3.1 As a further validation check against the predictions of the ForgeSolar glint and glare model, Aviatica has conducted analysis of UK and US aviation accident and incident data to find any reports in which glare from solar PV installations was cited as a causal or contributory factor.

Accident data

3.2 The likelihood of an aircraft crashing as a result of its pilot experiencing glare from a solar PV installation can be derived from UK Air Accident Investigation Branch (AAIB) data on similar occurrences. An online search of AAIB data was conducted on 26 November 2025. The search found twelve accidents since 1st January 2005 in which the word 'glare' was mentioned in the accident report. Eleven of these were accidents in which the aircraft's pilot was affected by glare from the sun. The twelfth was a helicopter night landing accident in which the pilot was dazzled by glare from the helicopter's landing light reflected by mist. There were no instances of accidents in which glare from solar PV installations was involved. None of the accidents found in the AAIB search occurred at locations with solar farms in the vicinity.

3.3 To provide a comparison with, and some validation of, the AAIB data, a search of the database of the US aviation accident investigation authority, the National Transportation Safety Board (NTSB) was conducted on 27 May 2024. The searches were for instances of the word 'glare' in the 'Probable Cause' field, which includes 'Contributory Factors'. These searches found 92 instances between 1 January 2000 and 31 December 2023, all of which referred to glare from the sun, in some instances (principally floatplane accidents) involving glare from the sun causing reflections from the water. None of the accident reports referred to glare from solar PV installations.

Incident data

3.4 Safety incidents that did not result in an aircraft accident are primarily recorded in the UK through the Mandatory Occurrence Reporting (MOR) system. Reporting of these incidents is mandatory under EU law (since transposed into UK law) for all aircraft types other than vintage, amateur-built and microlight types. Operators of the latter categories are "strongly encouraged" to report such incidents.[4]

3.5 In 2020 the CAA published a new edition of its guidance on aerodrome safeguarding, CAP 738. It stated:[5]

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[4] [redacted]

[5] CAA, *Safeguarding of Aerodromes*, CAP 738, Third Edition, 2020, Appendix C, paragraph 2.

> *In the United Kingdom there has been a further increase in SPV cells, including some located close to aerodrome boundaries; to date the CAA has not received any detrimental comments or issues of glare at these established sites. Whilst this early indication is encouraging, those responsible for safeguarding should remain vigilant to the possibility.*

3.6 In order to update the 2020 CAP 738 statement that the CAA had never received any detrimental comments or issues concerning glare from solar PV installations, Aviatica submitted a request to the CAA in May 2024 for release of MOR data relating to glare affecting pilots. The CAA responded with a list of 19 incidents that occurred between 1st April 2014 and 31st March 2024 in which the pilot referred to 'glare' as a factor. Of these, two involved flights at night in which pilots were dazzled by ground lighting at the airport. The other 17 were incidents in which the pilot was either directly dazzled by flying or taxi-ing directly into a low sun, or reflections of the sun made it difficult for the pilot to read the aircraft's instruments. There were no cases involving reflections from solar panels.

3.7 Again, in order to provide comparison with and validation of the UK CAA MOR data, a search of the database of the US Aviation Safety Reporting System (ASRS) was conducted on 15 May 2024. This found six incidents involving aircraft flying under the Visual Flight Rules (VFR) in the period January 2000 to May 2024 in which 'glare' was referred to by the pilot. Of these:

1) two involved aircraft landing on 'glare ice' and hitting obstructions;
2) one involved an aircraft flying into proximity with another aircraft while on approach into sun causing reduced visibility; and
3) three involved pilots being unable to maintain visual flight due to the "blinding" or "annoying and distracting" glare from the Ivanpah Solar Plant in California.

3.8 In relation to the three incidents caused by the Ivanpah Solar Plant, this is a concentrated solar thermal plant in which 173,500 heliostats (mirrors) track the sun and focus its radiation on a tower-mounted solar collector that drives steam boilers that generate electricity. It is not a solar PV system and the sunlight reflections from its heliostats are many orders of magnitude greater in intensity than the reflections from solar PV panels. It is not, therefore, comparable in any way with solar PV installations. There are no concentrated solar thermal plants in the UK.

4. Conclusions

4.1 The evidence from UK aerodromes with existing solar PV installations in their vicinity is that none have ever experienced adverse glint and/or glare effects from those installations.

4.2 ForgeSolar modelling of potential glare at five of the 65 UK aerodromes with solar farms in their vicinity and where no glare effects have been experienced confirms that the model does predict ‘yellow’ glare at those aerodromes. This suggests that the ForgeSolar model should not be used as the sole predictor of impacts to pilots from solar PV installations.

4.3 AAIB data show that there has never been an aircraft accident in the UK in which glare from solar PV installations was cited as a factor.

4.4 NTSB data show that there has never been an aircraft accident in the USA in which glare from solar PV installations was cited as a factor.

4.5 UK CAA Mandatory Occurrence Reporting data contain no instances of a reported incident in which glare from a solar PV installation was cited as a factor.

4.6 US Aviation Safety Reporting System data contain no instances of a reported incident in which glare from a solar PV installation was cited as a factor.

Examples of UK aerodromes with solar farms in proximity						
Aerodrome	***Licensed or unlicensed***	***Solar farm name***	***Capacity/no. of panels***	***Location relative to airfield***	***Date consented/status***	***References to solar farm in AIP/pilots guides***
Barrow/Walney Island (Cumbria)	Licensed	Sowerby Lodge	5MW	1100m final rw 23 (unlicensed)	Consented 13-2-15 Operational June 2018	None
Beccles (Norfolk)	Unlicensed	Ellough Airfield	14.1MW 57,522 panels	Across rw 09 approach at 300-500m from touchdown and extending to south	Consented Apr 2013 Operational Mar 2014	Shown on aerodrome chart. No text.
		Playters New Farm	7.245MW 27,864 panels	1.5km final rw09	Consented July 2014 Operational Feb 2016	None
Belfast International (Antrim)	Licensed	Crooked Stone Road	4.8MW	640m north of rw 25 threshold	Operational 2016 All electricity generated goes directly to the airport	None
Bognor (Sussex)	Unlicensed	Bilsham Farm	14.5MW 60,000 panels	1.4km final rw 23	Operational 2014	None
Boscombe Down (Wilts)	Government	Boscombe Down	12MW	On airfield	Operational 2015	None
Bourn (Cambs)	Unlicensed	Skylark Meadow	5MW 22,000 panels	1400m west of rw18 threshold – ahead of ac on right base 18	Consented 13-11-12 Operational Mar 2013	None
Bournemouth (Dorset)	Licensed	Parley	Extensive multi-phase development	Between 1 and 3km north of rw 08 threshold	Consented 2013-2015	None
Cae Mawr (Caernarfon)	Unlicensed	Parciau	13.86MW	50m north of rw 08 threshold	Operational March 2015	Shown on maps on website; no text.
Chalgrove (Oxon)	Licensed	Easington Farm	21.3MW	0.5nm final rw30	Consented 14-8-14 Operational March 2015	None
Coldharbour Farm (Kent)	Unlicensed	Sycamore Farm	20MW	500m east of runway	Consented 17-1-13 Operational 2014	Shown & mentioned on

Examples of UK aerodromes with solar farms in proximity						
Aerodrome	***Licensed or unlicensed***	***Solar farm name***	***Capacity/no. of panels***	***Location relative to airfield***	***Date consented/status***	***References to solar farm in AIP/pilots guides***
						plate as VRP, no warnings
Craysmarsh Farm (Wilts)	Unlicensed	Snarlton	49.6MW	300m final rw19	Consented on appeal June 2015	N/a
		Craysmarsh	1.8MW 6384 panels	50m west of runway 01/19	Consented Jun 2012	N/a
Croft Farm (Worcs)	Unlicensed	Defford Aerodrome	50MW	Across and to north of rw 10 approach at 1km from touchdown and 80m north of runway 10 threshold	Consented 10-7-20 Operational	None
Cromer (Norfolk)	Unlicensed	Manor Farm	9.9MW 44760 panels	700m final rw15	Consented Nov 2012 Operational	None
Crowland (Lincs)	Unlicensed	Decoy Farm	5MW	1200m S of rw03 threshold	Consented Aug 2014 Operational	None
Dairy House Farm (Cheshire)	Unlicensed	Dairy House Farm	3.4MW	200m N of rw 12/30	Consented 30-9-15 Operational 27-2-16	Shown on aerodrome chart. No text.
Dunkeswell (Devon)	Licensed	Dunkeswell	2MW	300m N of rw22 threshold	Operational 2015	Shown on aerodrome chart. No text.
Dunsfold (Surrey)	Unlicensed	Dunsfold	1.7MW 8,500 panels	400m N of rw 07 threshold	Operational 2011	Shown on aerodrome chart. No text.
East Midlands (Leics)	Licensed	Kegworth	1.5MW 6000 panels	0.7nm east of threshold rw27	Operational Oct 2015	None
		Marks & Spencer East Midlands Distribution Centre	6.1MW 24272 panels	2.2km north of threshold rw09	Consented 4-4-11; operational March 2015	None
Eastchurch (Kent)	Unlicensed	South Lees Farm	11MW	2.1km W of rw08 threshold	Consented 22-1-14 Operational 22-6-14	Shown on aerodrome chart. No text.

Examples of UK aerodromes with solar farms in proximity						
Aerodrome	***Licensed or unlicensed***	***Solar farm name***	***Capacity/no. of panels***	***Location relative to airfield***	***Date consented/status***	***References to solar farm in AIP/pilots guides***
		Old Rides Farm	8MW	1.6km SE of rw26 threshold	Consented 14-2-13 Operational 15-1-14	Shown on aerodrome chart. No text.
Forwood Farm (Notts)	Unlicensed	West End Farm	13.7MW 55132 panels	500m SE of airfield	Consented 27-2-15 Operational	None
Foston (Lincs)	Unlicensed	Toll Bar Road, Marston	4.4MW	1100m final rw28	Consented 19-5-11 Operational	N/a
Fowlmere (Cambs)	Unlicensed	Black Peak Farm	31.79MW	150m final rw07	Consented 15-12-14 Operational	Shown on aerodrome chart. No text.
		Muncey's Farm	31.6MW	Under base-final turn/joining route rw07	Consented 24-11-14 Operational	None
		Royston	14MW	Under joining route for rw07	Consented 29-10-14 Operational	None
		Bury Lane Fruit Farm	24MW 94,000 panels	Under crosswind/joining route for rw25	Consented 12-5-14 Operational	None
Freshwater (IoW)	Unlicensed	Wilmingham Lane	7MW	300m ENE of thr 17	Consented 12-4-12 Operational 14-3-13	N/a
Goodwood (W Sussex)	Licensed	Westhampnett	7.4MW 26,000 panels	0.6nm final rw32	Operational 2018	None
Harringe Court Farm (Kent)	Unlicensed	Partridge Farm	10.6MW 40,000 panels	950m NW of threshold rw20	Consented on appeal 6-10-15 Operational 2016	N/a
Haverfordwest (Pembs)	Licensed	Rudbaxton	9.9MW 43,348 panels	0.5nm final rw 21	Consented 27-7-12 Operational	None
Heywood Farm (Somerset)	Unlicensed	Grange Farm	4.9MW	1km NE of thr rw 09	Consented 14-1-13 Operational 28-8-13	N/a
Kitty Hawk (E Sussex)	Unlicensed	Laughton Level	7MW 33,000 panels	Along north side of runway 10/28	Consented 13-3-14 Operational	Shown on maps on website; text states "*Solar farm adjacent to NW edge of 10/28.*"

Examples of UK aerodromes with solar farms in proximity						
Aerodrome	***Licensed or unlicensed***	***Solar farm name***	***Capacity/no. of panels***	***Location relative to airfield***	***Date consented/status***	***References to solar farm in AIP/pilots guides***
Laddingford (Kent)	Unlicensed	Paddock Wood	9.2MW	1700m S of threshold rw03	Consented 19-12-14 Operational 2015	None
Lee-on-Solent (Hants)	Licensed	Fareham	17MW 90,000 panels	1100m north of rw 23 threshold	Consented Sep 2013 Operational	None
Little Staughton (Cambs)	Unlicensed	Little Staughton	40MW	On airfield, both sides of runway	Consented 28-9-15 Operational 2019	Shown on aerodrome chart. No text.
Membury (Wilts)	Unlicensed	Membury	17MW	On airfield both sides of rw 13/31	Consented 27-5-14 Operational	Shown on aerodrome chart. No text.
Mitchells Farm (Cambs)	Unlicensed	Mingay Farm	5MW 57120 panels	1500m W of airfield	Consented 9-2-11 Operational	None
		Mingay Farm Extension	17MW 69320 panels	1500m W of airfield	Consented 30-10-13 Operational	None
Newmarket Heath (Suffolk)	Unlicensed	Exning	29.9MW	1100m NW of Rowley Mile rotary airstrip; 1km N of thr 14 (July landing strip)	Consented 4-7-14 Operational 27-3-15	None
Newport City (Upfield Farm) (Newport)	Unlicensed	Llanwern	75MW 187,500 panels	270m final rw23 + 650m N of runway + 1km W of thr rw05	Consented 8-11-18 Operational 1-3-21	N/a
Nottingham (Tollerton) (Notts)	Licensed	Radcliffe	4.2MW	1.6km final rw 21	Consented 14-11-14 Operational 13-6-15	None
		Stragglethorpe Road	5MW	1.5km NE of thr rw 27	Consented 1-12-15 Operational 29-3-16	None
		Cotgrave	4.9MW	1.5km final rw 27	Consented 28-1-15 Operational 15-7-15	None
Old Hay (Kent)	Unlicensed	Paddock Wood	9.2MW	650m SW of threshold rw10	Consented 19-12-14 Operational 2015	Shown on aerodrome chart. No text.
Old Park Farm (Neath Port Talbot)	Unlicensed	Caegarw Farm	4.96MW	800m final rw 36	Consented 17-5-16 Operational	None

Examples of UK aerodromes with solar farms in proximity						
Aerodrome	***Licensed or unlicensed***	***Solar farm name***	***Capacity/no. of panels***	***Location relative to airfield***	***Date consented/status***	***References to solar farm in AIP/pilots guides***
Orston (Notts)	Unlicensed	Lodge Farm	12.4MW	200m SE thr rw 03/ 250m final rw 30	Consented 15-11-13 Operational March 2014	N/a
Park Farm (Newport)	Unlicensed	Lodge Farm	4MW	250m final rw06	Consented Feb 2016 Operational March 2017	N/a
Peterlee (Co Durham)	Unlicensed	Land North Of Mill Hill North West Industrial Estate	5MW 20,000 panels	900m NE of Peterlee airfield	Consented 14-1-16 Operational	None
		BHK (UK)	1.3MW rooftop 2344 panels	850m NE of Peterlee DZ	Consented 18-5-22 Operational	None
RAF Wyton (Cambs)	Unlicensed	Wiggin Hill	10.9MW	2.1km final rw 26	Phase 1 consented 19-2-13 Phase 2 consented 14-2-14 Operational March 2015	None
		Lodge Farm	2.4MW	1.7km N of rw 08G threshold	Consented 5-9-14	None
Rectory Farm (Cambs)	Unlicensed	Caldecote Manor Farm	5MW	1600m west of airstrip	Consented 7-1-15 Operational 24-2-16	None
Rhigos (Rhondda Cynon Taf)	Unlicensed	Hendre Fawr	11.6MW	Immediately south of the airfield	Operational March 2015	Shown on aerodrome chart. No text.
RNAS Yeovilton (Somerset)	Government	Bindwell Lane	10MW	2.2nm final rw26 Yeovilton	Consented 21-1-21	None
		Sutton Montis	5.3MW 22,680 panels	2.5nm final rw26 Yeovilton	Consented 28-1-14 Operational	None
		Southfield Farm	9.47MW	0.8nm final rw26 Yeovilton	Consented 9-7-15 Operational	None
Roche (Cornwall)	Unlicensed	Woodlands Barton	4.5MW 19,776 panels	Immediately north of airfield	Consented 2010 Operational	Shown on aerodrome chart. No text.

Examples of UK aerodromes with solar farms in proximity						
Aerodrome	***Licensed or unlicensed***	***Solar farm name***	***Capacity/no. of panels***	***Location relative to airfield***	***Date consented/status***	***References to solar farm in AIP/pilots guides***
Shacklewell (Rutland)	Unlicensed	Ketton	3MW	1km SE of airfield	Consented 2013 Operational	None
Sherburn in Elmet (N Yorks)	Licensed	Ash Row Farm	5MW	900m N of rw 19/24 thresholds	Operational	None
		Kingspan Insulation	5MW rooftop	800m N of rw06 threshold	Operational	None
St Athan (Glamorgan)	Licensed	Rosedew Farm	5MW	0.9nm final rw 07	Operational March 2016	None
		Llancadle Farm	5MW	1nm final rw 25	Operational Dec 2015	None
		West Hall	7MW	Under downwind/VFR East route	Operational March 2014	None
St Mellion (Cornwall)	Unlicensed	Newton Ferrers	19.5MW 75,168 panels	350m west of the runway	Consented 3-10-14	N/a
Stoke (Kent)	Unlicensed	Malmaynes Hall Farm	12MW	1.3km NW of airfield	Consented 6-11-14 Operational 31-3-15	None
Sywell (Northants)	Licensed	Sywell Road	4MW 30,000 panels	1km final rw23	Operational 2016	None
Thornborough Grounds (Bucks)	Unlicensed	Thornborough Grounds	5MW	150m final rw 24	Operational 2016	Shown on aerodrome chart. No text.
Thruxton	Licensed	Lains Farm	5MW	350m south of airfield boundary	Operational 2016	None
Tilstock (Shrops)	Unlicensed	Tilstock	79,968 panels	On airfield, west of rw 14/32	Consented 30-6-15 Operational	Shown on aerodrome chart. No text.
Tinnell Farm (Cornwall)	Unlicensed	North Wayton Farm	5MW	1km SW of threshold 06	Consented 8-4-13 Operational	N/a
Top Farm (Cambs)	Unlicensed	Manor Farm	21.6MW 82,944 panels	2km final rw24	Consented 20-8-14 Operational	None
Truro (Cornwall)	Unlicensed	Four Burrows	7MW 25,000 panels	800m N of rw14 threshold	Consented 9-7-13 Operational 2015	None

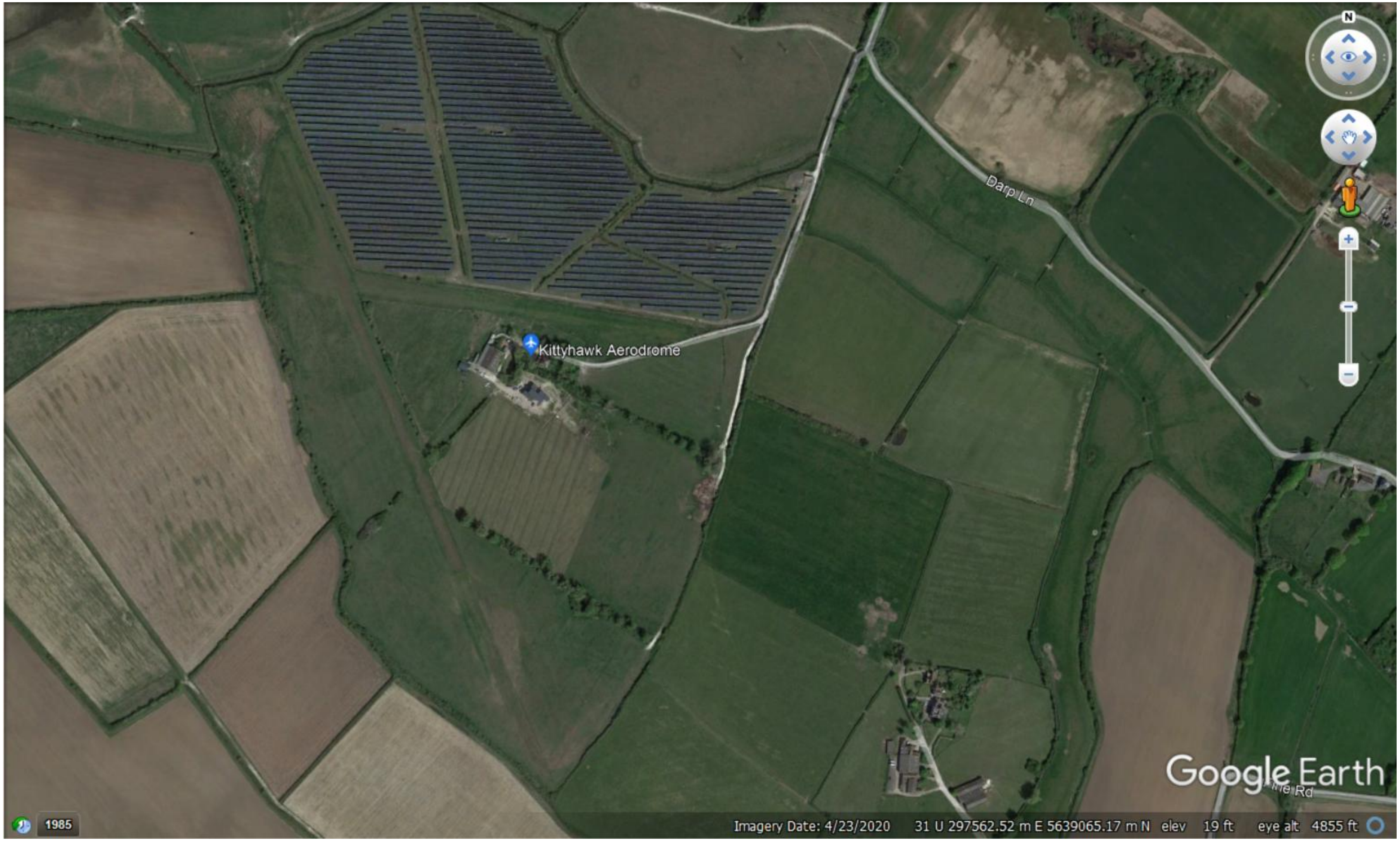
Examples of UK aerodromes with solar farms in proximity						
Aerodrome	***Licensed or unlicensed***	***Solar farm name***	***Capacity/no. of panels***	***Location relative to airfield***	***Date consented/status***	***References to solar farm in AIP/pilots guides***
		Garvinack	7MW	Under downwind for 14/32	Consented 23-5-14 Operational	None
		Causilgey Barton	5MW	Under downwind for 14/32	Consented 10-8-20 Operational	None
Turweston (Bucks)	Unlicensed	Turweston	16MW	Across rw 09 approach at 700m to 200m final	Consented Sep 2013 Operational	Shown on aerodrome chart; text states "*Solar farm on approach to Rwy 09.*"
Upwood (Hunts)	Unlicensed	Bury Green Farm	5MW 16880 panels	1km N of rw23 threshold	Consented Sep 2015 Operational	None
		Land at Biggin Lane	5MW 16880 panels	600m NE of rw23 threshold	Consented Sep 2015 Operational	None
Wadswick Farm (Wilts)	Unlicensed	Wadswick Farm	6.3MW	Immediately south of airfield	Consented 2014 Operational	Shown on aerodrome charts. Website states: "*There is a large solar farm to the south east of the runway.*"
Warton (Lancs)	Licensed	Clifton Marsh Waste Water Treatment Works	3MW	South of final approach 25 at c.1nm	Consented 30-11-18 Operational	None
West Horndon (Essex)	Unlicensed	Fairwind	10MW 40000 panels	1300m final rw24	Consented 25-11-13 Operational	None
West Wales (Ceredigion)	Licensed	Aberporth	1.5MW	900m N of airfield	Consented 24-12-14 Operational	None
		Llwyn Du	8MW	1700m SE of airfield	Consented 2013 Operational Feb 2015	None
Wood Walton (Hunts)	Unlicensed	Abbey Farm	9MW	500m east of runway	Consented 5-9-13 Operational 19-3-14	N/a

ANNEX 1

ANNEX 2

Beccles

ANNEX 2



Kitty Hawk

ANNEX 2

Membury

ANNEX 2

Thruxton

ANNEX 2

Turweston

AVIATICA – COMPANY QUALIFICATIONS AND EXPERIENCE

Aviatica is a trading name of the specialist planning consultancy Gladhouse Planning Ltd. This report was compiled by Malcolm Spaven, founder and director of Gladhouse Planning Ltd.

Mr Spaven holds a Master's degree in Rural and Regional Resources Planning from the University of Aberdeen and an MA (Hons) from the University of Edinburgh. He has served as a Specialist Adviser to the House of Commons Defence Committee and on the Aviation Study Group of the British Wind Energy Association.

Aviatica has been offering specialist services in the assessment and management of the effects of planning developments on defence and aviation since 1996.

The company has been carrying out assessments of the effects of buildings, wind turbines and solar energy developments on aviation for more than 25 years, including proposed developments in the vicinity of a wide range of UK civil and military airfields including Aberdeen, Bedford, Belfast City, Belfast International, Bourn, Broadford, Campbeltown, City of Derry, Clacton, Coventry, Cranfield, Doncaster-Sheffield, Dundee, Durham Tees Valley, Edinburgh, Enniskillen, Fairoaks, Fife, Fishburn, Gamston, Glasgow, Humberside, Inverness, Kinloss, Leeds-Bradford, Lee-on-Solent, London Gatwick, London Heathrow, Lossiemouth, Lydd, Manston, Newcastle, Newquay, Northolt, Norwich, Oban, Prestwick, Scatsta, Southend, Stornoway, Strathaven, Tatenhill, Thruxton, Tingwall, West Freugh, Wick and Woodvale.

Malcolm Spaven is an active light aircraft pilot and flying instructor with 2500 hours flying experience, including 2000 hours instructing on single-engine piston aeroplanes, mostly conducted from Fife Airport, which has three solar PV installations in the vicinity.

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