PAGERPOWER
Urban & Renewables

Solar Photovoltaic Glint and Glare Study

Marden Solar Energy

Origin Power Services Limited

January, 2022

PLANNING SOLUTIONS FOR:

- Solar
- Telecoms
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- Defence
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ADMINISTRATION PAGE

Job reference:	10393A
Date:	18th August 2021
Author:	Andrea Mariano
Telephone:	01787 319001
Email:	andrea@pagerpower.com

Reviewers:	Michael Sutton; Danny Scrivener
Date:	18th August 2021
Telephone:	01787 319001
Email:	michael@pagerpower.com; danny@pagerpower.com

Issue	Date	Detail of Changes
1	18th August 2021	Initial issue
2	6th January 2022	Second issue – Updated layout and modelling
3	24th February 2022	Third issue – Updated screening

Stour Valley Business Centre, Sudbury, Suffolk, CO10 7GB

T: +44 (0)1787 319001 E: info@pagerpower.com W: www.pagerpower.com

EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the possible glint and glare effects from a proposed solar photovoltaic (PV) installation to be located west of Marden in Kent. This assessment pertains to the possible effects upon aviation activity at Old Hay and Laddingford Airfields, railway infrastructure and operations and ground-based receptors such as roads and dwellings.

Assessment Results – Old Hay Aerodrome

The assessment has shown that:

- Solar reflections from the proposed development will have low impact upon pilots approaching thresholds 02, 09 and 20;
- Solar reflections from the proposed development will have moderate impact upon pilots approaching threshold 27. Reflections of this intensity towards an approach must be evaluated in a technical and operational context due to their potential to cause an impact. In this case, assessment the panel area visibility, glare duration and location relative to key operational areas and reflecting services has shown that the impact would be operationally tolerable without mitigation.

Although, a moderate impact is predicted, no mitigation is required due to mitigating factors. The findings of this report should be shared with the aerodrome safeguarding team (see Section 7.1 on page 65).

Assessment Results – Laddingford Aerodrome

The assessment has shown that solar reflections generated from the proposed development will have low impact upon pilots using all approach paths (see Section 7.2 on page 68).

Assessment Results – Dwelling Receptors

The results of the analysis have shown that reflections from the proposed development are geometrically possible towards 45 out of the 49 identified dwelling receptors. When existing obstructions such as vegetation or buildings are considered, no or low impact is predicted for 43 out of these 45 dwelling receptors.

For the remaining two receptors, which are expected to experience glare for more than 3 months per year (but less than 1 hour per day), the impact is expected to be moderate. Some screening, which might eliminate or reduce views of the reflective area has been identified. Furthermore, the developer has proposed screening in the form of vegetation which is expected to fully remove all views of the reflective areas.

Therefore, once mitigation will be implemented the level of impact upon the identified dwelling will be low at maximum and no further mitigation will be necessary (see Section 7.3 on page 68).

Assessment Results – Road Receptors

The results of the analysis have shown that reflections from the proposed development are geometrically possible towards 11 out of the 13 identified road receptors along 1.8km of road. Existing screening in the form of vegetation or buildings will screen solar reflections for all the receptors.

Therefore, no impact is expected, and no mitigation is required (see Section 7.4 on page 71).

Assessment Results – Railway Receptors

Consultation with Network Rails has been initiated on the 11th of August 2021.

Railway Signals

From the review of the available imagery, only one signal has been identified along the assessed section of the railway line. However, the signal faces away from the proposed development therefore any solar reflection would intercept the rear of the signal and will have no impact.

Train Driver Receptors

The results of the analysis have shown that reflections from the proposed development are geometrically possible towards eight out of the 15 identified train driver receptors along 2.1km or railway line. Existing screening in the form of vegetation or buildings will screen solar reflections for all the affected receptors.

Therefore, no impact is expected, and no mitigation is required (see Section 7.5 on page 72).

If Network Rails confirms that there are no signal locations along any of these railway lines, then no impacts would be possible. If railway signals are identified, then this report can be updated, however, based on the level of screening between the railway line and the proposed development, no impacts are predicted.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 51 countries within South Africa, Europe, America, Asia and Australasia.
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:

- Renewable energy projects.
- Building developments.
- 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 glint and glare effects from a proposed solar photovoltaic (PV) installation to be located west of Marden in Kent. This assessment pertains to the possible effects upon aviation activity at Old Hay and Laddingford Airfields, railway infrastructure and operations, and ground-based receptors such as roads and dwellings. A report has therefore been produced that contains the following:

- Details of the proposed solar development;
- Explanation of glint and glare;
- Overview of relevant guidance;
- Overview of relevant studies;
- Identification of aviation concerns and receptors;
- Assessment methodology;
- Glint and glare assessment for:
  - Road receptors;
  - Dwelling receptors;
  - Railway receptors;
  - Aircraft approach paths for the relevant runways.
- Results discussion.

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

Any reference to the visual impact made within this report should be read in the context of potential glint and glare. In addition, this report is solely desk-based and no site visit has taken place.

1.2 Pager Power's Experience

Pager Power has undertaken over 800 Glint and Glare assessments 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 of glint and glare can vary however, the definition used by Pager Power is as follows:

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

These definitions are aligned with those of the Federal Aviation Administration (FAA) in the United States of America. The term 'solar reflection' is used in this report to refer to both reflection types i.e. glint and glare.

2 PROPOSED DEVELOPMENT LOCATION AND DETAILS

2.1 Proposed Development Location

The proposed development is shown in Figure 1[1] below. The location of the proposed development is shown in the aerial image of Figure 2[2] on the following page. Specific details about the solar panel areas assessed (yellow line boundary) within this report can be seen in Section 5 and Appendix G.

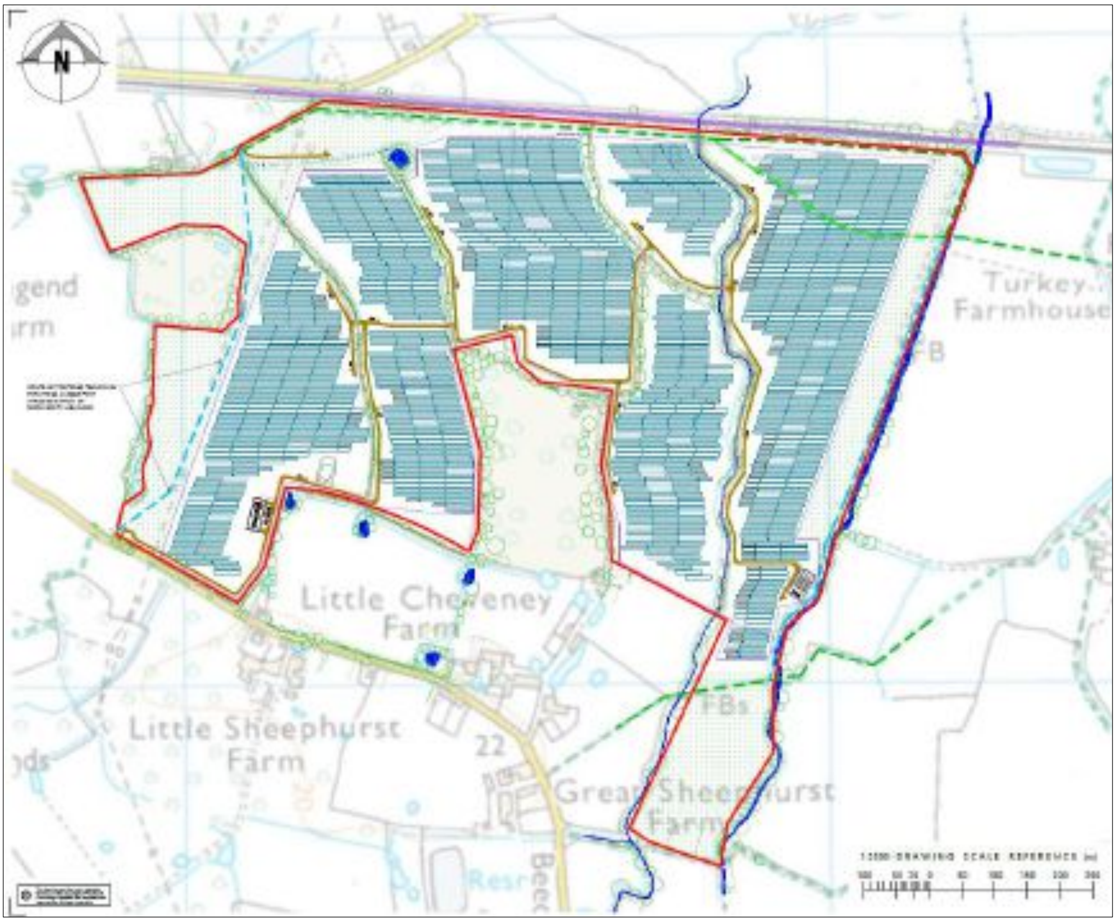

Figure 1 – Proposed solar development

[1] Proposed Solar Farm Site Layout, Proposed Solar Farm, Land North of Sheephurst Lane, Marden, TonbridgeStatkraft, date: 01/22, Drawing No.: 27899/050 B, cropped.
[2] Source: Aerial image copyright © 2021 Google.

Figure 2 – Proposed development red line boundary – aerial image

2.2 Proposed Solar Panel Details

The solar panel details are presented in Table 1[3] below.

Modelled Solar Panel Details	
Azimuth angle (°)	180
Elevation angle (°)	15
Panel centre height (m)	1.84 agl (above ground level)

Table 1 – Assessed panel information

[3] 100 General PV Layout, Statkraft, date: 10/11/21, Drawing No.: SCUKX-MARDN-000 100 (E), modified.

3 GLINT AND GLARE ASSESSMENT METHODOLOGY

3.1 Overview

The following sub-sections provide a general overview with respect to the guidance studies and methodology which informs this report.

3.2 Guidance and Studies

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

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

3.3 Background

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

3.4 Methodology

Information regarding the methodology of Pager Power's and Sandia National Laboratories' methodology is presented below.

3.4.1 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. The methodology for the aviation glint and glare assessment is as follows:

- Identify receptors in the area surrounding the proposed development;
- Consider direct solar reflections from the proposed development towards the identified receptors by undertaking geometric calculations;
- Consider the visibility of the reflectors from the receptor's location. If the reflectors are not visible from the receptor then no reflection can occur;
- Based on the results of the geometric calculations, determine whether a reflection can occur and if so, at what time it will occur, including consideration of its duration;
- Consider the solar reflection intensity, if appropriate;
- Consider both the solar reflection from the proposed development and the location of the direct sunlight with respect to the receptor's position;

- Consider the solar reflection with respect to the published studies and guidance;
- Determine whether a significant detrimental impact is expected in line with Appendix D.

Within the Pager Power model, the reflector area is defined, as well as the relevant receptor locations. The result is a chart that states whether a reflection can occur, the duration and the panels that can produce the solar reflection towards the receptor.

Where a solar reflection is identified for an aviation approach path receptor, intensity calculations are completed in line with the Sandia National Laboratories methodology (discussed in the following section).

3.4.2 Sandia National Laboratories' Methodology

Sandia National Laboratories developed the Solar Glare Hazard Analysis Tool (SGHAT) which is no longer available. Pager Power has since reviewed the Sandia National Laboratories model and is developing its own intensity calculation model in line with Sandia National Laboratories' methodology. Whilst strictly applicable in the USA and to solar photovoltaic developments only, the methodology and associated guidance is widely used by UK aviation stakeholders. The following text is taken from the SGHAT model methodology.

'*This tool determines when and where solar glare can occur throughout the year from a user-specified PV array as viewed from user-prescribed observation points. The potential ocular impact from the observed glare is also determined, along with a prediction of the annual energy production.*'
The result was a chart that states whether a reflection can occur, the duration and predicted intensity for aviation receptors.

Pager Power has undertaken many aviation glint and glare assessments with both models (SGHAT and Pager Power's) producing similar results. Therefore, where the Pager Power geometrical analysis indicates that a solar reflection is geometrically possible, an intensity calculation in line with Sandia National Laboratories' methodology has also been completed[4].

3.5 Railway Specific Methodology

The specific parameters for a railway glint and glare assessment are presented below:

- Does the solar reflection originate from within a train driver's field of view i.e. 30 degrees either side of the railway line with respect to the direction of travel?
- Will a train driver require sight of a signal from within the solar reflection zone?
- Does the façade capable of producing a solar reflection represent a significant proportion of the façade as a whole e.g. more than 50%?
- Does the solar reflection occur towards a complex section of railway line where, for example:
    - there are multiple lines with switches/points?
    - a station is present?

[4] Currently using the Forge Solar model, based on the Sandia methodology.

    - signals are present?
    - road or pedestrian crossings are present?
- Does the solar reflection last for a significant period of time?
- Is the proposed development in keeping with those around it and near to the assessed railway line?

If a solar reflection is possible and occurs under significant conditions as outlined above, intensity calculations may be requested. These must consider the façade composition i.e. the size of the individual reflectors.

3.6 Assumptions and Limitations

Key assumptions and limitations regarding the analysis in this report are listed below:

- The screening at the site boundary or anywhere between the railway line and the development is not included within the modelling output – which considers only the relative heights and geometric relationship between the Sun and the modelled reflectors. The actual predicted visibility is considered when classifying a potential impact following the modelling;
- The assessment assumes that a view of the entire reflector area is possible from the receptor location when in reality this may not occur. A solar reflection can only be experienced by a receptor where the source of the reflection is visible;
- Whilst there are windows on each floor of the development, each is separated by masonry/cladding. The greatest potential for impact is from the more reflective glass façades. It is predicted that approximately 10% of the modelled façade surfaces are capable of producing a specular reflection;
- Additional railway signals may exist however only those visible through the review of available imagery are assessed within this report.

Considering the first three bullets, the modelling is output is therefore conservative and further interpretation of the results is required to provide a more accurate result and determine any impact (see Section 8). Further assumptions and limitations are presented in Appendix E.

4 IDENTIFICATION OF RECEPTORS

4.1 Aviation Receptors – Approaching Aircraft

It is Pager Power's methodology to assess whether a solar reflection can be experienced on the approach paths for the associated runways. This is considered to be the most critical stage of the flight. Old Hay and Laddingford Airfields have two operational runways each with two associated approach paths, one for each bearing.

A geometric glint and glare assessment has been undertaken for all aircraft approach paths for each runway. The Pager Power approach for determining receptor (aircraft) locations on the approach path is to select locations along the extended runway centre line from 50ft above the runway threshold out to a distance of 2 miles. The height of the aircraft is determined by using a 3-degree descent path relative to the runway threshold height for approach paths:

- 02/20 and 09/27 for Old Hay Airfield;
- 02/20 and 10/28 for Laddingford Airfield.

The receptor details for each runway approach are presented in Appendix G.

Figure 3 on the following page shows the assessed aircraft receptor locations as radial icons.

Figure 3 – Identified Airfields: runway approach receptor locations – aerial image

4.2 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.

The above parameters and extensive experience over a significant number of glint and glare assessments undertaken, shows that a 1km assessment area from the proposed development is considered appropriate for glint and glare effects on ground-based receptors. Reflections towards ground-based receptors located further north than any proposed panel are highly unlikely. Therefore, receptors north of the panel areas have not been modelled. The assessment area (white outlined area in the proceeding figure) has been designed accordingly as a 1km from the assessed solar panel areas, disregarding the area to the north of the north-most solar panels.

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

Receptor details can be found in Appendix G.

4.2.1 Dwellings Receptors

The analysis has considered dwellings that:

- Are within one kilometer of the proposed development; and
- Have a potential view of the panels.

In total, 50 dwelling receptors points[5] have been identified for the assessment. The assessed dwellings are shown in Figure 4[6], Figure 5, Figure 6, Figure 7, Figure 8 and Figure 9 on the following pages. A height above ground level of 1.8 metres has been taken as the typical eye level for an observer on the ground floor of each dwelling[7].

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[5] The co-ordinates of the dwelling receptor points are presented in Appendix G.

[6] Source: Copyright © 2021 Google.

[7] In the results discussion the views from each floor have been considered. Glint and glare modelling results are not expected to change depending on the floor.

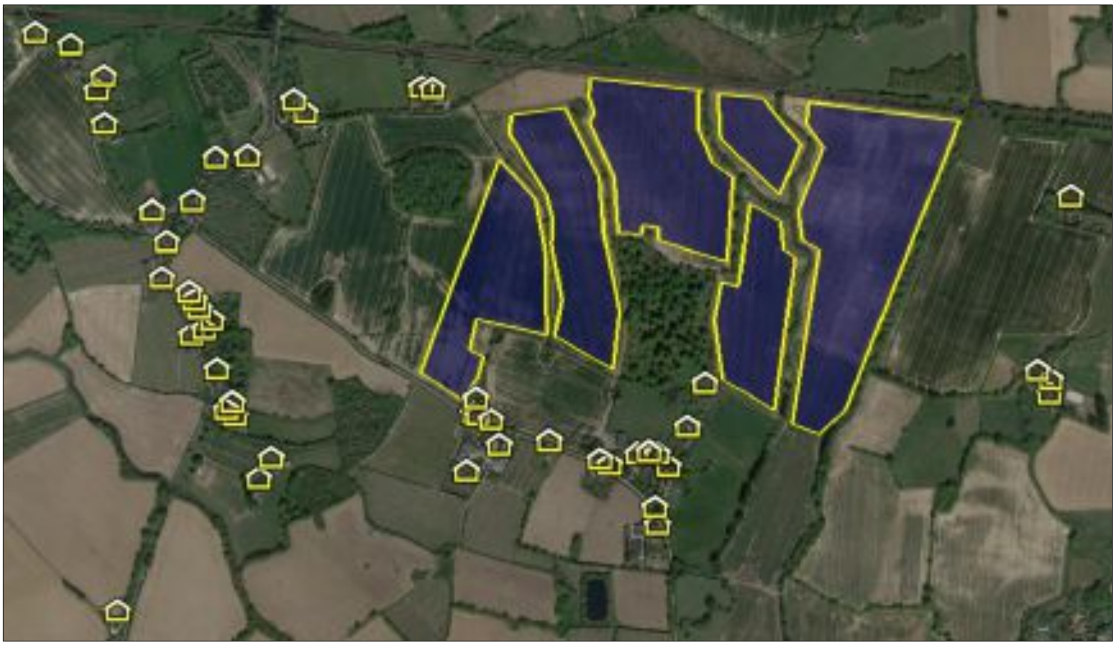

Figure 4 – Dwelling locations

Figure 5 – Dwellings location 1 to 8 and 23 to 28

Figure 6 – Dwelling location 8 to 21

Figure 7 – Dwelling location 22

Figure 8 – Dwelling location 29 to 45

Figure 9 – Dwelling location 46 to 49

4.3 Road Receptors

Road types can generally be categorised as:

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

Most of the roads surrounding the proposed development are considered local roads where traffic densities are likely to be relatively low. Local roads have not been taken forward for geometric modelling as any solar reflections from the proposed development that are experienced by a road user would be considered low impact in accordance with the guidance presented in Appendix D.

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

- Are within one kilometre of the proposed development;
- Have a potential view of the panels.

One major road has been identified for the assessment (see Figure 10[8] on the following page): Maidstone Road (green line – receptors 1 to 13[9]). The assessed road receptor points are shown as white icons in Figure 10. A height above ground level of 1.5 metres has been taken as a typical eye level for a road user for all roads.

[8] Source: Copyright © 2021 Google.

[9] The co-ordinates of the road receptor points are presented in Appendix G.

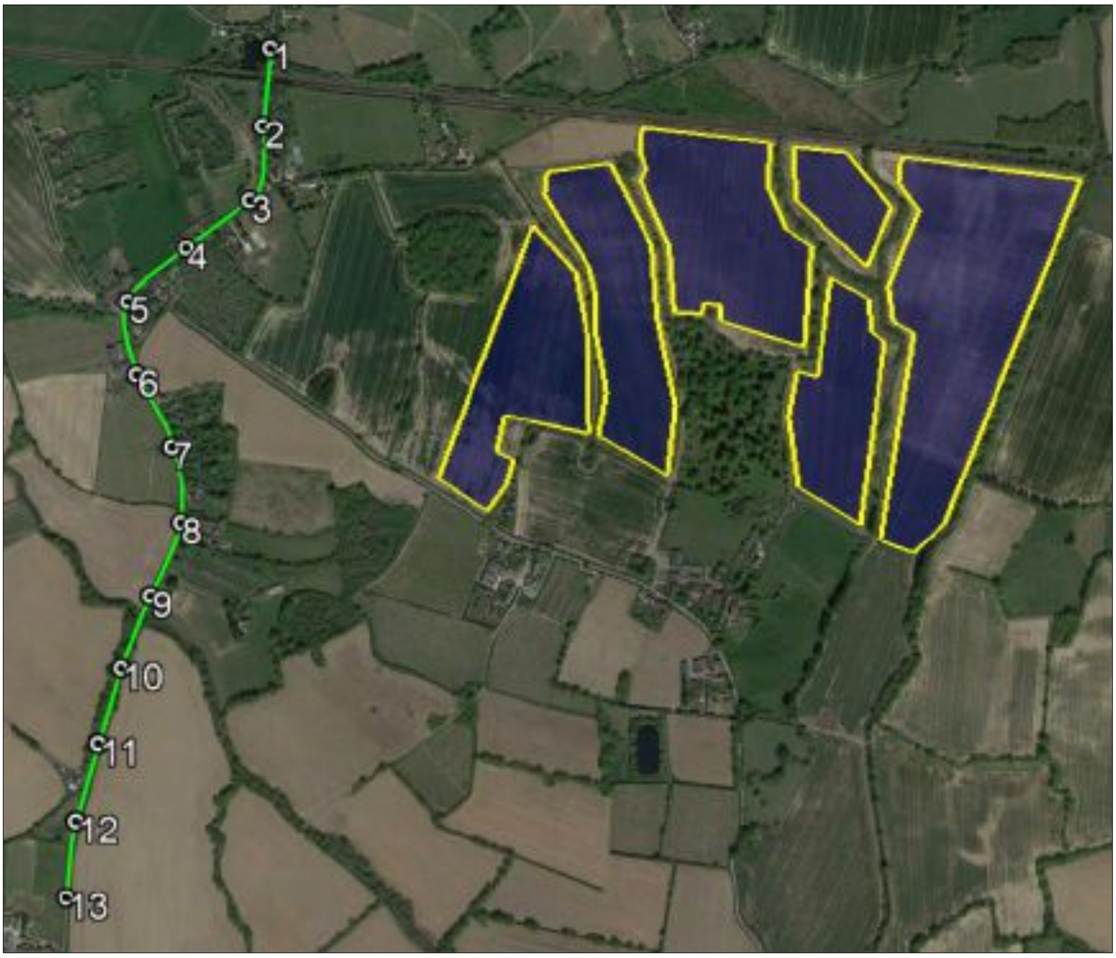

Figure 10 – Assessed road receptors

4.4 Railway Receptors

4.4.1 Common Concerns and Signal 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; and
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.[10]*'*

4.4.2 Railway Signals

The analysis has considered railway signal receptors[11] that:

- Are within 500 metres of the proposed development;
- Have a potential view of the panels.

From the review of the available imagery, only one signal has been identified along the assessed section of railway line are shown in Figure 11[12] on the following page. However, the signal faces away from the proposed development (see Figure 11[13]) therefore any solar reflection will intercept the rear of the signal and will have no impact. Consultation with Network Rails has been initiated on the 11th of August 2021. If Network Rails confirms that there are no signal locations along any of these railway lines, then no impacts would be possible[14]. If railway signals are identified, then this report can be updated, however based on the level of screening between the railway line and the proposed development, no impacts are predicted.

[10] Source: Glossary of Signalling Terms, Railway Group Guidance Note GK/GN0802. Issue One. Date April 2004.
[11] Pager Power has requested the railway signal information from Network Rail; however, no response has been received to date. This report will be updated if railway signals are identified by Network Rail.
[12] Copyright © 2021 Google.
[13] Copyright © 2021 Google.
[14] Pager Power requested the signal details from Network Rail in August 2021.

Figure 11 – Identified railway signal receptor

Figure 12 – Signal 1 and relative location of the proposed development

4.4.3 Train Driver Receptors

The analysis has considered train driver receptors that:

- Are within 500 metres of the proposed development;
- Have a potential view of the panels.

The assessed train driver receptor points along the assessed section of railway line are shown in Figure 13[15] below. Based on previous consultation[16], a train driver's eye level is typically 2.75m above rail level. This height has therefore been added to the ground height at each receptor location.

Figure 13 – Train Drivers locations

[15] Source: Google Earth Copyright © 2021.

[16] Consultation undertaken with Network Rail in the UK.

5 ASSESSED REFLECTOR AREAS

5.1 Overview

The following section presents the modelled reflector areas.

5.2 Reflector Areas

A number of representative panel locations are selected within the proposed reflector areas. The number of modelled reflector points being determined by the size of the reflector areas and the assessment resolution. The bounding co-ordinates for the proposed solar development have been extrapolated from the site maps. All ground heights and panel elevation data has been provided by the developer. The data can be found in Appendix G.

A resolution of 10m has been chosen for this assessment. This means that a geometric calculation is undertaken for each identified receptor every 10m from within the defined areas. This resolution is sufficiently high to maximise the accuracy of the results – increasing the resolution further would not significantly change the modelling output.

The reflector areas assessed are shown in Figure 14[17] below (defined by the red lines). The areas have been overlaid on aerial imagery.

Figure 14 – Assessed reflector areas

[17] Source: Aerial image copyright © 2021 Google.

6 GLINT AND GLARE ASSESSMENT RESULTS

6.1 Overview

The following section presents an overview of the glare for the identified receptors. The Pager Power model has been used initially. Where solar reflections have been predicted, intensity calculations in line with Sandia National Laboratories' methodology have been undertaken. The intensity calculations determine the potential for an after-image (or worse) occurring. The designation used by the model is presented in Table 2 below along with the associated colour coding.

Coding Used	Intensity Key
Glare beyond 50°	Glare beyond 50 deg from pilot line-of-sight
Low potential	Low potential for temporary after-image
Potential	Potential for temporary after-image
Potential for permanent eye damage	Potential for permanent eye damage

Table 2 – *Glare intensity designation*

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

In addition, the intensity model allows for assessment of a variety of solar panel surface materials. In the first instance, a surface material of 'smooth glass without an anti-reflective coating' is assessed. This is the most reflective surface and allows for a 'worst case' assessment. Other surfaces that could be modelled include:

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

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

The tables in the following subsections summarise the time (am or pm) and intensity for a solar reflection be experienced by a receptor. Appendix H presents the results charts.

6.2 Geometric Calculation Results Overview – Runway 27 Approach – Old Hay Aerodrome

The results of the geometric calculation for the aviation receptors are presented in Table 3 below. Discussed in Section 7.1.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
Threshold – 0.1 miles	None.	None.	None.	Solar reflections are not geometrically possible.
0.2 miles	At circa 06:12 during mid-March. At circa 05:53 during the end of September.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
0.3 miles	Between 06:13 and 06:16 during mid- March. Between 05:53 and 05:55 during the beginning of October.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
0.4 miles	Between 06:14 and 06:19 during mid- March. Between 05:54 and 05:57 during the end of September.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
0.5 miles	Between 06:15 and 06:23 during mid- March. Between 05:55 and 06:01 from late September to early October.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
0.6 miles	Between 06:16 and 06:28 from early March to mid-March. Between 05:57 and 06:04 from late September to early October.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
0.7 miles	Between 06:17 and 06:34 from the beginning of March to late March. Between 05:58 and 06:09 from late September to mid- October.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
0.8 miles	Between 06:19 and 06:41 from late February to late March. Between 06:00 and 06:14 from mid- September to mid- October.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
0.9 miles	Between 06:20 and 06:54 from late February to late March. Between 06:02 and 06:26 from mid- September to late October.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
1.0 mile	Between 06:21 and 07:13 from mid- February to the beginning of April. Between 06:04 and 06:43 from mid- September to the end of October.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
1.1 miles	Between 06:23 and 07:42 from late January to mid- April. Between 06:07 and 07:15 from the beginning of September to mid- November.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
1.2 miles	Between 06:25 and 08:28 from the beginning of January to late April. Between 06:11 and 08:26 from late August to the end of December.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
1.3 miles	Between 06:28 and 10:19 from the beginning of January to early June. Between 06:15 and 09:59 from early July to the end of December.	None.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
1.4 miles	Between 00:00 and 11:59 from the beginning of January to the end of December.	Between 13:12 and 14:07 from early January to late February. Between 13:02 and 13:34 from the beginning of April to late April. At circa 13:02 during early May. Between 13:05 and 13:21 during late May. Between 13:13 and 13:31 during mid- July. Between 13:02 and 13:35 from early August to the end of August. Between 13:05 and 13:50 from mid- October to the end of December.	"Green" with low potential for after-image.	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.5 miles	Between 00:04 and 11:59 from the beginning of January to the end of December.	Between 13:01 and 16:10 from the beginning of January to the end of December.	"Green" with low potential for after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
1.6 miles	Between 00:01 and 11:59 from the beginning of January to the end of December.	Between 13:00 and 16:53 from the beginning of January to the end of December.	"Yellow" glare with potential to cause temporary after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
1.7 miles	Between 00:00 and 11:59 from the beginning of January to the end of December.	Between 13:00 and 17:11 from the beginning of January to the end of December.	"Yellow" glare with potential to cause temporary after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
1.8 miles	Between 00:00 and 11:59 from the beginning of January to the end of December.	Between 13:06 and 17:22 from the beginning of January to the end of December.	"Yellow" glare with potential to cause temporary after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.
1.9 miles	Between 00:00 and 11:59 from mid- January to the beginning of January.	Between 13:00 and 17:33 from the beginning of January to the end of December.	"Yellow" glare with potential to cause temporary after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
2.0 miles	Between 00:51 and 00:52 from late April to mid- May. Between 00:43 and 00:55 during early June. At circa 00:49 during early July. At circa 00:58 during mid- August.	Between 13:00 and 17:38 from the beginning of January to the end of December.	"Yellow" glare with potential to cause temporary after-image.	Solar reflections with potential for after-image are geometrically possible. Moderate impact is predicted.

Table 3 – Geometric analysis results for the aviation receptors – Runway 27 Approach

6.3 Geometric Calculation Results Overview – Runway 09 Approach – Old Hay Aerodrome

The results of the geometric calculation for the aviation receptors are presented in Table 4 below. Discussed in Section 7.1.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
Threshold – 2.0 miles	None.	None.	None.	Solar reflections are not geometrically possible.

Table 4 – Geometric analysis results for the aviation receptors – Runway 09 Approach

6.4 Geometric Calculation Results Overview – Runway 20 Approach – Old Hay Aerodrome

The results of the geometric calculation for the aviation receptors are presented in Table 5 below. Discussed in Section 7.1.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
Threshold – 2.0 miles	None.	None.	None.	Solar reflections are not geometrically possible.

Table 5 – Geometric analysis results for the aviation receptors – Runway 20 Approach

6.5 Geometric Calculation Results Overview – Runway 02 Approach – Old Hay Aerodrome

The results of the geometric calculation for the aviation receptors are presented in Table 6 below. Discussed in Section 7.1.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
Threshold	Between 05:55 and 06:07 from mid- March to the beginning of April. Between 05:47 and 05:51 from mid-September to late September.	None.	"Green" with low potential for after-image.	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
0.1 miles	Between 05:49 and 06:09 from mid- March to early April. Between 05:47 and 05:52 from the beginning of September to the end of September.	None.	"Green" with low potential for after-image.	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
0.2 miles	Between 05:43 and 06:11 from mid- March to mid-April. Between 05:45 and 05:53 from late August to the end of September.	None.	"Green" with low potential for after-image.	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
0.3 miles	Between 05:38 and 06:11 from mid- March to late April. Between 05:44 and 05:53 from mid- August to the end of September.	None.	"Green" with low potential for after-image.	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
0.4 miles	Between 05:33 and 06:06 from late March to early May. Between 05:42 and 05:52 from mid- August to late September.	None.	“Green” with low potential for after-image.	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
0.5 miles	Between 05:29 and 06:01 from late March to mid- May. Between 05:39 and 05:52 from the beginning of August to mid- September.	None.	“Green” with low potential for after-image.	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
0.6 miles	Between 05:26 and 05:57 from the beginning of April to late May. Between 05:36 and 05:51 from late July to early September.	None.	“Green” with low potential for after-image.	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
0.7 miles	Between 05:25 and 05:52 from early April to early June. Between 05:32 and 05:50 from mid- July to the beginning of September.	None.	“Green” with low potential for after-image.	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
0.8 miles	Between 05:25 and 05:49 from mid- April to the end of August.	None.	“Green” with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
0.9 miles	Between 05:24 and 05:48 from late April to late August.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.0 mile	Between 05:24 and 05:46 from late April to mid- August.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.1 miles	Between 05:25 and 05:45 from the beginning of May to mid- August.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.2 miles	Between 05:26 and 05:43 from mid- May to early August.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.3 miles	Between 05:26 and 05:41 from mid- May to the end of July.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
1.4 miles	Between 05:27 and 05:38 from late May to late July.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.5 miles	Between 05:27 and 05:35 from the beginning of June to early July.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.6 – 2.0 miles	None.	None.	None.	Solar reflections are not geometrically possible.

Table 6 – Geometric analysis results for the aviation receptors – Runway 02 Approach

6.6 Geometric Calculation Results Overview – Runway 10 Approach – Laddingford Aerodrome

The results of the geometric calculation for the aviation receptors are presented in Table 7 below. Discussed in Section 7.2.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
Threshold – 2.0 miles	None.	None.	None.	Solar reflections are not geometrically possible.

Table 7 – Geometric analysis results for the aviation receptors – Runway 10 Approach

6.7 Geometric Calculation Results Overview – Runway 28 Approach – Laddingford Aerodrome

The results of the geometric calculation for the aviation receptors are presented in Table 8 below. Discussed in Section 7.2.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
Threshold – 2.0 miles	None.	None.	None.	Solar reflections are not geometrically possible..

Table 8 – Geometric analysis results for the aviation receptors – Runway 28 Approach

6.8 Geometric Calculation Results Overview – Runway 02 Approach – Laddingford Aerodrome

The results of the geometric calculation for the aviation receptors are presented in Table 9 below. Discussed in Section 7.2.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
Threshold – 0.8 miles	None.	None.	None.	Solar reflections are not geometrically possible.
0.9 miles	Between 06:13 and 06:16 during mid- March. Between 05:54 and 05:55 during the end of September.	None.	“Green” with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.0 mile	Between 06:09 and 06:17 from mid- March to late March. Between 05:53 and 05:56 from late September to the beginning of October.	None.	“Green” with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.1 miles	Between 06:06 and 06:18 from mid- March to late March. Between 05:53 and 05:57 from mid- September to early October.	None.	“Green” with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.2 miles	Between 06:02 and 06:19 from mid- March to the end of March. Between 05:53 and 05:57 from mid- September to early October.	None.	“Green” with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
1.3 miles	Between 05:58 and 06:18 from mid- March to the beginning of April. Between 05:52 and 05:58 from early September to the beginning of October.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.4 miles	Between 05:55 and 06:14 from mid- March to early April. Between 05:52 and 05:57 from early September to the end of September.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.5 miles	Between 05:51 and 06:11 from mid- March to mid-April. Between 05:51 and 05:56 from the end of August to late September.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.6 miles	Between 05:48 and 06:08 from late March to mid- April. Between 05:50 and 05:56 from late August to late September.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.7 miles	Between 05:45 and 06:05 from late March to late April. Between 05:49 and 05:55 from late August to mid-September.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
1.8 miles	Between 05:42 and 06:02 from the end of March to late April. Between 05:48 and 05:54 from mid- August to mid- September.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
1.9 miles	Between 05:40 and 05:59 from early April to the end of April. Between 05:47 and 05:54 from mid- August to early September.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.
2.0 miles	Between 05:37 and 05:56 from early April to early May. Between 05:46 and 05:53 from early August to early September.	None.	"Green" with low potential for after-image	Solar reflections with low potential for after-image are geometrically possible. Low impact is predicted.

Table 9 – Geometric analysis results for the aviation receptors – Runway 02 Approach

6.9 Geometric Calculation Results Overview – Runway 20 Approach – Laddingford Aerodrome

The results of the geometric calculation for the aviation receptors are presented in Table 10 below. Discussed in Section 7.2.

Receptor	Reflection possible toward the identified aviation receptors? (GMT)		Glare Type	Reflection Predicted
	am	pm		
Threshold – 2.0 miles	None.	None.	None.	Solar reflections are not geometrically possible.

Table 10 – Geometric analysis results for the aviation receptors – Runway 20 Approach

6.10 Geometric Calculation Results Overview – Dwelling Receptors

The results of the geometric calculations for the identified dwelling receptors are presented in Table 11 below. Discussed in Section 7.3.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
1 – 2	None.	None.	Solar reflections are not geometrically possible.
3	Between 06:01 and 06:03 during late March. Between 05:47 and 05:49 during late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
4	Between 05:58 and 06:04 during late March. Between 05:47 and 05:49 during late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
5	Between 05:49 and 06:04 from late March to early April. Between 05:45 and 05:49 from early September to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
6	Between 05:27 and 06:04 from late March to early May. Between 05:36 and 05:49 from early August to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
7	Between 05:26 and 06:04 from mid- March to mid- May. Between 05:36 and 05:49 from the beginning of August to late September.	None.	Solar reflections are geometrically possible. Views of the proposed development might be possible, however the separation distance between the proposed development and the dwelling is greater than 600m. Low impact predicted.
8	Between 05:20 and 06:04 from late March to late May. Between 05:29 and 05:49 from mid- July to late September.	None.	Solar reflections are geometrically possible. Views of the proposed development might be possible, however the separation distance between the proposed development and the dwelling is greater than 600m. Low impact predicted.
9	Between 05:18 and 06:04 from mid- March to late September.	None.	Solar reflections are geometrically possible. Views of the proposed development might be possible, however the separation distance between the proposed development and the dwelling is greater than 600m. Low impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
10	Between 05:18 and 06:04 from late March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
11	Between 05:18 and 06:05 from mid- March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
12	Between 05:18 and 06:04 from late March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
13	Between 05:18 and 06:04 from mid- March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
14	Between 05:18 and 06:04 from late March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
15	Between 05:18 and 06:04 from mid- March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
16	Between 05:17 and 06:04 from late March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
17	Between 05:18 and 06:04 from mid- March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
18	Between 05:18 and 06:04 from mid- March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
19	Between 05:18 and 06:04 from mid- March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
20	Between 05:18 and 05:56 from the end of March to mid- September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
21	Between 05:18 and 05:52 from the beginning of April to early September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
22	Between 05:19 and 05:40 from the end of April to mid- August.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
23	Between 05:36 and 06:04 from late March to late April. Between 05:41 and 05:49 from mid- August to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
24	Between 05:33 and 06:04 from mid- March to late April. Between 05:40 and 05:49 from mid- August to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
25	Between 05:50 and 06:04 from late March to early April. Between 05:45 and 05:49 from early September to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
26	Between 05:46 and 06:04 from mid- March to mid- April. Between 05:44 and 05:49 from the end of August to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
27	Between 05:48 and 06:05 from mid- March to early April. Between 05:45 and 05:49 from early September to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
28	Between 05:46 and 06:05 from mid- March to mid- April. Between 05:44 and 05:49 from the beginning of September to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
29	Between 05:19 and 06:06 from mid- March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
30	Between 05:19 and 06:05 from late March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
31	Between 05:19 and 06:05 from mid- March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
32	Between 05:19 and 06:05 from mid- March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
33	Between 05:19 and 05:48 from early April to the beginning of September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
34	Between 05:20 and 05:56 from the end of March to mid-September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
35	Between 05:20 and 05:54 from the beginning of April to mid-September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
36	Between 05:20 and 05:45 from mid- April to the end of August.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
37	Between 05:20 and 05:44 from mid- April to late August.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
38 – 39	None.	None.	Solar reflections are not geometrically possible.
40	Between 05:20 and 05:45 from mid- April to the end of August.	Between 18:26 and 18:40 from mid- May to late July.	Solar reflections are geometrically possible. Some existing screening in the form of vegetation or other building has been identified. Low impact predicted.
41	Between 05:20 and 05:45 from mid- April to the end of August.	Between 18:23 and 18:40 from mid- May to the beginning of August.	Solar reflections are geometrically possible. Some existing screening in the form of vegetation or other building has been identified. Low impact predicted.
42	Between 05:20 and 05:44 from mid- April to late August.	Between 18:23 and 18:40 from mid- May to the end of July.	Solar reflections are geometrically possible. Some existing screening in the form of vegetation or other building has been identified. Low impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
43	Between 05:20 and 06:00 from late March to mid- September.	Between 18:14 and 18:41 from mid- April to the end of August.	Solar reflections are geometrically possible. Some existing screening in the form of vegetation has been identified. Moderate impact predicted.
44	Between 05:19 and 06:05 from late March to late September.	Between 17:55 and 18:41 from late March to late September.	Solar reflections are geometrically possible. Some existing screening in the form of vegetation has been identified. Moderate impact predicted.
45	Between 05:21 and 05:40 from the beginning of May to mid-August.	Between 18:27 and 18:40 from mid- May to late July.	Solar reflections are geometrically possible. Some existing screening in the form of vegetation or other building has been identified. Low impact predicted.
46	None.	Between 17:52 and 18:41 from mid- March to late September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
47	None.	Between 17:53 and 18:41 from late March to late September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified dwelling receptors? (GMT)		Reflection Predicted
	am	pm	
48	None.	Between 17:53 and 18:41 from late March to late September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
49	None.	Between 17:52 and 18:40 from mid- March to late September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Table 11 – Geometric analysis results for the identified dwelling receptors

6.11 Geometric Calculation Results Overview – Roads Receptors

The results of the geometric calculations for the identified road receptors are presented in Table 12 below. Discussed in Section 7.4.

Receptor	Reflection possible toward the identified road receptors? (GMT)		Reflection Predicted
	am	pm	
1 – 2	None.	None.	Solar reflections are not geometrically possible.
3	Between 05:42 and 06:04 from late March to mid- April. Between 05:43 and 05:49 from the end of August to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
4	Between 05:34 and 06:04 from mid- March to late April. Between 05:40 and 05:49 from mid- August to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
5	Between 05:26 and 06:04 from late March to early May. Between 05:36 and 05:49 from early August to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
6	Between 05:18 and 06:04 from late March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified road receptors? (GMT)		Reflection Predicted
	am	pm	
7	Between 05:17 and 06:03 from late March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
8	Between 05:18 and 06:04 from mid- March to late September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
9	Between 05:17 and 05:58 from late March to mid-September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
10	Between 05:18 and 05:47 from early April to the beginning of September.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
11	Between 05:18 and 05:41 from late April to late August.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified road receptors? (GMT)		Reflection Predicted
	am	pm	
12	Between 05:18 and 05:37 from early May to early August.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
13	Between 05:19 and 05:31 from late May to late July.	None.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Table 12 – Geometric analysis results for the identified road receptors along Maidstone Road

6.12 Geometric Calculation Results Overview – Railway Receptors

The results of the geometric calculations for the identified train drivers receptors are presented in Table 13 below. Discussed in Section 7.5.

Receptor	Reflection possible toward the identified railway receptors? (GMT)		Reflection Predicted
	am	pm	
1 – 6	None.	None.	Solar reflections are not geometrically possible.
7	None.	At circa 18:06 during late March.	

Receptor	Reflection possible toward the identified railway receptors? (GMT)		Reflection Predicted
	am	pm	
8	None.	Between 18:07 and 18:08 during late March. Between 17:52 and 17:58 during mid- September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
9	None.	Between 18:07 and 18:09 during late March. Between 17:53 and 17:59 during mid- September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
10	None.	Between 18:06 and 18:09 from mid- March to the end of March. Between 17:52 and 18:00 from mid- September to late September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
11	None.	Between 18:05 and 18:09 from mid- March to the end of March. Between 17:48 and 18:02 from mid- September to late September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
12	None.	Between 18:06 and 18:10 from mid- March to the end of March. Between 17:51 and 18:02 from mid- September to late September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Receptor	Reflection possible toward the identified railway receptors? (GMT)		Reflection Predicted
	am	pm	
13	None.	Between 18:06 and 18:10 from mid- March to the beginning of April. Between 17:50 and 18:03 from mid-September to late September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
14	None.	Between 18:06 and 18:10 from mid- March to the beginning of April. Between 17:51 and 18:03 from mid-September to late September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.
15	None.	Between 18:06 and 18:10 from mid- March to the beginning of April. Between 17:51 and 18:03 from mid-September to late September.	Solar reflections are geometrically possible. Existing screening in the form of vegetation has been identified. No impact predicted.

Table 13 – Geometric analysis results for the identified train driver receptors

7 GEOMETRIC ASSESSMENT RESULTS AND DISCUSSION

7.1 Aviation Receptors - Old Hay Aerodrome

The assessment has shown that:

- Solar reflections are not possible for planes approaching threshold 09 and 20;
- Solar reflections with low potential for after-image ("green" glare) are possible towards planes approaching threshold 02;
- Solar reflections with potential for after-image ("yellow" glare) are possible towards planes approaching threshold 27.

Solar reflections with potential for temporary after-image are geometrically possible towards planes approaching threshold 27 (the areas generating solar reflection with potential for after-image are shown in Figure 15[18] below). These solar reflections are expected to occur between 2.0 miles to 1.6 miles from the threshold between mid-October to the end of March between 14:30 and 16:20 lasting for a maximum of 20 minutes per day.

Figure 15 – Sections of the proposed development which will generate yellow glare and relative section of the approach path affected

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Pager Power recommends a pragmatic approach when glare for potential for after-image within its guidance document. Therefore, the following should be considered:

1. Visibility of the solar panel areas;
2. The glare duration;
3. Glare location relative to key operational areas;
4. Existing reflecting surfaces.

7.1.1 Visibility of the solar panel areas

The area generating glare with potential for after-image will be within the primary field of view (50° on each side considering the direction of travel) of the pilots from the 2.0 miles to the 1.6 miles from the approach path; however, they will not be directly in front of the pilots (see Figure 16[19], Figure 17 below and Figure 18 on the following page).

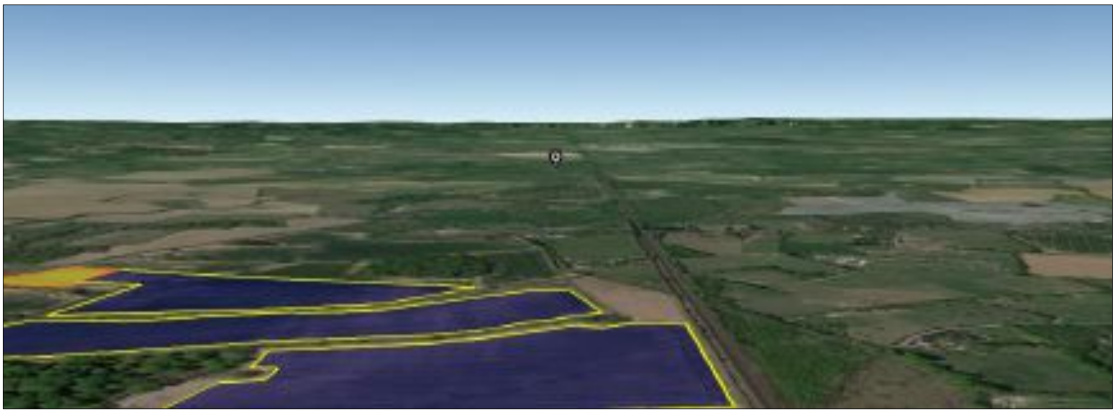

Figure 16 – Visibility of proposed development from 2.0miles from approach 27

Figure 17 – Visibility of proposed development from 1.9 miles from approach 27

[19] Copyright © 2022 Google.

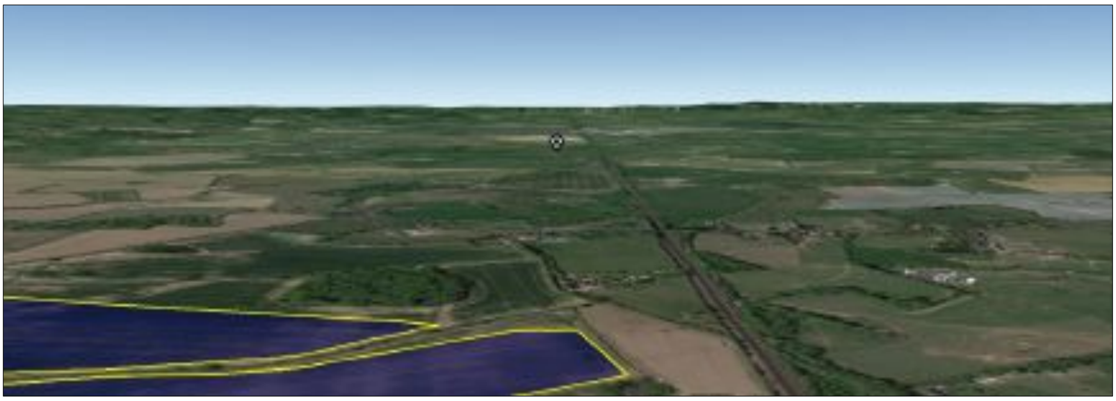

Figure 18 – Visibility of proposed development from 1.8 miles from approach 27

7.1.2 The glare duration

Solar reflections with potential for temporary after-image is to last up to 2690 minutes per year (equivalent to 1% of daylight time per year – this considering 12 hours and 11 minutes of daylight per day). Sun light and reflections will always generate from approximately the same point in space (see Figure 11 and Figure 12 below).

7.1.3 Glare location relative to key operational areas

As previously discussed (Section 7.1.1 on page 66) glare will not be generating directly in front of pilots approaching threshold 27. Furthermore, glare will be generated from a portion of the proposed development located 2.1km east of threshold 27.

7.1.4 Existing reflecting surfaces.

Another existing solar development (see Figure 19 below) is located nearby the Old Hay Airfield. It is extremely likely that this solar development will generate the same type of glare (with potential for after-image) towards pilots approaching Old Hay Airfield.

Figure 19 – Other large reflective areas near Old Hay airfield

Therefore, moderate impact is predicted upon pilots approaching threshold 27. Although mitigation is a requirement for this impact magnitude when all mitigating factors such as visibility of the solar panel areas, glare duration, glare location relative to key operational areas and existing reflecting surfaces are considered it can be concluded that mitigation is not a requirement. Therefore, the results of this report should be discussed with Old Hay's safeguarding team.

7.2 Aviation Receptors – Laddingford Aerodrome

The assessment has shown that:

1. Solar reflections are not possible for planes approaching threshold 10, 20 and 28;
2. Solar reflections are possible towards planes approaching threshold 02 however they will have a low potential for after-image, which is acceptable considering the associated guidance.

Therefore, a low impact is predicted, and no mitigation is required.

7.3 Dwelling Receptors

The results of the analysis have shown that reflections from the proposed development are geometrically possible towards 45 out of the 49 identified dwelling receptors. When existing obstructions such as vegetation or buildings are considered, no or low impact is predicted for 43 out of these 45 dwelling receptors. For the remaining two receptors 43 (see Figure 20 below) and 44 (see Figure 21 on the following page), which are expected to experience glare for more than 3 months per year (but less than 1 hour per day), the impact is expected to be moderate.

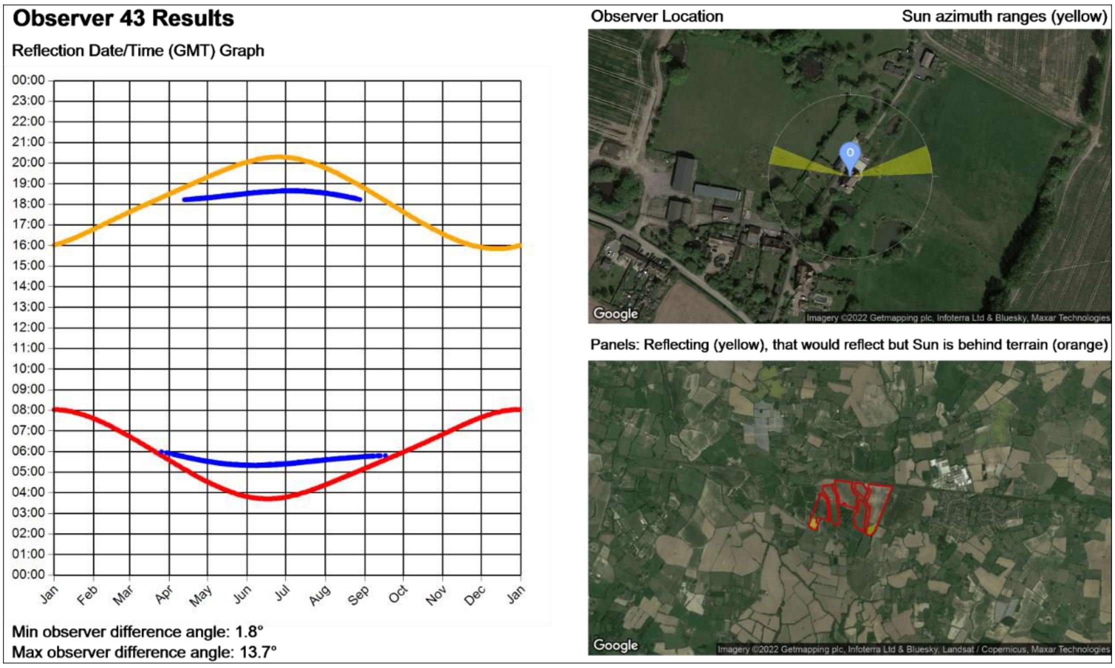

Figure 20 – Reflection chart for dwelling 43

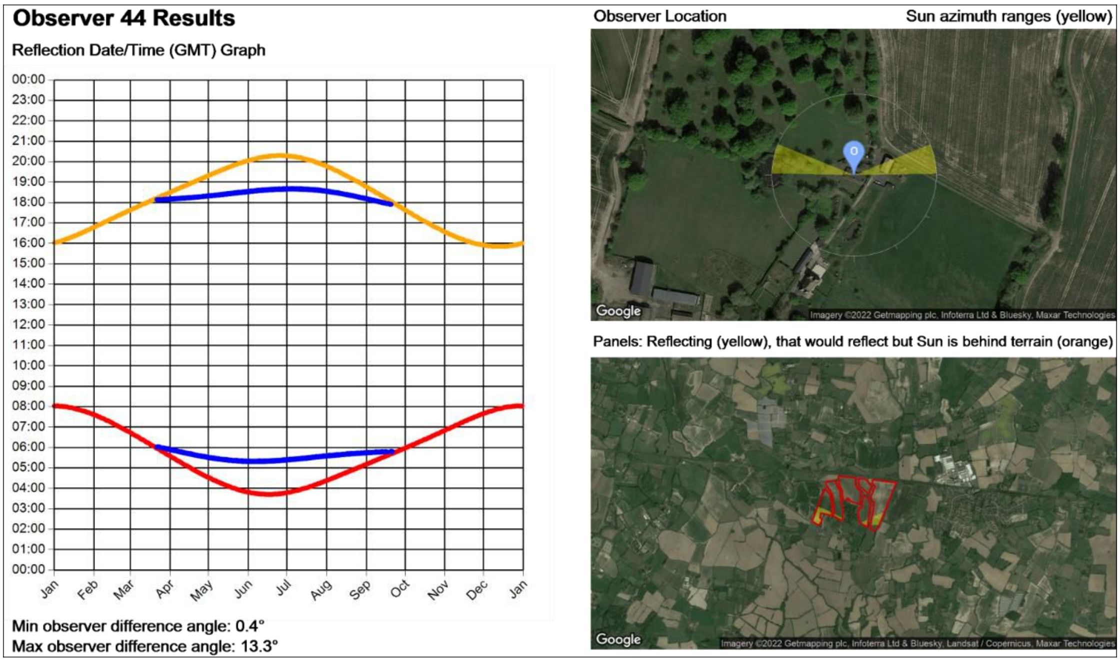

Figure 21 – Reflection chart for dwelling 44

However, the review of the available imagery has shown that some screening, in the form of existing vegetation, might reduce the views of the reflective areas (Figure 22 and Figure 23[20] below and on the following page).

Figure 22 – Reflective areas for dwelling 43 and relative screening

[20] Copyright © 2021 Google.

Figure 23 – Reflective areas for dwelling 44 and relative screening

Furthermore, the developer has proposed to improve the level of screening to block reflections (see Figure 24[21] below). The proposed screening, once fully grown, is expected to be sufficient to remove visibility of the reflective area.

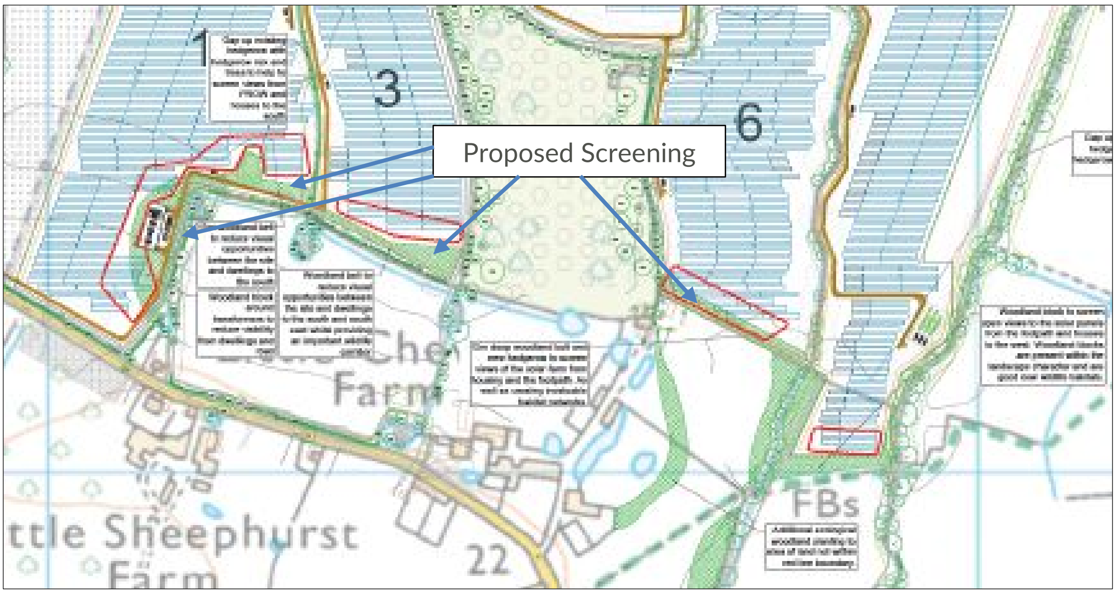

Figure 24 – Proposed screening in the form of vegetation

Therefore, once mitigation will be implemented the level of impact upon the identified dwelling will be low at maximum and no further mitigation will be necessary.

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[21] Proposed Mitigation Landscape and Ecology Enhancement, awSCAPE, date: 01/2022, drawing no.: AW0143-PL-001

7.4 Road Receptors

The results of the analysis have shown that reflections from the proposed development are geometrically possible towards 11 out of the 13 identified road receptors. Existing screening in the form of vegetation or buildings will screen solar reflections for all the receptors (see Figure 25[22] below).

Therefore, no impact is expected, and no mitigation is required.

Figure 25 – Identified screening for the road receptors

[22] Copyright © 2021 Google.

7.5 Railway Receptors

The results of the analysis have shown that reflections from the proposed development are geometrically possible towards eight out of the 15 identified train driver receptors. Solar reflections are expected to be generated from the northern portion of the proposed development. Solar reflections are expected to occur during mid-March and mid-September when leaves will be on the trees screening all views of the proposed development. Existing screening in the form of vegetation will screen solar reflections for all the affected receptors (see Figure 25[23] below).

Therefore, no impact is expected, and no mitigation is required.

Figure 26 – Identified screening for the railway receptors

[23] Copyright © 2021 Google.

8 OVERALL CONCLUSIONS

8.1 Assessment Results – Old Hay Aerodrome

The assessment has shown that:

- Solar reflections from the proposed development will have low impact upon pilots approaching thresholds 02, 09 and 20;
- Solar reflections from the proposed development will have moderate impact upon pilots approaching threshold 27. Reflections of this intensity towards an approach must be evaluated in a technical and operational context due to their potential to cause an impact. In this case, assessment the panel area visibility, glare duration and location relative to key operational areas and reflecting services has shown that the impact would be operationally tolerable without mitigation.

Although, a moderate impact is predicted, no mitigation is required due to mitigating factors. The findings of this report should be shared with the aerodrome safeguarding team (see Section 7.1 on page 65).

8.2 Assessment Results – Laddingford Aerodrome

The assessment has shown that solar reflections generated from the proposed development will have low impact upon pilots using all approach paths (see Section 7.2 on page 68).

8.3 Assessment Results – Dwelling Receptors

The results of the analysis have shown that reflections from the proposed development are geometrically possible towards 45 out of the 49 identified dwelling receptors. When existing obstructions such as vegetation or buildings are considered, no or low impact is predicted for 43 out of these 45 dwelling receptors.

For the remaining two receptors, which are expected to experience glare for more than 3 months per year (but less than 1 hour per day), the impact is expected to be moderate. Some screening, which might eliminate or reduce views of the reflective area has been identified. Furthermore, the developer has proposed screening in the form of vegetation which is expected to fully remove all views of the reflective areas.

Therefore, once mitigation will be implemented the level of impact upon the identified dwelling will be low at maximum and no further mitigation will be necessary (see Section 7.3 on page 68).

8.4 Assessment Results – Road Receptors

The results of the analysis have shown that reflections from the proposed development are geometrically possible towards 11 out of the 13 identified road receptors along 1.8km of road. Existing screening in the form of vegetation or buildings will screen solar reflections for all the receptors.

Therefore, no impact is expected, and no mitigation is required (see Section 7.4 on page 71).

8.5 Assessment Results – Railway Receptors

Consultation with Network Rails has been initiated on the 11th of August 2021.

8.5.1 Railway Signals

From the review of the available imagery, only one signal has been identified along the assessed section of the railway line. However, the signal faces away from the proposed development therefore any solar reflection would intercept the rear of the signal and will have no impact.

8.5.2 Train Driver Receptors

The results of the analysis have shown that reflections from the proposed development are geometrically possible towards eight out of the 15 identified train driver receptors along 2.1km or railway line. Existing screening in the form of vegetation or buildings will screen solar reflections for all the affected receptors.

Therefore, no impact is expected, and no mitigation is required (see Section 7.5 on page 72).

If Network Rails confirms that there are no signal locations along any of these railway lines, then no impacts would be possible. If railway signals are identified, then this report can be updated, however, based on the level of screening between the railway line and the proposed development, no impacts are predicted.

APPENDIX 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.

UK Planning Policy

The National Planning Policy Framework under the planning practice guidance for Renewable and Low Carbon Energy[24] (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:

…

- *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****;*
- *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 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.'

Assessment Process – Ground-Based Receptors

No process for determining and contextualising the effects of glint and glare are, however, 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 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

[24] Renewable and low carbon energy, Ministry of Housing, Communities & Local Government, date: 18 June 2015, accessed on: 17/06/2020

has been informed by the policy presented above, current studies (presented in Appendix B) and stakeholder consultation. Further information can be found in Pager Power's Glint and Glare Guidance document[25] which was produced due to the absence of existing guidance and a specific standardised assessment methodology.

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[26] however the advice is still applicable[27] 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):

'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[28], 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

[25] Solar Photovoltaic Development – Glint and Glare Guidance, Second Edition 2, October 2018. Pager Power.
[26] Archived at Pager Power
[27] Reference email from the CAA dated 19/05/2014.
[28] Aerodrome Licence Holder.

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.

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 were produced initially in November 2010 by the United States Federal Aviation Administration (FAA) and updated in 2013.

The 2010 document is entitled '*Technical Guidance for Evaluating Selected Solar Technologies on Airports'*[29] and the 2013 update is entitled '*Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports'*[30]. In April 2018 the FAA released a new version (Version 1.1) of the '*Technical Guidance for Evaluating Selected Solar Technologies on Airports'*[31].

An overview of the methodology presented within the 2013 interim guidance and adopted by the FAA is presented below. This methodology is not presented within the 2018 guidance.

- *Solar energy systems located on an airport that is not federally-obligated or located outside the property of a federally-obligated airport are not subject to this policy.*
- *Proponents of solar energy systems located off-airport property or on non-federally-obligated airports are strongly encouraged to consider the requirements of this policy when siting such system.*
- *FAA adopts the Solar Glare Hazard Analysis Plot…. as the standard for measuring the ocular impact of any proposed solar energy system on a federally-obligated airport. This is shown in the figure below.*

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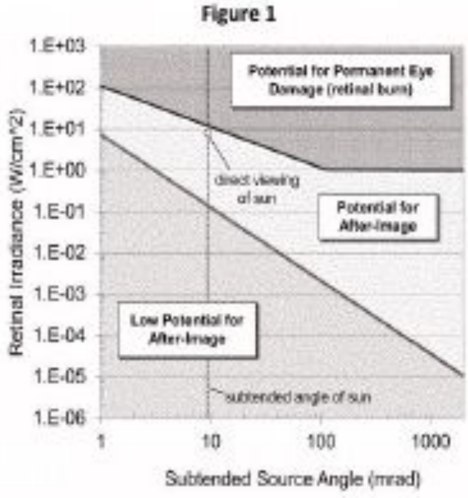
[29] Archived at Pager Power

[30] 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: 20/03/2019

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



Solar Glare Ocular Hazard Plot: The potential ocular hazard from solar glare is a function of retinal irradiance and the subtended angle (size/distance) of the glare source. It should be noted that the ratio of spectrally weighted solar illuminance to solar irradiance at the earth's surface yields a conversion factor of ~100 lumens/W. Plot adapted from Ho et al., 2011.

Chart References: Ho, C.K., C.M. Ghanbari, and R.B. Diver, 2011, Methodology to Assess Potential Glint and Glare Hazards from Concentrating Solar Power Plants: Analytical Models and Experimental Validation, J. Solar Energy Engineering, August 2011, Vol. 133, 031021-1 – 031021-9.

Solar Glare Hazard Analysis Plot (FAA)

- *To obtain FAA approval to revise an airport layout plan to depict a solar installation and/or a "no objection" … the airport sponsor will be required to demonstrate that the proposed solar energy system meets the following standards:*
- *No potential for glint or glare in the existing or planned Airport Traffic Control Tower (ATC) cab, and*
- *No potential for glare or "low potential for after-image" … along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved Airport Layout Plan (ALP). The final approach path is defined as two (2) miles from fifty (50) feet above the landing threshold using a standard three (3) degree glidepath.*
- *Ocular impact must be analysed over the entire calendar year in one (1) minute intervals from when the sun rises above the horizon until the sun sets below the horizon.*

The bullets highlighted above state there should be 'no potential for glare' at that ATC Tower and 'no' or 'low potential for glare' on the approach paths.

Key points from the 2018 FAA guidance are presented below.

- *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[32].

- *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.*
- *As illustrated on Figure 16*[33]*, 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.*
- *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 qualitative analysis of potential impact in consultation with the Control Tower, pilots and airport officials;*
    - *A demonstration field test with solar panels at the proposed site in coordination with FAA Tower personnel;*
    - *A geometric analysis to determine days and times when an impact is predicted.*
- *The extent of reflectivity analysis required to assess potential impacts will depend on the specific project site and system design.*
- ***1. 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, 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.*
- ***2. 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*

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[32] 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.
[33] First figure in Appendix B.

not significant. If there is a significant glare impact, the project can be modified by ensuring panels are not directed in that direction.

- ***3. 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.*
- *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*34 *but still requires further research to definitively answer.*
- ***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) 2009

In some instances, an aviation stakeholder can refer to the ANO 2009 with regard to safeguarding. Key points from the document are presented below.

Endangering safety of an aircraft

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

Lights liable to endanger

221.

(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.

[34] 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.

(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.

Lights which dazzle or distract
222. 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 document states that no 'light', 'dazzle' or 'glare' should be produced which will create a detrimental impact upon aircraft safety.

Assessment Process – Railways

Railway operations is not mentioned specifically within this guidance; however, it is stated 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 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.

Railway guidelines are presented below.
Signal Sighting and Determining the Field of Focus

The extract below is taken from Section A5 'Reflections and Glare' (pages 64-65) of the 'Signal Sighting Assessment Requirements'[35] which details the requirement for assessing glare towards railway signals.

A.5. Reflections and glare

Rationale

G A.5.1.1 Reflections can alter the appearance of a display so that it appears to be something else.

Guidance

G A.5.1.2 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.

G A.5.1.3 A5 is relevant to any lineside signalling asset that is capable of presenting a lit signal aspect or indication.

G A.5.1.4 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.

G A.5.1.5 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.

G A.5.1.6 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.

G A.5.1.7 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.

The extracts below are taken from F.6 (pages 98-101) of the same document under Appendix F 'Guidance on Field of Vision' which details the visibility of signals, train drivers' field of vision and the implications with regard to signal positioning.

[35] Source: RIS-0737-CCS. Signal Sighting Assessment Requirements, December 2016. Railway Group Guidance Note. Last accessed 13.08.2021.

Appendix F 'Guidance on Field of Vision'

F.5Asset visibility

F.5.1 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.*

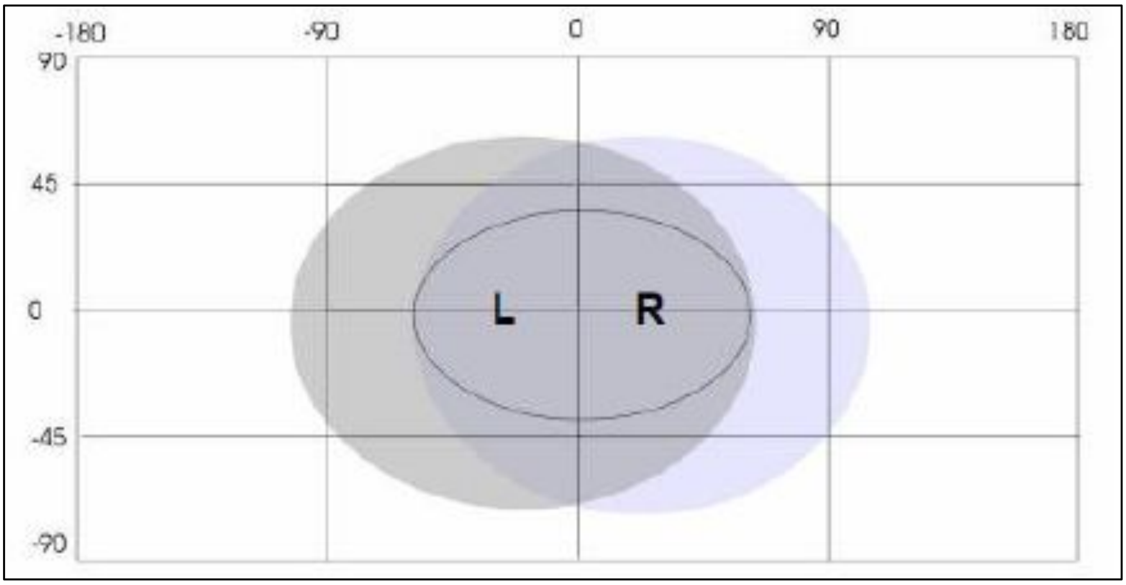
It is also influenced by the processes relating to colour vision, visual accommodation, and visual acuity. Each of these issues is described in the following sections.

F.6 Field of vision

F.6.1 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 135° in the vertical plane and 200° in the horizontal plane.

F.6.2 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°) to approximately 30° at each eye. The peripheral field extends from 30° 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



Field of view

F.6.4 In Figure G 21 (the figure above), *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.*

F*.6.5 Research has shown that drivers search for signs or signals towards the centre of the field of vision.*

F.6.6 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).

F.6.7 Figure 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.

F.6.8 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.

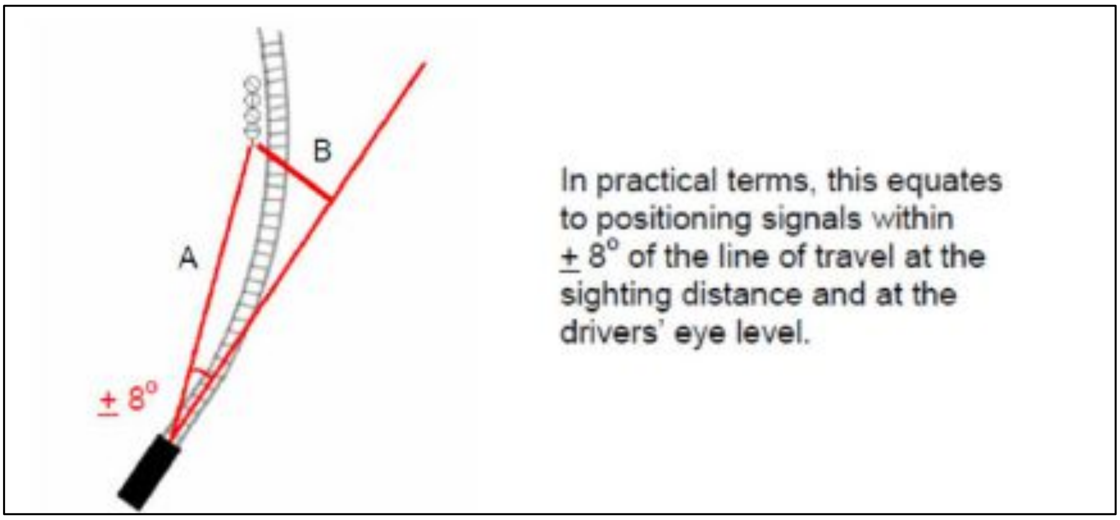
c) A right away indicator.

d) A sign to remind the driver to check the signal aspect.

F.6.9 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.

F.6.10 '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.

F.6.11 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



Signal positioning

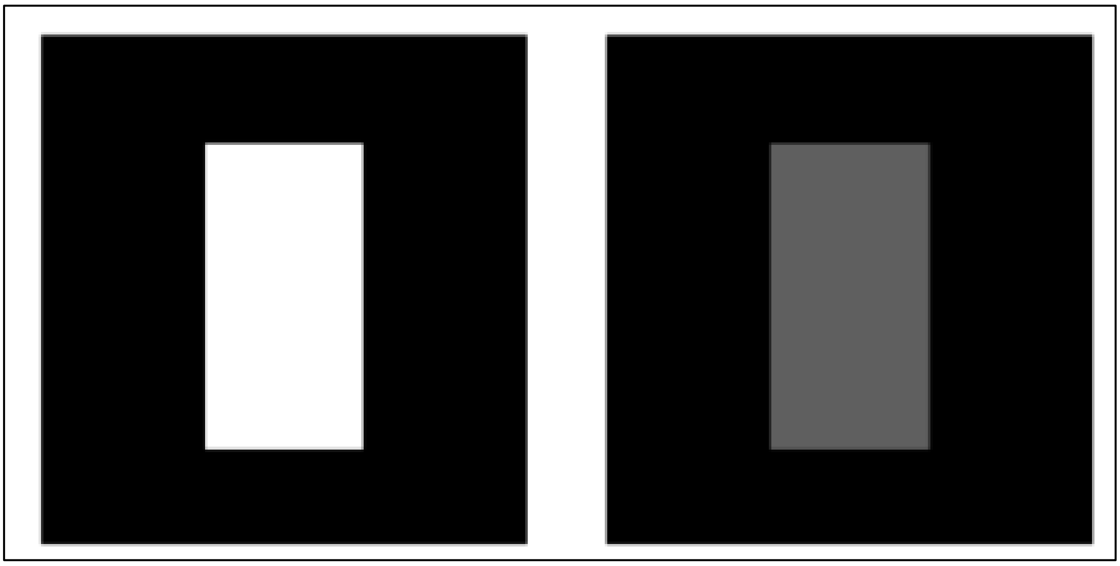
'A' (m)	*'B' (m)*	*Typical display positions*
5	*0.7*	-
6	*0.84*	-
7	*0.98*	-
8	*1.12*	-
9	*1.26*	-
10	*1.41*	-
11	*1.55*	-
12	*1.69*	-
13	*1.83*	-
14	*1.97*	-
15	*2.11*	*A stop aspect positioned 3.3 m above rail level and 2.1 m from the left hand rail is within the 8° cone at 15.44 m in front of the 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 hand rail is within the 8° cone at 17.93 m in front of the driver
19	2.67	-
20	2.81	-
21	2.95	-
22	3.09	-
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 hand rail is within the 8° cone at 25.46 m in front of the driver

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

F.7 Contrast sensitivity

F.7.1 We see objects not just because of their absolute brightness, but also by their contrast with the surrounding environment. When contrast is high, objects are more conspicuous. The contrast between an object and its background is especially important when we need to detect it from a distance.



Example of contrast sensitivity

F.7.2 In Figure G 23 (the figure above), *the white rectangle on the left is more conspicuous than the grey rectangle on the right because it is more highly contrasted with its background.*

F.7.3 Object orientation also affects our sensitivity to contrast. Targets that are normally presented (that is, at right angles) create greater contrast between themselves and their background than targets presented at oblique angles.

F.7.4 During the day, the contrast between a dark or cluttered background and a signal may be low, making signals less visible.

Example of low contrast due to background clutter

F.7.5 The use of sighting boards with a low level of hardware surface gloss and a contrasting colour can enhance the contrast between signalling displays and light, or cluttered backgrounds. Research has shown that increasing the size of the backboard can also improve visibility through the increased contrast between the asset and its background.

F.7.6 White, or blue and white, borders have been used in the past to try to draw attention to problem signals. However, unless the approach speed is slow (15 mph or under) and the view is uncluttered, borders can have the opposite effect as they merely serve to reduce the apparent size of the backboard, thereby reducing contrast and visibility. This is because of the way the visual system processes light / dark boundaries. Borders can blur into their background unless they are viewed close up. In order to be seen from a distance useful to train drivers, borders would need to be impractically large (approximately 500 mm wide).

F.7.7 If the asset background is dark (such as a structure), a white coloured area located behind a black backboard will draw the driver's eye to the asset and make it more conspicuous, only if the white area is much larger than the asset. An example is shown in Figure G 25.

F.7.8 Assets should be oriented towards the direction of approach for as much of the approach time as possible. This enhances the contrast between the asset and its background.

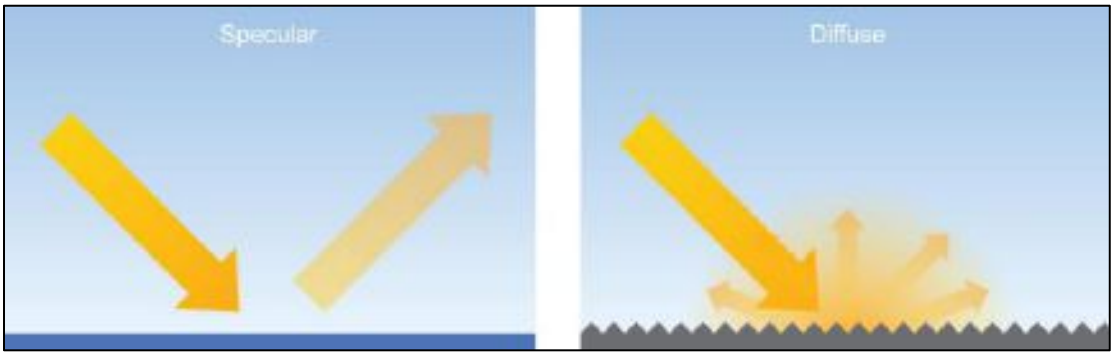
APPENDIX B – OVERVIEW OF GLINT AND GLARE STUDIES

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 figure below, taken from the FAA guidance[36], 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

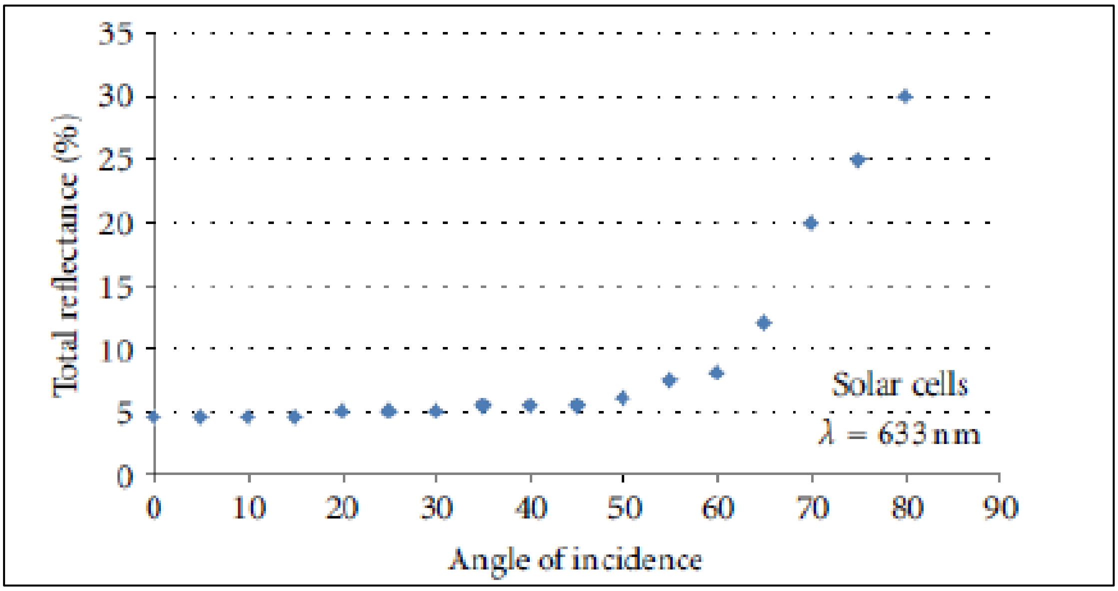
[36] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 20/03/2019.

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*[37]". 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 figure below.



Total reflectance % when compared to angle of incidence

The conclusions of the research study were:

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

[37] 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

FAA Guidance – "Technical Guidance for Evaluating Selected Solar Technologies on Airports"[38]

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[39]
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

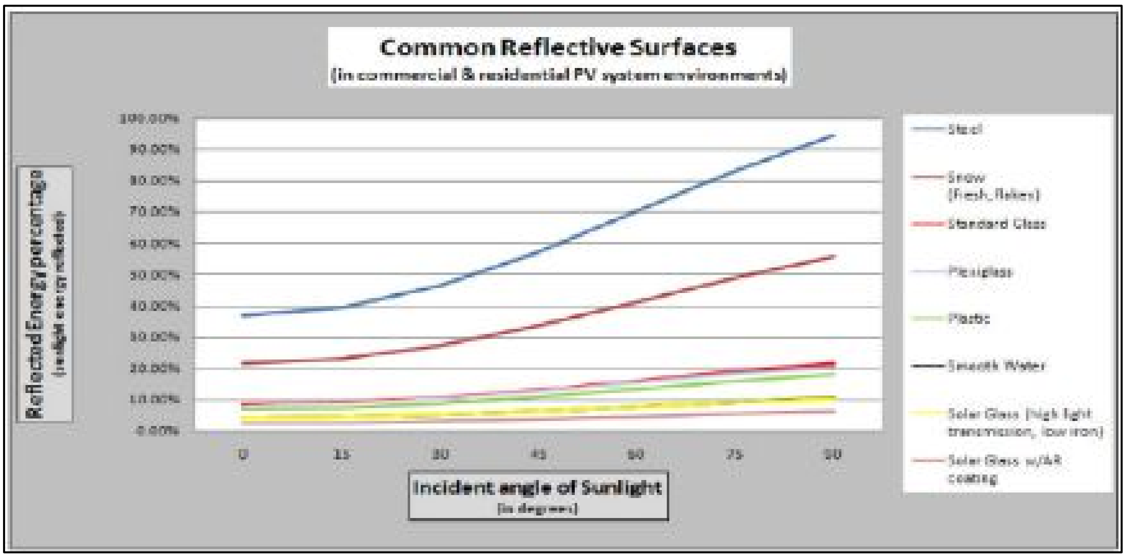
Note that the data above does not appear to consider the reflection type (specular or diffuse). An important comparison in this table is the reflectivity compared to water which will produce a reflection of very similar intensity when compared to that from a solar panel. The study by Riley and Olsen study (2011) also concludes that still water has a very similar reflectivity to solar panels.

[38] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 20/03/2019.
[39] Extrapolated data, baseline of 1,000 W/m^2 for incoming sunlight.

SunPower Technical Notification (2009)

SunPower published a technical notification[40] to '*increase awareness concerning the possible glare and reflectance impact of PV Systems on their surrounding environment'*.

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

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

APPENDIX C – OVERVIEW OF SUN MOVEMENTS AND RELATIVE REFLECTIONS

Overview

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).

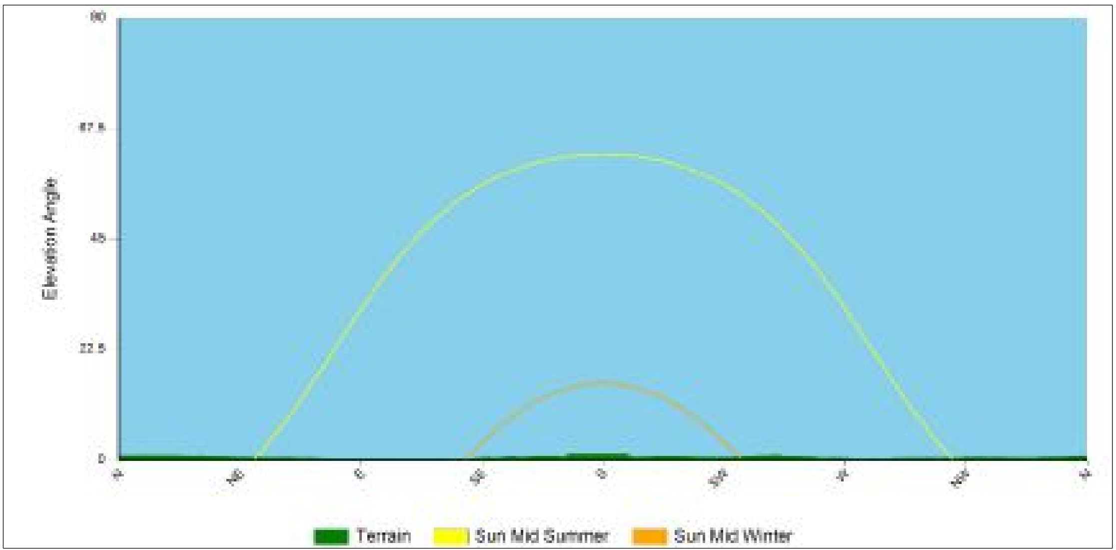
The Sun's position can be accurately calculated for a specific location. The following data being used for the calculation:

- Time;
- Date;
- Latitude;
- Longitude.

The following is true at the location of the solar development:

- The Sun is at its highest around midday and is to the south at this time;
- The Sun rises highest on 21 June reaching a maximum elevation of approximately 60-65 degrees (longest day);
- On 21 December, the maximum elevation reached by the Sun is approximately 10-15 degrees (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 figure below shows terrain at the horizon as well as the sunrise and sunset curves throughout the year. Terrain Sun Curve - From lon:0.466587 lat:51.174118.



APPENDIX 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.

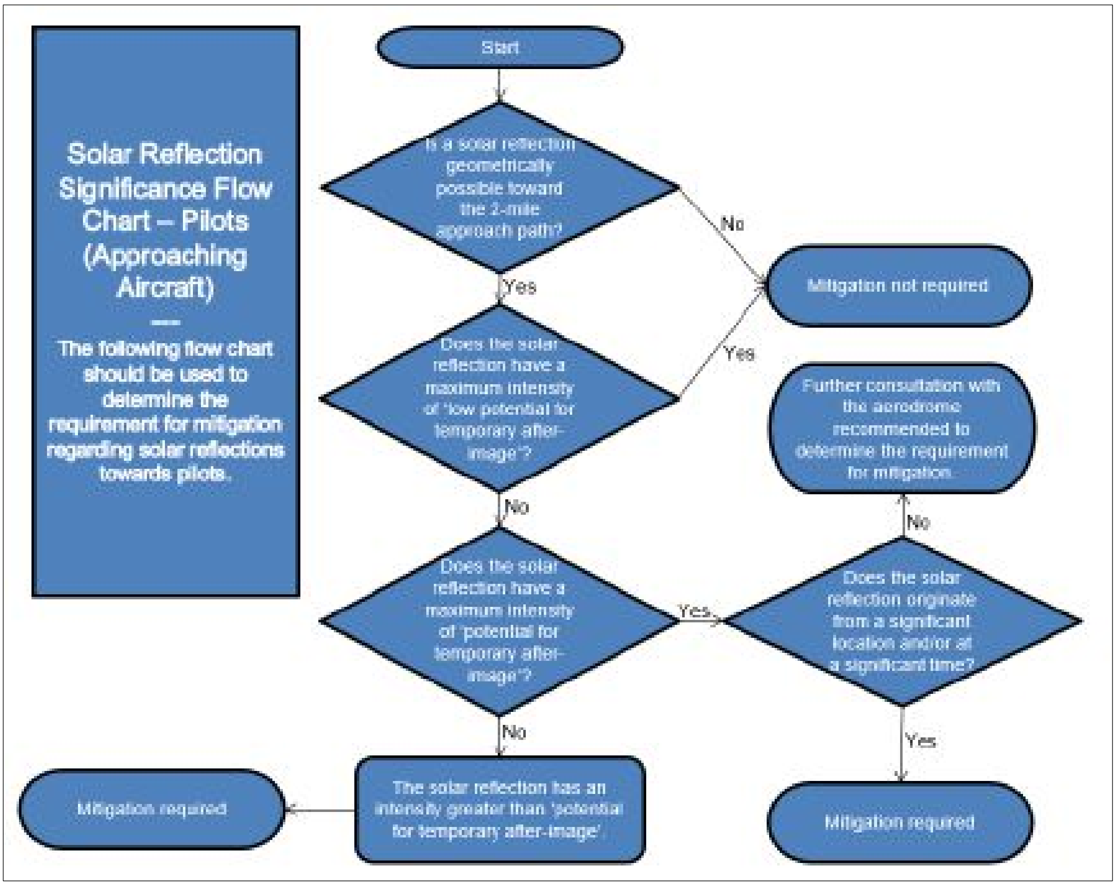
Impact Significance	Definition	Mitigation Requirement
No Impact	A solar reflection is not geometrically possible or will not be visible from the assessed receptor.	No mitigation required.
Low	A solar reflection is geometrically possible however any impact is considered to be small such that mitigation is not required e.g. intervening screening will limit the view of the reflecting solar panels.	No mitigation required.
Moderate	A solar reflection is geometrically possible and visible however it occurs under conditions that do not represent a worst-case.	Whilst the impact may be acceptable, consultation and/or further analysis should be undertaken to determine the requirement for mitigation.
Major	A solar reflection is geometrically possible and visible under conditions that will produce a significant impact. Mitigation and consultation is recommended.	Mitigation will be required if the proposed development is to proceed.

Impact significance definition

The flow charts presented in the following sub-sections have been followed when determining the mitigation requirement for aviation receptors.

Assessment Process – Approaching Aircraft

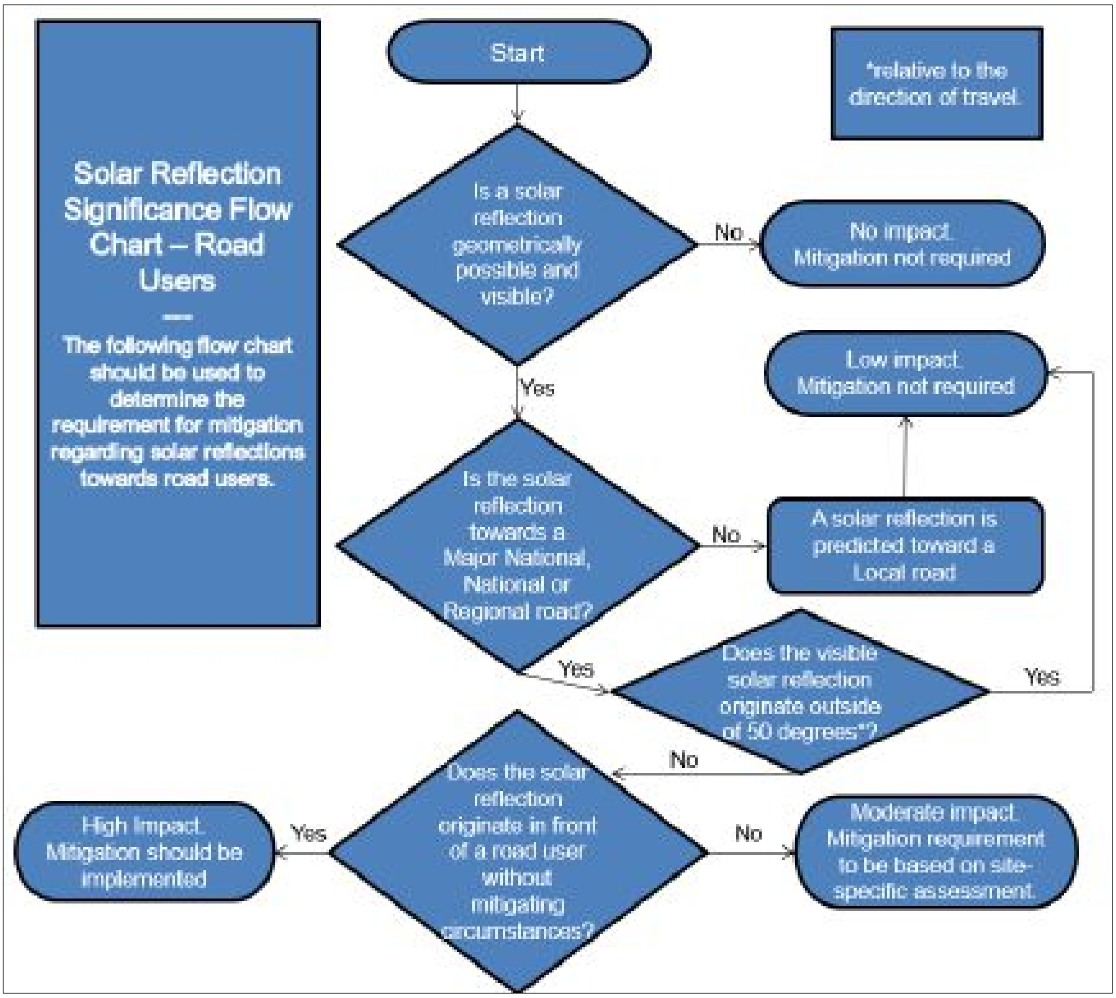
The charts relate to the determining the potential impact upon approaching aircraft.



Approaching aircraft receptor mitigation requirement flow chart

Assessment Process for Road Receptors

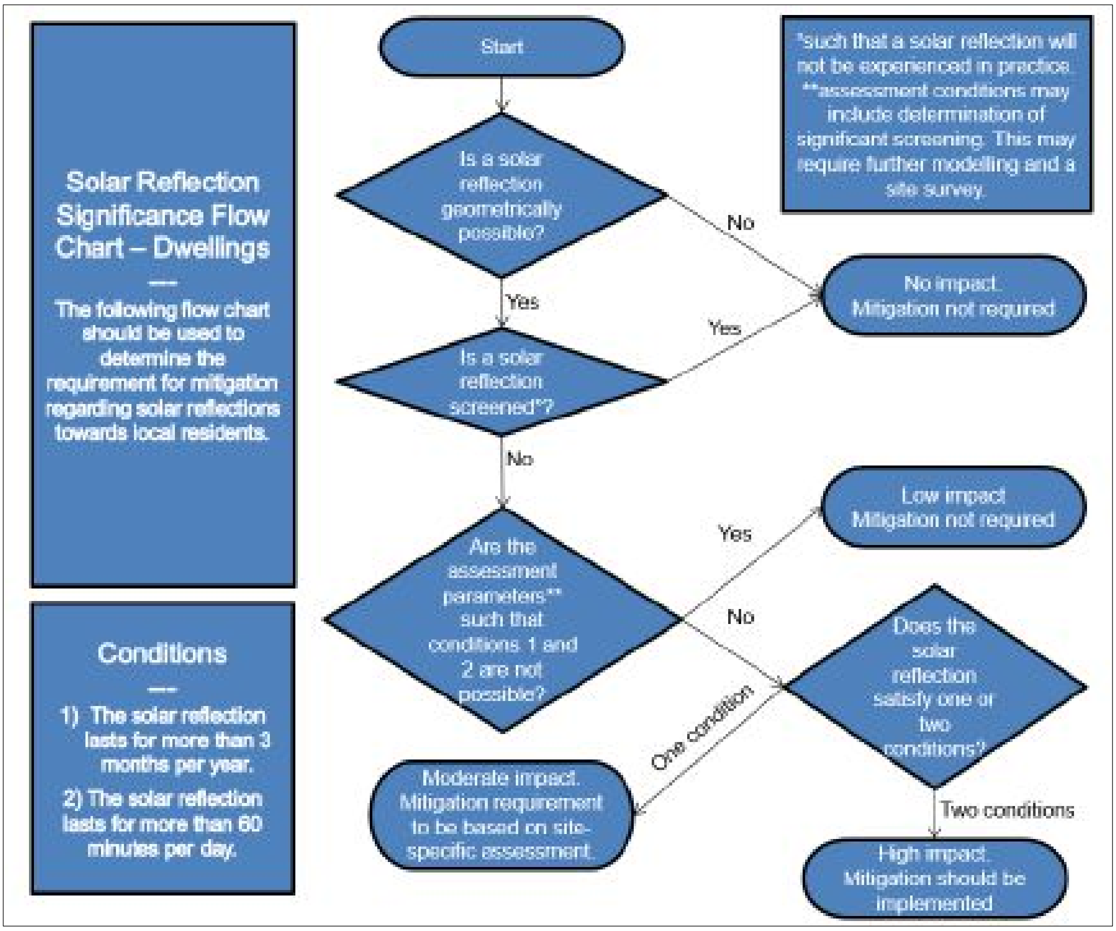
The flow chart presented below has been followed when determining the mitigation requirement for road receptors.



Road receptor mitigation requirement flow chart

Assessment Process for Dwelling Receptors

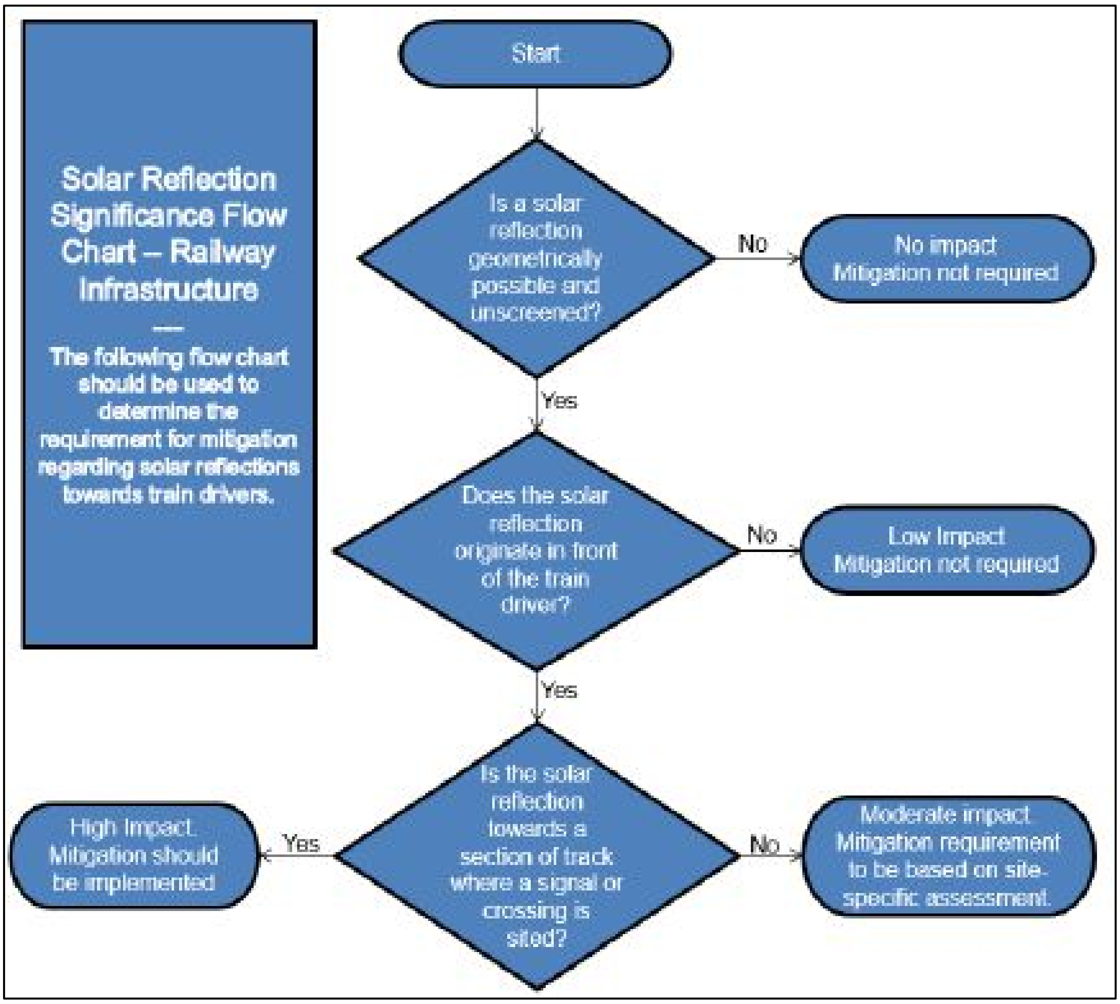
The flow chart presented below has been followed when determining the mitigation requirement for dwelling receptors.



Dwelling receptor mitigation requirement flow chart

Impact Significance Determination for Railway Receptors

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



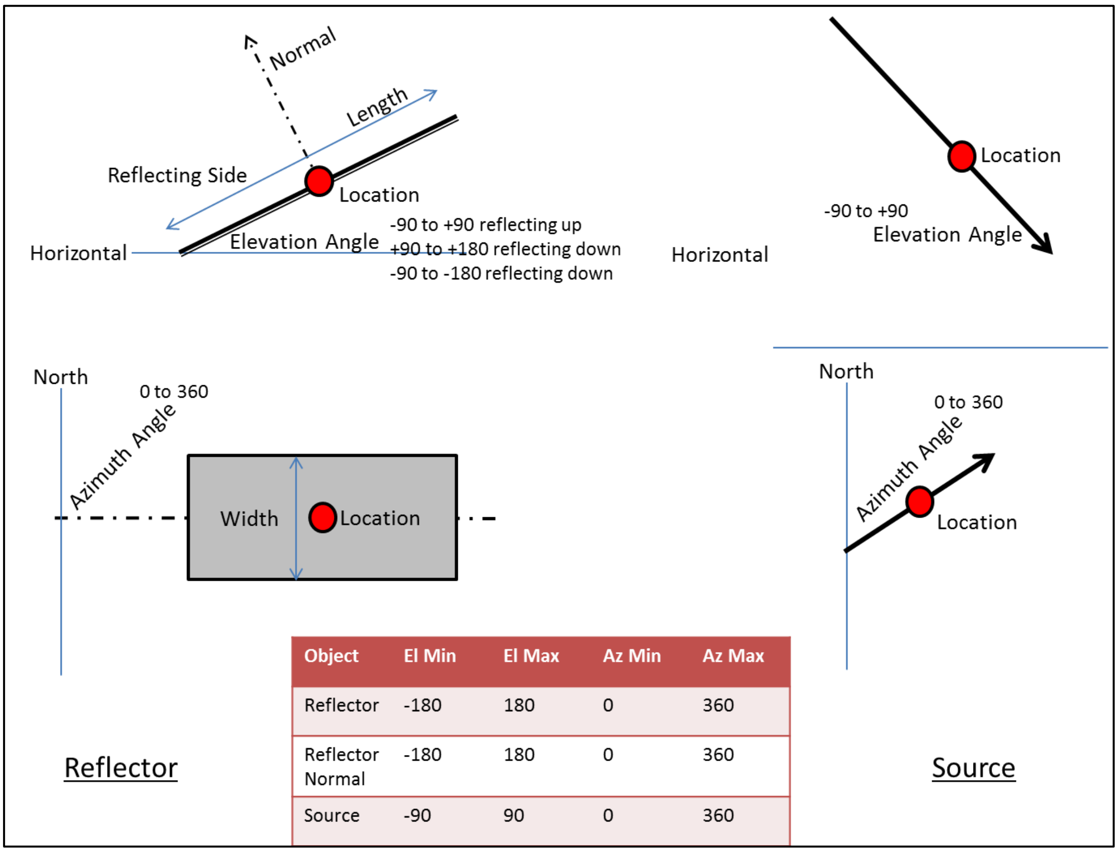
Train driver impact significance flow chart

APPENDIX E – PAGER POWER'S REFLECTION CALCULATIONS METHODOLOGY

The calculations are three dimensional and complex, accounting for:

- The Earth's orbit around the Sun;
- The Earth's rotation;
- The Earth's orientation;
- The reflector's location;
- 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

The following process is used to determine the 3D azimuth and elevation of a reflection:

- Use the Latitude and Longitude of reflector as the reference for calculation purposes;
- Calculate the Azimuth and Elevation of the normal to the reflector;
- Calculate the 3D angle between the source and the normal;

- 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;
- Calculate the Azimuth and Elevation of the reflection in accordance with the following:
    - The angle between source and normal is equal to angle between normal and reflection;
    - Source, Normal and Reflection are in the same plane.

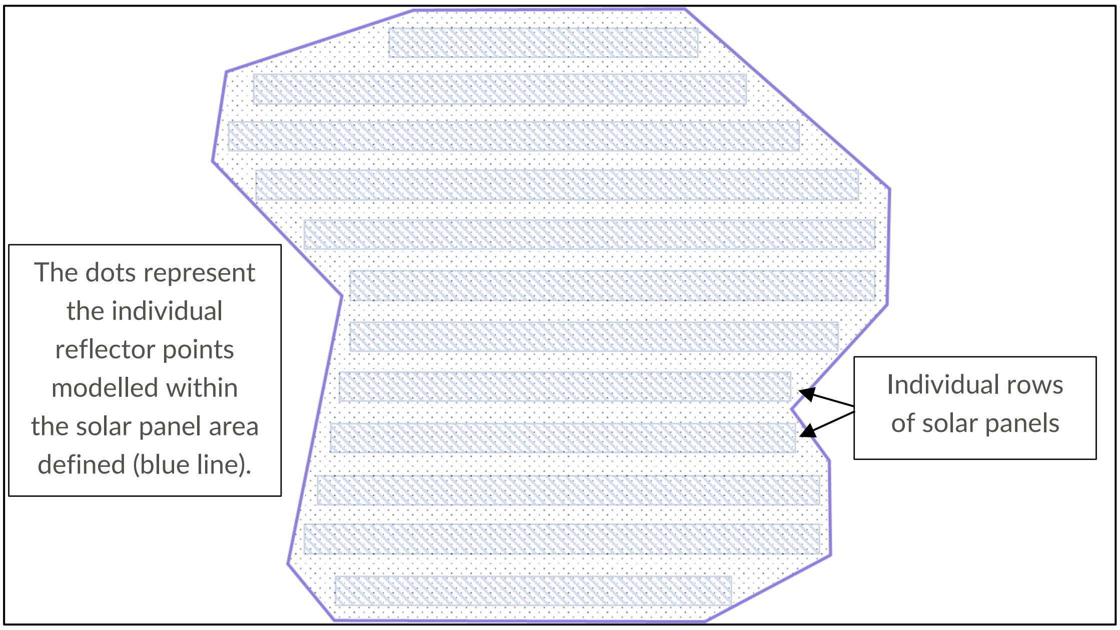
APPENDIX F – ASSESSMENT LIMITATIONS AND ASSUMPTIONS

Pager Power's Model

The model considers 100% sunlight during daylight hours which is highly conservative.

The model does not account for terrain between the reflecting solar panels and the assessed receptor where a solar reflection is geometrically possible. The model considers terrain between the reflecting solar panels and the visible horizon (where the sun may be obstructed from view of the panels)[41]. 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 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 figure below which illustrates this process.

[41] UK only.



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.

Forge's Sandia National Laboratories' (SGHAT) Model

The following text is taken from Forge[42] 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.

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[42] Source: https://www.forgesolar.com/help/#assumptions

APPENDIX G – RECEPTOR AND REFLECTOR AREA DETAILS

Receptor Locations for Aircraft Landing on Runway 27 – Old Hay Aerodrome

The table below presents the data for the assessed locations for aircraft on approach to runway 27. The altitude of the aircraft is based on a 3-degree descent path referenced to 50 feet (15.2m) above the runway threshold.

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 27 - Threshold	0.43053	51.17839	31.24
Approach 27 - 0.1 miles	0.43282	51.17824	39.66
Approach 27 - 0.2 miles	0.43511	51.17809	48.09
Approach 27 - 0.3 miles	0.43740	51.17794	56.51
Approach 27 - 0.4 miles	0.43969	51.17779	64.93
Approach 27 - 0.5 miles	0.44198	51.17764	73.35
Approach 27 - 0.6 miles	0.44427	51.17748	81.78
Approach 27 - 0.7 miles	0.44655	51.17733	90.20
Approach 27 - 0.8 miles	0.44884	51.17718	98.62
Approach 27 - 0.9 miles	0.45113	51.17703	107.04
Approach 27 - 1.0 mile	0.45342	51.17688	115.47
Approach 27 - 1.1 miles	0.45571	51.17673	123.89
Approach 27 - 1.2 miles	0.45800	51.17657	132.31
Approach 27 - 1.3 miles	0.46029	51.17642	140.73
Approach 27 - 1.4 miles	0.46258	51.17627	149.16
Approach 27 - 1.5 miles	0.46486	51.17612	157.58
Approach 27 - 1.6 miles	0.46715	51.17597	166.00
Approach 27 - 1.7 miles	0.46944	51.17582	174.43
Approach 27 - 1.8 miles	0.47173	51.17566	182.85

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 27 - 1.9 miles	0.47402	51.17551	191.27
Approach 27 - 2.0 miles	0.47631	51.17536	199.69

Assessed receptor (aircraft) locations on the approach path for runway 27

Receptor Locations for Aircraft Landing on Runway 09 – Old Hay Aerodrome

The table below presents the data for the assessed locations for aircraft on approach to runway 09. The altitude of the aircraft is based on a 3-degree descent path referenced to 50 feet (15.2m) above the runway threshold.

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 09 - Threshold	0.42136	51.17901	32.24
Approach 09 - 0.1 miles	0.41907	51.17916	40.66
Approach 09 - 0.2 miles	0.41678	51.17931	49.09
Approach 09 - 0.3 miles	0.41450	51.17946	57.51
Approach 09 - 0.4 miles	0.41221	51.17961	65.93
Approach 09 - 0.5 miles	0.40992	51.17977	74.35
Approach 09 - 0.6 miles	0.40763	51.17992	82.78
Approach 09 - 0.7 miles	0.40534	51.18007	91.20
Approach 09 - 0.8 miles	0.40305	51.18022	99.62
Approach 09 - 0.9 miles	0.40076	51.18037	108.04
Approach 09 - 1.0 mile	0.39847	51.18052	116.47
Approach 09 - 1.1 miles	0.39618	51.18067	124.89
Approach 09 - 1.2 miles	0.39389	51.18082	133.31
Approach 09 - 1.3 miles	0.39161	51.18097	141.73
Approach 09 - 1.4 miles	0.38932	51.18112	150.16
Approach 09 - 1.5 miles	0.38703	51.18127	158.58
Approach 09 - 1.6 miles	0.38474	51.18142	167.00

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 09 - 1.7 miles	0.38245	51.18157	175.43
Approach 09 - 1.8 miles	0.38016	51.18172	183.85
Approach 09 - 1.9 miles	0.37787	51.18187	192.27
Approach 09 - 2.0 miles	0.37558	51.18203	200.69

Assessed receptor (aircraft) locations on the approach path for runway 09

Receptor Locations for Aircraft Landing on Runway 20 – Old Hay Aerodrome

The table below presents the data for the assessed locations for aircraft on approach to runway 20. The altitude of the aircraft is based on a 3-degree descent path referenced to 50 feet (15.2m) above the runway threshold.

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 20 - Threshold	0.43026	51.17922	31.24
Approach 20 - 0.1 miles	0.43105	51.18058	39.66
Approach 20 - 0.2 miles	0.43184	51.18194	48.09
Approach 20 - 0.3 miles	0.43262	51.18330	56.51
Approach 20 - 0.4 miles	0.43341	51.18466	64.93
Approach 20 - 0.5 miles	0.43420	51.18602	73.35
Approach 20 - 0.6 miles	0.43498	51.18738	81.78
Approach 20 - 0.7 miles	0.43577	51.18874	90.20
Approach 20 - 0.8 miles	0.43656	51.19010	98.62
Approach 20 - 0.9 miles	0.43735	51.19146	107.04
Approach 20 - 1.0 mile	0.43813	51.19282	115.47
Approach 20 - 1.1 miles	0.43892	51.19417	123.89
Approach 20 - 1.2 miles	0.43971	51.19553	132.31
Approach 20 - 1.3 miles	0.44050	51.19689	140.73
Approach 20 - 1.4 miles	0.44129	51.19825	149.16

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 20 - 1.5 miles	0.44207	51.19961	157.58
Approach 20 - 1.6 miles	0.44286	51.20097	166.00
Approach 20 - 1.7 miles	0.44365	51.20233	174.43
Approach 20 - 1.8 miles	0.44444	51.20369	182.85
Approach 20 - 1.9 miles	0.44523	51.20505	191.27
Approach 20 - 2.0 miles	0.44601	51.20641	199.69

Assessed receptor (aircraft) locations on the approach path for runway 20

Receptor Locations for Aircraft Landing on Runway 02 – Old Hay Aerodrome

The table below presents the data for the assessed locations for aircraft on approach to runway 02. The altitude of the aircraft is based on a 3-degree descent path referenced to 50 feet (15.2m) above the runway threshold.

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 02 - Threshold	0.42796	51.17521	32.24
Approach 02 - 0.1 miles	0.42717	51.17385	40.66
Approach 02 - 0.2 miles	0.42638	51.17250	49.09
Approach 02 - 0.3 miles	0.42560	51.17114	57.51
Approach 02 - 0.4 miles	0.42481	51.16978	65.93
Approach 02 - 0.5 miles	0.42402	51.16842	74.35
Approach 02 - 0.6 miles	0.42324	51.16706	82.78
Approach 02 - 0.7 miles	0.42245	51.16570	91.20
Approach 02 - 0.8 miles	0.42166	51.16434	99.62
Approach 02 - 0.9 miles	0.42088	51.16298	108.04
Approach 02 - 1.0 mile	0.42009	51.16162	116.47
Approach 02 - 1.1 miles	0.41930	51.16026	124.89
Approach 02 - 1.2 miles	0.41852	51.15890	133.31

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 02 - 1.3 miles	0.41773	51.15754	141.73
Approach 02 - 1.4 miles	0.41694	51.15618	150.16
Approach 02 - 1.5 miles	0.41616	51.15482	158.58
Approach 02 - 1.6 miles	0.41537	51.15346	167.00
Approach 02 - 1.7 miles	0.41458	51.15210	175.43
Approach 02 - 1.8 miles	0.41380	51.15074	183.85
Approach 02 - 1.9 miles	0.41301	51.14939	192.27
Approach 02 - 2.0 miles	0.41222	51.14803	200.69

Assessed receptor (aircraft) locations on the approach path for runway 02

Receptor Locations for Aircraft Landing on Runway 10 – Laddingford Aerodrome

The table below presents the data for the assessed locations for aircraft on approach to runway 10. The altitude of the aircraft is based on a 3-degree descent path referenced to 50 feet (15.2m) above the runway threshold.

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 10 - Threshold	0.40758	51.19170	30.24
Approach 10 - 0.1 miles	0.40536	51.19207	38.66
Approach 10 - 0.2 miles	0.40313	51.19244	47.09
Approach 10 - 0.3 miles	0.40091	51.19282	55.51
Approach 10 - 0.4 miles	0.39869	51.19319	63.93
Approach 10 - 0.5 miles	0.39646	51.19357	72.35
Approach 10 - 0.6 miles	0.39424	51.19394	80.78
Approach 10 - 0.7 miles	0.39201	51.19431	89.20
Approach 10 - 0.8 miles	0.38979	51.19469	97.62
Approach 10 - 0.9 miles	0.38757	51.19506	106.04

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 10 - 1.0 mile	0.38534	51.19544	114.47
Approach 10 - 1.1 miles	0.38312	51.19581	122.89
Approach 10 - 1.2 miles	0.38089	51.19618	131.31
Approach 10 - 1.3 miles	0.37867	51.19656	139.73
Approach 10 - 1.4 miles	0.37645	51.19693	148.16
Approach 10 - 1.5 miles	0.37422	51.19731	156.58
Approach 10 - 1.6 miles	0.37200	51.19768	165.00
Approach 10 - 1.7 miles	0.36977	51.19805	173.43
Approach 10 - 1.8 miles	0.36755	51.19843	181.85
Approach 10 - 1.9 miles	0.36533	51.19880	190.27
Approach 10 - 2.0 miles	0.36310	51.19917	198.69

Assessed receptor (aircraft) locations on the approach path for runway 10

Receptor Locations for Aircraft Landing on Runway 28 – Laddingford Aerodrome

The table below presents the data for the assessed locations for aircraft on approach to runway 28. The altitude of the aircraft is based on a 3-degree descent path referenced to 50 feet (15.2m) above the runway threshold.

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 28 - Threshold	0.41729	51.19004	30.04
Approach 28 - 0.1 miles	0.41951	51.18966	38.46
Approach 28 - 0.2 miles	0.42174	51.18929	46.89
Approach 28 - 0.3 miles	0.42396	51.18892	55.31
Approach 28 - 0.4 miles	0.42618	51.18854	63.73
Approach 28 - 0.5 miles	0.42841	51.18817	72.15
Approach 28 - 0.6 miles	0.43063	51.18779	80.58

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 28 - 0.7 miles	0.43285	51.18742	89.00
Approach 28 - 0.8 miles	0.43508	51.18704	97.42
Approach 28 - 0.9 miles	0.43730	51.18667	105.84
Approach 28 - 1.0 mile	0.43952	51.18629	114.27
Approach 28 - 1.1 miles	0.44175	51.18592	122.69
Approach 28 - 1.2 miles	0.44397	51.18554	131.11
Approach 28 - 1.3 miles	0.44619	51.18517	139.53
Approach 28 - 1.4 miles	0.44841	51.18479	147.96
Approach 28 - 1.5 miles	0.45064	51.18442	156.38
Approach 28 - 1.6 miles	0.45286	51.18404	164.80
Approach 28 - 1.7 miles	0.45508	51.18367	173.23
Approach 28 - 1.8 miles	0.45731	51.18329	181.65
Approach 28 - 1.9 miles	0.45953	51.18292	190.07
Approach 28 - 2.0 miles	0.46175	51.18254	198.49

Assessed receptor (aircraft) locations on the approach path for runway 28

Receptor Locations for Aircraft Landing on Runway 02 – Laddingford Aerodrome

The table below presents the data for the assessed locations for aircraft on approach to runway 02. The altitude of the aircraft is based on a 3-degree descent path referenced to 50 feet (15.2m) above the runway threshold.

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 02 - Threshold	0.41015	51.19088	30.24
Approach 02 - 0.1 miles	0.40933	51.18953	38.66
Approach 02 - 0.2 miles	0.40850	51.18818	47.09
Approach 02 - 0.3 miles	0.40768	51.18683	55.51

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 02 - 0.4 miles	0.40685	51.18548	63.93
Approach 02 - 0.5 miles	0.40603	51.18413	72.35
Approach 02 - 0.6 miles	0.40520	51.18278	80.78
Approach 02 - 0.7 miles	0.40438	51.18143	89.20
Approach 02 - 0.8 miles	0.40355	51.18008	97.62
Approach 02 - 0.9 miles	0.40273	51.17873	106.04
Approach 02 - 1.0 mile	0.40190	51.17738	114.47
Approach 02 - 1.1 miles	0.40108	51.17603	122.89
Approach 02 - 1.2 miles	0.40025	51.17468	131.31
Approach 02 - 1.3 miles	0.39943	51.17333	139.73
Approach 02 - 1.4 miles	0.39861	51.17197	148.16
Approach 02 - 1.5 miles	0.39778	51.17062	156.58
Approach 02 - 1.6 miles	0.39696	51.16927	165.00
Approach 02 - 1.7 miles	0.39613	51.16792	173.43
Approach 02 - 1.8 miles	0.39531	51.16657	181.85
Approach 02 - 1.9 miles	0.39448	51.16522	190.27
Approach 02 - 2.0 miles	0.39366	51.16387	198.69

Assessed receptor (aircraft) locations on the approach path for runway 02

Receptor Locations for Aircraft Landing on Runway 20 – Laddingford Aerodrome

The table below presents the data for the assessed locations for aircraft on approach to runway 20. The altitude of the aircraft is based on a 3-degree descent path referenced to 50 feet (15.2m) above the runway threshold.

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 20 - Threshold	0.41265	51.19485	28.95

No.	Longitude (°)	Latitude (°)	Assessed Altitude (m amsl)
Approach 20 - 0.1 miles	0.41347	51.19620	37.37
Approach 20 - 0.2 miles	0.41430	51.19755	45.80
Approach 20 - 0.3 miles	0.41512	51.19890	54.22
Approach 20 - 0.4 miles	0.41595	51.20025	62.64
Approach 20 - 0.5 miles	0.41677	51.20160	71.06
Approach 20 - 0.6 miles	0.41760	51.20295	79.49
Approach 20 - 0.7 miles	0.41842	51.20430	87.91
Approach 20 - 0.8 miles	0.41925	51.20565	96.33
Approach 20 - 0.9 miles	0.42007	51.20700	104.75
Approach 20 - 1.0 mile	0.42090	51.20835	113.18
Approach 20 - 1.1 miles	0.42172	51.20971	121.60
Approach 20 - 1.2 miles	0.42255	51.21106	130.02
Approach 20 - 1.3 miles	0.42338	51.21241	138.44
Approach 20 - 1.4 miles	0.42420	51.21376	146.87
Approach 20 - 1.5 miles	0.42503	51.21511	155.29
Approach 20 - 1.6 miles	0.42585	51.21646	163.71
Approach 20 - 1.7 miles	0.42668	51.21781	172.14
Approach 20 - 1.8 miles	0.42750	51.21916	180.56
Approach 20 - 1.9 miles	0.42833	51.22051	188.98
Approach 20 - 2.0 miles	0.42916	51.22186	197.40

Assessed receptor (aircraft) locations on the approach path for runway 20

Dwelling Receptor Details

The dwelling receptors details are presented in the table below.

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
1	51.17784	0.44631	26	51.176223	0.455053
2	51.17760	0.44745	27	51.176717	0.458888
3	51.17696	0.44853	28	51.176698	0.459236
4	51.17667	0.44831	29	51.170374	0.460658
5	51.17599	0.44856	30	51.170083	0.460586
6	51.17421	0.45011	31	51.170035	0.460705
7	51.17441	0.45142	32	51.169939	0.461144
8	51.17357	0.45060	33	51.168894	0.460356
9	51.17283	0.45044	34	51.169427	0.461414
10	51.17255	0.45133	35	51.16951	0.463039
11	51.17238	0.45150	36	51.169135	0.464694
12	51.17221	0.45166	37	51.169029	0.465009
13	51.17198	0.45208	38	51.16816	0.466472
14	51.17178	0.45182	39	51.167803	0.466556
15	51.17167	0.45142	40	51.169247	0.465917
16	51.17098	0.45224	41	51.169286	0.466284
17	51.17030	0.45273	42	51.169253	0.466552
18	51.17015	0.45253	43	51.169796	0.467537
19	51.17003	0.45281	44	51.170678	0.468112
20	51.16917	0.45399	45	51.16899	0.466913
21	51.16874	0.45359	46	51.170468	0.479317
22	51.16605	0.44899	47	51.170742	0.479364
23	51.17529	0.45218	48	51.170935	0.478932

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
24	51.17533	0.45322	49	51.174492	0.480021
25	51.17647	0.45471			

Assessed receptor (dwellings) locations

Road Receptor Details

The road receptors details are presented in the tables below.

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
1	51.178588	0.454278	8	51.170464	0.451849
2	51.177250	0.454088	9	51.16921	0.451027
3	51.175978	0.453727	10	51.167966	0.450222
4	51.175162	0.451997	11	51.166681	0.449599
5	51.174247	0.450401	12	51.165357	0.449005
6	51.172987	0.450659	13	51.164045	0.448734
7	51.171752	0.451615			

Assessed road receptor locations

Railway Receptor Details

The train driver receptors details are presented in the tables below.

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
1	51.178022	0.454282	9	51.176881	0.471502
2	51.177872	0.456547	10	51.176748	0.473498
3	51.177736	0.458602	11	51.176608	0.475613
4	51.177596	0.460717	12	51.176464	0.477788
5	51.177454	0.462862	13	51.176315	0.480022
6	51.177314	0.464978	14	51.176181	0.482048
7	51.177173	0.467093	15	51.176048	0.484044
8	51.177035	0.469178			

Assessed train driver receptor locations

Modelled Reflector Area Details

The modelled reflector area details are presented in the tables below.

Site 1

ID	Longitude (°)	Latitude (°)	ID	Longitude (°)	Latitude (°)
1	0.47149	51.17670	6	0.47180	51.17362
2	0.47635	51.17634	7	0.47125	51.17388
3	0.47267	51.17036	8	0.47119	51.17443
4	0.47184	51.16990	9	0.47192	51.17578
5	0.47086	51.17011	10	0.47139	51.17622

Modelled reflector area Site 1

Site 2

ID	Longitude (°)	Latitude (°)	ID	Longitude (°)	Latitude (°)
1	0.46854	51.17688	4	0.47055	51.17481
2	0.47000	51.17679	5	0.46862	51.17594
3	0.47123	51.17583			

Modelled reflector area Site 2

Site 3

ID	Longitude (°)	Latitude (°)	ID	Longitude (°)	Latitude (°)
1	0.46954	51.17465	6	0.46870	51.17101
2	0.47062	51.17424	7	0.46844	51.17221
3	0.47072	51.17369	8	0.46863	51.17300
4	0.47107	51.17354	9	0.46920	51.17295
5	0.47035	51.17042			

Modelled reflector area Site 3

Site 4

ID	Longitude (°)	Latitude (°)	ID	Longitude (°)	Latitude (°)
1	0.46440	51.17718	9	0.46610	51.17419
2	0.46793	51.17693	10	0.46607	51.17401
3	0.46788	51.17622	11	0.46529	51.17405
4	0.46839	51.17545	12	0.46514	51.17517

ID	Longitude (°)	Latitude (°)	ID	Longitude (°)	Latitude (°)
5	0.46899	51.17515	13	0.46436	51.17629
6	0.46885	51.17342	14	0.46451	51.17651
7	0.46659	51.17385	15	0.46433	51.17679
8	0.46657	51.17416			

Modelled reflector area Site 4

Site 6

ID	Longitude (°)	Latitude (°)	ID	Longitude (°)	Latitude (°)
1	0.46181	51.17647	7	0.46324	51.17193
2	0.46355	51.17659	8	0.46344	51.17267
3	0.46467	51.17516	9	0.46312	51.17375
4	0.46484	51.17393	10	0.46314	51.17432
5	0.46534	51.17243	11	0.46297	51.17478
6	0.46512	51.17128	12	0.46175	51.17607

Modelled reflector area Site 6

Site 6

ID	Longitude (°)	Latitude (°)	ID	Longitude (°)	Latitude (°)
1	0.46143	51.17555	6	0.46091	51.17153
2	0.46260	51.17469	7	0.46073	51.17109
3	0.46292	51.17366	8	0.46019	51.17064
3	0.46298	51.17195	9	0.45885	51.17118
4	0.46065	51.17228			

Modelled reflector area Site 6

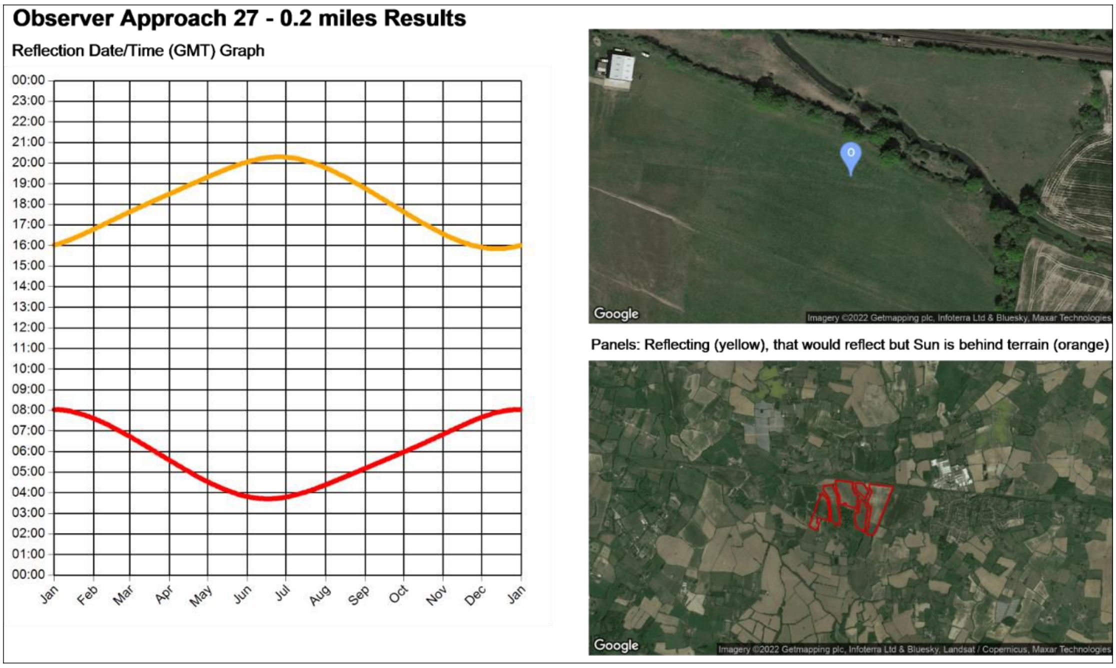
APPENDIX H – GEOMETRIC CALCULATION RESULTS – PAGER POWER RESULTS

The charts for the receptors are shown on the following pages. Each 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 reflecting areas – bottom right image. The reflecting area is shown in yellow. If the yellow panels are not visible from the observer location, no issues will occur in practice. Additional obstructions which may obscure the reflector area from view are considered separately within the analysis;
- The reflection date/time graph – left hand side of the page. The blue line indicates the dates and times at which geometric reflections are possible. This relates to reflections from the yellow areas only.

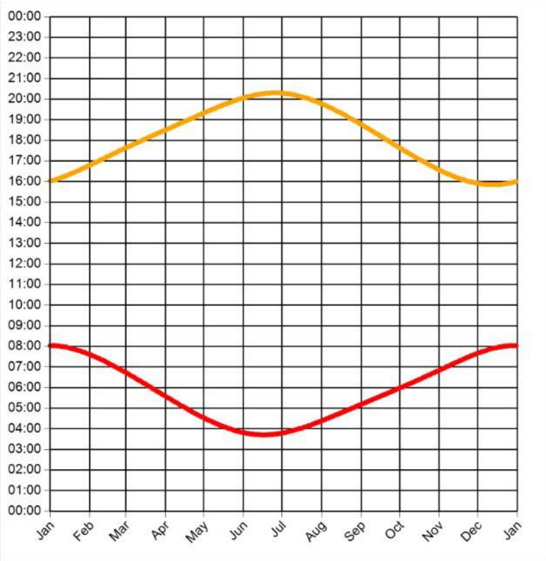
Aerodromes

Only glint and glare charts for approach path 27 are shown in this section. Other can be provided upon request.



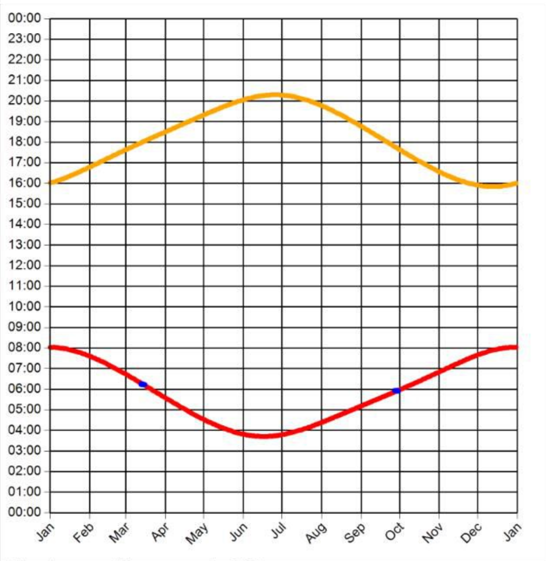
Observer Approach 27 - 0.3 miles Results

Reflection Date/Time (GMT) Graph



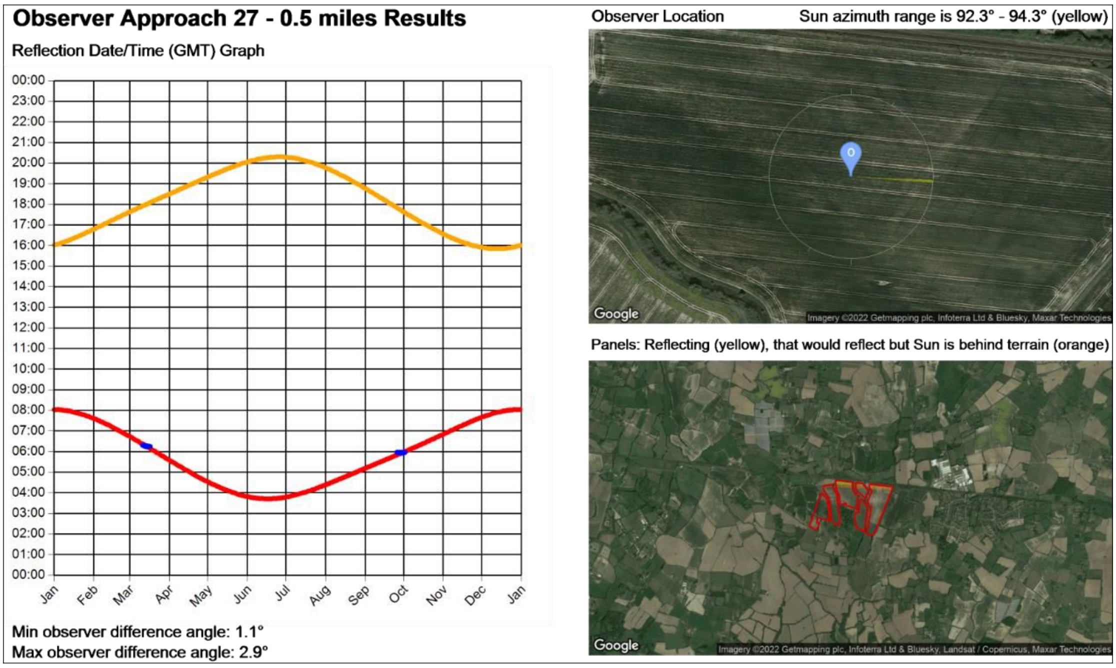
Observer Approach 27 - 0.4 miles Results

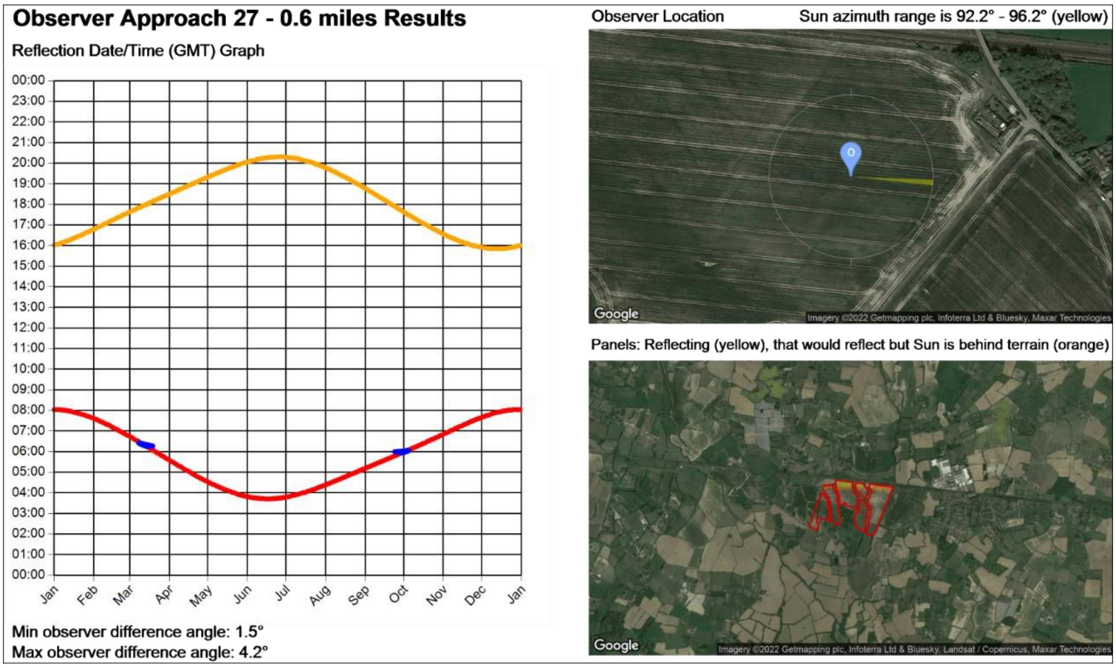
Reflection Date/Time (GMT) Graph

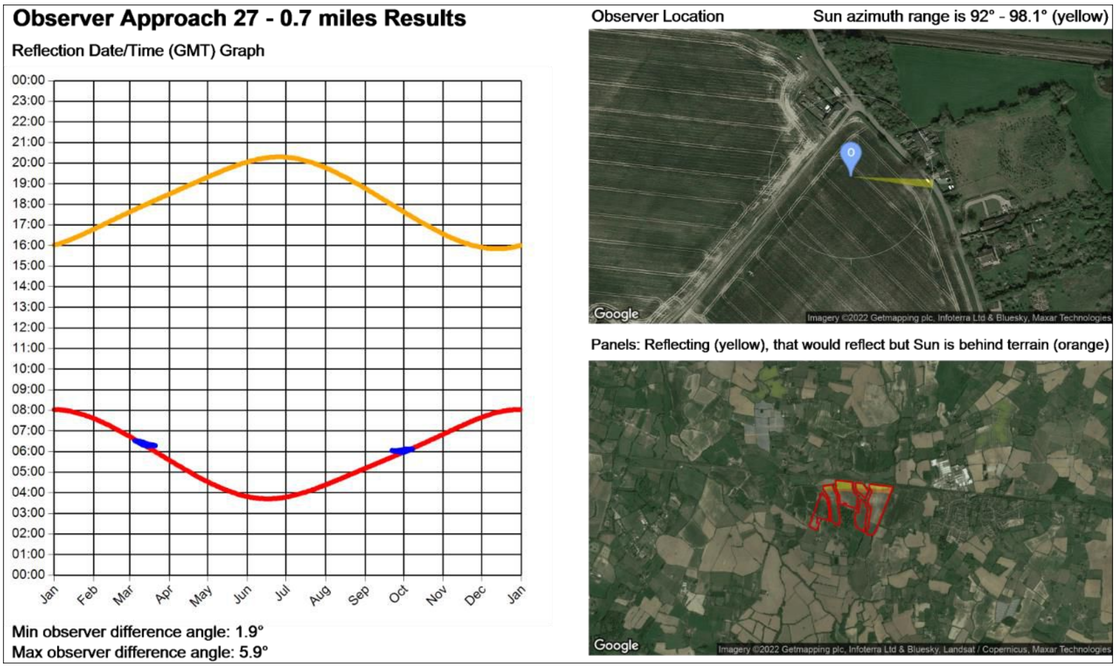


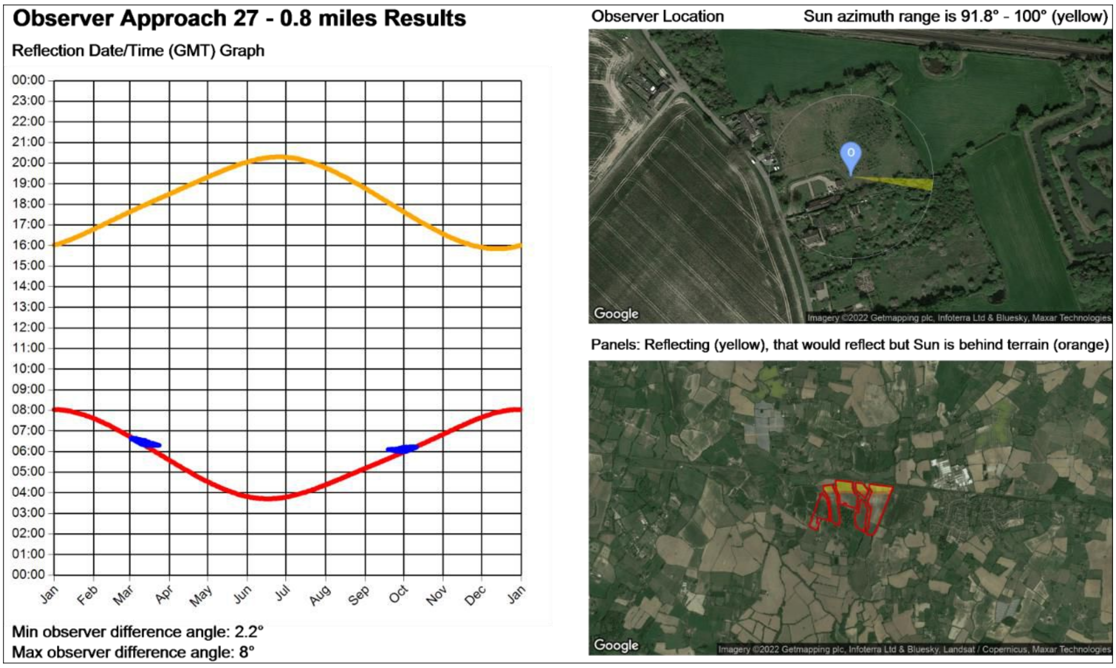
Min observer difference angle: 0.8°
Max observer difference angle: 1.9°

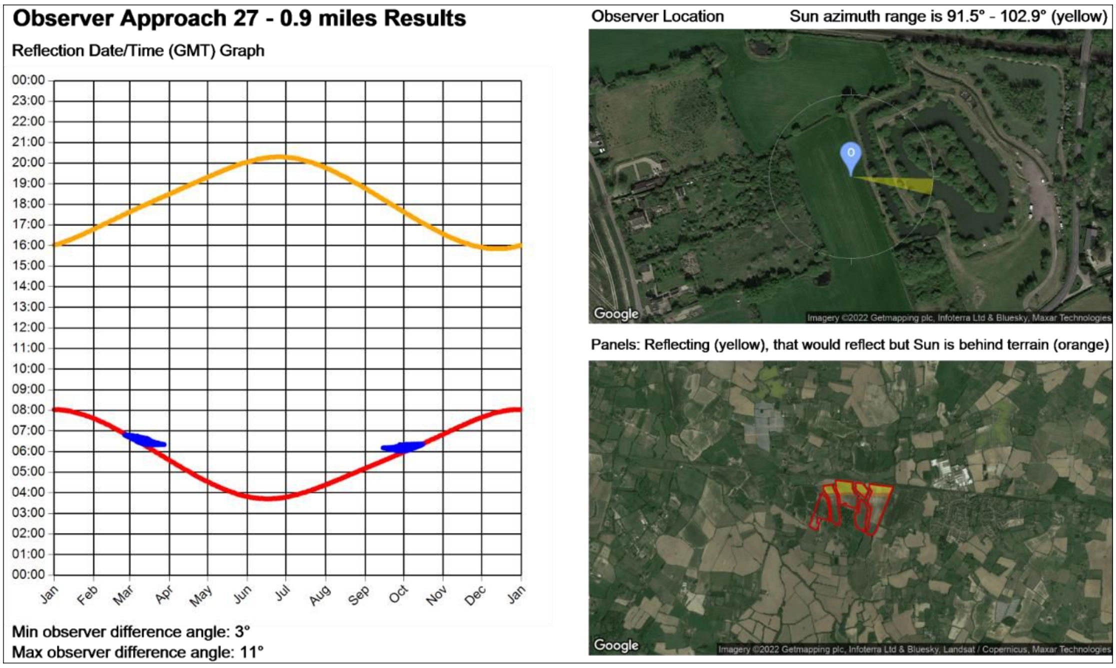
Observer Location — Sun azimuth range is 92.4° - 93.3° (yellow)

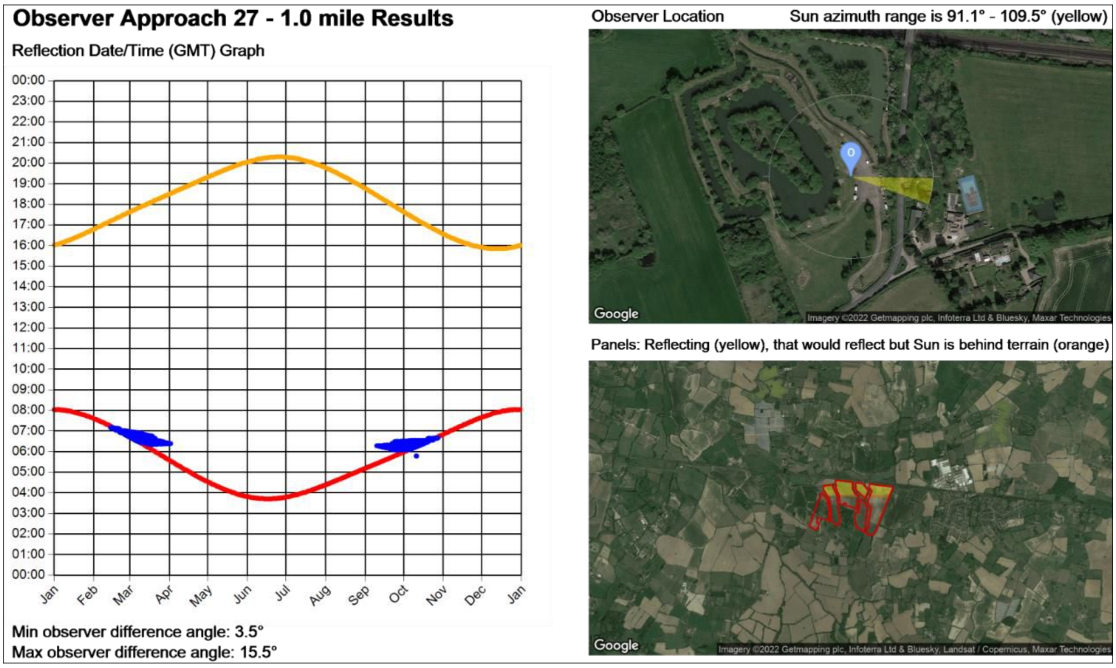

Observer Approach 27 - 0.5 miles Results
Reflection Date/Time (GMT) Graph
Min observer difference angle: 1.1°
Max observer difference angle: 2.9°
Observer Location
Sun azimuth range is 92.3° - 94.3° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

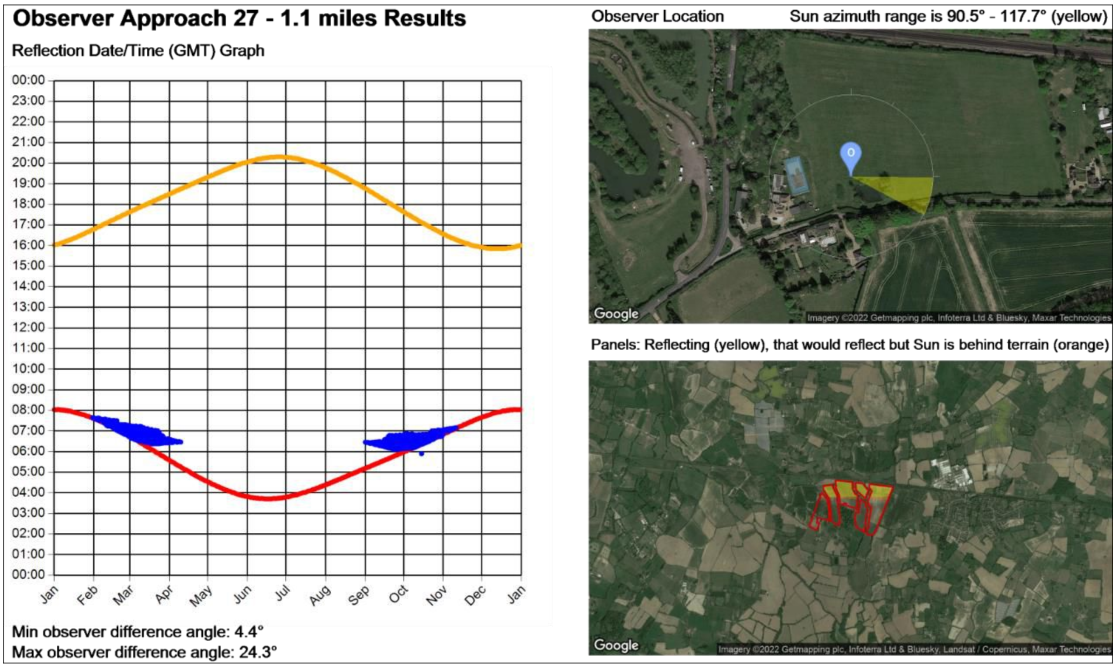

Observer Approach 27 - 0.6 miles Results
Reflection Date/Time (GMT) Graph
Min observer difference angle: 1.5°
Max observer difference angle: 4.2°
Observer Location
Sun azimuth range is 92.2° - 96.2° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

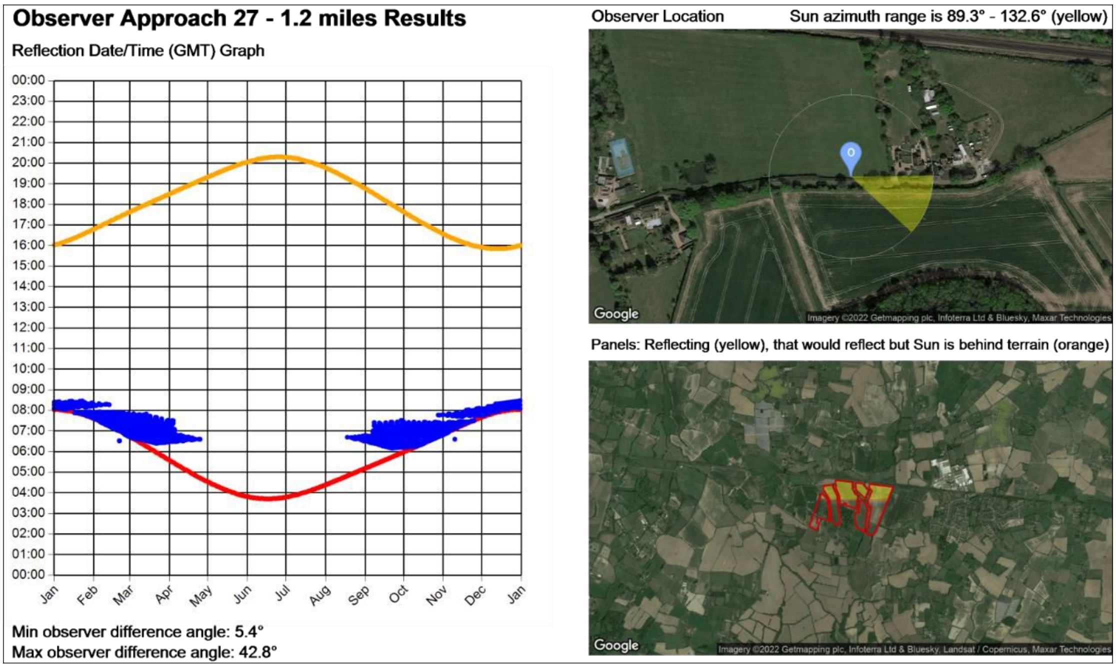

Observer Approach 27 - 0.7 miles Results
Reflection Date/Time (GMT) Graph
00:00
23:00
22:00
21:00
20:00
19:00
18:00
17:00
16:00
15:00
14:00
13:00
12:00
11:00
10:00
09:00
08:00
07:00
06:00
05:00
04:00
03:00
02:00
01:00
00:00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 1.9°
Max observer difference angle: 5.9°
Observer Location
Sun azimuth range is 92° - 98.1° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

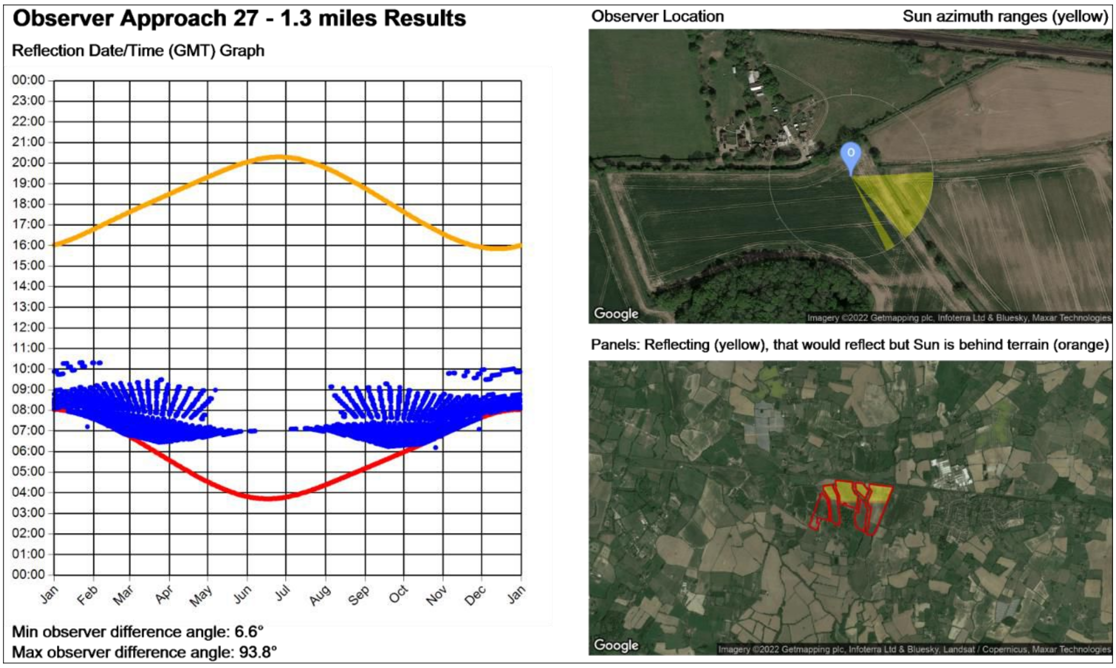

Observer Approach 27 - 0.8 miles Results
Reflection Date/Time (GMT) Graph
00:00
23:00
22:00
21:00
20:00
19:00
18:00
17:00
16:00
15:00
14:00
13:00
12:00
11:00
10:00
09:00
08:00
07:00
06:00
05:00
04:00
03:00
02:00
01:00
00:00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 2.2°
Max observer difference angle: 8°
Observer Location
Sun azimuth range is 91.8° - 100° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

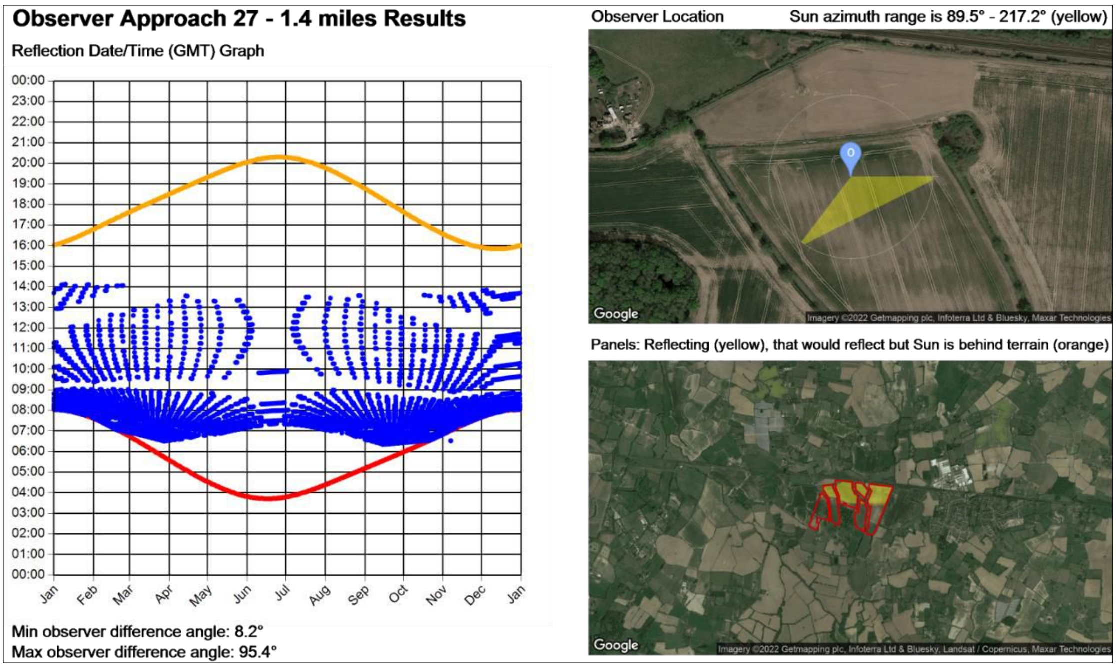

Observer Approach 27 - 0.9 miles Results
Reflection Date/Time (GMT) Graph
Min observer difference angle: 3°
Max observer difference angle: 11°
Observer Location
Sun azimuth range is 91.5° - 102.9° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)


Observer Approach 27 - 1.0 mile Results
Reflection Date/Time (GMT) Graph
Min observer difference angle: 3.5°
Max observer difference angle: 15.5°
Observer Location
Sun azimuth range is 91.1° - 109.5° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)


Observer Approach 27 - 1.1 miles Results
Reflection Date/Time (GMT) Graph
Min observer difference angle: 4.4°
Max observer difference angle: 24.3°
Observer Location
Sun azimuth range is 90.5° - 117.7° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)


Observer Approach 27 - 1.2 miles Results
Reflection Date/Time (GMT) Graph
Min observer difference angle: 5.4°
Max observer difference angle: 42.8°
Observer Location
Sun azimuth range is 89.3° - 132.6° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)


Observer Approach 27 - 1.3 miles Results
Reflection Date/Time (GMT) Graph
00:00
23:00
22:00
21:00
20:00
19:00
18:00
17:00
16:00
15:00
14:00
13:00
12:00
11:00
10:00
09:00
08:00
07:00
06:00
05:00
04:00
03:00
02:00
01:00
00:00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Min observer difference angle: 6.6°
Max observer difference angle: 93.8°
Observer Location
Sun azimuth ranges (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer Approach 27 - 1.4 miles Results
Reflection Date/Time (GMT) Graph
00:00
23:00
22:00
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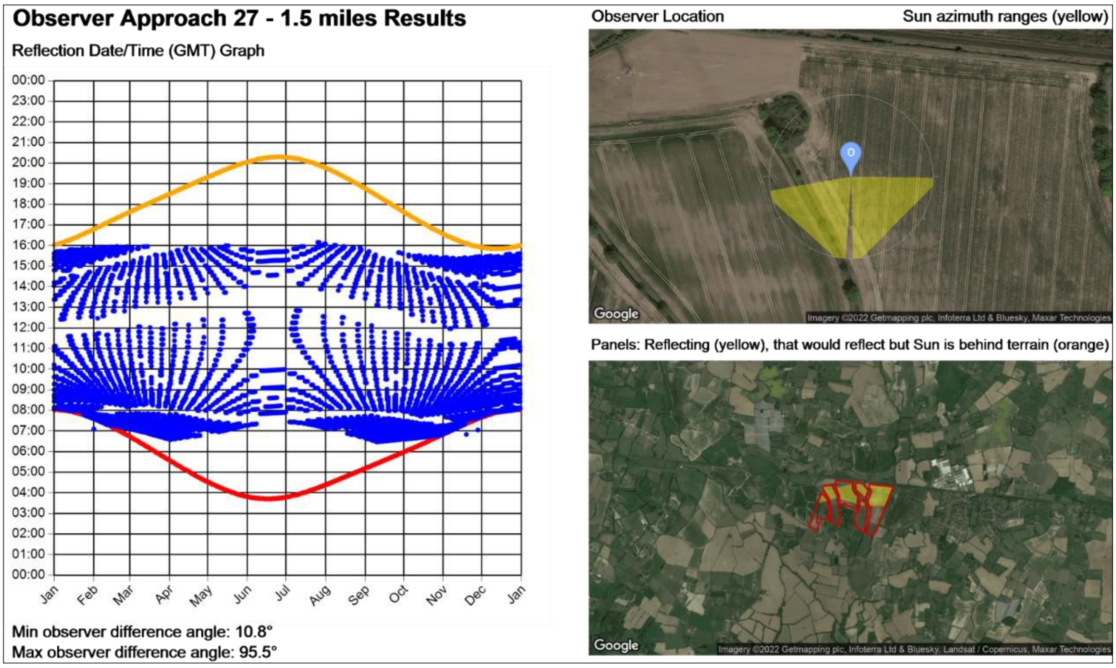
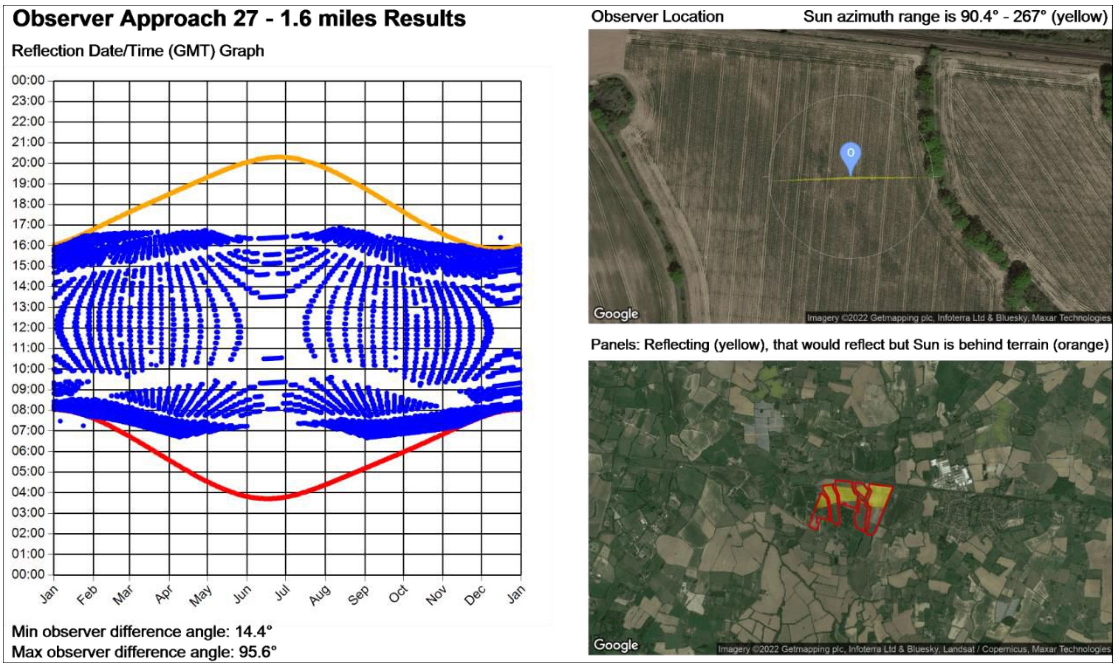
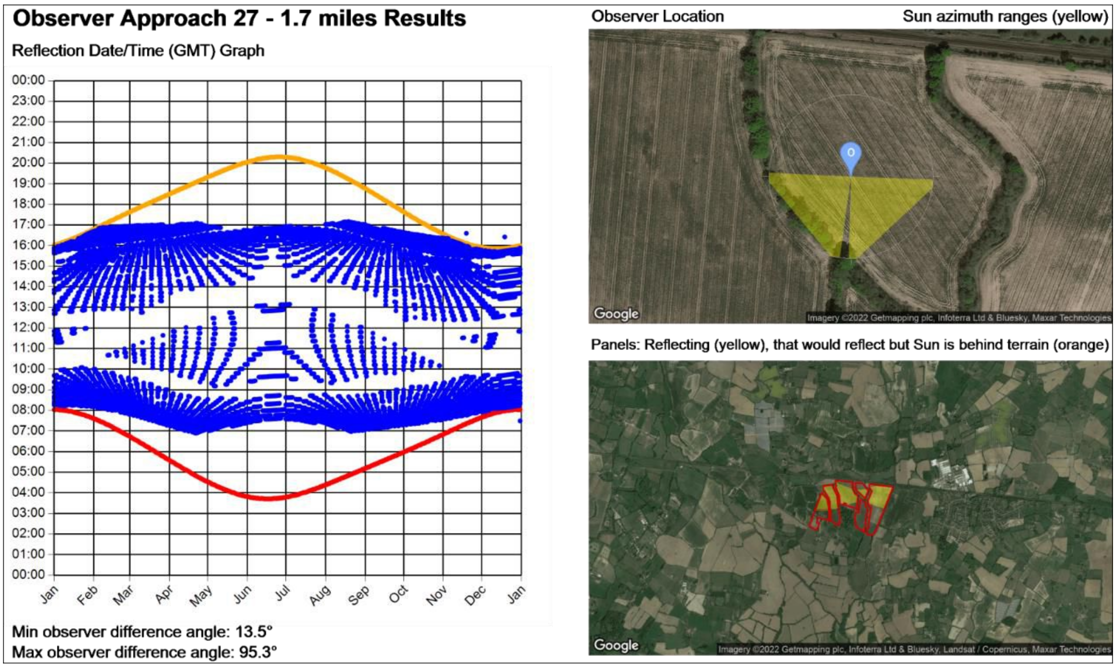
Jan
Min observer difference angle: 8.2°
Max observer difference angle: 95.4°
Observer Location
Sun azimuth range is 89.5° - 217.2° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer Approach 27 - 1.5 miles Results
Reflection Date/Time (GMT) Graph
00:00 23:00 22:00 21:00 20:00 19:00 18:00 17:00 16:00 15:00 14:00 13:00 12:00 11:00 10:00 09:00 08:00 07:00 06:00 05:00 04:00 03:00 02:00 01:00 00:00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 10.8°
Max observer difference angle: 95.5°
Observer Location
Sun azimuth ranges (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer Approach 27 - 1.6 miles Results
Reflection Date/Time (GMT) Graph
00:00 23:00 22:00 21:00 20:00 19:00 18:00 17:00 16:00 15:00 14:00 13:00 12:00 11:00 10:00 09:00 08:00 07:00 06:00 05:00 04:00 03:00 02:00 01:00 00:00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 14.4°
Max observer difference angle: 95.6°
Observer Location
Sun azimuth range is 90.4° - 267° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer Approach 27 - 1.7 miles Results
Reflection Date/Time (GMT) Graph
00:00
23:00
22:00
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17:00
16:00
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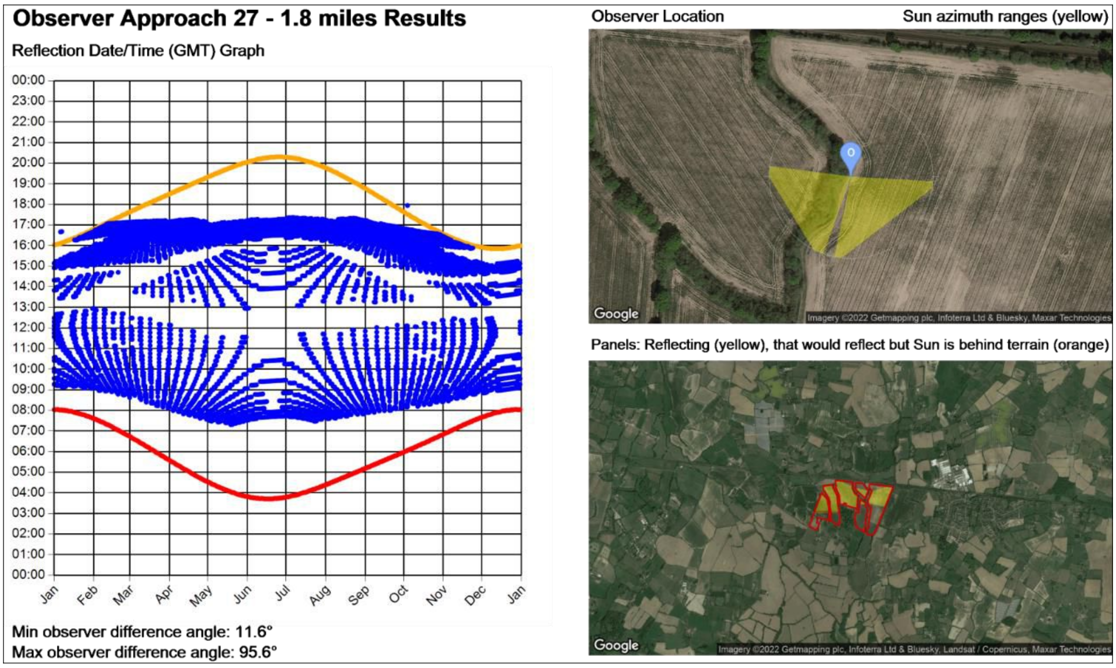
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 13.5°
Max observer difference angle: 95.3°
Observer Location
Sun azimuth ranges (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer Approach 27 - 1.8 miles Results
Reflection Date/Time (GMT) Graph
00:00
23:00
22:00
21:00
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17:00
16:00
15:00
14:00
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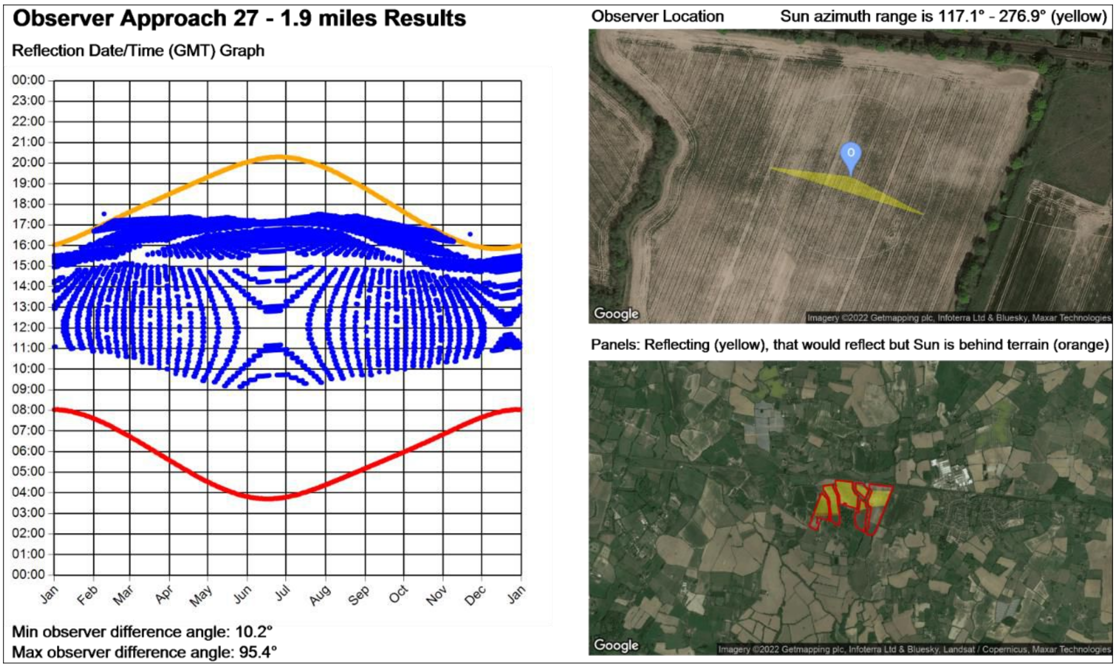
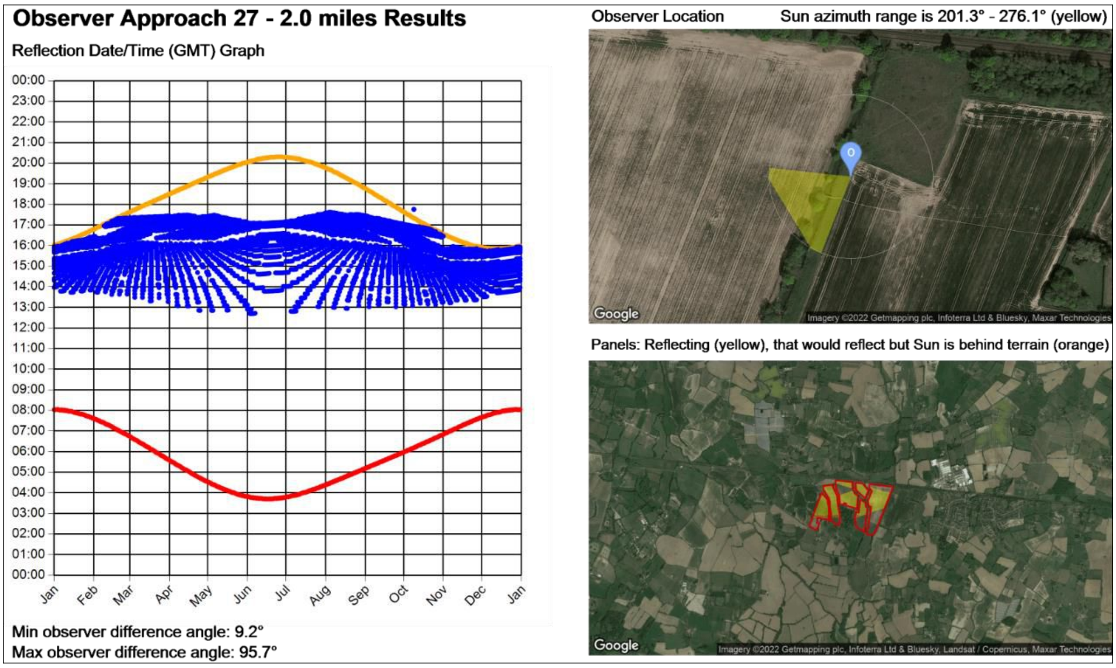
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 11.6°
Max observer difference angle: 95.6°
Observer Location
Sun azimuth ranges (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

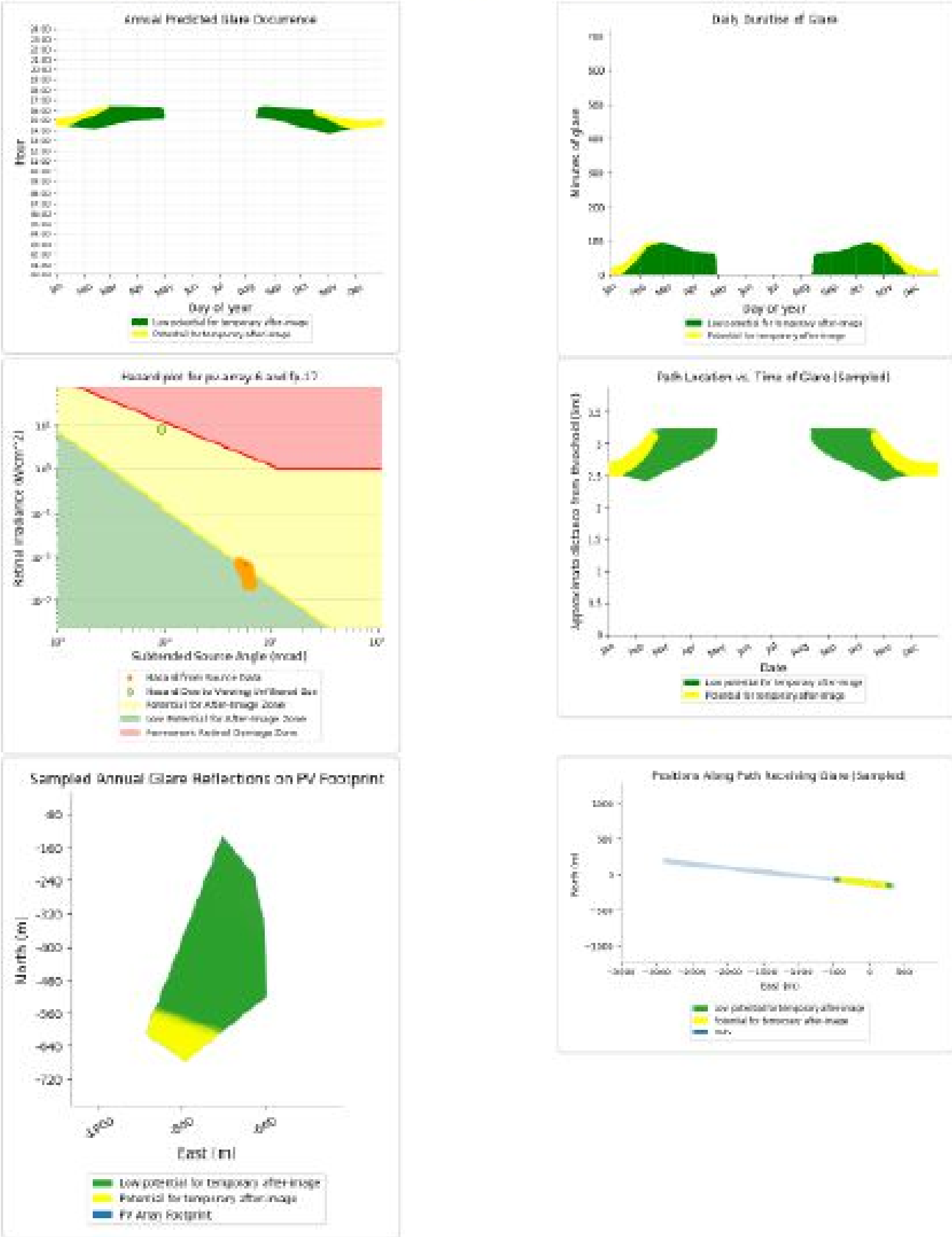

Observer Approach 27 - 1.9 miles Results
Reflection Date/Time (GMT) Graph
00:00 23:00 22:00 21:00 20:00 19:00 18:00 17:00 16:00 15:00 14:00 13:00 12:00 11:00 10:00 09:00 08:00 07:00 06:00 05:00 04:00 03:00 02:00 01:00 00:00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 10.2°
Max observer difference angle: 95.4°
Observer Location
Sun azimuth range is 117.1° - 276.9° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer Approach 27 - 2.0 miles Results
Reflection Date/Time (GMT) Graph
00:00 23:00 22:00 21:00 20:00 19:00 18:00 17:00 16:00 15:00 14:00 13:00 12:00 11:00 10:00 09:00 08:00 07:00 06:00 05:00 04:00 03:00 02:00 01:00 00:00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 9.2°
Max observer difference angle: 95.7°
Observer Location
Sun azimuth range is 201.3° - 276.1° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

PV array 6 - Receptor (FP 27)

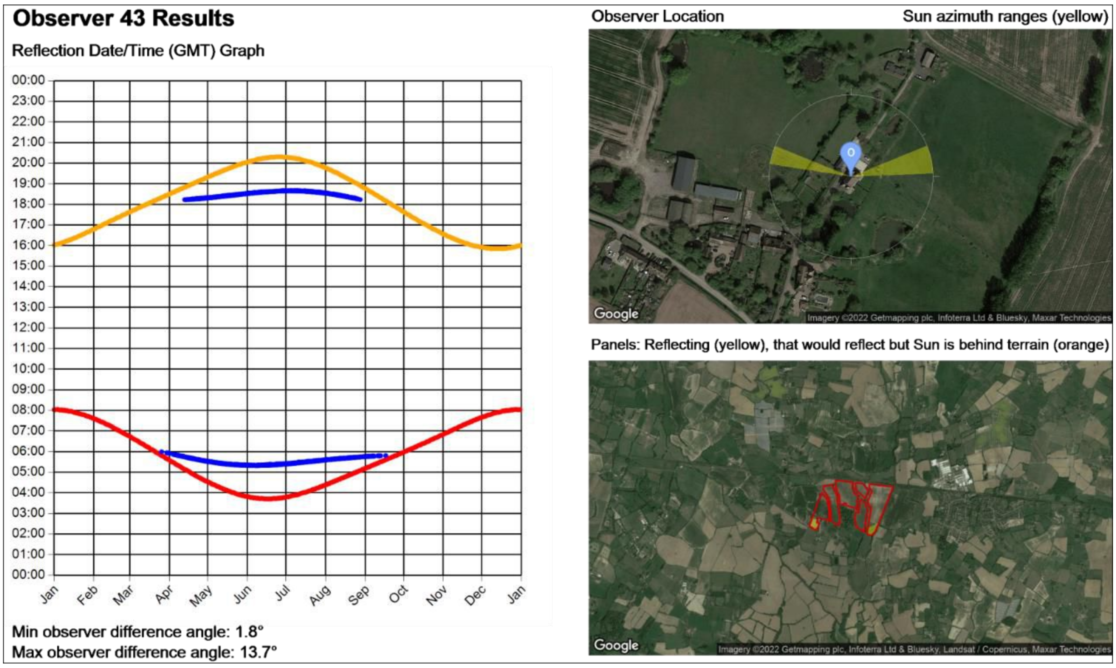
PV array is expected to produce the following glare for observers on this flight path:

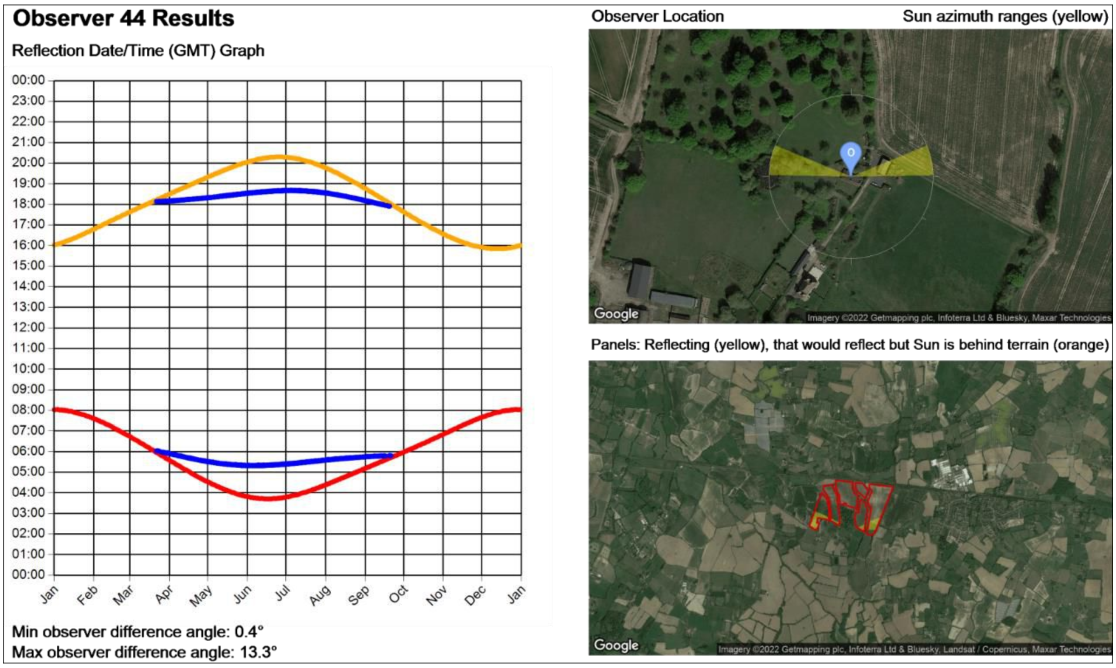
- 14,385 minutes of "green" glare with low potential to cause temporary after-image.
- 2,690 minutes of "yellow" glare with potential to cause temporary after-image.



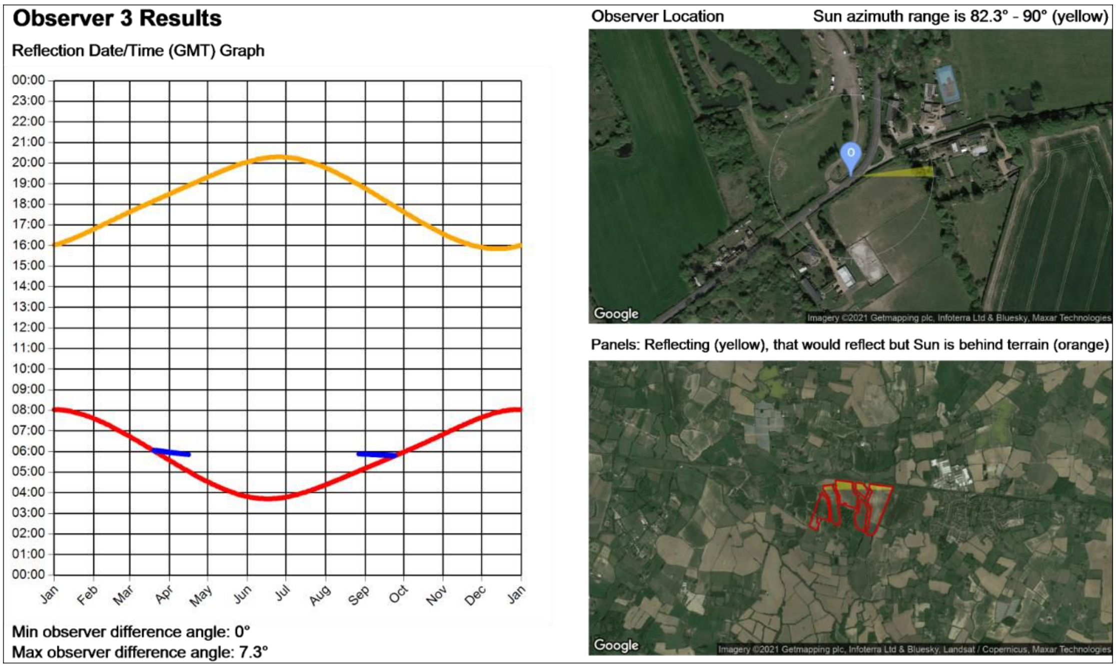
Dwelling Receptors

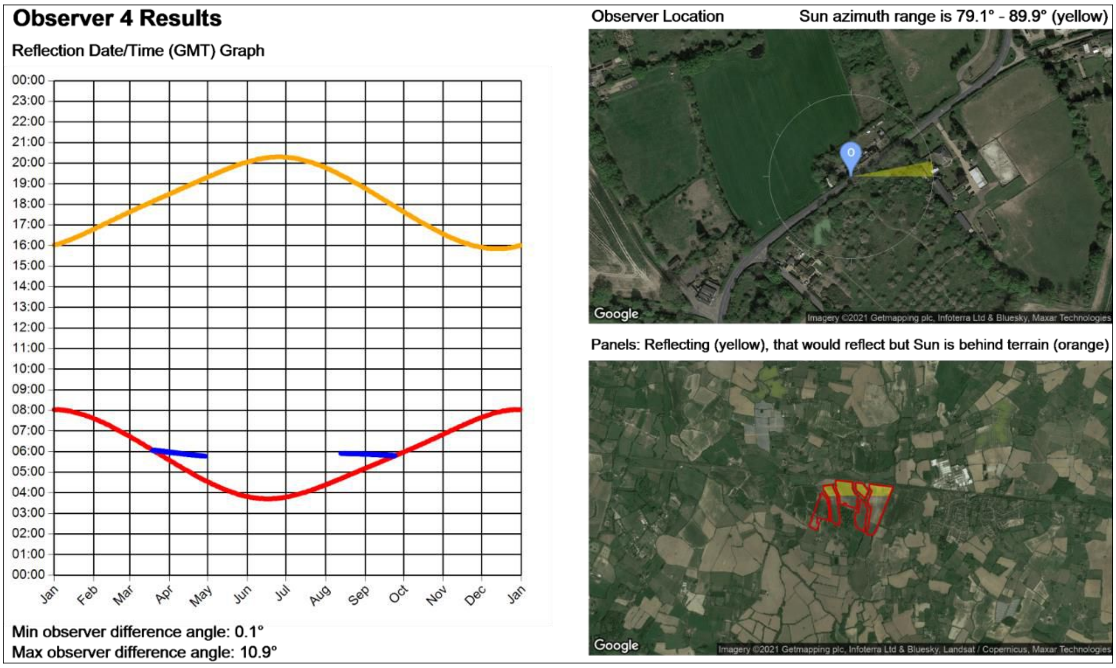
Only dwellings where impact is considered to be moderate are shown.

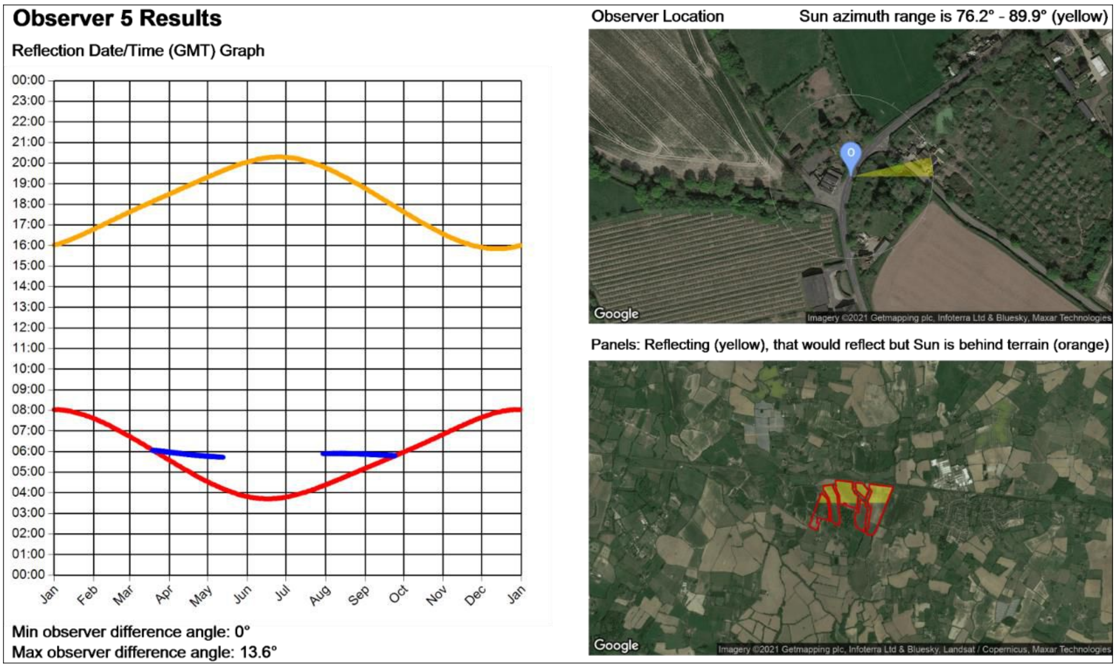


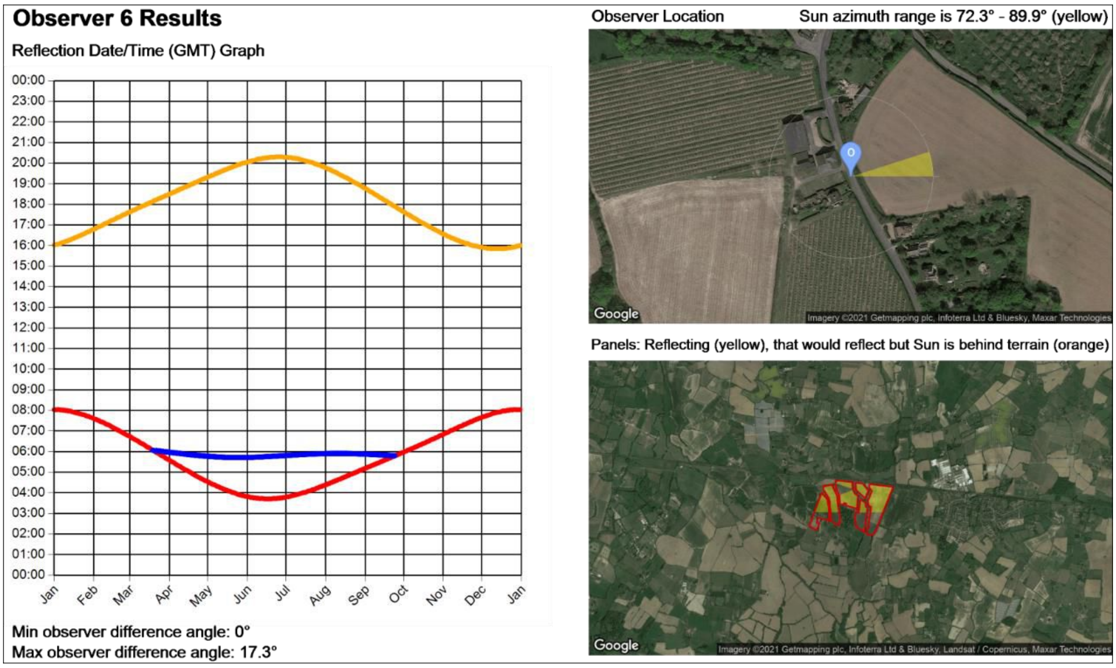


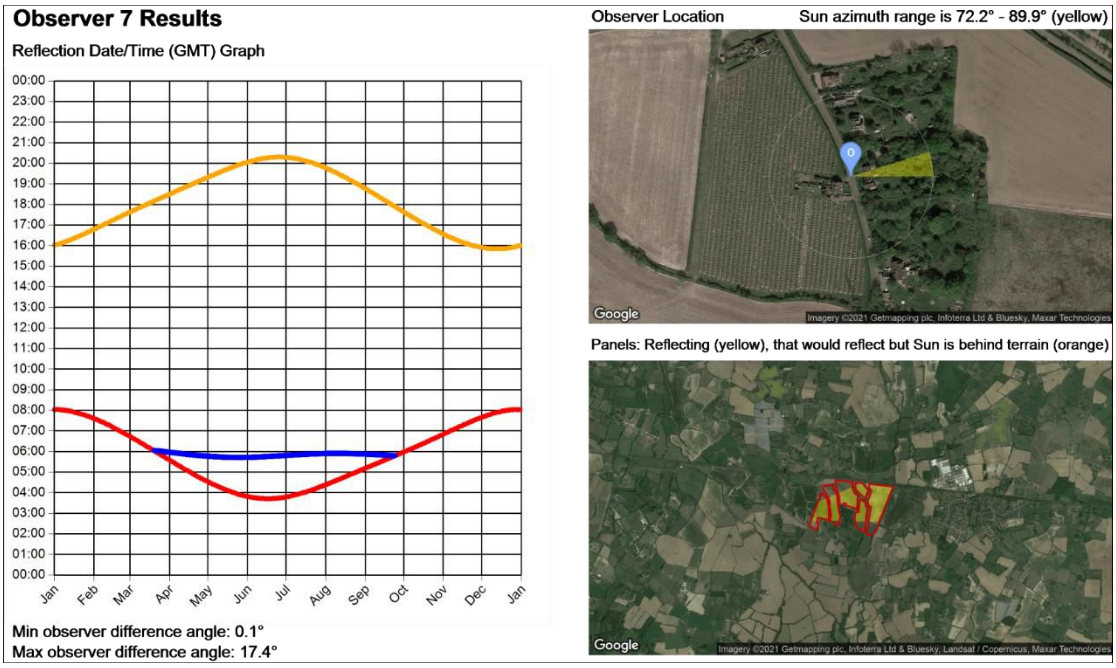
Road Receptors






Observer 5 Results
Reflection Date/Time (GMT) Graph
Min observer difference angle: 0°
Max observer difference angle: 13.6°
Observer Location
Sun azimuth range is 76.2° - 89.9° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 6 Results
Reflection Date/Time (GMT) Graph
Min observer difference angle: 0°
Max observer difference angle: 17.3°
Observer Location
Sun azimuth range is 72.3° - 89.9° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 7 Results
Reflection Date/Time (GMT) Graph
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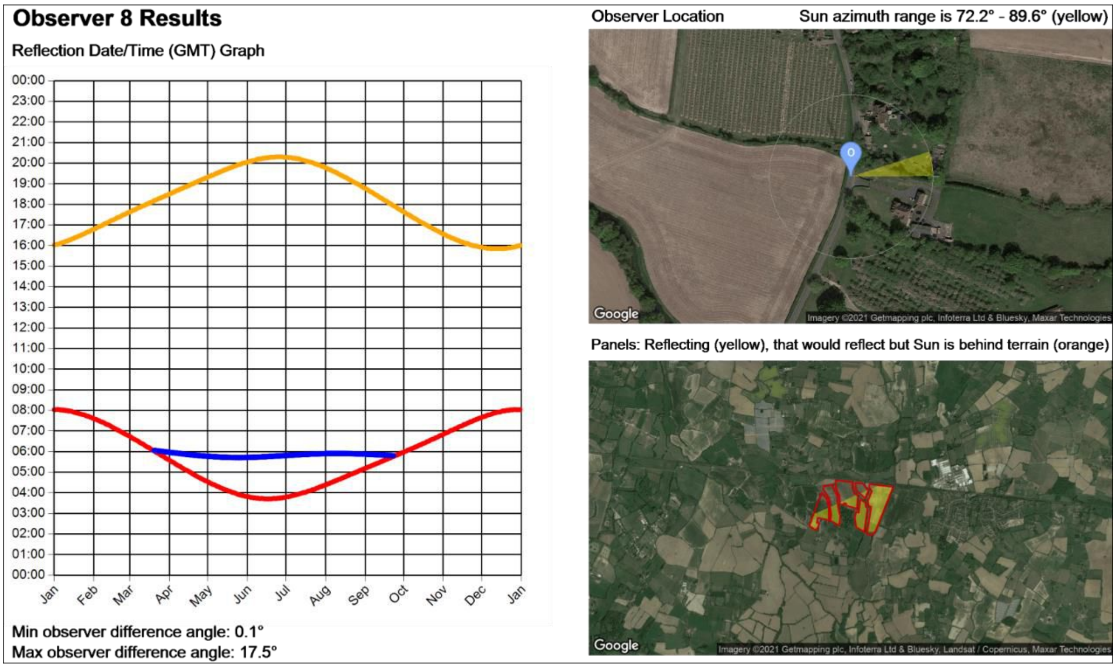
Jan
Min observer difference angle: 0.1°
Max observer difference angle: 17.4°
Observer Location
Sun azimuth range is 72.2° - 89.9° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 8 Results
Reflection Date/Time (GMT) Graph
00:00
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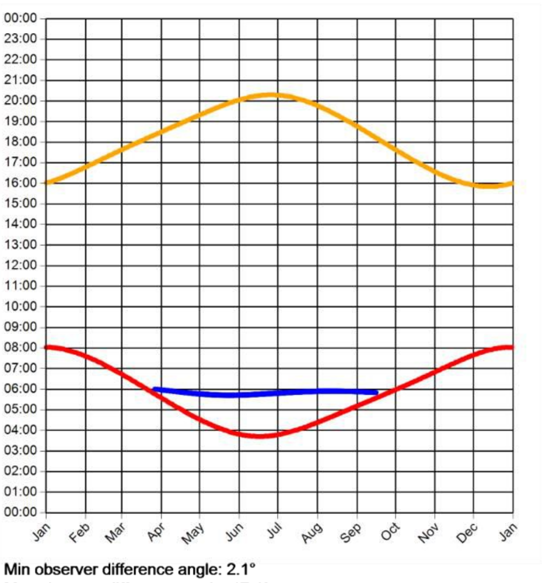
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Min observer difference angle: 0.1°
Max observer difference angle: 17.5°
Observer Location
Sun azimuth range is 72.2° - 89.6° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

Observer 9 Results

Reflection Date/Time (GMT) Graph



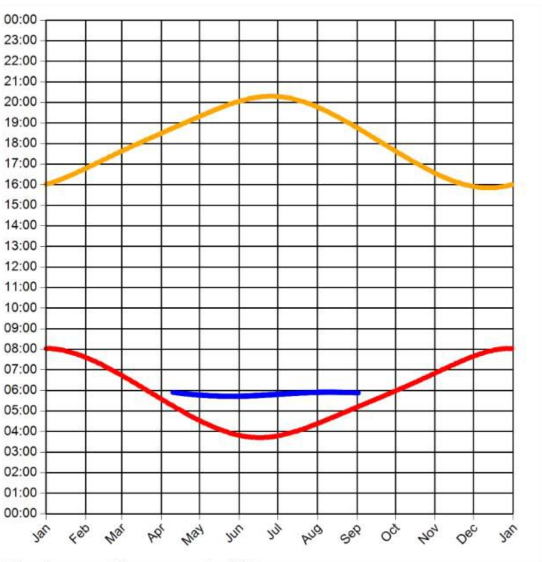
Min observer difference angle: 2.1°
Max observer difference angle: 17.4°

Observer Location — Sun azimuth range is 72.2° - 87.8° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 10 Results

Reflection Date/Time (GMT) Graph

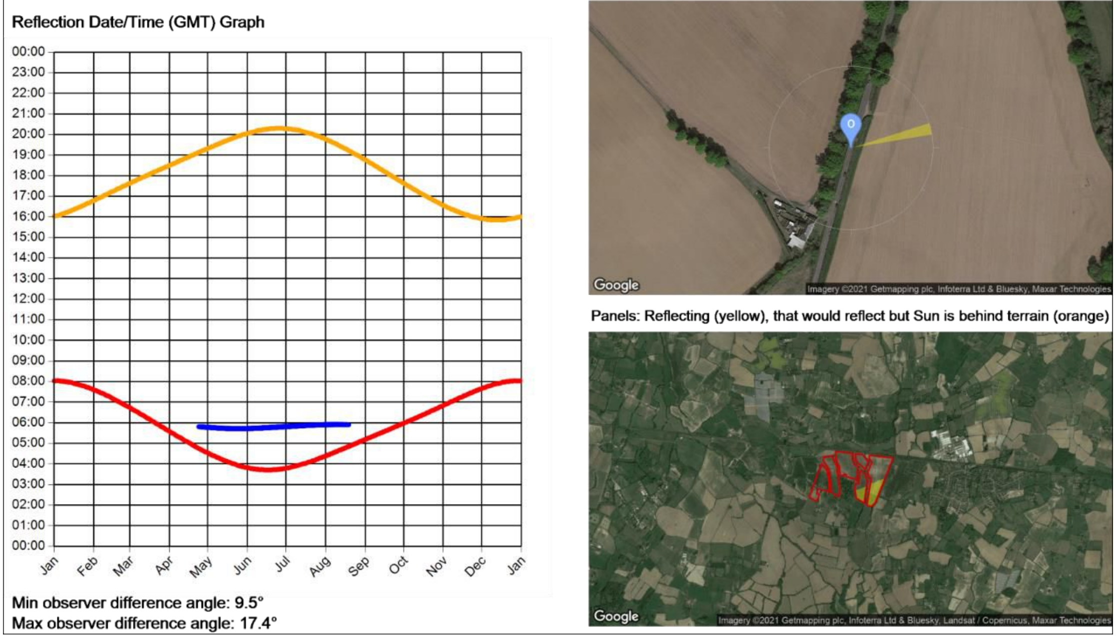


Min observer difference angle: 5.9°
Max observer difference angle: 17.4°

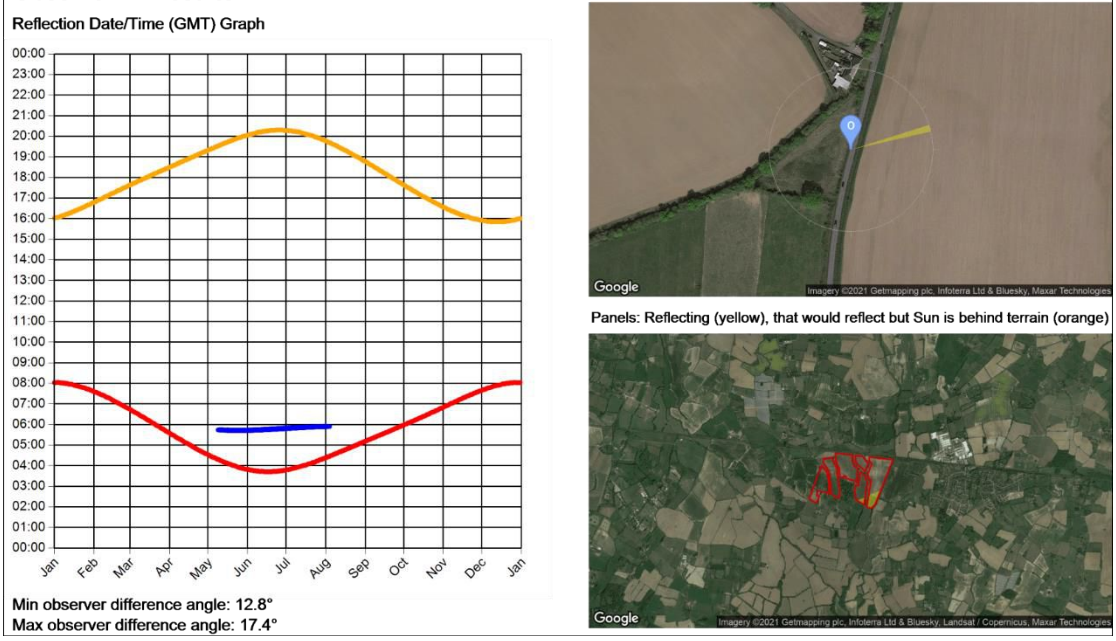
Observer Location — Sun azimuth range is 72.2° - 84° (yellow)

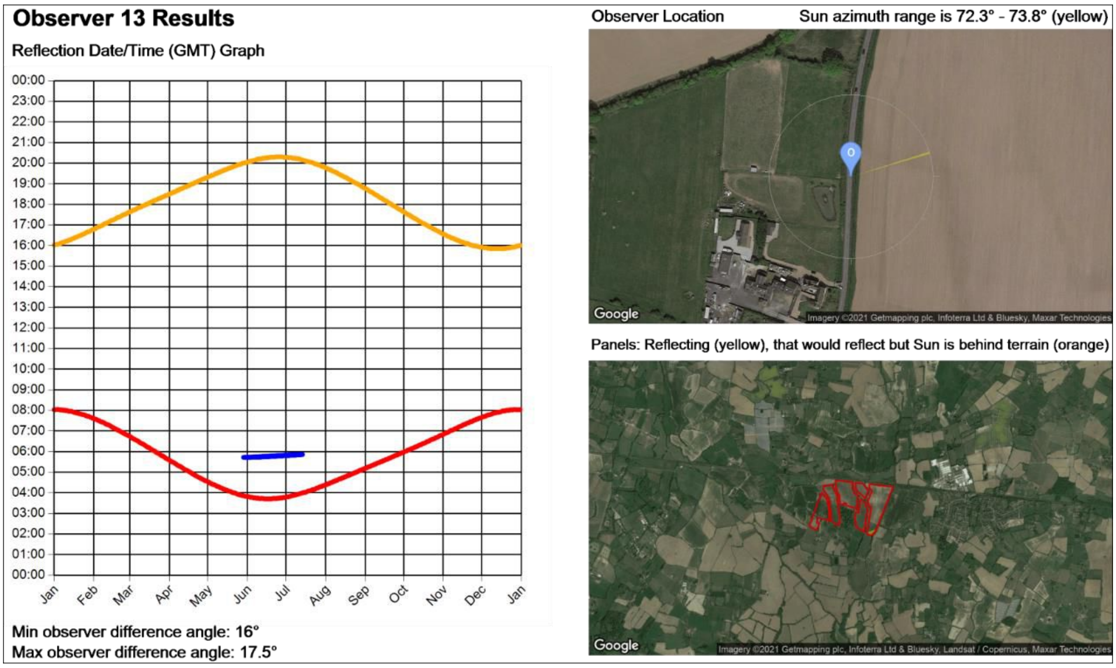
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 11 Results



Observer 12 Results




Observer 13 Results
Reflection Date/Time (GMT) Graph
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16:00
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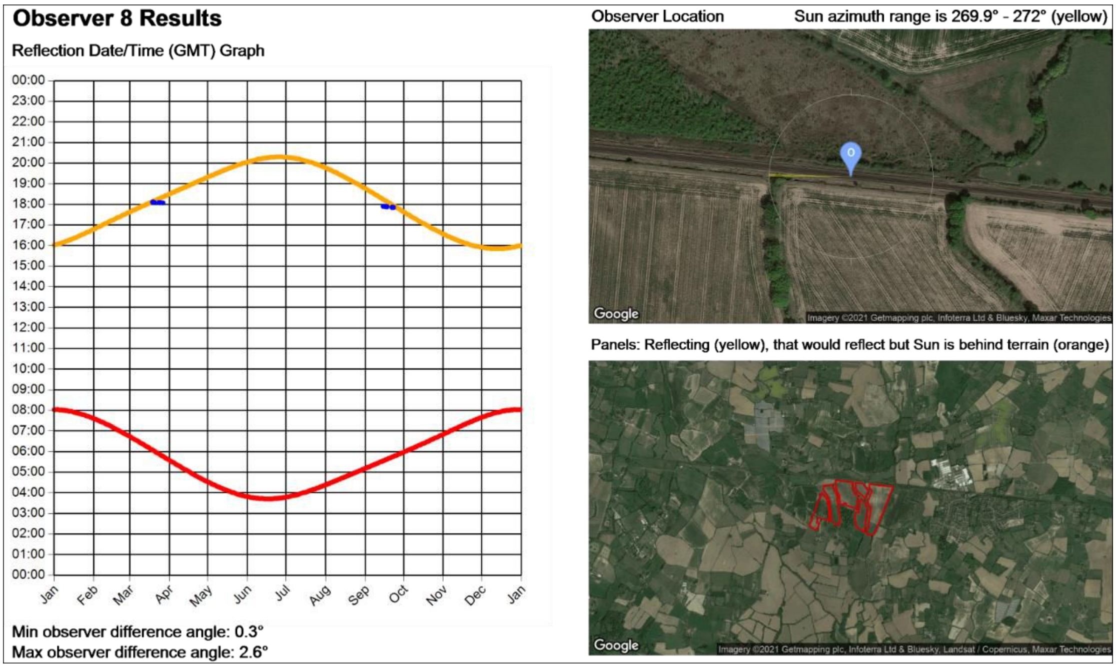
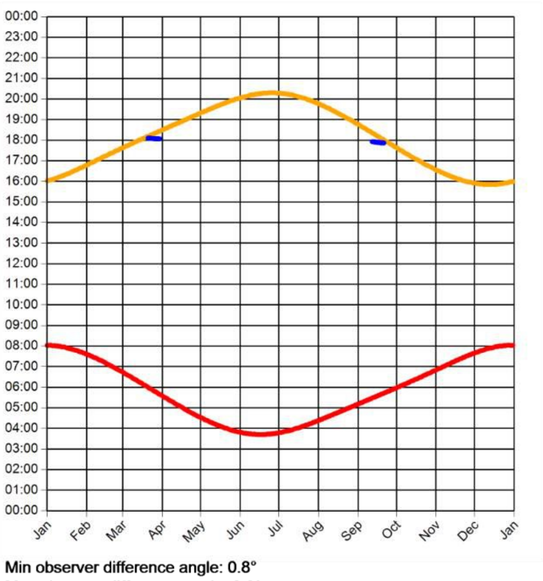
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 16°
Max observer difference angle: 17.5°
Observer Location
Sun azimuth range is 72.3° - 73.8° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google

Railway Receptors



Observer 9 Results

Reflection Date/Time (GMT) Graph



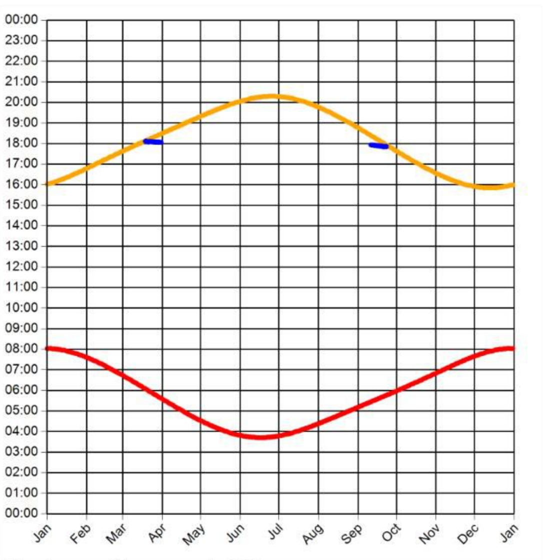
Min observer difference angle: 0.8°
Max observer difference angle: 3.3°

Observer Location — Sun azimuth range is 270.5° - 272.8° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 10 Results

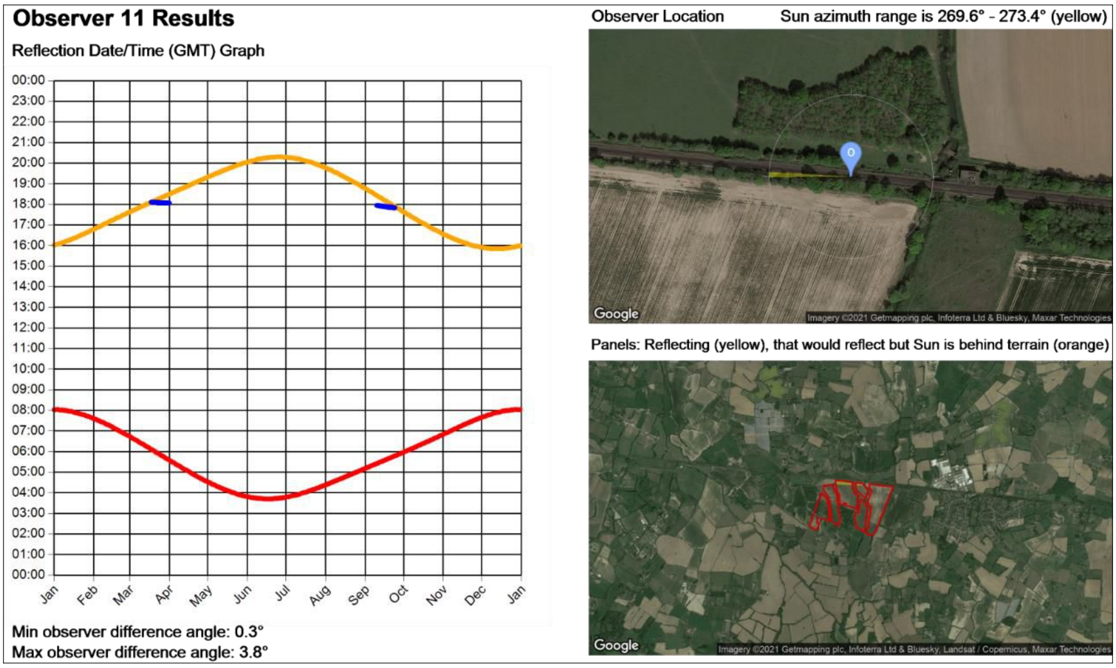
Reflection Date/Time (GMT) Graph

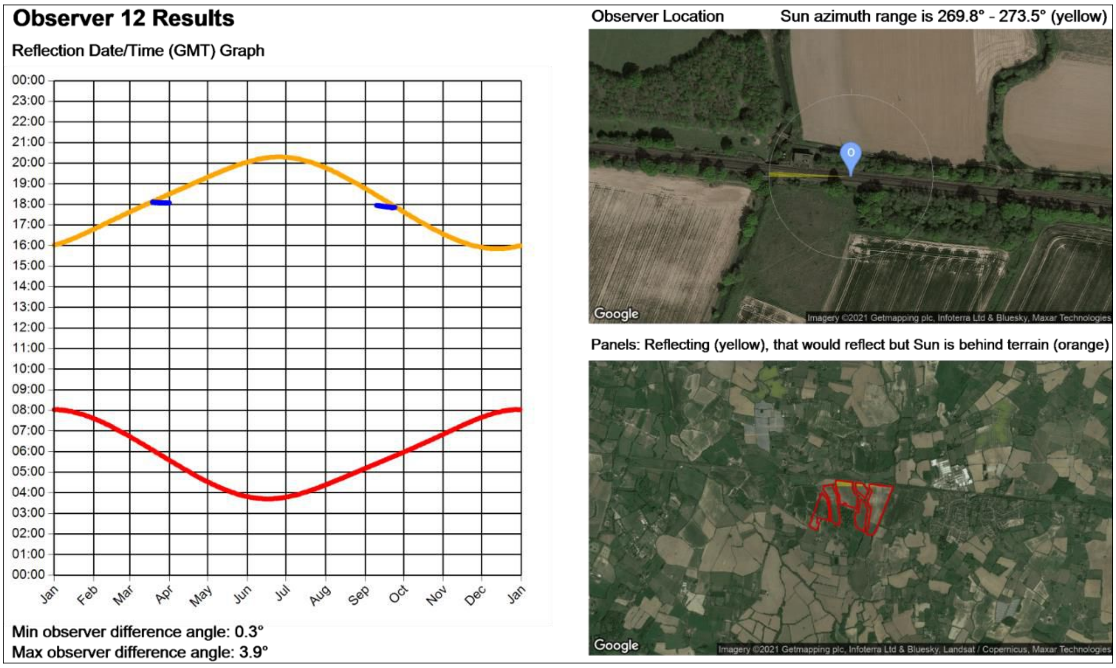


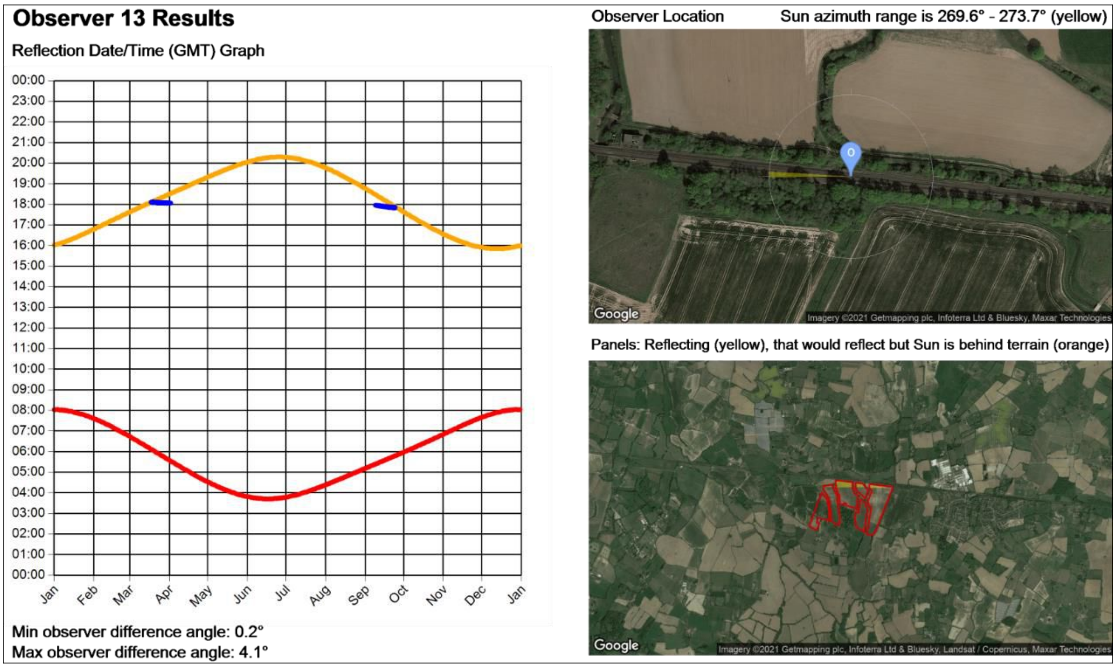
Min observer difference angle: 0.3°
Max observer difference angle: 3.6°

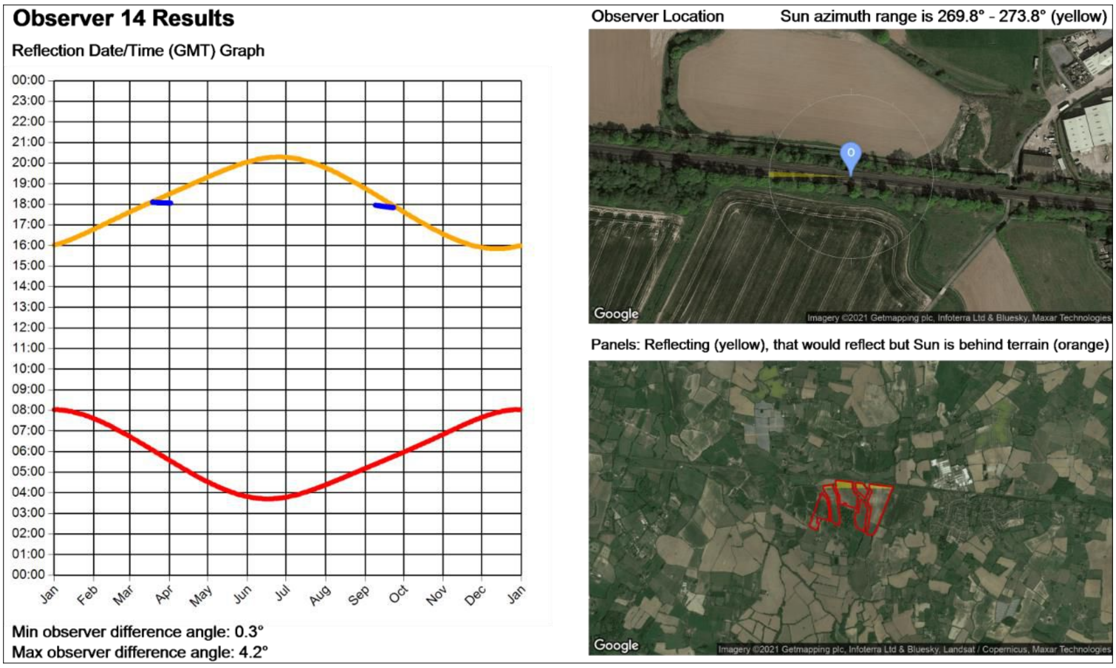
Observer Location — Sun azimuth range is 269.9° - 273.1° (yellow)

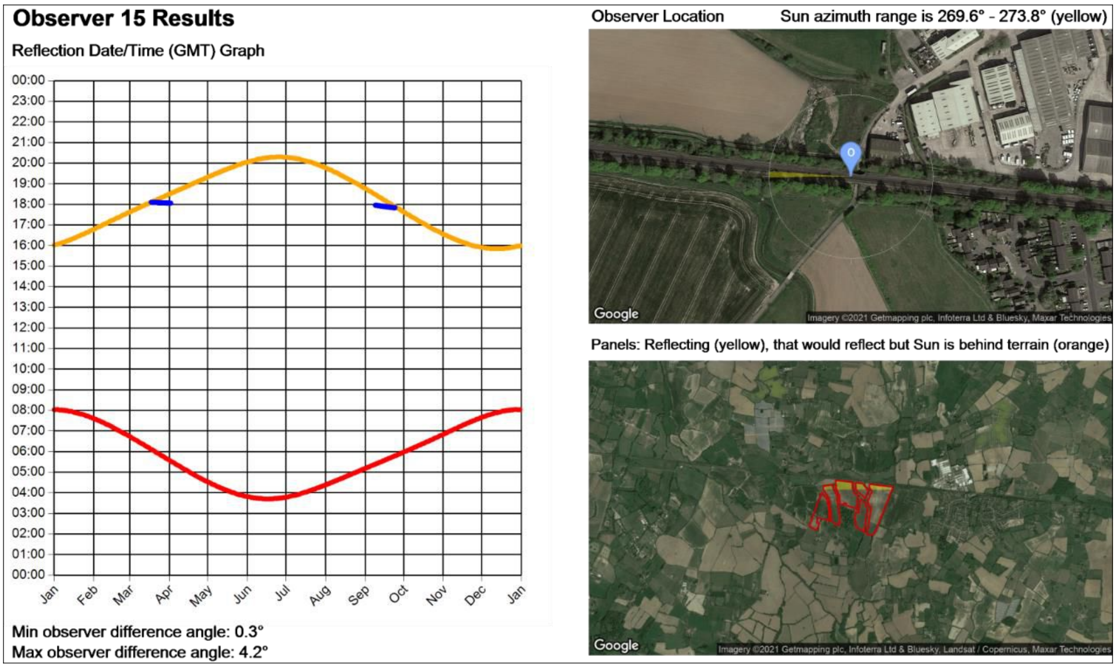
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)


Observer 11 Results
Reflection Date/Time (GMT) Graph
Observer Location
Sun azimuth range is 269.6° - 273.4° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Min observer difference angle: 0.3°
Max observer difference angle: 3.8°


Observer 12 Results
Reflection Date/Time (GMT) Graph
Observer Location
Sun azimuth range is 269.8° - 273.5° (yellow)
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Min observer difference angle: 0.3°
Max observer difference angle: 3.9°


Observer 13 Results
Reflection Date/Time (GMT) Graph
00:00 23:00 22:00 21:00 20:00 19:00 18:00 17:00 16:00 15:00 14:00 13:00 12:00 11:00 10:00 09:00 08:00 07:00 06:00 05:00 04:00 03:00 02:00 01:00 00:00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 0.2°
Max observer difference angle: 4.1°
Observer Location
Sun azimuth range is 269.6° - 273.7° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 14 Results
Reflection Date/Time (GMT) Graph
00:00 23:00 22:00 21:00 20:00 19:00 18:00 17:00 16:00 15:00 14:00 13:00 12:00 11:00 10:00 09:00 08:00 07:00 06:00 05:00 04:00 03:00 02:00 01:00 00:00
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 0.3°
Max observer difference angle: 4.2°
Observer Location
Sun azimuth range is 269.8° - 273.8° (yellow)
Google
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google


Observer 15 Results
Reflection Date/Time (GMT) Graph
00:00
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16:00
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Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan
Min observer difference angle: 0.3°
Max observer difference angle: 4.2°
Observer Location
Sun azimuth range is 269.6° - 273.8° (yellow)
Google
Imagery ©2021 Getmapping plc, Infoterra Ltd & Bluesky, Maxar Technologies
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google
Imagery ©2021 Getmapping plc, Infoterra Ltd & Bluesky, Landsat / Copernicus, Maxar Technologies

PAGERPOWER

Urban & Renewables

Pager Power Limited
Stour Valley Business Centre
Sudbury
Suffolk
CO10 7GB

Tel: +44 1787 319001 **Email:** info@pagerpower.com **Web:** www.pagerpower.com