Dean Moor
Solar Farm

Environmental Statement:
Appendix 7.9 –Glint and Glare Assessment (2 of 2)
on behalf of **FVS Dean Moor Limited**

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Prepared by: Pager Power
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Figure 5.7: Screening for road receptors 64 to 72

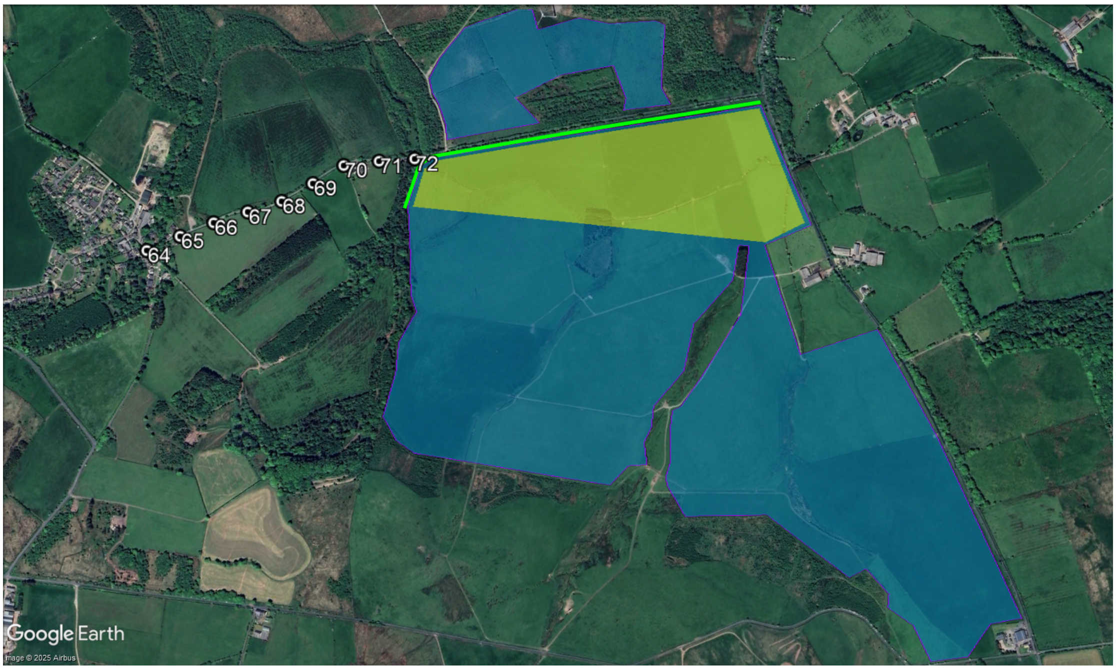


Figure 5.8: Screening for road receptors 73 to 74

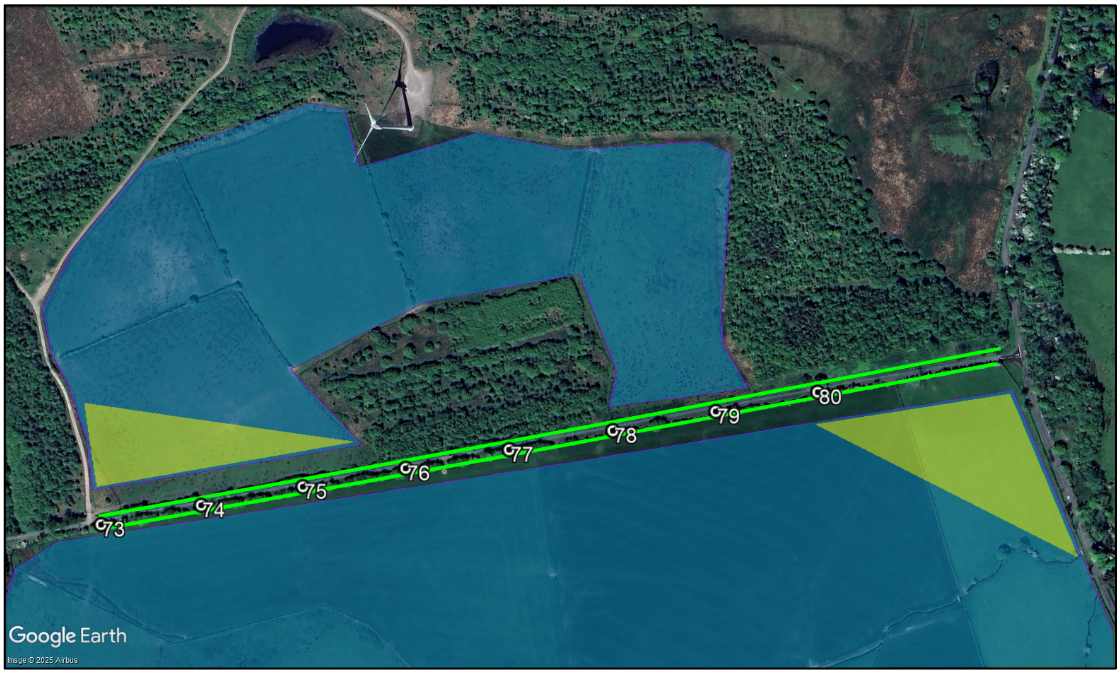


Figure 5.9: Screening for road receptors 81 to 83

5.5 Assessment results – dwelling receptors

5.5.1 The key considerations for residential dwellings are:

- Whether a reflection is predicted to be experienced in practice; and
- The duration of the predicted effects, relative to thresholds of:
  - Three months per year:
  - 60 minutes on any given day.

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

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

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

- The separation distance to the panel area – larger separation distances reduce the proportion of an observer's field of view that is affected by glare;
- The position of the sun – effects that coincide with direct sunlight appear less prominent than those that do not;
- Whether visibility is likely from all storeys – the ground floor is typically considered the main living space and has a greater significance with respect to residential amenity; and
- Whether the dwelling appears to have windows facing the reflecting area – factors that restrict potential views of a reflecting area reduce the level of impact.

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

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

5.5.7 Table 5.4 on the following pages presents the geometric modelling results and predicted impacts significance for the assessed dwelling receptors.

Table 5.4: Geometric modelling results and predicted impact classification - dwelling receptors

Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening and Predicted Visibility (desk-based review)	Mitigating Factors	Predicted Impact
1	Solar reflections are not geometrically possible.	N/A	N/A	No impact
2 – 20	Solar reflections geometrically possible for more than 3 months per year but less than 60 minutes on any given day.	Existing vegetation to be retained and enhanced predicted to significantly obstruct views of reflecting panels.	N/A	No impact

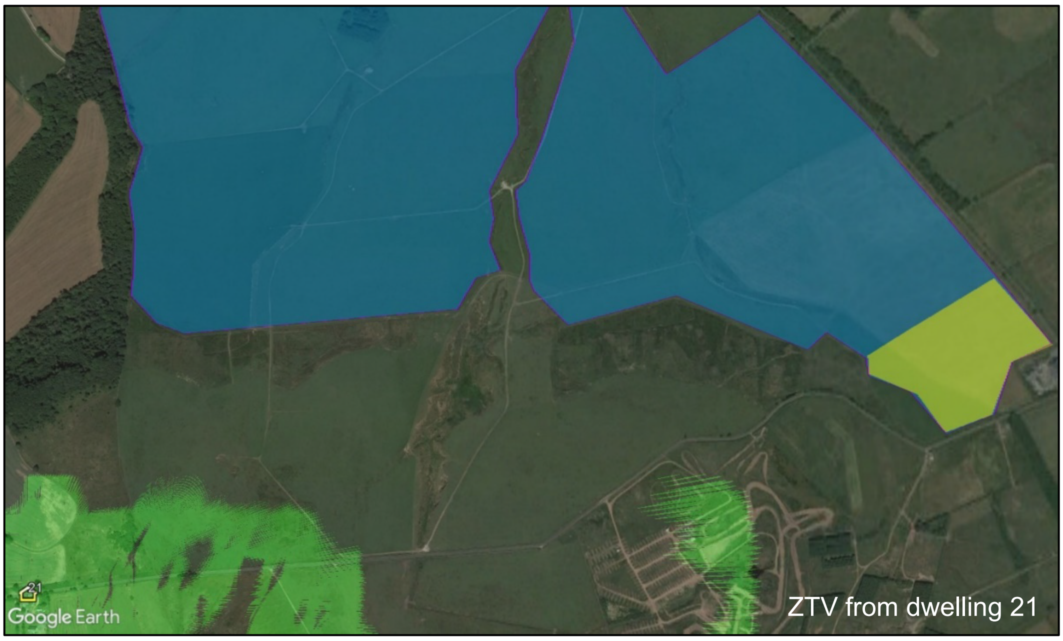
Dwelling Receptor	Geometric Modelling Results (screening not considered)	Identified Screening and Predicted Visibility (desk-based review)	Mitigating Factors	Predicted Impact
21	Solar reflections geometrically possible for more than 3 months per year but less than 60 minutes on any given day.	Existing vegetation and intervening terrain predicted to significantly obstruct views of reflecting panels.	N/A	No impact
22	Solar reflections are not geometrically possible.	N/A	N/A	No impact
23	Solar reflections geometrically possible for more than 3 months per year but less than 60 minutes on any given day.	Existing vegetation and intervening terrain predicted to significantly obstruct views of reflecting panels.	N/A	No impact
24 – 25	Solar reflections geometrically possible for more than 3 months per year but less than 60 minutes on any given day.	Existing vegetation to be retained and enhanced, and proposed vegetation predicted to obstruct views of reflecting panels with marginal views considered possible.	Screening is predicted to reduce effects to less than 3 months per year. Effects will coincide with the sun.	Low impact
26 – 34	Solar reflections geometrically possible for more than 3 months per year but less than 60 minutes on any given day.	Existing vegetation to be retained and enhanced predicted to significantly obstruct views of reflecting panels.	N/A	No impact
35	Solar reflections geometrically possible for more than 3 months per year but less than 60 minutes on any given day.	Existing vegetation to be retained and enhanced, and existing buildings predicted to obstruct views of reflecting panels with marginal views considered possible.	Views will be limited to above ground floor levels. Effects will coincide with the sun.	Low impact

5.5.8 The glint and glare assessment on dwellings identifies low impacts on dwellings 24, 25 and 35. These effects have informed judgments on visual effects reported in ES Chapter 7 – Landscape and Visual.

5.5.9 A desk-based review of the available imagery is presented in Figures 5.10 to 5.17. The cumulative reflecting panel areas are indicated by regions of yellow. The identified screening in the form of existing vegetation to be retained and enhanced, and proposed vegetation is outlined in green and orange respectively. High-level zones of theoretical visibility[17] are shown in scattered regions of green.

Figure 5.10: Screening for dwelling receptors 2 to 20

Figure 5.11: Screening for dwelling receptor 21



[17] Generated by Google Earth viewshed at 5 metres above ground level to account for views above ground level

Figure 5.12: Screening for dwelling receptor 23

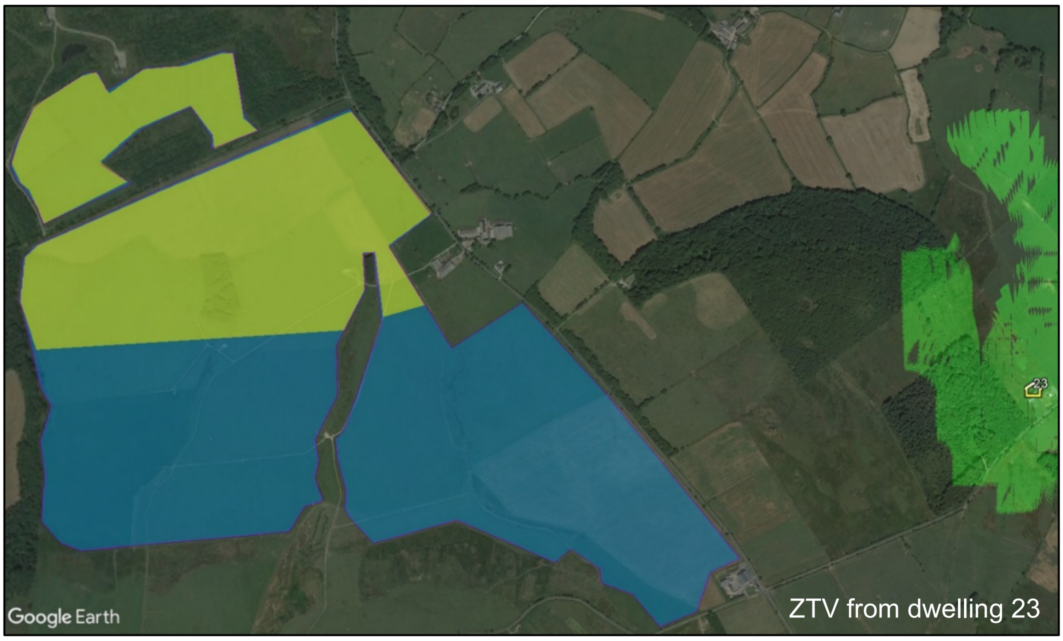


Figure 5.13: Screening for dwelling receptors 24 to 25

Figure 5.14: Screening for dwelling receptors 26 to 32

Figure 5.15: Screening for dwelling receptor 33

Figure 5.16: Screening for dwelling receptor 34

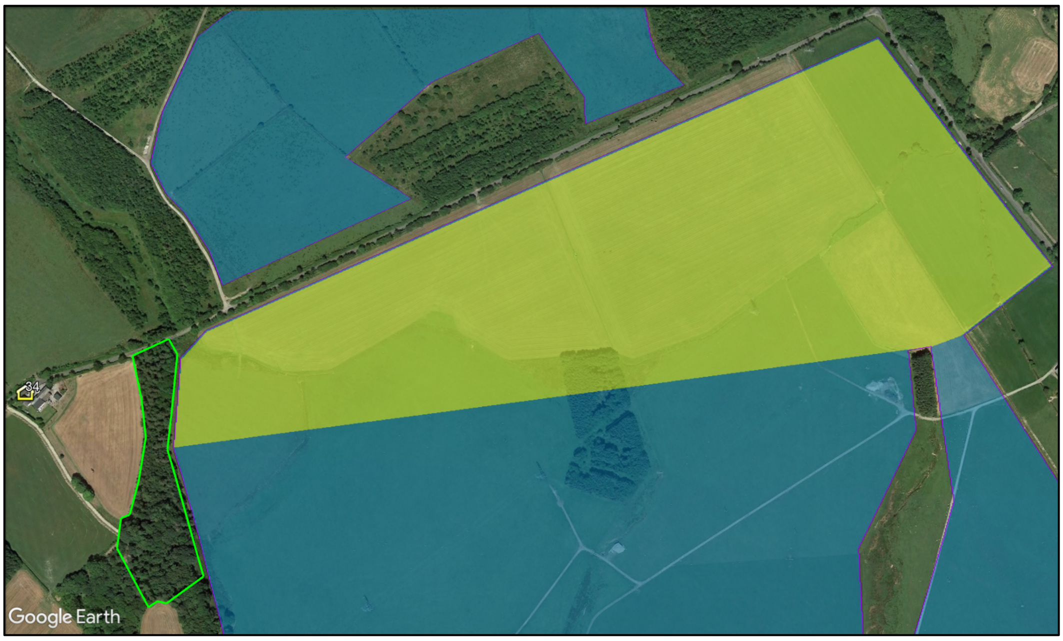


Figure 5.17: Screening for dwelling receptor 35

6 Overall Conclusions

6.1.1 Solar reflections of glare intensities with ‘potential for temporary after-image’ are geometrically possible towards the 1-mile splayed approach paths and final sections of visual circuits for runway 04/22. The glare scenario is considered in an operational context (see section 5.3) and considered operationally accommodatable. A low impact is predicted, and mitigation is not recommended.

6.1.2 Solar reflections are geometrically possible towards the following sections of road:

- 1.5km of Branthwaite Edge Road;
- 1.4km of a local road; and
- 1.6km of Gilgarran Road.

6.1.3 Screening in the form of existing vegetation to be maintained and enhanced, and intervening terrain is predicted to significantly obstruct views of reflecting panels, such that solar reflections are not predicted to be experienced by road users. No impact is predicted, and mitigation is not required.

6.1.4 Solar reflections are geometrically possible towards 33 of the 35 assessed dwelling receptors. Screening in the form of existing vegetation to be retained and enhanced, proposed vegetation, and intervening terrain that significantly obstructs views of the reflecting panels has been identified for 30 dwellings, such that no solar reflections will be experienced in practice. No impact is predicted, and mitigation is not required.

6.1.5 For the remaining three dwellings, solar reflections are geometrically possible for more than three months per year, but less than 60 minutes on any given day. Screening in the form of existing vegetation to be retained and enhanced, existing buildings and proposed vegetation is predicted to partially obstruct views of reflecting panels with marginal views considered possible. The identified screening is predicted to reduce effects to less than three months per year, in addition to effects coinciding with the sun. Therefore, a low impact is predicted for these three dwellings, and mitigation is not recommended.

6.1.6 No significant impacts are predicted upon road safety, residential amenity, and aviation activity associated with Gilgarran Airfield. Mitigation is not required. It is recommended to share the geometric modelling results with the airfield to make them aware of the potential impacts at specific times.

Appendix A Overview of Glint and Glare Guidance

A.1.1 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'.

A.1.2 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

Renewable and Low Carbon Energy

A.1.3 The National Planning Policy Framework under the planning practice guidance for Renewable and Low Carbon Energy[18] (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.'

National Policy Statement for Renewable Energy Infrastructure

A.1.4 The National Policy Statement for Renewable Energy Infrastructure (EN-3) sets out the primary policy for decisions by the Secretary of State for

[18] Renewable and low carbon energy, Ministry of Housing, Communities & Local Government (18 June 2015). Available at: https://www.gov.uk/guidance/renewable-and-low-carbon-energy Accessed on: 01/11/2021

nationally significant renewable energy infrastructure. Sections 3.10.93-97 state:

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

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

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

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

2.10.106 When a glint and glare assessment is undertaken, the potential for solar PV panels, frames and supports to have a combined reflective quality may need to be assessed, although the glint and glare of the frames and supports is likely to be significantly less than the panels.'

A.1.5 The EN-3 does not state which receptors should be considered as part of a quantitative glint and glare assessment. Based on Pager Power's extensive project experience, typical receptors include residential dwellings, road users, aviation infrastructure, and railway infrastructure. Sections 2.10.134-136 state:

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

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

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

A.1.6 The mitigation strategies listed within the EN-3 are relevant strategies that are frequently utilised to eliminate or reduce glint and glare effects towards surrounding observers. The most common form of mitigation is the implementation of screening along the site boundary. Sections 2.10.158-159 state:

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

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

A.1.7 The latest version of the draft EN-3 goes some way in referencing that the issue is more complex than presented in the previous issue; though, this is still unlikely to be welcomed by aviation stakeholders, who will still request a glint and glare assessment on the basis that glare may lead to impact upon aviation safety. It is possible that the final issue of the policy will change in light of further consultation responses from aviation stakeholders.

Assessment Process – Ground-Based Receptors

A.1.8 No process for determining and contextualising the effects of glint and glare has been determined when assessing the impact of solar reflections upon surrounding roads and dwellings. Therefore, the Pager Power approach is to determine whether a reflection from a 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 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 which was produced due to the absence of existing guidance and a specific standardised assessment methodology.

Aviation Assessment Guidance

A.1.9 The UK Civil Aviation Authority 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[19] however the advice is still applicable[20] until a formal policy is developed. The relevant aviation guidance from the CAA is presented in the section below.

CAA Interim Guidance

A.1.10 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 , as part of a condition of a CAA Aerodrome Licence, the ALH is required to obtain prior consent from CAA Aerodrome Standards Department before any work is begun or approval to the developer or LPA is granted, in accordance with the procedures set out in CAP 791 Procedures for Changes to Aerodrome Infrastructure.

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

[19] Archived at Pager Power

[20] Reference email from the CAA dated 19/05/2014.

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

A.1.11 The most comprehensive guidelines available for the assessment of solar developments near aerodromes has been produced by the United States Federal Aviation Administration. The first guidelines were produced initially in November 2010 and updated in 2013. A final policy was released in 2021, which superseded the interim guidance.

A.1.12 The 2010 document is entitled 'Technical Guidance for Evaluating Selected Solar Technologies on Airports', the 2013 update is entitled 'Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports', and the 2021 final policy is entitled 'Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports'.

A.1.13 A summary of the final policy is presented below.

A.1.14 Initially, FAA believed that solar energy systems could introduce a novel glint and glare effect to pilots on final approach. FAA has subsequently concluded that in most cases, the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. However, FAA has continued to receive reports of potential glint and glare from on-airport solar energy systems on personnel working in ATCT cabs. Therefore, FAA has determined the scope of agency policy should be focused on the impact of on-airport solar energy systems to federally-obligated towered airports, specifically the airport's ATCT cab.

A.1.15 The policy in this document updates and replaces the previous policy by encouraging airport sponsors to conduct an ocular analysis of potential impacts to ATCT cabs prior to submittal of a Notice of Proposed Construction or Alteration Form 7460-1 (hereinafter Form 7460-1). Airport sponsors are no longer required to submit the results of an ocular analysis to FAA. Instead, to demonstrate compliance with 14 CFR 77.5(c), FAA will rely on the submittal of Form 7460-1 in which the sponsor confirms that it has analyzed the potential for glint and glare and determined there is no potential for ocular impact to the airport's ATCT cab. This process will enable FAA to evaluate the solar energy system project, with assurance that the system will not impact the ATCT cab.

A.1.16 FAA encourages airport sponsors of federally-obligated towered airports to conduct a sufficient analysis to support their assertion that a proposed solar energy system will not result in ocular impacts. There are several tools available on the open market to airport sponsors that can analyse potential glint and glare to an ATCT cab. For proposed systems that will clearly not impact ATCT cabs (e.g., on-airport solar energy systems that are blocked from the ATCT cab's view by another structure), the use of such tools may not be necessary to support the assertion that a proposed solar energy system will not result in ocular impacts.

A.1.17 The excerpt above states where a solar PV development is to be located on a federally obligated aerodrome with an ATC Tower, it will require a glint and glare assessment to accompany its application. It states that pilots on approach are no longer a specific assessment requirement due to effects from solar energy systems being similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. Ultimately it comes down to the specific aerodrome to ensure it is adequately safeguarded, and it is on this basis that glint and glare assessments are routinely still requested.

A.1.18 The policy also states that several different tools and methodologies can be used to assess the impacts of glint and glare, which was previously required to be undertaken by the *Solar Glare Hazard Analysis Tool (SGHAT)* using the Sandia National Laboratories methodology.

A.1.19 In 2018, the FAA released the latest version (Version 1.1) of the *'Technical Guidance for Evaluating Selected Solar Technologies on Airports'*. Whilst the 2021 policy also supersedes this guidance, many of the points remain relevant because aerodromes are still safeguarding against glint and glare irrespective of the FAA guidance. The key points are presented below for reference:

A.1.20 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

A.1.21 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.

A.1.22 As illustrated on Figure 16, 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.

A.1.23 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 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.

A.1.24 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 but still requires further research to definitively answer.

A.1.25 Experiences of Existing Airport Solar Projects – Solar installations are presently operating at a number of airports, including megawatt-sized solar facilities covering multiple acres. Air traffic control towers have expressed concern about glint and glare from a small number of solar installations. These were often instances when solar installations were sited between the tower and airfield, or for installations with inadequate or no reflectivity analysis. Adequate reflectivity analysis and alternative siting addressed initial issues at those installations.

Air Navigation Order (ANO) 2016

A.1.26 In some instances, an aviation stakeholder can refer to the ANO 2016 with regard to safeguarding. Key points from the document are presented below.

'Lights liable to endanger

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

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

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

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

(a) to extinguish or screen the light; and

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

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

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

Lights which dazzle or distract

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

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

Endangering safety of an aircraft

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

Endangering safety of any person or property

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

Civil Aviation Authority Consolidation of UK Regulation 139/2014

A.1.27 The Civil Aviation Authority published a consolidating document of UK regulations, (Implementing Rules, Acceptable Means of Compliance and

Guidance Material), in 2023. A summary of material relevant to aerodrome safeguarding is presented below:

‘(a) The aerodrome operator should have procedures to monitor the changes in the obstacle environment, marking and lighting, and in human activities or land use on the aerodrome and the areas around the aerodrome, as defined in coordination with the CAA. The scope, limits, tasks and responsibilities for the monitoring should be defined in coordination with the relevant air traffic services providers, and with the CAA and other relevant authorities.

(b) The limits of the aerodrome surroundings that should be monitored by the aerodrome operator are defined in coordination with the CAA and should include the areas that can be visually monitored during the inspections of the manoeuvring area.

(c) The aerodrome operator should have procedures to mitigate the risks associated with changes on the aerodrome and its surroundings identified with the monitoring procedures. The scope, limits, tasks, and responsibilities for the mitigation of risks associated to obstacles or hazards outside the perimeter fence of the aerodrome should be defined in coordination with the relevant air traffic services providers, and with the CAA and other relevant authorities.

(d) The risks caused by human activities and land use which should be assessed and mitigated should include:

1. Obstacles and the possibility of induced turbulence;

2. The use of hazardous, confusing, and misleading lights;

3. The dazzling caused by large and highly reflective surfaces;

4. Sources of non-visible radiation, or the presence of moving, or fixed objects which may interfere with, or adversely affect, the performance of aeronautical communications, navigation and surveillance systems; and

5. Non-aeronautical ground light near an aerodrome which may endanger the safety of aircraft and which should be extinguished, screened, or otherwise modified so as to eliminate the source of danger.’

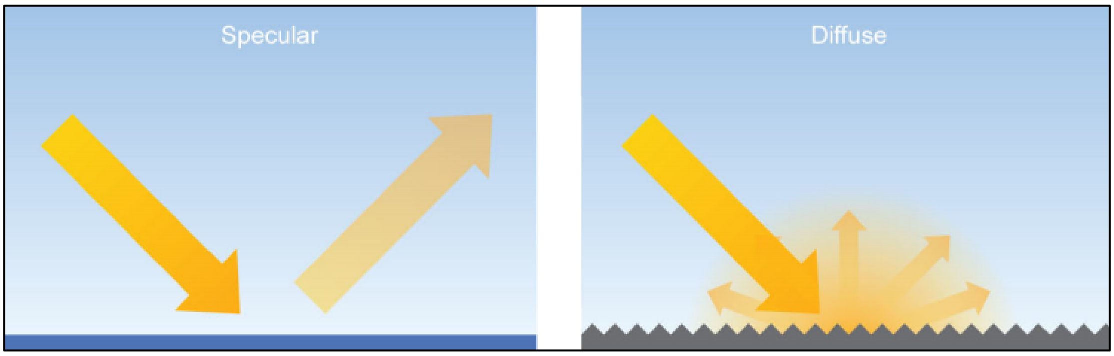
Appendix B Overview of Glint and Glare Studies

B.1.1 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.

B.1.2 The guidelines presented are related to aviation safety. The results are applicable for the purpose of this analysis.

Reflection type from solar panels

B.1.3 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[21], 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.



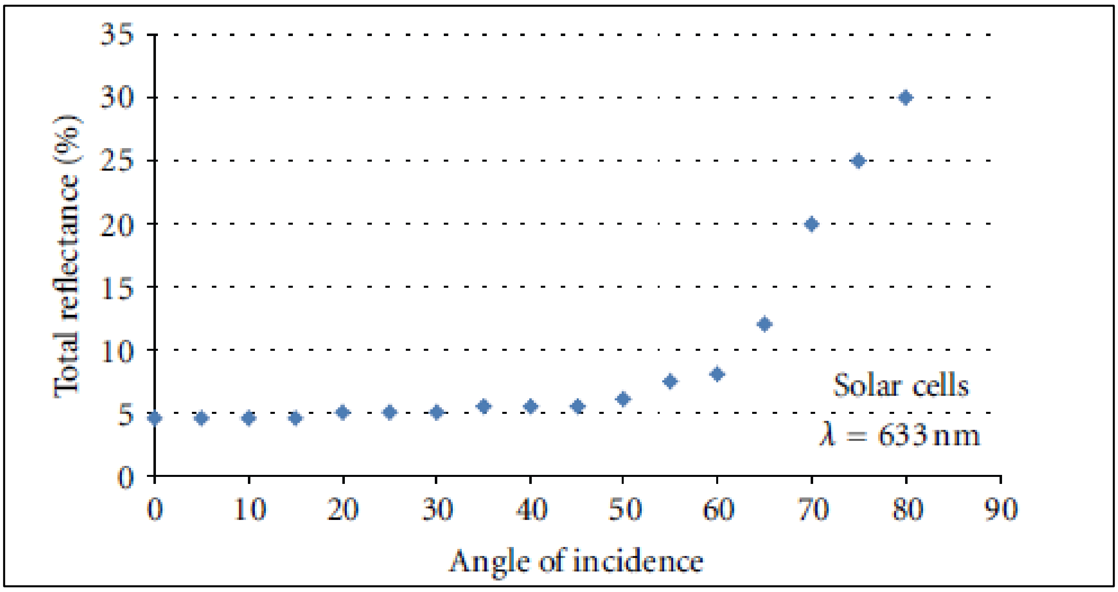
Solar reflection studies

B.1.4 An overview of content from identified solar panel reflectivity studies is presented in the subsections below.

[21] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA) (April 2018). Available at: https://www.faa.gov/sites/faa.gov/files/airports/environmental/FAA-Airport-Solar-Guide-2018.pdf Accessed on: 20/03/2019.

A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems

B.1.5 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*[22]". 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.



B.1.6 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.

[22] 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"[23]

B.1.7 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
Snow	80
White Concrete	77
Bare Aluminium	74
Vegetation	50
Bare Soil	30
Wood Shingle	17
Water	5
Solar Panels	5
Black Asphalt	2

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

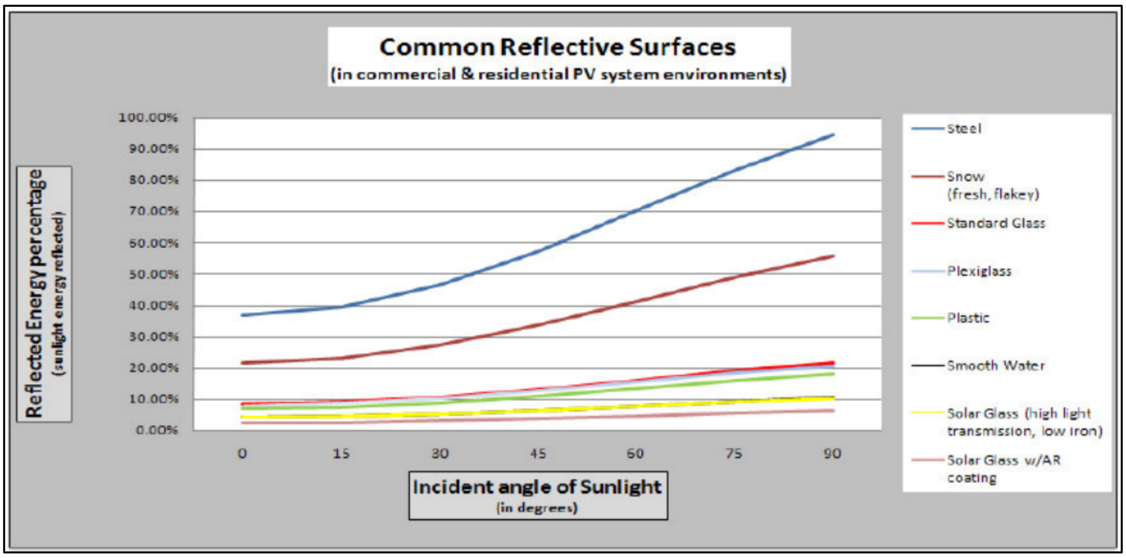
B.1.8 An important comparison in this table is the reflectivity compared to water which will produce a reflection of very similar intensity when compared to that from a solar panel. The study by Riley and Olsen study (2011) also concludes that still water has a very similar reflectivity to solar panels.

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

SunPower Technical Notification (2009)

B.1.9 SunPower published a technical notification[24] to *'increase awareness concerning the possible glare and reflectance impact of PV Systems on their surrounding environment'.*

B.1.10 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.



B.1.11 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'.*

B.1.12 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.

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

Appendix C Overview of Sun Movements

C.1.1 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).

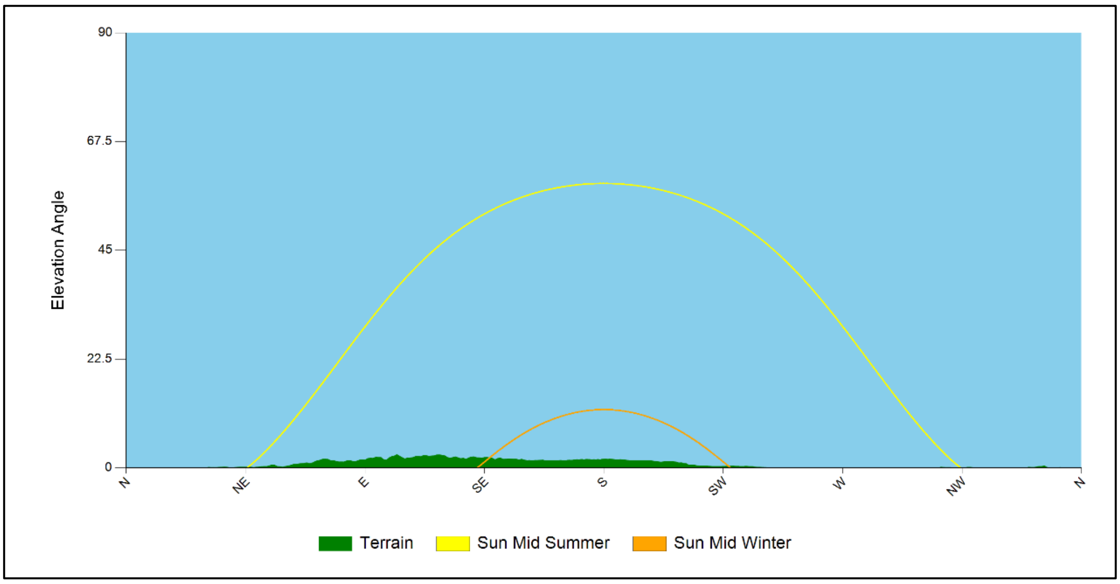
C.1.2 The sun's position can be accurately calculated for a specific location. The following data being used for the calculation:

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

C.1.3 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 (longest day);
- On 21 December, the maximum elevation reached by the sun is at its lowest (shortest day).

C.1.4 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 from lon:-3.48075 lat:54.597577



Appendix D Glint and Glare Impact Significance

D.1.1 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.

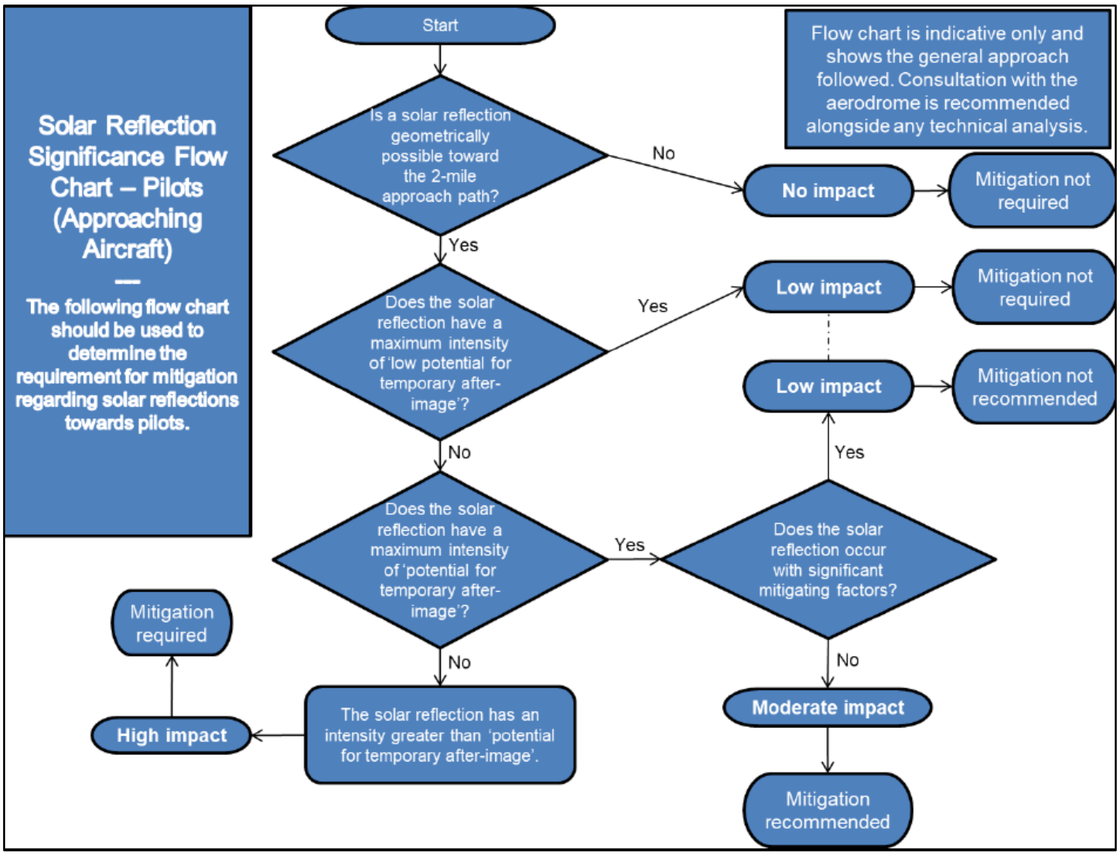
Impact significance definition

D.1.2 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 significantly.	No mitigation recommended.
Moderate	A solar reflection is geometrically possible and visible however it occurs under conditions that do not represent a worst-case given individual receptor criteria.	Mitigation recommended.
High	A solar reflection is geometrically possible and visible under worst-case conditions that will produce a significant impact given individual receptor criteria	Mitigation will be required if the Proposed Development is to proceed.

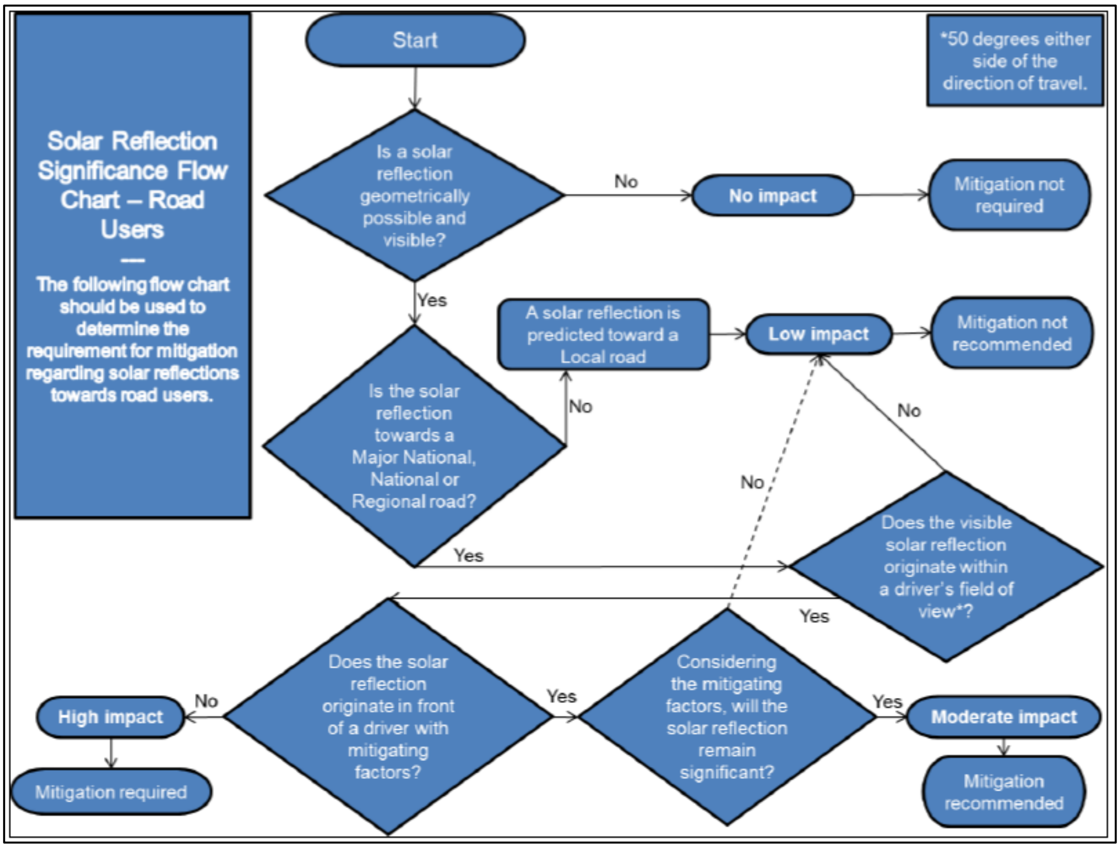
Impact significance determination for approaching aircraft

D.1.3 The flow chart presented below has been followed when determining the impact significance for approaching aircraft.



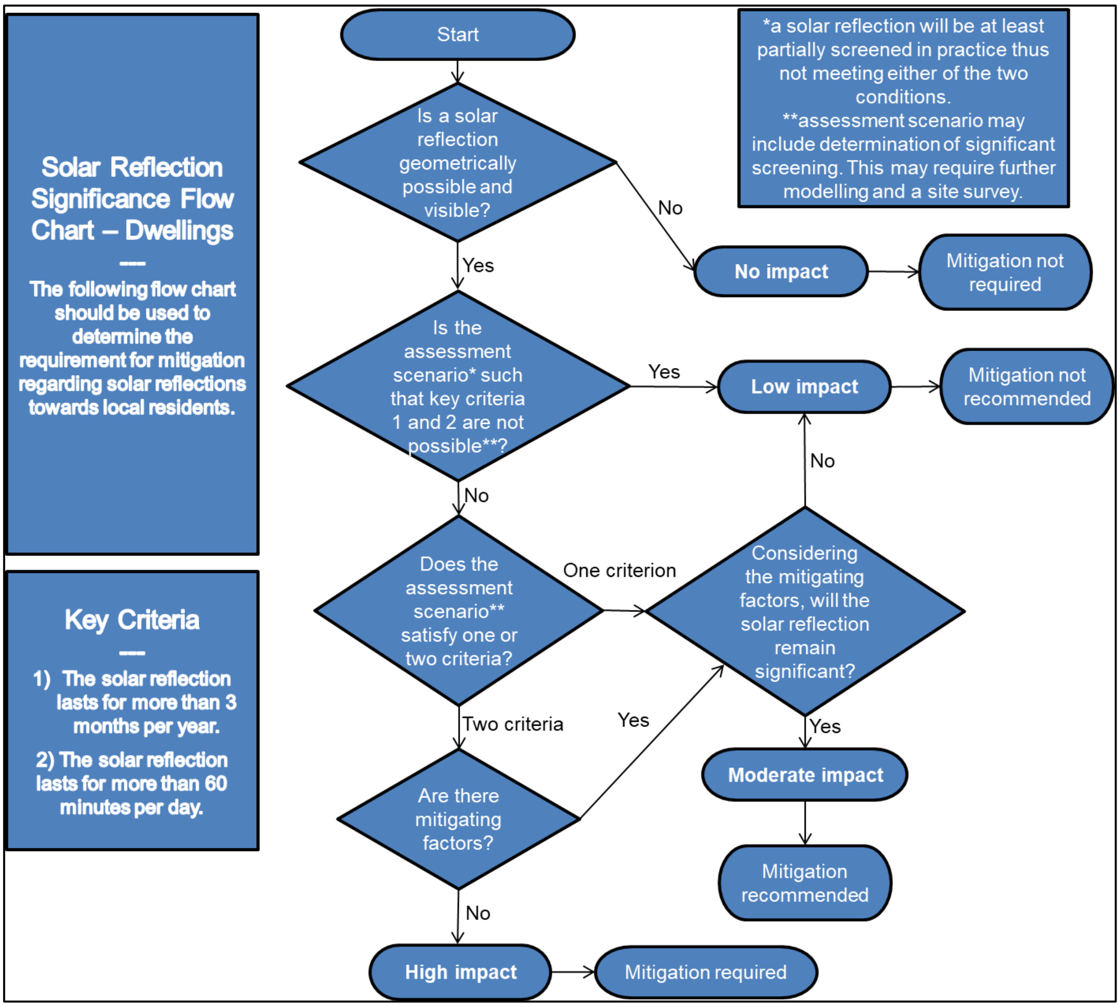
Impact significance determination for road receptors

D.1.4 The flow chart presented below has been followed when determining the impact significance for road receptors.



Impact significance determination for dwelling receptors

D.1.5 The flow chart presented below has been followed when determining the impact significance for dwelling receptors.

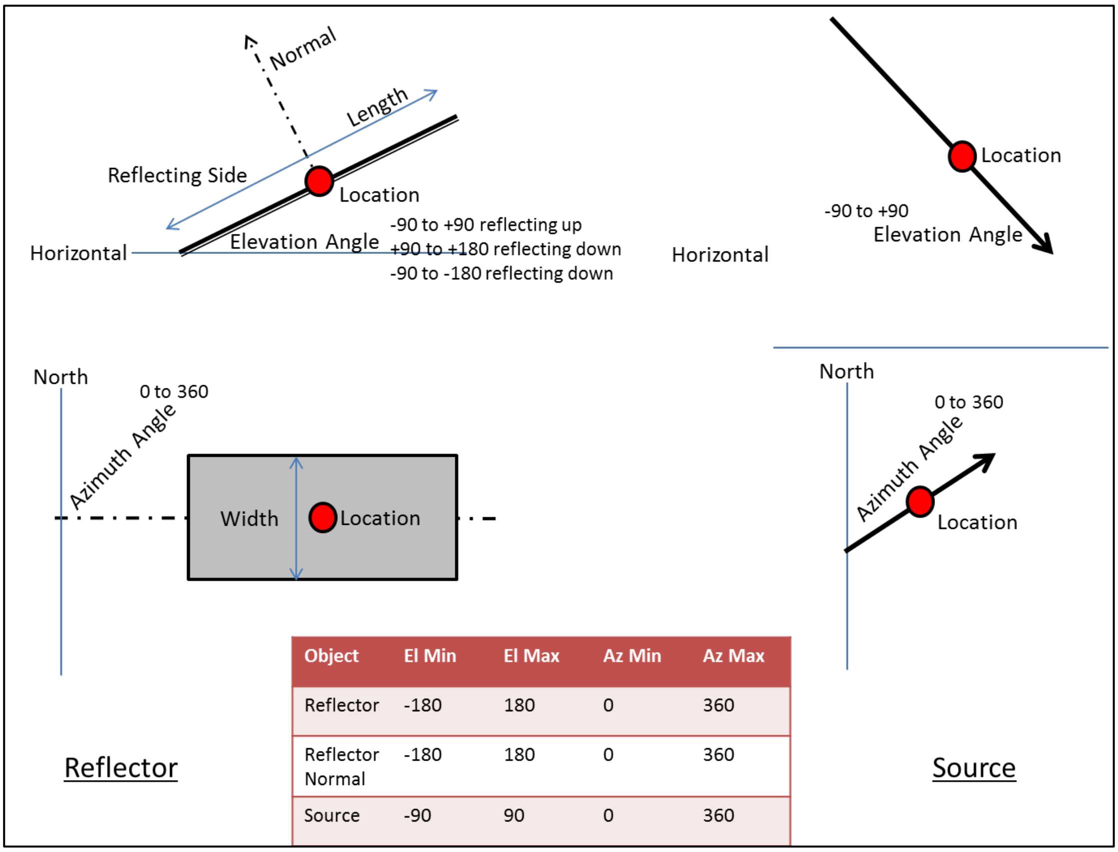

Solar Reflection Significance Flow Chart – Dwellings
The following flow chart should be used to determine the requirement for mitigation regarding solar reflections towards local residents.
Key Criteria
1) The solar reflection lasts for more than 3 months per year.
2) The solar reflection lasts for more than 60 minutes per day.
Start
Is a solar reflection geometrically possible and visible?
*a solar reflection will be at least partially screened in practice thus not meeting either of the two conditions.
**assessment scenario may include determination of significant screening. This may require further modelling and a site survey.
No
No impact
Mitigation not required
Yes
Is the assessment scenario* such that key criteria 1 and 2 are not possible**?
Yes
Low impact
Mitigation not recommended
No
No
Does the assessment scenario** satisfy one or two criteria?
One criterion
Considering the mitigating factors, will the solar reflection remain significant?
Two criteria
Yes
Yes
Moderate impact
Mitigation recommended
Are there mitigating factors?
No
High impact
Mitigation required

Appendix E Reflection Calculation Methodology

E.1.1 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.

E.1.2 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

E.1.3 The following process is used to determine the 3D Azimuth and Elevation of a reflection:

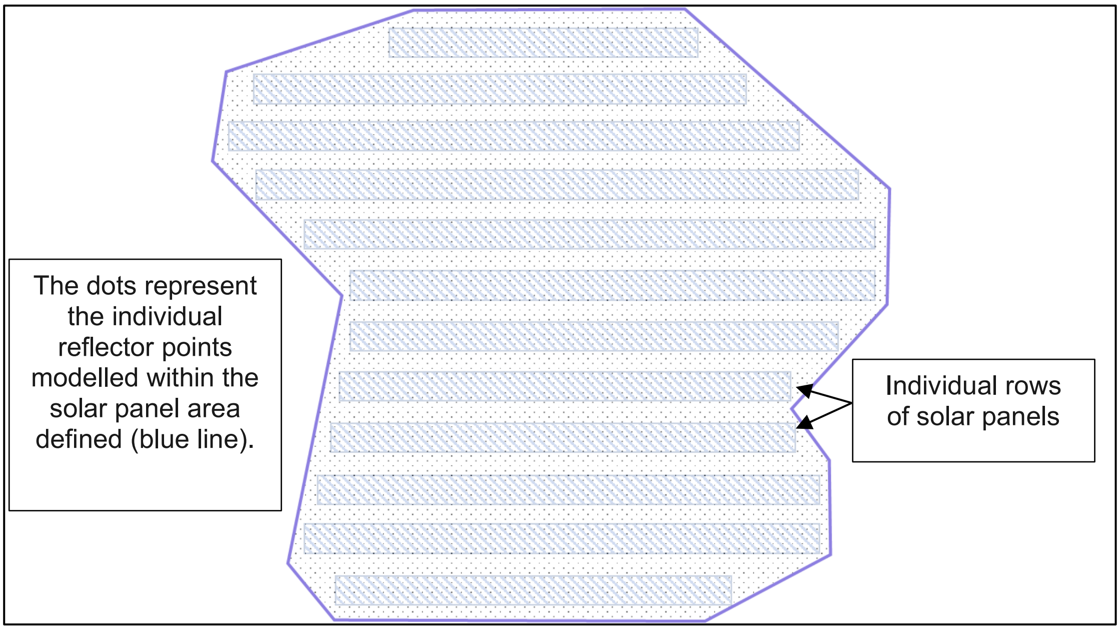
- Use the Latitude and Longitude of reflector as the reference for calculation purposes;
- Calculate the Azimuth and Elevation of the normal to the reflector;
- Calculate the 3D angle between the source and the normal;

- 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).
- 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.



F.1.1 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.

F.1.2 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.

F.1.3 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

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.

Appendix G Receptor and Reflector Area Details

Aviation receptor data

Runway Threshold	Latitude (°)	Longitude (°)	Elevation (m amsl)
04	54.59133	-3.49399	151
22	54.59362	-3.49083	139

Dwelling receptor data

No.	Latitude (°)	Longitude (°)	Assessed Height (m amsl)	No.	Latitude (°)	Longitude (°)	Assessed Height (m amsl)
1	-3.49506	54.60988	92.51	19	-3.49834	54.59189	145.39
2	-3.50250	54.59423	139.28	20	-3.49830	54.59171	146.20
3	-3.50211	54.59404	140.52	21	-3.48999	54.58470	185.79
4	-3.50178	54.59403	140.68	22	-3.48450	54.58064	192.60
5	-3.50146	54.59399	138.89	23	-3.44610	54.59304	134.60
6	-3.50103	54.59386	140.01	24	-3.46825	54.59619	127.83
7	-3.50069	54.59378	137.28	25	-3.46885	54.59684	121.85
8	-3.50069	54.59357	139.57	26	-3.45816	54.60202	123.64
9	-3.50044	54.59344	141.00	27	-3.46915	54.60052	119.90
10	-3.49902	54.59339	132.68	28	-3.47091	54.60007	115.10
11	-3.49801	54.59338	136.51	29	-3.46192	54.60344	119.88
12	-3.49815	54.59315	138.76	30	-3.47374	54.60282	106.34
13	-3.49774	54.59303	140.37	31	-3.47365	54.60371	101.80
14	-3.49803	54.59266	142.06	32	-3.47556	54.60590	101.30
15	-3.49850	54.59234	142.68	33	-3.50588	54.60427	99.83
16	-3.49840	54.59221	143.90	34	-3.49138	54.59599	122.58
17	-3.49777	54.59220	144.42	35	-3.45769	54.58857	170.81
18	-3.49837	54.59204	144.81				

Modelled reflector area 1

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
1	-3.49130	54.60717	12	-3.48761	54.60349
2	-3.48909	54.60588	13	-3.48586	54.60395
3	-3.49097	54.60548	14	-3.48572	54.60379
4	-3.49331	54.60541	15	-3.48290	54.60523
5	-3.49404	54.60475	16	-3.48336	54.60659
6	-3.49574	54.60415	17	-3.48522	54.60909
7	-3.49288	54.60275	18	-3.48469	54.60930
8	-3.49150	54.60337	19	-3.48464	54.60956
9	-3.49146	54.60383	20	-3.48430	54.61011
10	-3.48873	54.60378	21	-3.49197	54.60951
11	-3.48858	54.60348	22	-3.49192	54.60883

Modelled reflector area 2

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
1	-3.48876	54.59930	14	-3.47898	54.59990
2	-3.48899	54.59872	15	-3.47912	54.60013
3	-3.48868	54.59837	16	-3.47956	54.60152
4	-3.48832	54.59815	17	-3.48000	54.60156
5	-3.48781	54.59772	18	-3.48197	54.60120
6	-3.48754	54.59731	19	-3.48330	54.60116
7	-3.48380	54.59829	20	-3.48491	54.60061
8	-3.48510	54.59877	21	-3.48536	54.60107
9	-3.48341	54.59962	22	-3.48589	54.60104
10	-3.48131	54.60018	23	-3.48758	54.60040
11	-3.48042	54.59945	24	-3.48807	54.60018
12	-3.48040	54.59914	25	-3.48828	54.59990
13	-3.47846	54.59959			

Modelled reflector area 3

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
1	-3.48848	54.59546	25	-3.47497	54.59160
2	-3.48792	54.59449	26	-3.47462	54.59087
3	-3.48732	54.59328	27	-3.47465	54.59045
4	-3.48689	54.59289	28	-3.47450	54.59025
5	-3.48728	54.59205	29	-3.47344	54.58963
6	-3.48708	54.59129	30	-3.47002	54.59016
7	-3.48712	54.59016	31	-3.46596	54.58918
8	-3.48628	54.58966	32	-3.46533	54.58949
9	-3.48541	54.58948	33	-3.46412	54.58902
10	-3.47691	54.58991	34	-3.46405	54.58870
11	-3.47634	54.59049	35	-3.46278	54.58842
12	-3.47557	54.59063	36	-3.46166	54.58766
13	-3.47593	54.59115	37	-3.46016	54.58800
14	-3.47578	54.59157	38	-3.45961	54.58894
15	-3.47592	54.59209	39	-3.45841	54.58928
16	-3.47503	54.59313	40	-3.46382	54.59316
17	-3.47510	54.59435	41	-3.46732	54.59537
18	-3.47392	54.59567	42	-3.47028	54.59427
19	-3.47404	54.59657	43	-3.47294	54.59674
20	-3.47359	54.59662	44	-3.47116	54.59753
21	-3.47321	54.59488	45	-3.47326	54.59913
22	-3.47423	54.59308	46	-3.47462	54.60015
23	-3.47477	54.59226	47	-3.48787	54.59680
24	-3.47508	54.59209	48	-3.48837	54.59649

Appendix H Detailed Modelling Results

H.1.1 The Pager Power charts for the receptors are shown below and on the following pages. Each chart shows:

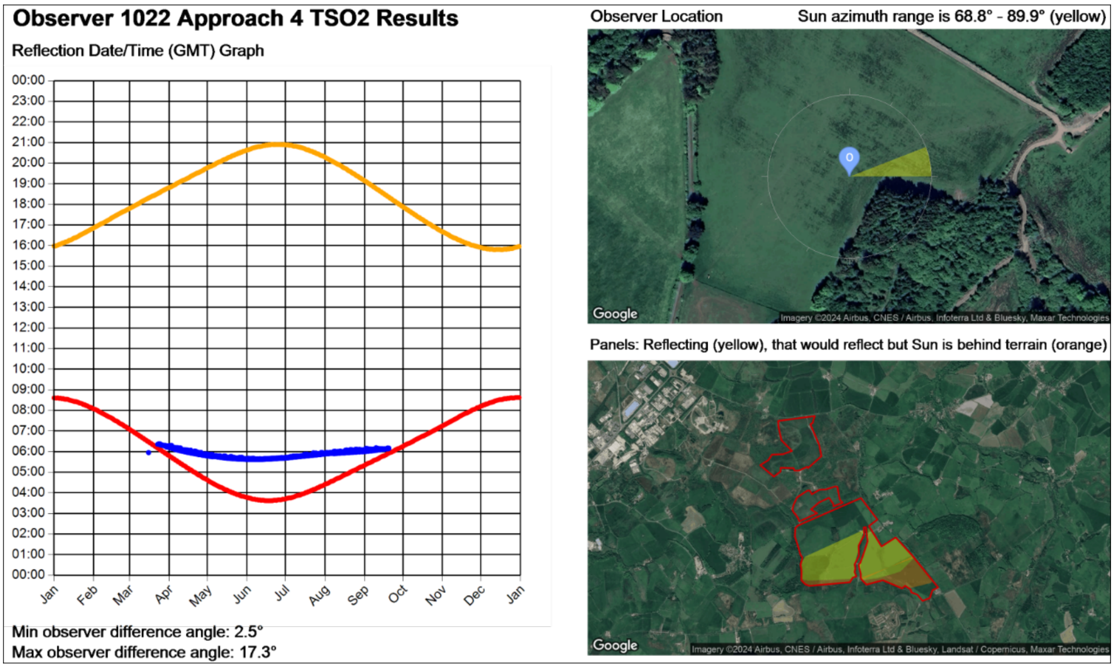
- The receptor (observer) location – top right image. This also shows the azimuth range of the sun itself at times when reflections are possible. If sunlight is experienced from the same direction as the reflecting panels, the overall impact of the reflection is reduced as discussed within the body of the report;
- The reflecting panels – 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 panels 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.
- The sunrise and sunset curves throughout the year (red and yellow lines).

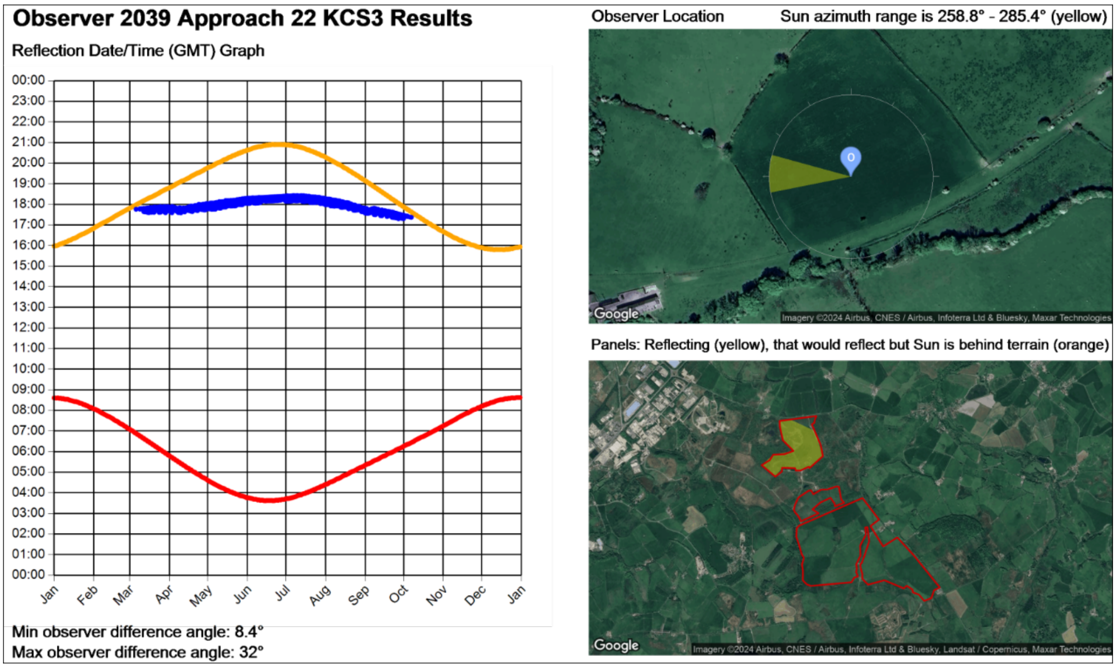
H.1.2 The Forge charts for the receptors are shown on the following pages. Each chart shows:

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

Aviation Receptors

H.1.3 Results considered for section 9.3 are presented. Full modelling results are available upon request.

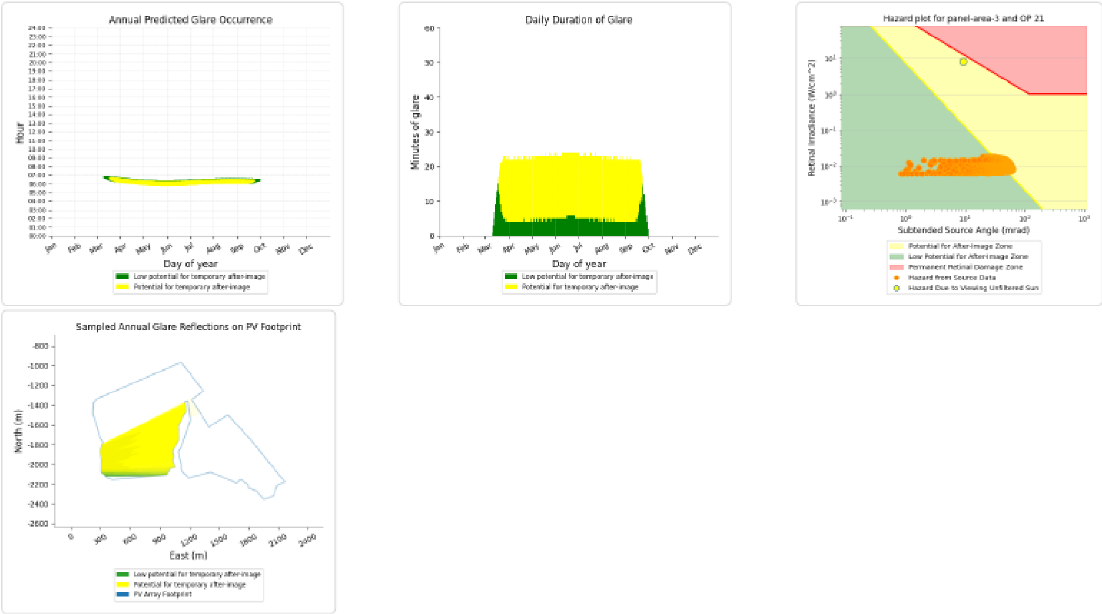

Observer 1022 Approach 4 TSO2 Results
Reflection Date/Time (GMT) Graph
00:00
23:00
22:00
21:00
20:00
19:00
18:00
17:00
16:00
15:00
14:00
13:00
12:00
11:00
10:00
09:00
08:00
07:00
06:00
05:00
04:00
03:00
02:00
01:00
00:00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Min observer difference angle: 2.5°
Max observer difference angle: 17.3°
Observer Location
Sun azimuth range is 68.8° - 89.9° (yellow)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Maxar Technologies
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Landsat / Copernicus, Maxar Technologies


Observer 2039 Approach 22 KCS3 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: 8.4°
Max observer difference angle: 32°
Observer Location
Sun azimuth range is 258.8° - 285.4° (yellow)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Maxar Technologies
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Landsat / Copernicus, Maxar Technologies

Panel Area 3: OP 21

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

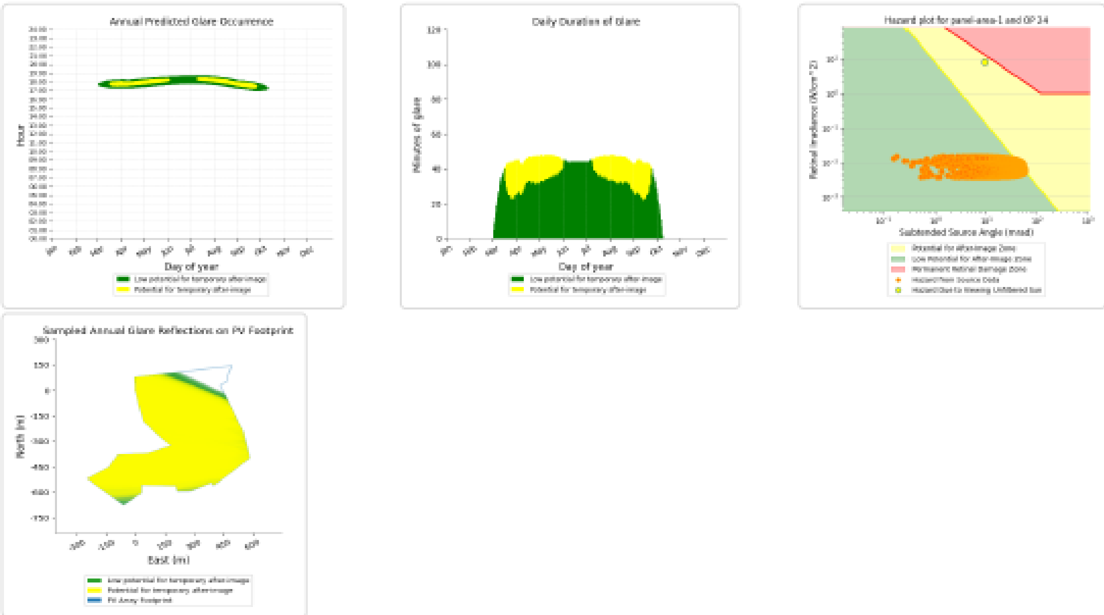
- 1,050 minutes of "green" glare with low potential to cause temporary after-image.
- 3,380 minutes of "yellow" glare with potential to cause temporary after-image.



Panel Area 1: OP 24

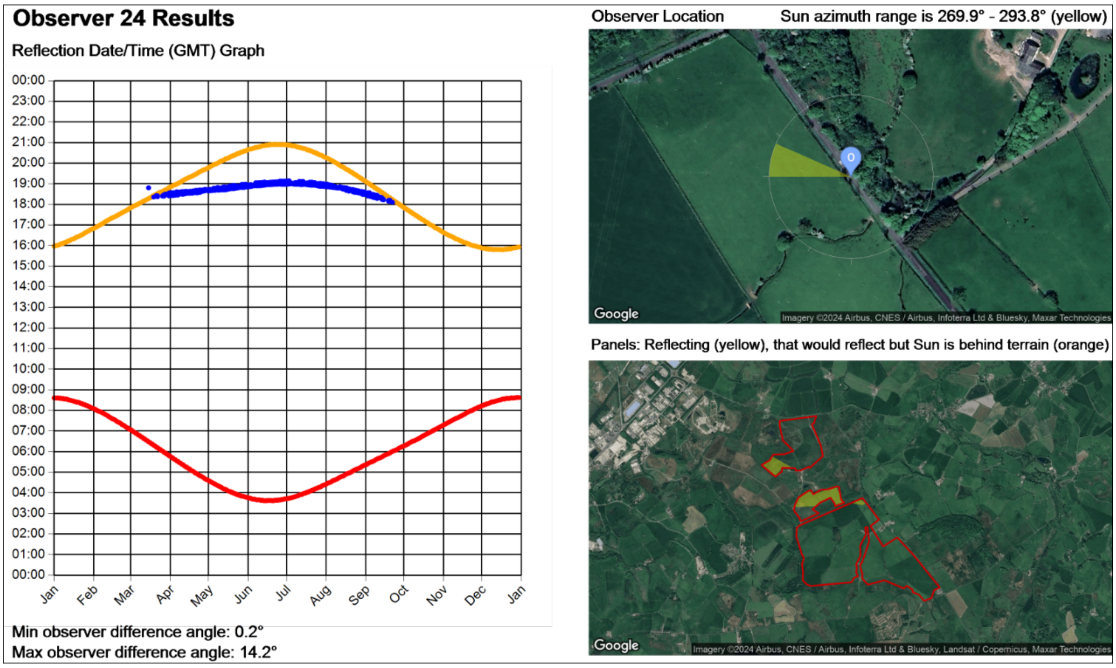
PV array is expected to produce the following glare for this receptor:

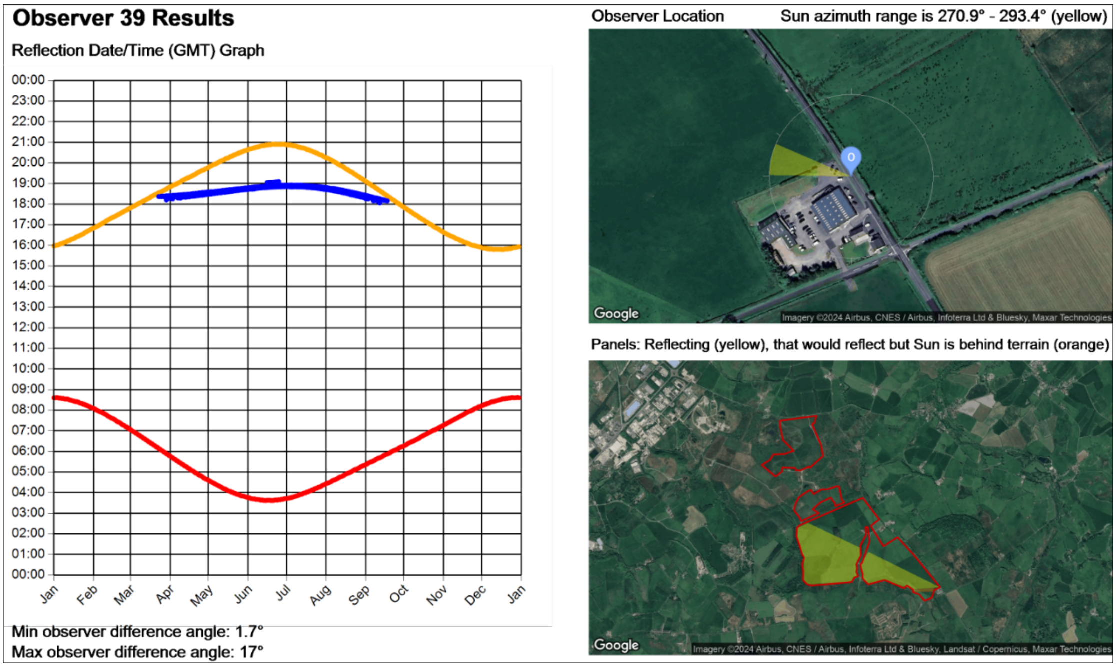
- 7,237 minutes of "green" glare with low potential to cause temporary after-image.
- 2,255 minutes of "yellow" glare with potential to cause temporary after-image.

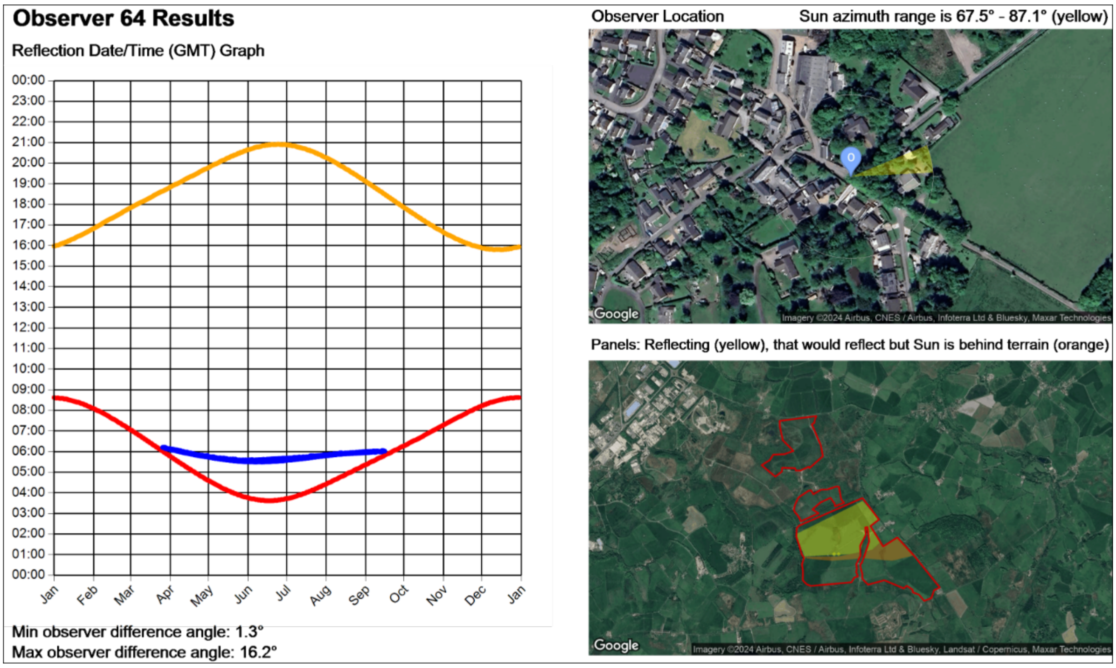


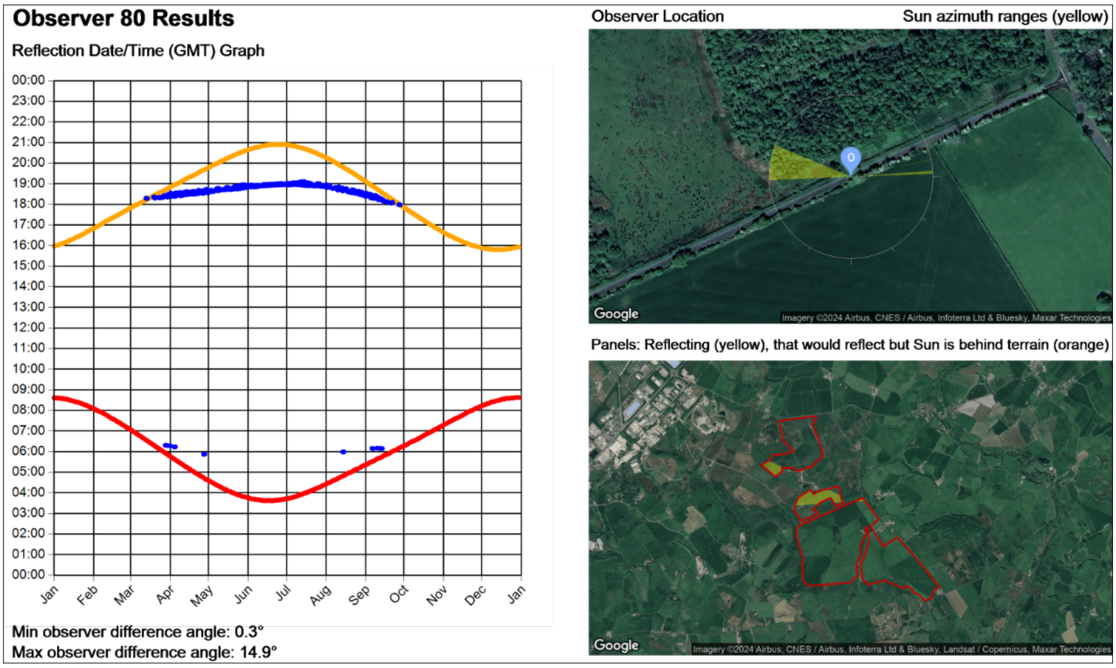
Road Receptors

H.1.4 Modelling results for receptors where mitigation is recommended are presented. Full modelling results are available upon request.


Observer 24 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: 14.2°
Observer Location
Sun azimuth range is 269.9° - 293.8° (yellow)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Maxar Technologies
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Landsat / Copernicus, Maxar Technologies

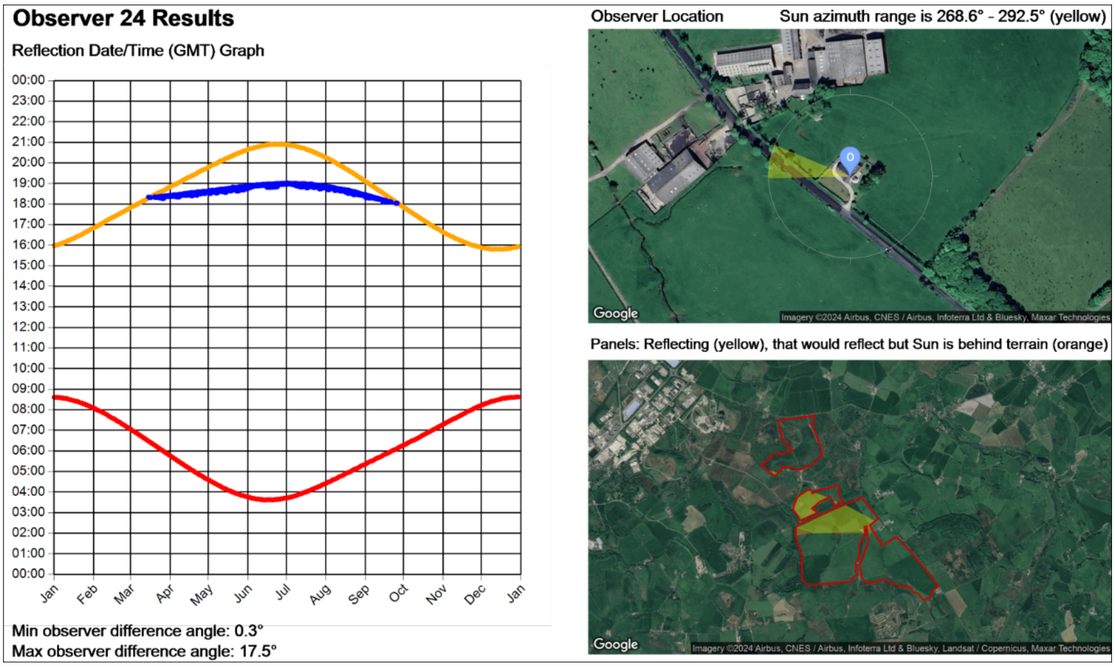

Observer 39 Results
Reflection Date/Time (GMT) Graph
00:00
23:00
22:00
21:00
20:00
19:00
18:00
17:00
16:00
15:00
14:00
13:00
12:00
11:00
10:00
09:00
08:00
07:00
06:00
05:00
04:00
03:00
02:00
01:00
00:00
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Min observer difference angle: 1.7°
Max observer difference angle: 17°
Observer Location
Sun azimuth range is 270.9° - 293.4° (yellow)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Maxar Technologies
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Landsat / Copernicus, Maxar Technologies

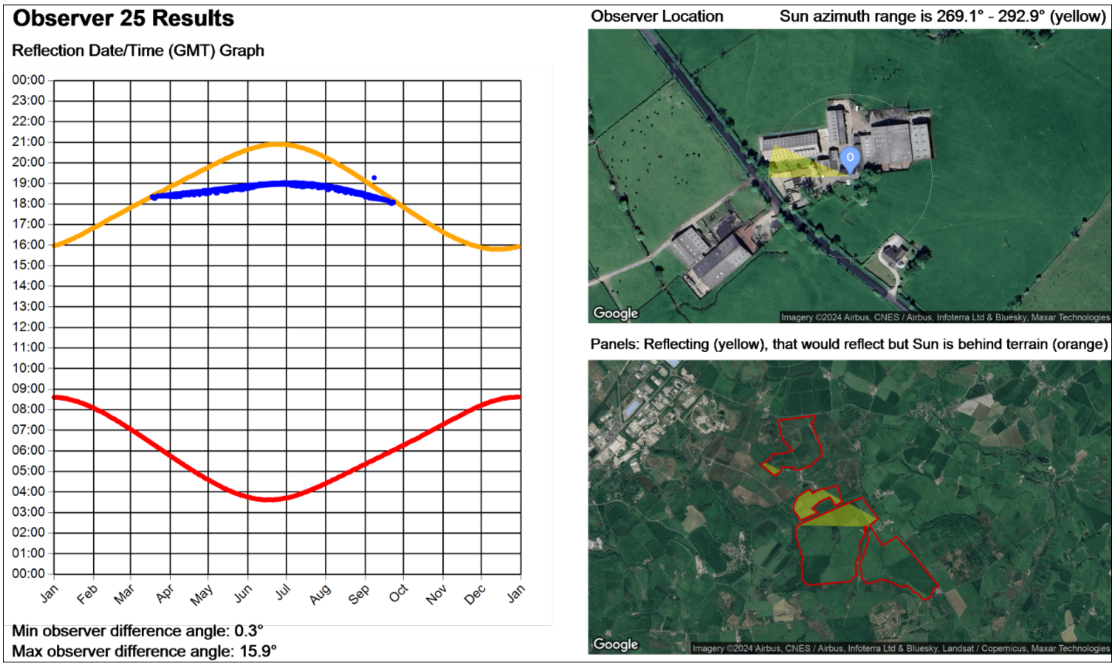


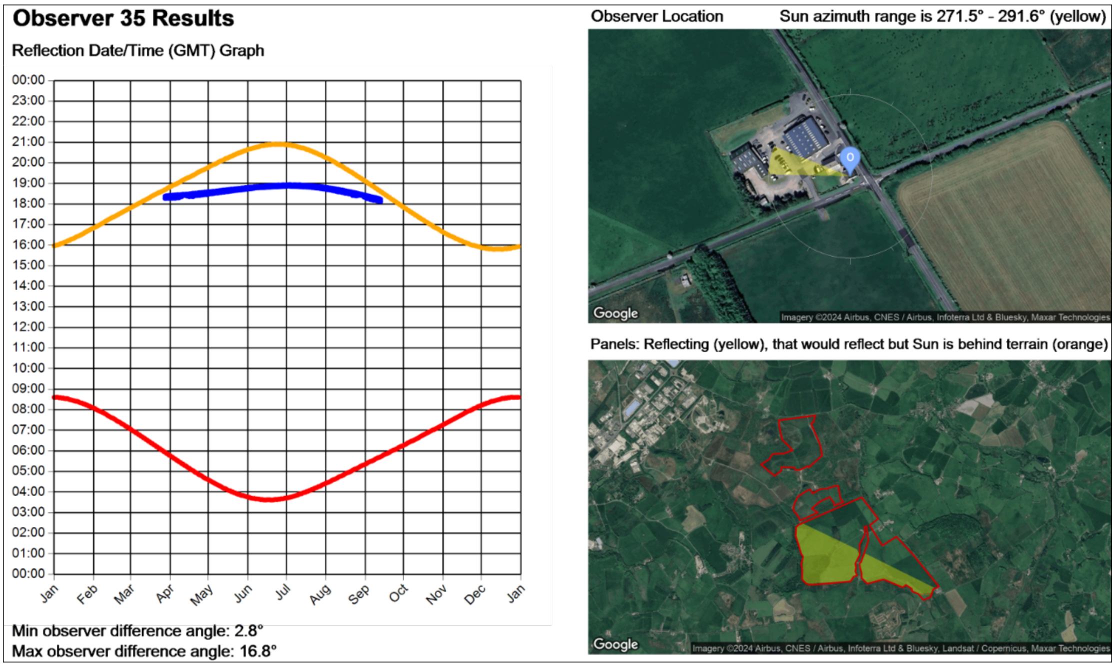


Dwelling Receptors

H.1.5 Modelling results for receptors where a low impact is predicted are presented. Full modelling results are available upon request.


Observer 24 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: 17.5°
Observer Location
Sun azimuth range is 268.6° - 292.5° (yellow)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Maxar Technologies
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Landsat / Copernicus, Maxar Technologies


Observer 25 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: 15.9°
Observer Location
Sun azimuth range is 269.1° - 292.9° (yellow)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Maxar Technologies
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Landsat / Copernicus, Maxar Technologies


Observer 35 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: 2.8°
Max observer difference angle: 16.8°
Observer Location
Sun azimuth range is 271.5° - 291.6° (yellow)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Maxar Technologies
Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)
Google
Imagery ©2024 Airbus, CNES / Airbus, Infoterra Ltd & Bluesky, Landsat / Copernicus, Maxar Technologies